ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

ICMJE Form for Disclosure of Potential Conflicts of Interest

Instructions

The purpose of this form is to provide readers of your manuscript with information about your other interests that could influence how they receive and understand your work. The form is designed to be completed electronically and stored electronically. It contains programming that allows appropriate data display. Each author should submit a separate form and is responsible for the accuracy and completeness of the submitted information. The form is in four parts.

1. Identifying information.

Enter your full name. If you are NOT the corresponding author please check the box "no" and a space to enter the name of the corresponding author in the space that appears. Provide the requested manuscript information. Double-check the manuscript number and enter it.

2. The work under consideration for publication.

This section asks for information about the work that you have submitted for publication. The time frame for this reporting is that of the work itself, from the initial conception and planning to the present. The requested information is about resources that you received, either directly or indirectly (via your institution), to enable you to complete the work. Checking "No" means that you did the work without receiving any financial support from any third party -- that is, the work was supported by funds from the same institution that pays your salary and that institution did not receive third-party funds with which to pay you. If you or your institution received funds from a third party to support the work, such as a government granting agency, charitable foundation or commercial sponsor, check "Yes". Then complete the appropriate boxes to indicate the type of support and whether the payment went to you, or to your institution, or both.

3. Relevant financial activities outside the submitted work.

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ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Helen
2. Surname (Last Name): Parsons
3. Effective Date (07-August-2008): 05-January-2021

4. Are you the corresponding author? ☐ Yes ☑ No
Corresponding Author's Name: Peter Wall

5. Manuscript Title
Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane systematic review and meta-analysis

6. Manuscript Identifying Number (if you know it)
BJJ-2020-1926.R1

Section 2. The Work Under Consideration for Publication

Did you or your institution at any time receive payment or services from a third party for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc…)?

Complete each row by checking "No" or providing the requested information. If you have more than one relationship click the "Add" button to add a row. Excess rows can be removed by clicking the "X" button.

The Work Under Consideration for Publication

Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
1. Grant	☐	☐	☑	NIHR		×
						ADD
2. Consulting fee or honorarium	☑	☐	☐			×
						ADD
3. Support for travel to meetings for the study or other purposes	☑	☐	☐			×
						ADD
4. Fees for participation in review activities such as data monitoring boards, statistical analysis, end point committees, and the like	☑	☐	☐			×
						ADD
5. Payment for writing or reviewing the manuscript	☑	☐	☐			×
						ADD
6. Provision of writing assistance, medicines, equipment, or administrative support	☑	☐	☐			×

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The Work Under Consideration for Publication

Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
						ADD
7. Other	☑	☐	☐			×
						ADD

* This means money that your institution received for your efforts on this study.
** Use this section to provide any needed explanation.

Section 3. Relevant financial activities outside the submitted work.

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Relevant financial activities outside the submitted work

Type of Relationship (in alphabetical order)	No	Money Paid to You	Money to Your Institution*	Entity	Comments	
1. Board membership	☑	☐	☐			×
						ADD
2. Consultancy	☑	☐	☐			×
						ADD
3. Employment	☑	☐	☐			×
						ADD
4. Expert testimony	☑	☐	☐			×
						ADD
5. Grants/grants pending	☐	☐	☑	NIHR		×
						ADD
6. Payment for lectures including service on speakers bureaus	☑	☐	☐			×
						ADD
7. Payment for manuscript preparation	☑	☐	☐			×

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Relevant financial activities outside the submitted work

Type of Relationship (in alphabetical order)	No	Money Paid to You	Money to Your Institution*	Entity	Comments	
						ADD
8. Patents (planned, pending or issued)	☑	☐	☐			×
						ADD
9. Royalties	☑	☐	☐			×
						ADD
10. Payment for development of educational presentations	☑	☐	☐			×
						ADD
11. Stock/stock options	☑	☐	☐			×
						ADD
12. Travel/accommodations/ meeting expenses unrelated to activities listed**	☑	☐	☐			×
						ADD
13. Other (err on the side of full disclosure)	☐	☐	☑	Stryker Ltd	Funding in kind to cover excess treatment costs	×
						ADD

* This means money that your institution received for your efforts.
** For example, if you report a consultancy above there is no need to report travel related to that consultancy on this line.

Section 4. Other relationships

Are there other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, what you wrote in the submitted work?

☑ No other relationships/conditions/circumstances that present a potential conflict of interest

☐ Yes, the following relationships/conditions/circumstances are present (explain below):

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Hide All Table Rows Checked 'No' SAVE

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4. Intellectual Property.

This section asks about patents and copyrights, whether pending, issued, licensed and/or receiving royalties.

5. Relationships not covered above.

Use this section to report other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, what you wrote in the submitted work.

Definitions.

Entity: government agency, foundation, commercial sponsor, academic institution, etc.
Grant: A grant from an entity, generally [but not always] paid to your organization
Personal Fees: Monies paid to you for services rendered, generally honoraria, royalties, or fees for consulting , lectures, speakers bureaus, expert testimony, employment, or other affiliations
Non-Financial Support: Examples include drugs/equipment supplied by the entity, travel paid by the entity, writing assistance, administrative support, etc.
Other: Anything not covered under the previous three boxes
Pending: The patent has been filed but not issued
Issued: The patent has been issued by the agency
Licensed: The patent has been licensed to an entity, whether earning royalties or not
Royalties: Funds are coming in to you or your institution due to your patent

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ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Andrew
2. Surname (Last Name): Price
3. Date: 10-January-2021

4. Are you the corresponding author? ☐ Yes ☑ No

Corresponding Author's Name: Peter Wall

5. Manuscript Title: Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane systematic review and meta-analysis

6. Manuscript Identifying Number (if you know it): BJJ-2020-1926.R1

Section 2. The Work Under Consideration for Publication

Did you or your institution **at any time** receive payment or services from a third party (government, commercial, private foundation, etc.) for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.)?

Are there any relevant conflicts of interest? ☐ Yes ☑ No

Section 3. Relevant financial activities outside the submitted work.

Place a check in the appropriate boxes in the table to indicate whether you have financial relationships (regardless of amount of compensation) with entities as described in the instructions. Use one line for each entity; add as many lines as you need by clicking the "Add +" box. You should report relationships that were **present during the 36 months prior to publication**.

Are there any relevant conflicts of interest? ☐ Yes ☑ No

Section 4. Intellectual Property -- Patents & Copyrights

Do you have any patents, whether planned, pending or issued, broadly relevant to the work? ☐ Yes ☑ No

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Section 5. Relationships not covered above

Are there other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, what you wrote in the submitted work?

☐ Yes, the following relationships/conditions/circumstances are present (explain below):

☑ No other relationships/conditions/circumstances that present a potential conflict of interest

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Section 6. Disclosure Statement

Based on the above disclosures, this form will automatically generate a disclosure statement, which will appear in the box below.

Dr. Price has nothing to disclose.

Evaluation and Feedback

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ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Kate
2. Surname (Last Name): Seers
3. Effective Date (07-August-2008): 22-December-2020

4. Are you the corresponding author? ☐ Yes ☑ No

Corresponding Author's Name: Peter Wall

5. Manuscript Title

Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane

6. Manuscript Identifying Number (if you know it)

BJJ-2020-1926.R1

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The Work Under Consideration for Publication

Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
1. Grant	☑	☐	☐			×
						ADD
2. Consulting fee or honorarium	☑	☐	☐			×
						ADD
3. Support for travel to meetings for the study or other purposes	☑	☐	☐			×
						ADD
4. Fees for participation in review activities such as data monitoring boards, statistical analysis, end point committees, and the like	☑	☐	☐			×
						ADD
5. Payment for writing or reviewing the manuscript	☑	☐	☐			×
						ADD
6. Provision of writing assistance, medicines, equipment, or administrative support	☑	☐	☐			×

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Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
						ADD
7. Other	☑	☐	☐			×
						ADD

* This means money that your institution received for your efforts on this study.
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1. Board membership	☑	☐	☐			×
						ADD
2. Consultancy	☑	☐	☐			×
						ADD
3. Employment	☐	☑	☐	Univeisty of Warwick	employer	×
						ADD
4. Expert testimony	☑	☐	☐			×
						ADD
5. Grants/grants pending	☐	☐	☑	University of Warwick	several grants awarded or pending	×
						ADD
6. Payment for lectures including service on speakers bureaus	☑	☐	☐			×
						ADD
7. Payment for manuscript preparation	☑	☐	☐			×

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						ADD
8. Patents (planned, pending or issued)	☑	☐	☐			×
						ADD
9. Royalties	☑	☐	☐			×
						ADD
10. Payment for development of educational presentations	☑	☐	☐			×
						ADD
11. Stock/stock options	☑	☐	☐			×
						ADD
12. Travel/accommodations/ meeting expenses unrelated to activities listed**	☐	☑	☐	University of Warwick	Travel and accommodation for various unrelated conferneces	×
						ADD
13. Other (err on the side of full disclosure)	☑	☐	☐			×
						ADD

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ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Jane
2. Surname (Last Name): Warwick
3. Effective Date (07-August-2008): 04-January-2021

4. Are you the corresponding author? ☐ Yes ☑ No

Corresponding Author's Name: Peter Wall

5. Manuscript Title: Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane systematic review and meta-analysis

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Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
1. Grant	☐	☐	☑	NIHR		×
						ADD
2. Consulting fee or honorarium	☑	☐	☐			×
						ADD
3. Support for travel to meetings for the study or other purposes	☑	☐	☐			×
						ADD
4. Fees for participation in review activities such as data monitoring boards, statistical analysis, end point committees, and the like	☑	☐	☐			×
						ADD
5. Payment for writing or reviewing the manuscript	☑	☐	☐			×
						ADD
6. Provision of writing assistance, medicines, equipment, or administrative support	☑	☐	☐			×

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2. Consultancy	☑	☐	☐			×
						ADD
3. Employment	☑	☐	☐			×
						ADD
4. Expert testimony	☑	☐	☐			×
						ADD
5. Grants/grants pending	☑	☐	☐			×
						ADD
6. Payment for lectures including service on speakers bureaus	☑	☐	☐			×
						ADD
7. Payment for manuscript preparation	☑	☐	☐			×

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Relevant financial activities outside the submitted work

Type of Relationship (in alphabetical order)	No	Money Paid to You	Money to Your Institution*	Entity	Comments	
						ADD
8. Patents (planned, pending or issued)	☑	☐	☐			×
						ADD
9. Royalties	☑	☐	☐			×
						ADD
10. Payment for development of educational presentations	☑	☐	☐			×
						ADD
11. Stock/stock options	☑	☐	☐			×
						ADD
12. Travel/accommodations/ meeting expenses unrelated to activities listed**	☑	☐	☐			×
						ADD
13. Other (err on the side of full disclosure)	☑	☐	☐			×
						ADD

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ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

ICMJE Form for Disclosure of Potential Conflicts of Interest

Instructions

The purpose of this form is to provide readers of your manuscript with information about your other interests that could influence how they receive and understand your work. The form is designed to be completed electronically and stored electronically. It contains programming that allows appropriate data display. Each author should submit a separate form and is responsible for the accuracy and completeness of the submitted information. The form is in six parts.

1. Identifying information.

2. The work under consideration for publication.

This section asks for information about the work that you have submitted for publication. The time frame for this reporting is that of the work itself, from the initial conception and planning to the present. The requested information is about resources that you received, either directly or indirectly (via your institution), to enable you to complete the work. Checking "No" means that you did the work without receiving any financial support from any third party -- that is, the work was supported by funds from the same institution that pays your salary and that institution did not receive third-party funds with which to pay you. If you or your institution received funds from a third party to support the work, such as a government granting agency, charitable foundation or commercial sponsor, check "Yes".

3. Relevant financial activities outside the submitted work.

This section asks about your financial relationships with entities in the bio-medical arena that could be perceived to influence, or that give the appearance of potentially influencing, what you wrote in the submitted work. You should disclose interactions with ANY entity that could be considered broadly relevant to the work. For example, if your article is about testing an epidermal growth factor receptor (EGFR) antagonist in lung cancer, you should report all associations with entities pursuing diagnostic or therapeutic strategies in cancer in general, not just in the area of EGFR or lung cancer.

Report all sources of revenue paid (or promised to be paid) directly to you or your institution on your behalf over the 36 months prior to submission of the work. This should include all monies from sources with relevance to the submitted work, not just monies from the entity that sponsored the research. Please note that your interactions with the work's sponsor that are outside the submitted work should also be listed here. If there is any question, it is usually better to disclose a relationship than not to do so.

For grants you have received for work outside the submitted work, you should disclose support ONLY from entities that could be perceived to be affected financially by the published work, such as drug companies, or foundations supported by entities that could be perceived to have a financial stake in the outcome. Public funding sources, such as government agencies, charitable foundations or academic institutions, need not be disclosed. For example, if a government agency sponsored a study in which you have been involved and drugs were provided by a pharmaceutical company, you need only list the pharmaceutical company.

4. Intellectual Property.

This section asks about patents and copyrights, whether pending, issued, licensed and/or receiving royalties.

5. Relationships not covered above.

Use this section to report other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, what you wrote in the submitted work.

Definitions.

Entity: government agency, foundation, commercial sponsor, academic institution, etc.
Grant: A grant from an entity, generally [but not always] paid to your organization
Personal Fees: Monies paid to you for services rendered, generally honoraria, royalties, or fees for consulting , lectures, speakers bureaus, expert testimony, employment, or other affiliations
Non-Financial Support: Examples include drugs/equipment supplied by the entity, travel paid by the entity, writing assistance, administrative support, etc.
Other: Anything not covered under the previous three boxes
Pending: The patent has been filed but not issued
Issued: The patent has been issued by the agency
Licensed: The patent has been licensed to an entity, whether earning royalties or not
Royalties: Funds are coming in to you or your institution due to your patent

ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Martin
2. Surname (Last Name): Underwood
3. Date: 22-December-2020

4. Are you the corresponding author? ☐ Yes ☑ No

Corresponding Author's Name: Peter Wall

5. Manuscript Title
Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane systematic review and meta-analysis

6. Manuscript Identifying Number (if you know it)
BJJ-2020-1926.R1

Section 2. The Work Under Consideration for Publication

Did you or your institution **at any time** receive payment or services from a third party (government, commercial, private foundation, etc.) for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.)?

Are there any relevant conflicts of interest? ☑ Yes ☐ No

If yes, please fill out the appropriate information below. If you have more than one entity press the "ADD" button to add a row. Excess rows can be removed by pressing the "X" button.

Name of Institution/Company	Grant?	Personal Fees?	Non-Financial Support?	Other?	Comments	
National Institute for Health Research	☑	☐	☐	☐		

Section 3. Relevant financial activities outside the submitted work.

Place a check in the appropriate boxes in the table to indicate whether you have financial relationships (regardless of amount of compensation) with entities as described in the instructions. Use one line for each entity; add as many lines as you need by clicking the "Add +" box. You should report relationships that were **present during the 36 months prior to publication**.

Are there any relevant conflicts of interest? ☑ Yes ☐ No

If yes, please fill out the appropriate information below.

Name of Entity	Grant?	Personal Fees?	Non-Financial Support?	Other?	Comments	
National Institute for Health Research	☐	☑	☐	☐	Fee for acting as journal editor, and member of journal editors group for NIHR paid to my organisation	
National Institute for Health Research	☑	☐	☐	☐	Chief investigator and co-investigator on multiple research grants	

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Name of Entity	Grant?	Personal Fees?	Non-Financial Support?	Other?	Comments
Versus Arthritis	☑	☐	☐	☐	Co-investigator on research grants funded by Versus Arthritis
Multiple professional conferences	☐	☐	☐	☑	Reimbursement of travel and accomodation
Stryker Ltd	☑	☐	☐	☐	Co-investigator on two NIHR funded research projects receiving additional support from Stryker Ltd
SERCO Ltd	☑	☐	☐	☐	Co-investigator in an academic partnership with SERCO funded by the European Social Fund
Confederation for Advanced Research Training in Africa (CARTA)	☐	☐	☐	☑	Travel expenses and honorarium paid to my institution for research training workshop in Nairobi
Clinvivo Ltd	☐	☑	☐	☐	Director and shareholder

Section 4. Intellectual Property -- Patents & Copyrights

Do you have any patents, whether planned, pending or issued, broadly relevant to the work? ☐ Yes ☑ No

Section 5. Relationships not covered above

Are there other relationships or activities that readers could perceive to have influenced, or that give the appearance of potentially influencing, what you wrote in the submitted work?

☑ Yes, the following relationships/conditions/circumstances are present (explain below):

☐ No other relationships/conditions/circumstances that present a potential conflict of interest

Investigator on multiple research grants from Australian National Health and Medical Research Council

At the time of manuscript acceptance, journals will ask authors to confirm and, if necessary, update their disclosure statements. On occasion, journals may ask authors to disclose further information about reported relationships.

ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 6. Disclosure Statement

Based on the above disclosures, this form will automatically generate a disclosure statement, which will appear in the box below.

Dr. Underwood reports grants from National Institute for Health Research, during the conduct of the study; personal fees from National Institute for Health Research, grants from National Institute for Health Research , grants from Versus Arthritis, other from Multiple professional conferences, grants from Stryker Ltd, grants from SERCO Ltd, other from Confederation for Advanced Research Training in Africa (CARTA), personal fees from Clinvivo Ltd, outside the submitted work; and Investigator on multiple research grants from Australian National Health and Medical Research Council.

Evaluation and Feedback

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ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Imran
2. Surname (Last Name): Ahmed
3. Effective Date (07-August-2008): 11-December-2020

4. Are you the corresponding author? ☐ Yes ☑ No

Corresponding Author's Name: Peter Wall

5. Manuscript Title
Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane systematic review and meta-analysis

6. Manuscript Identifying Number (if you know it)
BJJ-2020-1926.R1

Section 2. The Work Under Consideration for Publication

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Complete each row by checking "No" or providing the requested information. If you have more than one relationship click the "Add" button to add a row. Excess rows can be removed by clicking the "X" button.

The Work Under Consideration for Publication

Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
1. Grant	☐	☐	☑	NIHR Postdoctoral fellowship award for corresponding author.		×
						ADD
2. Consulting fee or honorarium	☑	☐	☐			×
						ADD
3. Support for travel to meetings for the study or other purposes	☑	☐	☐			×
						ADD
4. Fees for participation in review activities such as data monitoring boards, statistical analysis, end point committees, and the like	☑	☐	☐			×
						ADD
5. Payment for writing or reviewing the manuscript	☑	☐	☐			×
						ADD

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The Work Under Consideration for Publication						
Type	**No**	**Money Paid to You**	**Money to Your Institution***	**Name of Entity**	**Comments****	
6. Provision of writing assistance, medicines, equipment, or administrative support	☑	☐	☐			×
						ADD
7. Other	☑	☐	☐			×
						ADD

* This means money that your institution received for your efforts on this study.
** Use this section to provide any needed explanation.

Section 3. Relevant financial activities outside the submitted work.

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Relevant financial activities outside the submitted work						
Type of Relationship (in alphabetical order)	**No**	**Money Paid to You**	**Money to Your Institution***	**Entity**	**Comments**	
1. Board membership	☑	☐	☐			×
						ADD
2. Consultancy	☑	☐	☐			×
						ADD
3. Employment	☑	☐	☐			×
						ADD
4. Expert testimony	☑	☐	☐			×
						ADD
5. Grants/grants pending	☐	☑	☐	NIHR Doctoral Research Fellowship grant awarded. £363000		×
						ADD

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Relevant financial activities outside the submitted work

Type of Relationship (in alphabetical order)	No	Money Paid to You	Money to Your Institution*	Entity	Comments	
6. Payment for lectures including service on speakers bureaus	☑	☐	☐			×
						ADD
7. Payment for manuscript preparation	☑	☐	☐			×
						ADD
8. Patents (planned, pending or issued)	☑	☐	☐			×
						ADD
9. Royalties	☑	☐	☐			×
						ADD
10. Payment for development of educational presentations	☑	☐	☐			×
						ADD
11. Stock/stock options	☑	☐	☐			×
						ADD
12. Travel/accommodations/ meeting expenses unrelated to activities listed**	☑	☐	☐			×
						ADD
13. Other (err on the side of full disclosure)	☑	☐	☐			×
						ADD

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Section 4. Other relationships

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Hide All Table Rows Checked 'No' SAVE

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ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Peter
2. Surname (Last Name): Wall
3. Effective Date (07-August-2008): 11-December-2020

4. Are you the corresponding author? ☑ Yes ☐ No

5. Manuscript Title
Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane systematic review and meta-analysis

6. Manuscript Identifying Number (if you know it)
BJJ-2020-1926.R1

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Complete each row by checking "No" or providing the requested information. If you have more than one relationship click the "Add" button to add a row. Excess rows can be removed by clicking the "X" button.

The Work Under Consideration for Publication

Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
1. Grant	☐	☑	☑	NIHR Postdoctoral Fellowship Award		×
						ADD
2. Consulting fee or honorarium	☑	☐	☐			×
						ADD
3. Support for travel to meetings for the study or other purposes	☑	☐	☐			×
						ADD
4. Fees for participation in review activities such as data monitoring boards, statistical analysis, end point committees, and the like	☑	☐	☐			×
						ADD
5. Payment for writing or reviewing the manuscript	☑	☐	☐			×
						ADD

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The Work Under Consideration for Publication						
Type	**No**	**Money Paid to You**	**Money to Your Institution***	**Name of Entity**	**Comments****	
6. Provision of writing assistance, medicines, equipment, or administrative support	☑	☐	☐			×
						ADD
7. Other	☑	☐	☐			×
						ADD

* This means money that your institution received for your efforts on this study.
** Use this section to provide any needed explanation.

Section 3. Relevant financial activities outside the submitted work.

Place a check in the appropriate boxes in the table to indicate whether you have financial relationships (regardless of amount of compensation) with entities as described in the instructions. Use one line for each entity; add as many lines as you need by clicking the "Add +" box. You should report relationships that were present during the 36 months prior to submission.

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Relevant financial activities outside the submitted work						
Type of Relationship (in alphabetical order)	**No**	**Money Paid to You**	**Money to Your Institution***	**Entity**	**Comments**	
1. Board membership	☑	☐	☐			×
						ADD
2. Consultancy	☑	☐	☐			×
						ADD
3. Employment	☑	☐	☐			×
						ADD
4. Expert testimony	☑	☐	☐			×
						ADD
5. Grants/grants pending	☐	☐	☑	NIHR HTA Awards		×
						ADD
6. Payment for lectures including service on speakers bureaus	☑	☐	☐			×

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Relevant financial activities outside the submitted work

Type of Relationship (in alphabetical order)	No	Money Paid to You	Money to Your Institution*	Entity	Comments	
						ADD
7. Payment for manuscript preparation	☑	☐	☐			×
						ADD
8. Patents (planned, pending or issued)	☑	☐	☐			×
						ADD
9. Royalties	☑	☐	☐			×
						ADD
10. Payment for development of educational presentations	☑	☐	☐			×
						ADD
11. Stock/stock options	☑	☐	☐			×
						ADD
12. Travel/accommodations/ meeting expenses unrelated to activities listed**	☑	☐	☐			×
						ADD
13. Other (err on the side of full disclosure)	☑	☐	☐			×
						ADD

* This means money that your institution received for your efforts.
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Section 4. Other relationships

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ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

ICMJE Form for Disclosure of Potential Conflicts of Interest

Section 1. Identifying Information

1. Given Name (First Name): Amit
2. Surname (Last Name): Chawla
3. Effective Date (07-August-2008): 11-December-2020

4. Are you the corresponding author? ☐ Yes ☑ No

Corresponding Author's Name: Peter Wall

5. Manuscript Title: Time to reconsider the routine use of tourniquets in total knee replacement surgery: An abridged version of a Cochrane systematic review and meta-analysis

6. Manuscript Identifying Number (if you know it): BJJ-2020-1926.R1

Section 2. The Work Under Consideration for Publication

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The Work Under Consideration for Publication

Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
1. Grant	☑	☐	☐			×
						ADD
2. Consulting fee or honorarium	☑	☐	☐			×
						ADD
3. Support for travel to meetings for the study or other purposes	☑	☐	☐			×
						ADD
4. Fees for participation in review activities such as data monitoring boards, statistical analysis, end point committees, and the like	☑	☐	☐			×
						ADD
5. Payment for writing or reviewing the manuscript	☑	☐	☐			×
						ADD
6. Provision of writing assistance, medicines, equipment, or administrative support	☑	☐	☐			×

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The Work Under Consideration for Publication

Type	No	Money Paid to You	Money to Your Institution*	Name of Entity	Comments**	
						ADD
7. Other	☑	☐	☐			✕
						ADD

* This means money that your institution received for your efforts on this study.
** Use this section to provide any needed explanation.

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Relevant financial activities outside the submitted work

Type of Relationship (in alphabetical order)	No	Money Paid to You	Money to Your Institution*	Entity	Comments	
1. Board membership	☑	☐	☐			✕
						ADD
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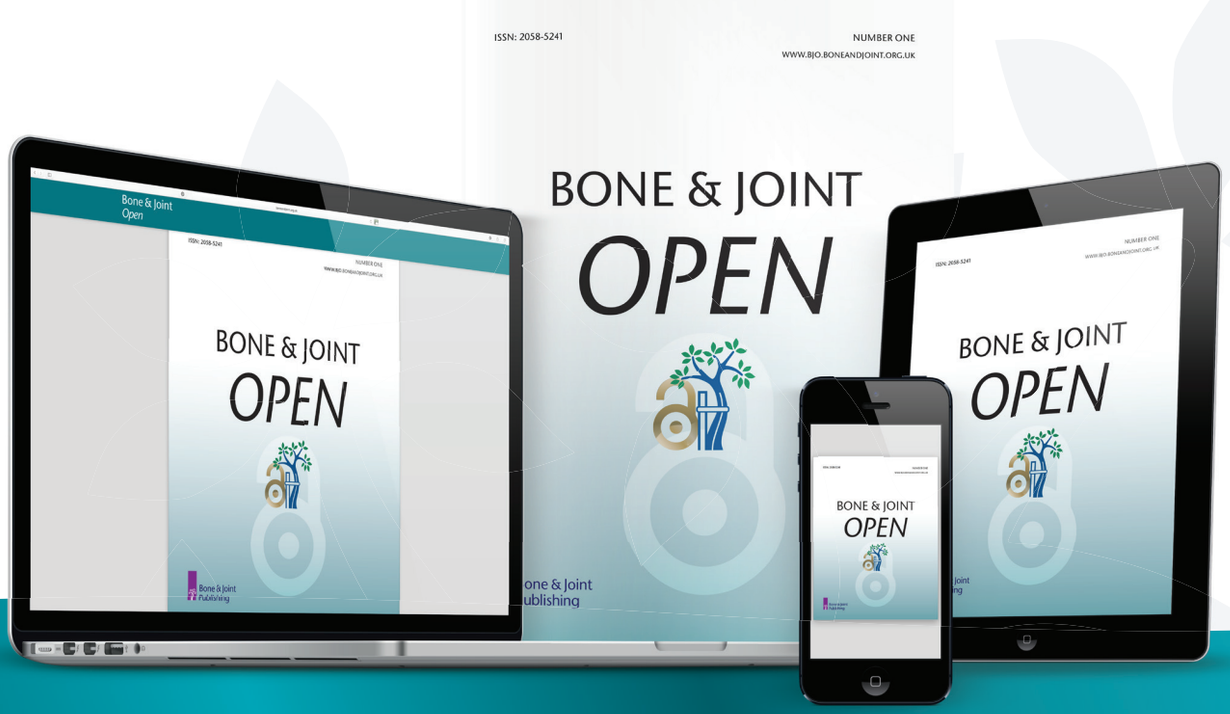

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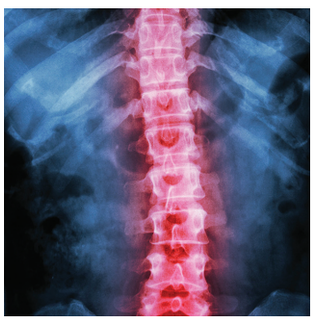

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Editorial

New evidence points to a strong case for early decompression in spinal cord injury: time is spine

Brett Rocos
Deputy Editor
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Despite the progress made in recreational and industrial safety, spinal cord injuries continue to plague society, with enormous associated costs to the individual and the population.[1] It goes without saying that these are debilitating injuries, which transform the lives of patients and their families. Sadly, the immediate treatments available to the astute surgeon are unchanged in recent times, being limited to managing associated injuries, controlling blood pressure and haemoglobin concentration, and external stabilization using collar and the ubiquitous spinal precautions.

Is there a role for urgent surgery? Historically, decompression was assumed to add to the care of these patients only when circumstances allowed, and certainly not in complete cord injuries where recovery was thought impossible. As a result of these uncertainties, some patients spent days languishing for an experienced eye and a treatment plan.

And that was the way of it for a long time. However, we are now entering a new era in the management of spinal cord injury. A greater understanding of the pathoanatomy and physiology of cord injury and a growing interest in how treatments can influence recovery can be found in the literature, and from a surgical perspective, the last decade has seen an astounding application of the scientific method to the problem. As a result, there is now convincing evidence to suggest that decompression has a role in improving the outcomes of these patients.[2] The question remains, though: when should this take place?

The last decade has seen a few animal studies and tentative guidelines, which have suggested that decompression within 24 hours improves overall outcomes and increases the rate of conversion from American Spinal Cord Injury Association (ASIA) grade A (complete sensory or motor function loss below the level of injury) to ASIA grade B (sensation is preserved below the level of injury, but motor function is lost) or better.[3,4] However, the strength of that evidence has been low relative to the logistical and technical challenges that urgent decompression presents.[5] Now though, we may have an answer. In the most recent development, a joint neurosurgical and orthopaedic effort in Toronto, Canada, has conducted a novel study investigating the timing of surgical decompression following cord injury and its effect on neurological recovery.[6] In this study, data from four databases spanning 25 years to 2017 and representing over 1,500 patients with spinal cord injury was analyzed to find out which factors influenced the motor score at one year following injury (an interval chosen because the majority of recovery occurs by this time).

Patients were, on average, in their fourth decade, with 528 undergoing decompression within 24 hours and the remainder later. A comprehensive statistical analysis reveals the bottom line: patients undergoing decompression within 24 hours show greater improvements in their sensorimotor function. Importantly, waiting for more than 24 hours leads to a rapid decline in recovery, and after 36 hours recovery reaches a plateau, suggesting that by that stage any potential benefit of decompression has been missed. The study goes on to show that this improvement is significantly greater than those treated with delayed decompression, and that in the most common cervical injuries, this effect is even more pronounced in the upper limbs.

This is powerful evidence for prompt decompression and firmly sets out a new

standard of care, namely that we should be able to investigate, manage, and operate on patients with spinal cord injury regardless of time or location within 24 hours. Of course, in many healthcare systems, particularly in a post-COVID-19 world, this is easier said than done. At the moment, we have limited evidence for the role of urgent MRI in trauma, though it seems likely that this will be part of the system needed to offer a comprehensive system of care. Similarly, it is safe to bet that many hospitals will not yet have in place the theatre staff and equipment needed for these sometimes difficult operations out of hours. Add to this the paucity of spinal training for some trauma and orthopaedic surgeons as a catalyst, and we have the potential for these patients to be ill-served without specific efforts.

Transformative though this study is, there is more to be done. The authors admit that this study took 24 hours as a line in the sand based on work that had gone before, and confess that a shorter interval may yield even better results. The heterogeneity of patients, injury patterns, and surgical strategies are all areas where future work might be useful, and could perhaps add to the generalizability of the conclusions.

So it would seem that 'time really is spine', and that these patients should be treated with the same urgency as the compartment syndromes and septic joints of the world, with prompt and expert surgical treatment. Being present at the trauma calls as orthopaedic surgeons, we have an opportunity to dramatically impact the recovery of these patients through prompt recognition of those at risk and initiating the steps towards theatre. This work will have far-reaching consequences to surgical workload, training, logistics, and emergency care. Nonetheless, if we want to transform these devastating injuries, it is essential that we approach them with the purpose and energy that we now know they deserve.

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Feature

Meniscal allograft transplants: state of the art

For over 80 years, the deleterious effects of meniscectomy have been known. In 1936, King[1] showed experimentally the degenerative changes induced by meniscectomy in an experimental dog model. In 1948, Fairbank[2] described the radiological arthritic changes after meniscectomy in the human knee. Nevertheless, total or subtotal meniscectomy was the treatment of choice for a symptomatic meniscal tear for many years. It was a relatively easy procedure with predictable and excellent clinical results in the short-term. However, it is now beyond doubt that partial or total meniscectomy leads to increased rates of osteoarthritis (OA) and subsequent arthroplasty.[3] In an effort to prevent or delay the onset of OA and reduce pain, the first meniscus allograft transplantation (MAT), using lyophilization as the preservation method, was performed in 1984 by Milachowski in Munich, Germany.[4] Since then, MAT has grown to be more popular worldwide. In Europe,[5,6] the USA,[7,8] and Asia,[9,10] multiple studies have shown the benefits of MAT in terms of clinical and radiological outcomes. As with any novel and state of the art procedure, indications, techniques, and outcomes have evolved over time. This review will summarize where we are now and, importantly, what still needs to be achieved.

BIOMECHANICS OF MENISCAL TRANSPLANTATION

The menisci are an important structure in the knee and are an essential mechanical component in a number of different ways, including load distribution, secondary stabilization of the knee, and tibiofemoral congruity.[11-13] It is well established with a variety of studies that the load distribution role varies between approximately 50% of the load acting on the extended knee joint being transmitted to the menisci; while in flexion, this increases up to 85% to 90%.[14-17] These loads are well and evenly distributed when the menisci are intact.[18] However, removal of the medial meniscus results in a 50% to 70% reduction in femoral condyle contact area, and a 100% increase in contact stress in the medial compartment.[19] In contrast, total lateral meniscectomy results in a 40% to 50% decrease in contact area and increases contact stress in the lateral component by 200% to 300%.[20,21] This significantly increases the load per unit area and may contribute to accelerated articular cartilage damage and degeneration.[22] Removal of almost 50% of the posterior horn of the medial meniscus has been reported to produce an increase in the strain on the anterior cruciate ligament (ACL),[23] an increase in anterior tibial translation,[24] and a posterior shift of the femur under axial compression.[25] Partial or total medial meniscectomy has also been shown to significantly increase anteroposterior (AP) translation and pivot-shift in the ACL-deficient knee in cadaveric specimens, while meniscal repair effectively improved stability.[26] The lateral meniscus is an important stabilizer of the knee under both isolated and combined rotatory loads, and tear or resection also results in a significant increase of dynamic laxity in the ACL-deficient knee. More recently, it has been found that the lateral meniscus plays a major role in restricting the pivot-shift manoeuvre, as a lateral meniscectomy increases translation and rotation and increases the pivot shift.[27-29] A similar effect has also been noted after lateral meniscus posterior root tears.[30,31]

MAT has been reported to be effective in the treatment of meniscus injury, and is thought to do so by partially restoring the biomechanical function of the knee after the meniscectomy.[32] In vitro studies demonstrated that joint contact pressure in meniscectomized knees were significantly higher than pressures after MAT,[33] which were similar to those in the intact knee.[14] MAT has also been reported to reduce the anterior tibial translation. Recently, Zaffagnini et al[34] conducted an in vivo study and confirmed that AP laxity and rotation were reduced by 25% to 50% at both 30° and 90° of knee flexion after meniscal transplantation in two different cases (one medial and the other lateral). The biomechanical goal of meniscal transplantation is therefore to re-establish the functional status of the meniscus, providing protection and stability to the joint.

INDICATIONS

Loss of meniscus function can result in joint pain, decreased joint function, and the onset of OA.[35] After a pain-free interval, the patient develops activity related pain resulting in reduction in activity and may eventually result in a "toothache"-type pain that is dull and nagging. Symptomatic unicompartmental pain in the meniscus-deficient knee without significant articular cartilage wear is referred to as the 'post-meniscectomy syndrome,[36,37] and is the primary indication for MAT (Figure 1).

The International Meniscus Reconstruction Forum (IMReF) consensus statements proposed that MAT is also indicated in the following scenarios:

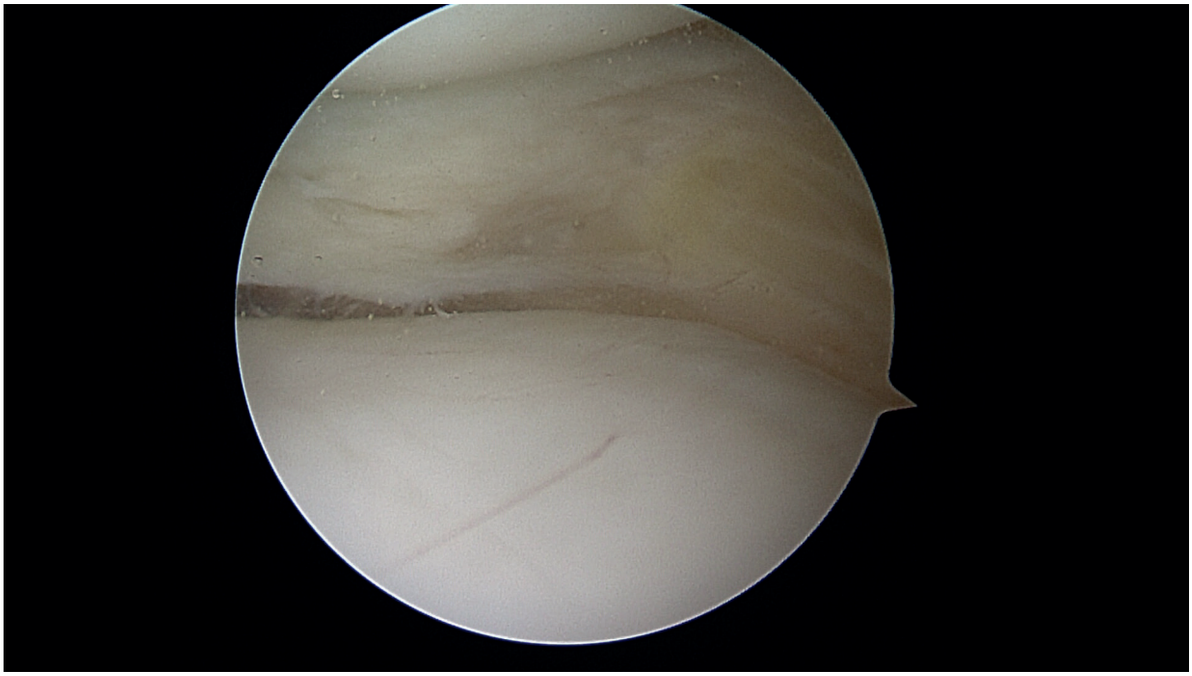


Fig. 1. The lateral meniscus-deficient knee. The edge of the tibial plateau is clearly seen with no meniscal tissue remaining.

1. Persistent unicompartmental pain in the presence of total or subtotal "functional" meniscectomy. The knee joint should be stable and with normal alignment, and without radiographic evidence of advanced degenerative changes (Kellgren-Lawrence grade ≥ 3).
2. As a concomitant procedure to revise anterior cruciate ligament (ACL) reconstruction to aid in joint stability when meniscal deficiency is believed to be a contributing factor to failure. An ACL graft is significantly protected by the meniscus allografts as much as the meniscus is protected by an ACL graft.
3. As a concomitant procedure with articular cartilage repair in a meniscal deficient compartment.
4. Young, athletic patients who have had complete meniscectomy and who might be considered meniscal transplantation candidates prior to symptom onset in an effort to avert early joint degeneration. This last context for meniscal transplantation has also been advocated by some, but is still debated within the IMReF.

Although there is some evidence that patches of exposed bare bone at the time of transplantation ought not be a contraindication,[38] the acceptable threshold of articular cartilage damage is currently not known, with the majority of surgeons reporting moderate or severe degeneration to be an exclusion criterion.[39] Therefore, significant articular cartilage defects, such as bipolar lesions or multicompartment degeneration that cannot undergo concomitant restorative cartilage procedures should be a contraindication for MAT.

Other contraindications to MAT include severe OA, uncorrectable malalignment or instability, irreparable chondral damage, active infection, inflammatory arthropathy, and obesity (BMI > 35 kg/m^2).[40] Lastly, it is imperative that candidates have a high potential for successful follow-up and compliance with postoperative rehabilitation protocols. Rucinski et al[41] found that patients who were compliant with their postoperative rehabilitation protocols were 6.3-times less likely to need allograft revision or progress to total knee arthroplasty (TKA) and were 7.5-times more likely to have successful outcomes one to three years post-transplantation. Factors predictive of poorer outcome were reported in a meta-analysis by Fanelli et al,[42] suggesting that poorer outcomes were associated with: increasing age, female sex, high BMI, multiple previous knee surgeries, and medial transplants. While the 'ideal' patient for MAT is still debated, it should take into account the factors mentioned.

GRAFT PROCUREMENT

One of the difficulties with centres offering MAT has always been graft availability and procurement. Four methods for graft preservation have been described as lyophilized (freeze-dried), cryopreserved, fresh frozen (deep frozen), and fresh-viable grafts. Lyophilization has been abandoned due to the high temperatures and gamma irradiation having deleterious effects on the mechanical properties of the allograft.[43-45] Cryopreservation, stored at -196°C, is believed to preserve cell membrane integrity and to protect cell viability using a cryoprotectant such as glycerol or dimethyl sulfoxide that avoids formation of intracellular ice crystals, but it is difficult to perform and expensive.[46,47] The fresh frozen preservation technique, packaged in sterile plastic bags and stored in a mechanical freezer at -80°C, is the most cost-efficient and simple method that gives the graft a typical shelf life of five years.[48] Compared to cryopreservation, fresh frozen grafts are cheaper and have a low risk of disease transmission and immunogenicity with a good preservation of biomechanical properties and, although they have reduced chondrocyte viability, appear to be the best choice currently.[49] Despite containing live chondrocytes, fresh-viable grafts are expensive and have the logistical challenges of delivering fresh graft to recipient within ten to 14 days, in addition to being associated with a higher rate of disease transmission; for this reason, the majority of grafts performed are fresh frozen grafts.

GRAFT SIZING

Allograft size should ideally be matched as accurately as possible. Dienst et al[50] showed that the meniscus can be matched to within 10% of the size of the native meniscus to produce contact biomechanics similar to those with the healthy knee. An oversized meniscus may result in increased loads within the joint, whereas an undersized graft may inadequately distribute the load and experience increased hoop stresses that lead to graft failure.[51] On balance, the opinion is that it is better to be slightly oversized than undersized,[52] and that graft width size-matching is more important than graft length-size matching.[51] Different methods and modalities have been described to determine the size of a meniscus.

The first meniscus sizing method was published by Pollard in 1995.[53,54] Meniscal width was defined as the distance from the peak of the tibial eminence to the periphery of the tibial metaphysis on anteroposterior radiographs. Meniscal length was measured from lateral radiographs. Medial meniscal length was taken as 80%, and lateral meniscal length as 70%, of the measured sagittal length of the tibial plateau. Because of indistinct bony landmarks, which may vary according to the rotation and the inclination when the radiographs are taken, especially for the lateral tibial plateau, Yoon et al[55] found the accuracy of Pollard's method of measuring meniscal width to be low (40%), and proposed a modification which increased the accuracy to 92%. The Yoon modification to calculate lateral meniscal length (mm) was 0.52 x plateau length (according to Pollard method) + 5.2.

Alternatively, and more frequently performed today, MRIs can be used to calculate the meniscal size. Prodromos et al[56] proposed contralateral MRI meniscal measurement to size menisci before transplantation. The meniscal widths and lengths were determined as the maximal coronal and sagittal measurements on their respective reconstructions. Of the 500 pairs of menisci, 97% had sagittal and coronal dimensions that were within 3 mm of the contralateral meniscus. Moreover, menisci were found to have an average error rate of 4.0% using MRI compared with 19.1% using the Pollard method for medial side. The average error rate for lateral menisci was 5.3% using MRI compared with 9.6% using the Pollard method.

Haen et al[57] compared radiographs with MRI measurements and determined that while sagittal measurements were comparable, radiographic coronal measurements were inferior to MRI. The authors proposed specific equations for the determination of meniscal dimensions based on measurement of the length or width of the bone on MRI or on radiographs. Finally, anthropometric data (sex, weight, height) can been used to estimate meniscal width, as proposed by Van Thiel et al,[58] but within the IMReF group, it is used by only 12% of surgeons.[39] There is no definitive evidence that MRI is better than plain radiograph for graft sizing, but it is not inferior.[59-61] Hence, IMReF recommends the use of MRI or radiographs as gold standard for determination of meniscal dimensions.[39] Interestingly, biomechanical studies have demonstrated that variations in the meniscal height result in significant changes in contact pressure on the articular surface,[62,63] and a recent study found a weak statistical correlation between the meniscal height and the meniscal width and length, in addition to the meniscal height and anthropometric data, and between the heights of the segments (anterior horn, body, and posterior horn) in the same meniscus.[64] The height of the meniscal segments may be a new important recordable variable in preoperative meniscal measurement in order to increase the chances of success in meniscal transplantation. In the future, 3D-CT and 3D-MRI have been proposed as methods to estimate the size of the MAT graft with promising results.[65,66]

MODERN SURGICAL TECHNIQUES

Current practice within the IMReF group observed 74% of surgeons preferring to use bone fixation compared with 26% preferring soft tissue fixation.[39] The suture-only fixation technique involves detaching the meniscus from bone and fixing the posterior and anterior roots using a transtibial suture technique, similar to meniscal root repairs (Figure 2). The peripheral rim is fixed to the prepared meniscal bed in the host using all-inside and/or inside-out sutures through the body and meniscal horns (Figure 3).

This is arguably less invasive and easier to match with the patient than bony fixation technique as fit can be adjusted by varying position of the fixation in the tibial tunnels. The bony fixation techniques can be divided in two types: bone block/bridge and bone plugs. Bone blocks require the creation of a trough (bridge-in-slot technique) or tapered keyhole technique in the recipient tibial plateau where the bone graft is securely placed (Figure 4).

The bone plug technique may be performed using a double plug technique, in which small amounts of bone are left attached to the anterior and posterior horns forming bone plugs, which are then pulled down into the tibia. Bony fixation has theoretical advantages in reducing meniscal extrusion and re-tearing of the anterior and posterior roots postoperatively. Meniscal extrusion seems to occur more often in lateral transplants;[67,68] however, there is little evidence to suggest that graft extrusion affects long-term outcomes[69] and it also does not significantly progress over time.[70] The bone 'block' or bone 'bridge' technique is more commonly used for the lateral MAT, where the meniscal roots are close together and the bridge does not interfere with the ACL. The bone plug technique is more commonly used for medial transplants, where the roots are further apart and creating a trough risks damaging the tibial attachment of the ACL (Figure 5).[71]

Although bone plug fixation seems to provide superior load distribution in medial MAT compared with soft tissue fixation,[72,73] the soft tissue fixation is less technically challenging and seems to have histological advantages.[74,75] Bone bridge, using keyhole fixation, restores the distribution of contact stresses closer to that of the normal knee.[76] Bony fixation also lowers the risk of meniscal extrusion, but requires perfect sizing as malposition could lead to cartilage damage[77] and it is complex when combined with an ACL reconstruction. Overall, recent studies have found no difference in terms of kinematics and forces between the soft tissue and bone fixation techniques, as well as clinical outcome, reoperation rates, and failure rates.[78] Additional techniques have been described to reduce meniscal extrusion, including soft-tissue fixation incorporating the anterior intermeniscal ligament,[79] the three-tunnel technique,[80] and lateral capsular fixation.[81]

REHABILITATION AND RETURN TO SPORT

The aim of MAT is to facilitate the return of knee function, and rehabilitation should aim to achieve this while respecting the healing process of the graft. The ideal rehabilitation protocol has not been established, and variations exists among the authors;[82] however, a few biological and biomechanical principles are useful when guiding the rehabilitation process, and an equilibrium should be obtained between a too aggressive or too cautious management since both approaches could be responsible for sub-optimal results.

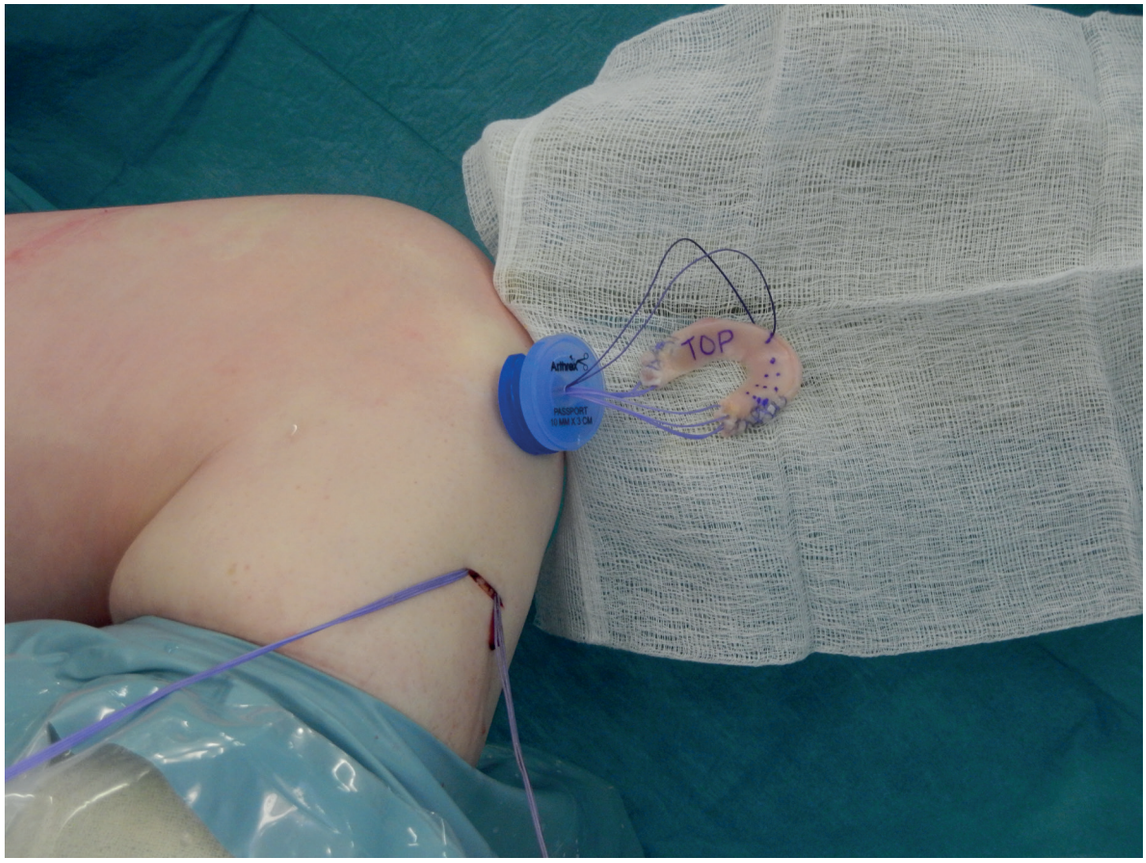
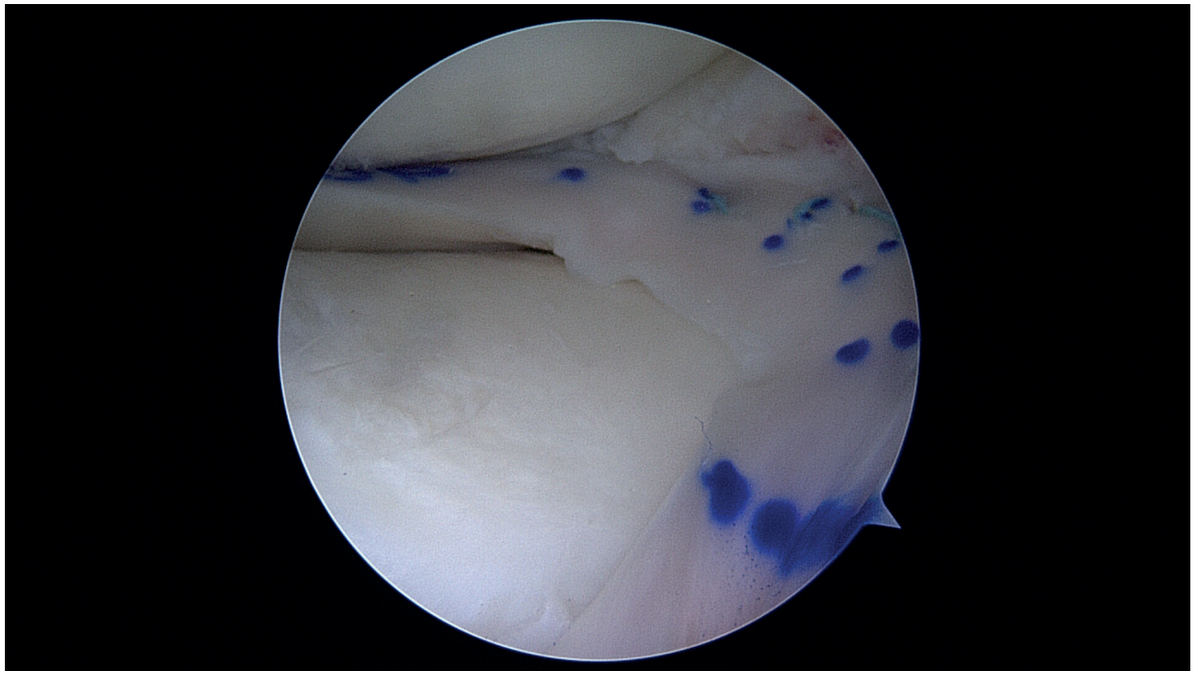


Fig. 2. The suture-only fixation technique. Left knee in 'figure 4 position' Lead sutures attached to meniscus allograft are passed through tunnels in the tibia. The graft is drawn into the knee through a cannula.

From a biological point of view, the healing process requires several months to guarantee an effective graft integration. In fact, a stable connection between the graft and joint capsule is known to be obtained after three months,[83] while an almost physiological metabolic activity of the transplanted meniscus is present after six months.83–85 From a mechanical point of view, the load on the graft should be applied with caution during the first weeks, load with knee flexion between 30° and 90° causes posterior translation of the graft posterior horn, resulting in high stress on the repair site, especially if coupled with rotatory movements.[83–85] Conversely, joint load with the knee in extension could have a beneficial role due to the "squeezing" of graft periphery against joint capsule, favouring its healing.[83–85] Based on this, the IMReF suggested a personalized, goal-oriented approach, consisting of four stages, with each stage requiring specific goals to be met before progression to the next stage is allowed:[39]

1. **Stage 1: Early restorative phase (0 to six/eight weeks).** The principal aim is to control pain and swelling, with adequate medications, ice, and extension brace. A period of non-weightbearing for four weeks is usually prescribed. Range of motion (ROM) exercises are started immediately or after one week, without exceeding 90° during the first month. Full weightbearing and ROM are achieved after six to eight weeks.
2. **Stage 2: Strength and conditioning phase (two to six months).** The principal aim of this phase is to recover gait and joint functionality. ROM exercises are aimed to achieve contralateral joint mobility. Mini-squat, leg press, and cycling could be progressively started.
3. **Stage 3: Functional rehabilitation progression phase (six to nine months).** The principal aim is to recover preoperative activity level. Particular care is used to recover muscle strength, coordination, core stability, and the control of the whole body. Complexity of motor tasks is progressively increased. Training should be implemented with cycling and swimming to improve stamina.
4. **Stage 4: Sport-specific training and return to sport (from eight to nine months).** It is important to counsel patients regarding the risk of returning to sport practice, especially in high-impact sports. Thus far, MAT in athletes has been recommended with caution because of concerns for high failure rates and long recovery times.

These stages represent a balanced approach for rehabilitation and return to sport activity after MAT, and alternative approaches have been suggested.[41,86,87] However, a recent systematic review higlighted that most of the studies (70%) agreed to initiate flexion of the knee during the first week and allowed full ROM between six and eight weeks (67%). In contrast, partial weightbearing was allowed immediately by 32% of studies and after one month in 43% of studies, while the achievement of full weightbearing at six weeks was shared in the majority of studies (66%). An early or delayed rehabilitation could have a



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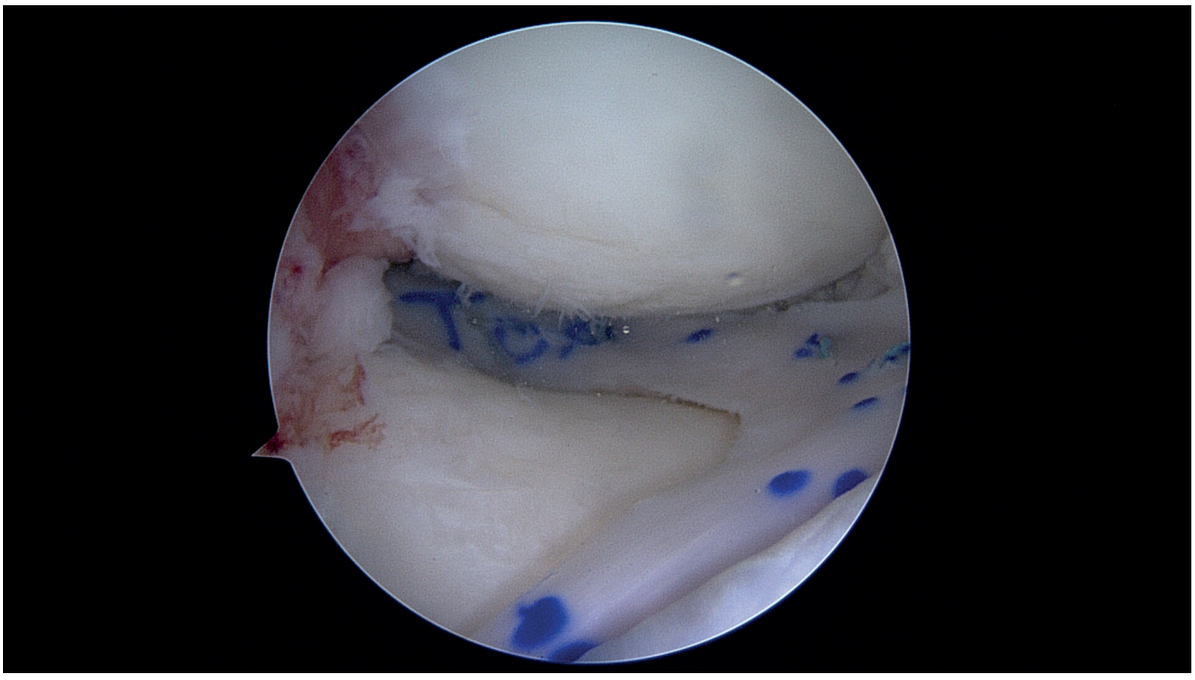

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Fig. 3. a) The peripheral rim is fixed to the prepared meniscal bed in the host using all-inside and/or inside-out sutures through the body; b) the meniscal horns are fixed to the peripheral rim using all-inside and/or inside-out sutures while the posterior and anterior roots using a transtibial suture technique, similar to meniscal root repairs.

relevant role in MAT outcomes, as Lee et al[86] reported less graft extrusion in patients that followed a more cautious and slower rehabilitation protocol, including immobilization in extension for three weeks, an unloading brace for further seven weeks, light running after five months, and return to sport after nine months, rather than six months.

When to return to sport, and which type of sports activity should be advised against, continues to be a matter of debate. Despite some authors suggesting abandoning high-impact

Fig. 4. Example of meniscal allograft supplied by the tissue bank. Final preparation can be with using the sutures through bone technique or a bone bridge technique.

sports due to the risk of graft injuries, good results have been reported in a few clinical studies involving athletes and active patients. A systematic review of 467 patients showed that 77% returned to sport after an average of 9.2 months, and 67% returned to the same pre-injury level. Overall, 23% underwent a reoperation during an average follow-up of 3.4 years, but only 13% were related to the graft.[88] Another recent clinical study highlighted the conundrum of MAT, in that one of the main reasons for patients undergoing MAT was to have a chance to continue play sport and remain active, while the main reason for activity level reduction or stopping sports after MAT was to prevent further joint damage. In addition, more than one-third of patients reduced activity levels due to surgeon recommendation.[89] It is therefore very important to discuss the general and sport-related expectations with each patient, and in particular that though the good results achieved in terms of pain reduction that resumption of pre-injury activity, should only be performed with extreme caution, and after full explanation of the risks. Unsurprisingly, higher degree of satisfaction and higher patient-reported outcome measures (PROMs) have been reported in patients who were able to return to sports.[90] Thus, participation in low-impact activities such as swimming, cycling, golf, and yoga should be encouraged to maintain knee and overall wellness.

CLINICAL OUTCOMES AND SURVIVORSHIP

The clinical outcomes of patients following MAT have been assessed by using a wide range of outcome measures, including Lysholm, Knee injury and Osteoarthritis Outcome Score (KOOS), International Knee Documentation Committee (IKDC), and visual analogue scale (VAS) scores, which are summarized in Table I.

One pilot randomized controlled trial (RCT) designed to assess the benefits of MAT versus meniscectomy and a programme of personalized physiotherapy demonstrated that patients

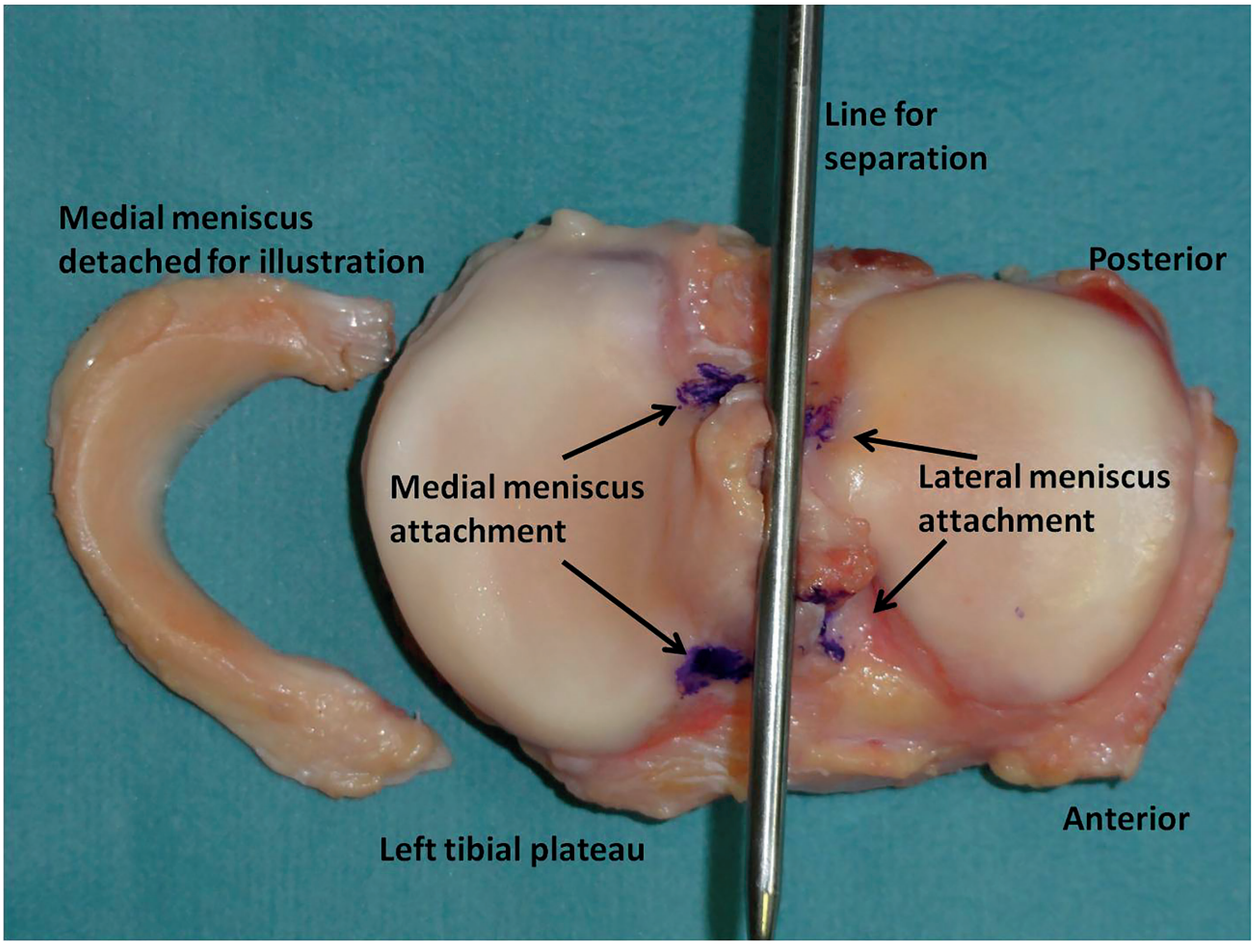

Fig. 5. Relationship between meniscal roots and tibial attachment of the ACL, showing how the tibial plateau can be split into two allowing separate allocation of allograft menisci.

undergoing MAT showed better PROMs at one year.[91] Many other reviews show that MAT provides good clinical results at short- and mid-term follow-up, especially in terms of pain and mechanical function.[92,93] In a meta-analysis study of 3,157 allografts, a significant improvement in clinical outcomes at both medium- and long-term follow-ups (five to 15 years) across all outcome measures and good patient satisfaction at long-term follow-up was reported.[94] Even with advanced wear or older age, MAT has been shown to achieve prolonged good outcomes in terms of pain relief, satisfactory level of work and recreational daily activity.[38,95,96] Moreover, a systematic review showed that there is no significant difference between the postoperative PROMs for isolated MAT and MAT with concomitant osteotomy, ligament, and cartilages procedures.[97] However, although good improvements in PROMs have been seen, the question regarding the chondroprotective effect of MAT is unanswered and the need for long-term evidence remains.

Table 1. Clinical outcomes of patients following meniscus allograft transplantation.

Outcome, mean (SD); and/or range	Van Arkel et al[130]	Saltzman et al[116]	Rue et al[112]	Laprade et al[113]	Stone et al[114]	Abat et al[115]	Kim et al[117]	Zaffagnini et al[125]	Grassi et al[127]
Lysholm									
Preop value	35 (15 to 56)	53.2 (19.2)	48.7 (16.4)			62.3 (9)	72.7		57 (19)
Final FU value	80 (19 to 100)	74.1 (16.1)	74.0 (17.7)			91.2 (6.9)	92.3		82 (20)
p-value	< 0.001	< 0.001	< 0.001			< 0.001	< 0.001		< 0.001
IKDC									
Preop value		41.3 (13.6)	38.7 (12.7)	54.3	48				
Final FU value		60.97 (16.8)	66.9 (17.2)	72	75				
p-value		< 0.001	< 0.001	< 0.001	< 0.001				
KOOS Pain									
Preop value		58.33 (15.6)	55.4 (15.7)					36.6 (23.1)	N/A
Final-FU value		79.42 (19.8)	81.3 (16.7)					89.6 (14.1)	81 (20)
p-value		< 0.001	< 0.001					< 0.001	N/A
KOOS Symptoms									
Preop value		60.37 (17.3)	56.6 (16.3)					48.9 (23.1)	N/A
Final FU value		75.65 (14.4)	73.0 (18.0)					88.6 (13.7)	85 (20)
p-value		< 0.001	< 0.001					< 0.001	N/A
KOOS ADL									
Preop value		74.16 (17.1)	72.1 (20.1)					40.8 (27.5)	N/A
Final FU value		87.17 (15.8)	91.1 (11.6)					91.0 (13.6)	90 (21)
p-value		< 0.001	< 0.001					< 0.001	N/A
KOOS Sport									
Preop value		32.14 (14.4)	25.4 (16.2)					31.6 (25.4)	N/A
Final FU value		60 (28.1)	57.0 (23.9)					81.7 (22.8)	63 (38)
p-value		< 0.001	< 0.001					< 0.001	N/A
KOOS QoL									
Preop value		31.25 (17.9)	25.2 (18.9)					30.1 (19.7)	N/A
Final FU value		54.83 (24.2)	55.1 (20.4)					81.5 6 19.6	70 (24)
p-value		0.001	< 0.001					< 0.001	N/A
VAS									
Preop value						6.7 (2)			68 (25)
Final FU value						0.9 (1.3)			26 (32)
p-value									< 0.001

ADL, activities of daily living; FU, follow-up; IKDC, International Knee Documentation Committee; KOOS, Knee Injury and Osteoarthritis Outcome Score; N/A, not applicable; preop, preoperative; QoL, quality of life; VAS, visual activity score.

Table 2. Summary of the previous literature concerning failure and survivorship.

Year	Authors	MAT number	FU time, yrs (SD); range	Definition of failure	Rate of failure, %	Survival rate at χ years, %	Mean survival time, yrs	Reoperation rate, %
2002	Van Arkel et al[109]	63	13.8 (2.8)	Complete resection of the graft	29	N/A	7.4	N/A
2005	Verdonk et al[110]	100	7.2 (3.6); 0.5 to 14.5	HSS pain subscore < 30, or HSS function score < 80, or conversion to arthroplasty	21	79	11.6	N/A
2006	Cole et al[111]	45	2.8; 2 to 4.8	Removal, revision or conversion to TKA or UKA	6.6	N/A	N/A	N/A
2008	Rue et al[112]	29	3.1 (1.2); 1.9 to 5.6	Revision of either the MAT or cartilage repair procedure or arthroscopic confirmation of MAT or cartilage repair failure	6.5	N/A	N/A	17.2
2010	Laprade et al[113]	40	2.5	N/A	N/A	N/A	N/A	N/A
2010	Stone et al[114]	119	5.8; 0.2 to 12.3	Removal of allograft or conversion to TKA or UKA	20.1	N/A	10	N/A
2012	Abat et al[115]	88	5 : 2.5 to 10	Removal of allograft	5.6	N/A	N/A	18.2
2012	Cole and Saltzman et al[116]	29	8.5 (1.3)	Revision procedure or UKA	12	N/A	N/A	N/A
2012	Kim et al[117]	116	4.12; 2 to 13.6	Poor overall results on MRI, arthroscopy or modified Lysholm; or non-satisfactory overall results	10.9 (poor overall results); 18.2 (non-satisfactory overall results)	N/A	N/A	N/A
2014	Kazi et al[118]	86	15	Conversion to TKA	27.9	71	N/A	45.3
2014	McCormick et al[119]	172	4.9; 2 to 9.8	Revision MAT or KA	4.7	95	N/A	32
2015	Van Der Straeten et al[120]	265	6.8; 0.2 to 24.3	Removal of allograft or conversion to TKA or UKA	27.4	15.1 at 24 years	15.2	61
2015	Stone et al[121]	49	8.6 (4.2); 2 to 15	Removal of allograft or conversion to TKA or UKA, pain greater than preoperatively, or constant moderate pain with no relief from non-operative treatment.	22.4	N/A	N/A	32.7
2016	Parkinson et al[122]	125	3; 1 to 10	Removal, revision or conversion to TKA or UKA	18	82 at 5 years	N/A	NA
2016	Noyes et al[123]	69	11.9 (3.2)	Reoperation related to transplant: removal or revision, TKA or UKA, osteotomy. Adverse MRI or radiographic changes	N/A	85 at 2 years 77 at 5 years 69 at 7 years 45 at 10 years 19 at 15 years	N/A	N/A
2016	Kim et al[124]	49	11.5; 8 to 17	Removal, revision or conversion to TKA or UKA, or Lysholm score < 65 or lower than preoperative status	4	98 at 10 years 93.3 at 15 years	N/A	N/A
2016	Zaffagnini et al[125]	147	4.0 (1.9); 2.0 to 10.2	Removal, revision or conversion to TKA or UKA, or Lysholm score < 65	16.3	N/A	9.7	16
2020	Carter et al[126]	48	20 years minimum	Removal, revision or conversion to TKA or UKA	N/A	56.2%	N/A	N/A
2020	Grassi et al[127]	46	10 years minimum	Removal, revision or conversion to TKA or UKA, or Lysholm score < 65	N/A	91 at 5 years 86 at 10 years	N/A	26
2020	Van der Wal et al[128]	109	2.8; 1 to 14	Removal of the allograft	10	N/A	16.1	32
2020	Searle et al[129]	60	3.4 (1.6)	Surgical failure (removal of most/all the graft, revision MAT or conversion to arthroplasty), clinical failure (Lysholm < 65)	9	N/A	N/A	21

HSS, Hospital for Special Surgery; MAT, meniscus allograft transplantation; N/A, not applicable; SD, standard deviation; TKA, total knee arthroplasty; UKA, unicompartmental knee arthroplasty.

Recently, Carter et al[71] reported that graft survivorship was 56.2% with a 20-year minimum follow-up in a cohort of 48 patients. Favourable survivorship reported here is likely primarily to do with exclusion of limb malalignment or the presence of a chondral defects. Secondly, patients were explicitly counselled regarding the pain-relieving aim of MAT, rather than returning to pre-existing activity levels. The authors also utilized grafts which were cryopreserved with no irradiation and the bone block technique used. Another large cohort study of 265 patients reported by Van Der Straaten et al[98] showed a survivorship of 51.9% at 20.2 years in patients younger than 35 years with no-to-mild cartilage damage and an overall mean survival of 15.2 years. Novaretti et al[99] also reported reasonable long-term survivorship, with 73.5% and 60.3% of allografts remaining functional after ten and 15 years, respectively. Recently, Grassi et al[100] reported good outcome and 86% of rate survivorship at ten years in MAT with soft tissue technique. The survival rates and outcome scores are similar between medial and lateral MAT at midterm follow-up (five to ten years).[101,102] Table II gives a summary of the previous literature concerning failure and survivorship. However, one of the complicating issues is that there is currently no consistent definition of failure, complication, or reoperation, which often leads to confusion and prevents meta-analysis or comparison. This is certainly an area which requires clarification.

RADIOLOGICAL EVALUATION

Comparison between second-look arthroscopy and MRI findings demonstrates that MRI is an accurate indicator of the status of the graft with regard to its position within the tibiofemoral joint and its capsular attachment. MRI can also detect areas of meniscal transplant degeneration and the condition of the adjacent articular cartilage.[90,91] Radial displacement of the body of the meniscus on MRI, often termed 'extrusion', is quite a common finding after MAT,[105] especially on the medial side, but it does not seem to correlate with short- or long-term clinical outcomes.[69,106,107] Generalized or focal areas of high signal are often seen in the graft, but these areas are just the normal biological changes within the meniscus graft without any clinical associations.[108] Recently analyzing the joint space width, Lee et al[69] found that the extrusion group after lateral MAT showed greater decrease of joint space width than the non-extrusion group at ten-year follow-up, so a good position of MAT could really make a difference in terms of chondroprotective role. We are currently unable to adequately assess MRIs pre- or postoperatively to predict graft failure. However, as data sets and computer analysis increase in size and ability, this is something to aim for in the future.

HEALTH ECONOMIC ASPECTS

The known benefits of MAT are the relief of symptoms and improvement of quality of life, and the potential benefits of MAT are the avoidance or delay in the development of symptomatic OA and the subsequent need for knee replacement. There is currently no data regarding any chondroprotective effects. Unsurprisingly, a systematic review by Waugh et al[131] concluded that cost-effectiveness analysis is not possible due to a lack of data on the effectiveness of MAT compared to non-surgical care in symptomatic patients. Bendich et al[132] attempted to show how effective MAT would need to be to be cost-effective in reducing arthroplasty surgery. They reported that MAT would have to reduce progression to severe OA (the time for knee arthroplasty) by 31%, from 1.8% a year to 1.2% a year to be cost-effective. This 'base case' scenario would be in a patient aged 30 years with no OA and a BMI of 20 kg/m^2. However, in patients with a BMI over 30 kg/m^2, the reduction in progression to severe OA would only have to be 10% for MAT to be cost-effective. Essentially, MAT was considered to be more cost-effective in lower ages, higher BMIs, and pre-existing OA.

THE FUTURE

As with any novel technique, MAT will be refined across the whole patient pathway as new data and technology becomes available. In particular, a well-designed RCT comparing MAT versus non-surgical treatment needs to be performed, which will allow clinicians to fully evaluate clinical and cost-effectiveness. The indications for MAT should also be re-assessed at regular intervals; in particular, further data should inform clinicians as to whether MAT can be reliably extended to those patients with cartilage damage of International Cartilage Repair Society grade 3 or above in the knee. Indications also need to be determined for the asymptomatic patient, balancing the risk of surgery against the potential for preventing joint deterioration. Greater awareness as to the indications for MAT across the wider orthopaedic community will hopefully see patients referred to specialist centres earlier, and before patients become entrenched in a low activity/high pain cycle. Graft availability needs to improve so patients do not have excessive waits for treatment. Reoperation and failure rates must also progress with advances in fixation techniques, especially with regard to root fixation. Finally, long-term data is required to assess any chondroprotective effect of MAT, and also the effects of returning to high-level or impact sports on MAT survival.

In conclusion, MAT is a pain relieving and clinically effective operation that involves complex patients, surgery, and rehabilitation. Cost-effectiveness has yet to be fully established.

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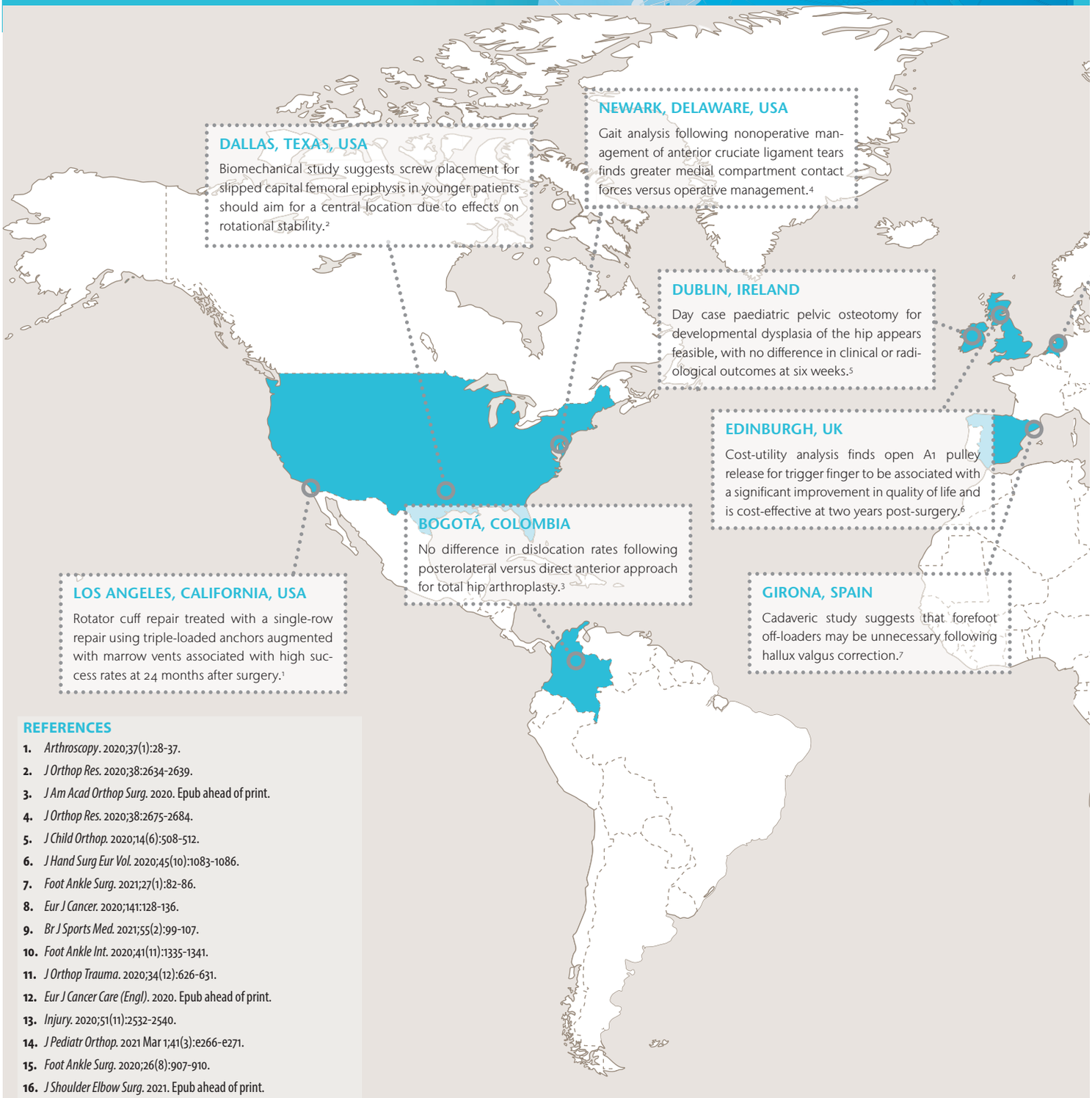
Global View



DALLAS, TEXAS, USA

Biomechanical study suggests screw placement for slipped capital femoral epiphysis in younger patients should aim for a central location due to effects on rotational stability.[2]

NEWARK, DELAWARE, USA

Gait analysis following nonoperative management of anterior cruciate ligament tears finds greater medial compartment contact forces versus operative management.[4]

DUBLIN, IRELAND

Day case paediatric pelvic osteotomy for developmental dysplasia of the hip appears feasible, with no difference in clinical or radiological outcomes at six weeks.[5]

EDINBURGH, UK

Cost-utility analysis finds open A1 pulley release for trigger finger to be associated with a significant improvement in quality of life and is cost-effective at two years post-surgery.[6]

BOGOTÁ, COLOMBIA

No difference in dislocation rates following posterolateral versus direct anterior approach for total hip arthroplasty.[3]

LOS ANGELES, CALIFORNIA, USA

Rotator cuff repair treated with a single-row repair using triple-loaded anchors augmented with marrow vents associated with high success rates at 24 months after surgery.[1]

GIRONA, SPAIN

Cadaveric study suggests that forefoot off-loaders may be unnecessary following hallux valgus correction.[7]

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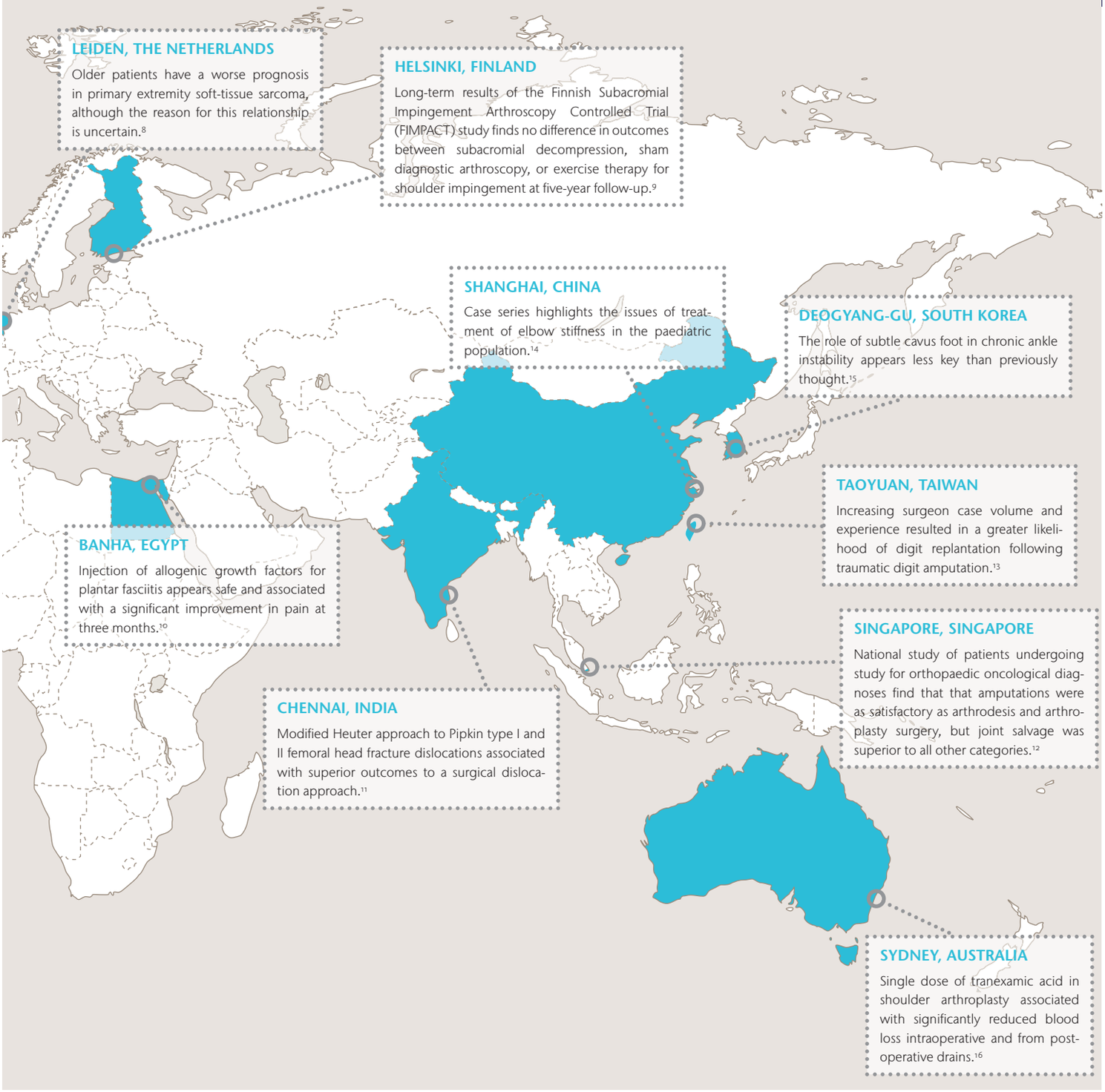
A quick glance at recent orthopaedic developments around the world



LEIDEN, THE NETHERLANDS

Older patients have a worse prognosis in primary extremity soft-tissue sarcoma, although the reason for this relationship is uncertain.[8]

HELSINKI, FINLAND

Long-term results of the Finnish Subacromial Impingement Arthroscopy Controlled Trial (FIMPACT) study finds no difference in outcomes between subacromial decompression, sham diagnostic arthroscopy, or exercise therapy for shoulder impingement at five-year follow-up.[9]

SHANGHAI, CHINA

Case series highlights the issues of treatment of elbow stiffness in the paediatric population.[14]

DEOGYANG-GU, SOUTH KOREA

The role of subtle cavus foot in chronic ankle instability appears less key than previously thought.[15]

TAOYUAN, TAIWAN

Increasing surgeon case volume and experience resulted in a greater likelihood of digit replantation following traumatic digit amputation.[13]

BANHA, EGYPT

Injection of allogenic growth factors for plantar fasciitis appears safe and associated with a significant improvement in pain at three months.[10]

SINGAPORE, SINGAPORE

National study of patients undergoing study for orthopaedic oncological diagnoses find that that amputations were as satisfactory as arthrodesis and arthroplasty surgery, but joint salvage was superior to all other categories.[12]

CHENNAI, INDIA

Modified Heuter approach to Pipkin type I and II femoral head fracture dislocations associated with superior outcomes to a surgical dislocation approach.[11]

SYDNEY, AUSTRALIA

Single dose of tranexamic acid in shoulder arthroplasty associated with significantly reduced blood loss intraoperative and from postoperative drains.[16]

Roundup360

Hip & Pelvis

X-ref *For other Roundups in this issue that cross-reference with Hip & Pelvis see: Children's orthopaedics round-up 4; Knee round-up 2; Research round-ups 2, 3 & 6; Trauma round-ups 2 & 3.*

Is surgical dislocation superior to the modified Heuter anterior approach for Pipkin I and II femoral head fracture dislocations? X-ref

Femoral head fractures are high-energy shear injuries often associated with a posterior hip dislocation. According to Pipkin classification, type I and II are isolated head fractures differentiated by location, while types III and IV have associated fractures in the femoral neck or acetabulum, respectively. Type I and II injuries require prompt reduction of the hip joint followed by internal fixation. Operative intervention is recommended in cases of irreducibility, persistent fracture displacement after joint reduction, or incongruent joint reduction created by articular loose fragments. The choice of surgical approach to treat these injuries is less clear based on published results. In many centres, the emergent reduction will be undertaken by the surgeon on call and definitive fixation by a specialist trauma, acetabular, or perhaps most commonly hip surgeon. A discussion often then ensues about the most effective approach to reduce the hip. Opting for a posterior approach is logical because the dislocation is often posterior, resulting in a variable degree of posterior capsular tear, which can give access to the fracture without further capsular disruption. This approach is often favoured by hip specialists as it is both familiar territory and for many the preferred approach for hip arthroplasty. However, concerns about interfering with the predominantly posterior-based blood supply to the femoral head have influenced surgeons to use anterior surgical approaches for fixation. Currently, the modified Heuter anterior approach, which uses the distal extent of Smith-Peterson approach between the tensor fascia lata and the sartorius, and the surgical dislocation popularized by Ganz, are the two most commonly performed approaches for treating femoral head fractures. Both approaches use an anterior-based capsulotomy to address the fracture, thereby avoiding further injury to the femoral head blood supply and providing direct access to the fracture site for reduction and fixation. To answer the difficult question of which approach is more effective, the authors from **Chennai (India)** compared outcomes after surgical treatment of Pipkin I and II femoral head fractures treated with either a surgical dislocation or a direct anterior approach (the modified Heuter approach) in a retrospective multicentre study, including three Indian level I trauma centres.[1] They included 49 patients operated for Pipkin types I or II femoral head fractures with the approach determined according to surgeon preference. Overall, the series included 27 using surgical dislocation and 22 using the modified Heuter approach. After initial closed reduction of the joint, open reduction and internal fixation of the fracture/fragment excision was followed. Fixation was performed using headless or countersunk mini-fragment screws. The two groups were compared for: 1) perioperative measures: blood loss, surgical time, pain (visual analogue scale (VAS)), and length of hospital stay; 2) radiological outcome in terms of fracture union, occurrence of post-traumatic hip arthritis, and femoral head osteonecrosis; and 3) functional outcome using the modified Merle d'Aubigne score and Oxford Hip Scores. The authors found out that surgical time, blood loss, and VAS at 24 hours were significantly lower in the modified Heuter group. The VAS at discharge and length of stay were similar in both groups. All fractures had united by final follow-up and in their series no cases of osteonecrosis were observed. Functional outcome and complications were similar in both groups. They concluded that both surgical dislocation and the modified Heuter approach are effective in treating patients with Pipkin I and II femoral head fractures with comparable radiological and functional outcomes. So this is one of those situations where it really is dealer's choice.

Medial plating of Pauwels type III femoral neck fractures decreases shear and angular displacement compared to a de-rotational screw X-ref

This is the second interesting and useful paper to look at femoral neck fractures, in this case the Pauwels type III. Despite urgent diagnosis and treatment by experienced orthopaedic trauma surgeons, complication rates for femoral neck fracture fixation in young patients remain high. Reoperation is reported in nearly 20% of cases in a meta-analysis with rates of avascular necrosis and nonunion of approximately 15% and 10%, respectively. In addition, vertically oriented femoral neck fracture (Pauwels type III — OTA/AO classification 31-B2.3) is subjected to increased varus and shear forces, leading to even higher rates of complication and treatment failure. Various implants and fixation constructs for vertical femoral neck fractures have been investigated with mixed results. Most consistently a fixed angle device, such as a sliding hip screw (SHS), has been shown to be superior to cannulated screws; however, although the SHSs are 'rotationally stable' in the plate they of course have a single point of fixation in the head of the femur. The addition of one or more screws above the dynamic hip screw, a 'de-rotational screw', has been repeatedly shown to improve the mechanical stability of vertical femoral neck fractures. This may be by providing an additional point of fixation to neutralize the shear forces or possibly through the de-rotation effect. More recently, it has been hypothesized that a plate

applied to the inferomedial femoral neck will provide a buttressing effect to resist the high shear forces across the fracture. To answer the question of the biomechanical significance of this method, the authors from **New York (New York, USA)** and **Pittsburgh (Pennsylvania, USA)** compared the biomechanical stability of two augmentation fixation methods for Pauwels Type III femoral neck fractures in ten matched pairs of young cadaveric bone — the de-rotational screw versus medial femoral neck plate.[2] All specimens had a standardized fracture pattern created distal to the lesser trochanter and a 70° osteotomy. They were then stabilized with a 135° SHSs. The pairs were then augmented with either a fully threaded cannulated screw or a neck plate. Testing was via the familiar cyclical approach and loads to failure. The angular displacement (varus), interfragmentary (shear) displacement, and failure loads were then calculated as the outcomes. In pretty much all cases the medial neck plate provided improved stability over the fully threaded screw on its own. The difficulty of course is that the fully threaded screw provides better stability for the high Pauwels type fractures, although it is a technically difficult option that is somewhat easier to apply in a cadaver than in an actual patient – especially one on a traction table.

A systematic review and meta-analysis comparing arthroplasty and internal fixation in the treatment of elderly displaced femoral neck fractures

Every year, about 1.6 million individuals worldwide suffer from a displaced femoral neck fracture. It is predicted that this number will continue to rise to 6.26 million by 2050. Moreover, femoral neck fractures are associated with a high incidence of complications including nonunion and femoral head necrosis. Arthroplasty, including total hip arthroplasty (THA) and hemiarthroplasty (HA), and internal fixation (IF) are still the two primary alternatives for treatment with different complication profiles. While the majority of surgeons would advocate fixation in the age group that is too young for arthroplasty, as the population gets older the best option becomes more difficult to establish so both adult reconstruction (AR) and IF have been, and are currently, widely used in the treatment of displaced neck fractures. The trade-off of the potential for a better, long-lasting but less reliable result, versus a more reliable, less functional result involving a bigger operative insult has been well elaborated in favour of fixation and arthroplasty, respectively, over the years. Here at *BJ360*, we were delighted to come across this meta-analysis, performed by investigators from **China**, including more recent randomized controlled trials (RCTs) to evaluate mortality, reoperation rate, complications, and pain between patients treated either by arthroplasty or by IF.[3] In addition, a trial sequential analysis (TSA) was used to determine whether there had been enough proof to convince us of the best option between AR and IF. A total of 31 relevant RCTs were included in the meta-analysis and the investigators found no significant difference between arthroplasty and IF at either short-term or long-term follow-up. However, patients treated with arthroplasty showed significantly lowered risks of reoperation both at short-term (5.6% vs 31.5%; relative risk (RR) = 0.19) and long-term follow-up (9.5% vs 45.9%; RR = 0.23). Similarly, arthroplasty-treated patients demonstrated a significant decrease in the risk of postoperative complications at short-term (10.3% vs 34.4%) and long-term follow-up (11.7% vs 42.5%; RR = 0.30). Postoperative pain levels were also lower in arthroplasty group (18.3% vs 31.1%; RR = 0.50). The TSAs suggested suitably sized trials to report a reliable result. The investigators concluded that arthroplasty leads to a lower rate of reoperation, a reduced risk of complications, and a better alleviation of postoperative pain both at short-term and long-term follow-up. Most importantly, and according to TSAs, more than enough evidence has demonstrated that arthroplasty does show better outcomes than IF in terms of reoperation rate, complications, and postoperative pain.

Dual mobility total hip arthroplasty in the treatment of femoral neck fractures X-ref

Total hip arthroplasty (THA) for hip fracture continues to be controversial. Do the improved patient-reported outcome measures, which are known to be relatively small, justify the increased risks, particularly of dislocation? Some surgeons favour the compromise of a bipolar hemiarthroplasty, with the assumption that there will be fewer dislocations when compared with THA in the hip fracture population. Dual mobility THA has gained favour as the arthroplasty of choice in situations where the risk of dislocation is increased. In this paper from **Daejeon (South Korea)**, the authors set out to compare outcomes for hip fracture patients undergoing either dual mobility THA or bipolar hemiarthroplasty for hip fracture to establish if there are advantages over the traditional bipolar.[4] Their study design was a systematic literature review and meta-analysis. They went on to select 17 studies, including the outcomes of 2,263 hips in the dual mobility cohort and 530 in the bipolar group. Their analysis demonstrated that there was a lower dislocation rate in the dual mobility group. They also noted that there were fewer reoperations in the dual mobility group (but not deep infections, where the rates were the same). The one-year mortality was better in the dual mobility group, which does lead to the suspicion that the dual mobility group are likely to consist of a healthier population. The inclusion criteria included non-randomized studies, so there may be selection bias affecting the results, which is particularly relevant for interpreting the significance of the mortality data. Nonetheless, this is an important level 1 evidence study that adds to weight of evidence in favour of THA for hip fracture, using the dual mobility construct to minimize dislocation and reoperation.

High mortality following revision hip arthroplasty for periprosthetic femoral fracture

The incidence of elderly patients presenting following low-energy trauma with a periprosthetic femoral fracture is increasing, and as arthroplasty designs, standards of surgery, and tribology of bearing surfaces improve, periprosthetic fracture and infection have become more important in driving revision rates than aseptic loosening, which has driven the historic series. The best treatment option for these patients is often to manage the fracture with a revision hip prosthesis allowing early weight-bearing. However, revision hip surgery in this population of patients is a significant undertaking associated with considerable risk. In order to quantify this risk, guide treatment, and enable a more accurate prognosis investigators from **Nottingham (UK)** set out to accurately determine the mortality risk in this population and

compare it to primary hip arthroplasty and first revision hip arthroplasty for other indications.[5] The team linked the data from the UK National Joint Registry with national mortality data. They identified 675,078 primary and 74,223 first revision hip arthroplasties. In the latter group, the indication for revision in 6,131 was periprosthetic fracture. Patients were stratified by age, sex, and American Society of Anesthesiologists (ASA) grade. Perhaps unsurprisingly, when compared to primary hip arthroplasty, the mortality risk was greater in those undergoing revision for periprosthetic fracture irrespective of age, sex, or ASA grade. When compared to first-time revisions for non-periprosthetic fracture (e.g. infection, dislocation, or aseptic loosening), revisions for periprosthetic fracture had an increased five-year mortality in all groups except males < 75 years with an ASA ≤ 2. The highest mortality risk group undergoing revision for periprosthetic fracture were males, ≥ 75 years, and with an ASA ≥ 3. This highest mortality risk group had a mortality of 9% at 90 days, 21% at one year, and 60% at five years. One of the particular strengths of this study is their use of competing risks models which allows for the accurate quantification of revision of one type or another while allowing for other risks such as death or infection. The study has quantified the mortality risk after revision surgery for periprosthetic fracture, and for most patient groups it is significantly higher than first-time revision surgery for other causes. The mortality seen is similar to that expected in elderly hip fracture patients. This study is helpful in guiding treatment and improving prognostic accuracy when discussing treatment options with patients.

Surgical approach does not determine hip stability

Prosthetic instability is the main indication of hip revision surgery in the USA and is associated with poor patient-reported outcomes; therefore, prevention of this complication is one of the main hip arthroplasty goals. Both patient and surgical factors associated with hip instability must be considered to reduce the frequency of prosthetic hip dislocations. The surgical approach has been historically associated with an increased risk of postoperative dislocation. The posterolateral approach (PA) is one of the most widely used approaches for total hip arthroplasty (THA); however, the disruption of posterior soft-tissue structures with this approach remains a concern. On the other hand, the direct anterior approach (DAA) has become popular in recent years, as it minimizes muscle damage and weakness by using an intermuscular plane. However, after introducing extended offset femoral stems and larger femoral head diameters, a substantial decrease in the rate of dislocation was observed in the PA along with a higher reported rate of intraoperative complications such as femoral fracture. The purpose of this study was to determine whether the surgical approach used in primary THA is associated with postoperative hip instability through the analysis of dislocation rates and other surgical outcomes such as learning curve, implant positioning, posterior soft-tissue repair, and leg length discrepancy. In order to determine whether the surgical approach influences joint stability, these authors from **Bogota (Colombia)** performed a systematic search in PubMed, MEDLINE, and Embase databases including randomized controlled trials (RCTs) and non-RCTs comparing DAA with PA in primary THA.[6] They reported pooled effect measure of risk differences, relative risk, and mean differences for postoperative dislocation, acetabular implant positioning, and leg length discrepancy, thereby covering the majority of outcomes of interest for surgical approaches, not just dislocation. In all, 25 studies (five RCTs and 20 non-RCTs) were suitable for inclusion reporting the outcomes of 7,172 THAs. There were no overall significant differences in dislocation rates between approaches. Results were also similar in the subgroup analysis stratified by study type, posterior soft-tissue repair, and learning curve. The acetabular implant was better positioned within the safe zone in the DAA group (relative risk = 1.17), but no significant differences were found in component inclination, anteversion, and leg length discrepancy. According to these results, the authors concluded that there is no difference in the dislocation rate after THA between PA and DAA, and the selection of surgical approach has little influence in the development of this complication. Furthermore, they did not find notable differences between either approach in the dislocation rate associated with component positioning in the safe zone, or when surgical factors related with prosthetic hip instability were assessed and compared for each approach.

Efficiency and outcomes: influenced by team composition?

The authors of this interesting study from **Stanford (California, USA)** set out to establish if non-technical factors (in terms of team composition) have a major effect on the outcomes of standardized surgical procedures; in this case hip and knee arthroplasty.[7] Reasoning that intraoperative communication is one of the key determinants of outcomes, the authors try to understand how non-surgeon personnel affects intraoperative communication. A secondary measure for the study team was operative efficiency, which is also highly dependent on effective team function, which can in itself therefore offer a proxy for effective communication, especially when undertaking planned limited variation procedures such as hip and knee arthroplasty. Where a time and motion study might be the most effective way to answer these questions, these authors instead undertook a retrospective review, with a convenience sample of 112 patients consisting of 70 primary total hip arthroplasties (THAs) and 42 primary total knee arthroplasties (TKAs). The procedures were performed by a single surgeon and details of the theatre team and operative timings were extracted from the system notes. Measures included operative duration, presence of surgeon-preferred staff, and turnover of trainees, nurses, and other non-surgical personnel. The patient factors considered as potential confounders included BMI, presence of osteoarthritis, and American Society of Anesthesiologists (ASA) grade. As one might expect, turnover among the anaesthetist, circulating nurse, and scrub nurse increased the operative duration. Perhaps surprisingly, the presence of both medical and nursing students was associated with improved intraoperative efficiency in TKA and THA. This is contrasted with no effects seen in efficiency associated with the presence of surgical fellows, company representatives, and physician assistants. While this may be distressing to some surgeons there was no evidence that the presence of the surgeon's 'preferred' staff would significantly shorten operative duration, except in the case of surgical trainees.

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Knee

X-ref ***For other Roundups in this issue that cross-reference with Knee see: Research round-up 2; Sports round-up 5.***

Platelet-rich plasma with hyaluronic acid: a reasonable treatment option?

Injection for presurgical arthritis offers a tantalizing option for patients who have moderate degenerative changes, and perhaps have made little progress with conservative treatments but are otherwise too young for, or have contraindications to, arthroplasty or joint-preserving surgery. Up to this point, each innovation has been met with enthusiasm from the orthopaedic community, given the need for a solution for this problem. However, there are few interventions that have reliable evidence behind them — the venerable steroid injection provides the most reliable pain relief but is blighted by an increase in complications when followed by surgery. The two most regularly investigated interventions are platelet-rich plasma (PRP) and hyaluronic acid injections (HAs). While usually evaluated on their own, in this comprehensive systematic review from **Thessaloniki (Greece)** the authors question if HA is more effective when combined with PRP than on its own.[1] The authors undertook a well conducted systematic review and reported it according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Both observational studies and randomized controlled trials were included. Overall, there were four studies suitable for inclusion in the review reporting the outcomes of 377 patients (184 with HA alone and 293 with a combination). These were used on patients with Kellgren-Lawrence grades I-IV osteoarthritis. Follow-up was not terribly long with one study reporting out to six months and the other three reporting to one year following intervention. The bottom line is that patients who received PRP combined with HA had significantly greater improvements compared with those injected with HA alone in terms of visual analogue scale scores at all timepoints. Similar improvements were seen in the 12-month Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) physical functioning and stiffness scores. There were no statistically significant differences in WOMAC pain scores. It does seem that there may be combination effects between PRP and HA injections in these studies. It would be worthwhile at least in a cohort study investigating the combination treatment against the gold standard of steroids or sham injections. There is a population need to provide a suitable treatment for patients with these problems which are debilitating, and a structured approach to evaluation of available treatments is clearly the starting point.

The effect of antibiotic-loaded bone cement on risk of revision following hip and knee arthroplasty X-ref

Infection remains the single biggest heart-sink complication for many arthroplasty surgeons. With complications being a little difficult to treat and surgeons preferring to avoid rather than deal with them, the use of local antibiotic-laden cement has become commonplace across much of the western world. However, in the USA particularly, antibiotic-loaded cement is not routinely used mainly due to cost issues. This was brought into sharp relief at the International Consensus Meeting Philly for periprosthetic joint infection (PJI), where this was one of the topics that caused the most debate, and was largely rejected. This article from **Bristol (UK)** is essentially a meta-analysis combining registry data and reported scientific studies.[2] The authors were able to include nine studies and one registry report which brings the reported arthroplasties to 371,977 total hip arthroplasties (THAs) and 671,246 total knee arthroplasties (TKAs) — probably the largest combined study on a specific aspect of large joint arthroplasty in existence. The authors were able to undertake a pooled analysis to explore the effect of antibiotic-laden cement on all-cause revision and on infected revision. In the case of THA the authors demonstrated that the use of antibiotic-laden cement reduced the risk of infected revision (relative risk 0.66); however, they report no differences in the overall all-cause revision rate. In the case of TKA, there were no significant differences in revision rates for PJI or all causes whether or not antibiotic-laden cement was used. What this article demonstrates is that revision rates due to PJI can be reduced using antibiotic-loaded cement in hip arthroplasties. There did not, however, appear to be a difference in the overall revision rate; or revision for periprosthetic infection.

International organism profile of periprosthetic total hip and knee infections

One of the perennial difficulties with treating periprosthetic joint infection (PJI) in total knee arthroplasty is that the diagnosis can be difficult to reach and often a definitive diagnosis including sensitivities is not available until after the either the definitive surgery or the first of two stages has been completed. This results in the majority of infections being treated empirically. This, of course, requires knowledge of the usual causative organisms and likely antibiotic sensitivities prior to gaining patient-specific tissue cultures. While there has been much movement in the diagnosis of infection in the form of new bedside tests (although the diagnostic accuracy remains debated) there is currently nothing better than the empirical 'best guess' to treat. This interesting international article revisits in a timely manner the profile of the organisms causing PJI around the world.[3] The study was retrospective in nature and consisted of 654 PJIs (293 knees and 361 hips) from the USA, Argentina, Uruguay, UK, Germany, and Russia. As would of course be predicted, most infections (46.5%) were staphylococcus infections (24.8% *Staphylococcus aureus* and 21.7% *Staphylococcus epidermidus)*. The good news for knee surgeons is that the incidence of resistant infection is lower than that in hips (52.6% vs 62.3%); although worryingly high, this did vary by country: 37.7% in the USA, 66.7% in Argentina, 71.5% in Uruguay, 40.8% in the UK, 62.7% in Germany, and 77.9% in Russia. Polymicrobial infections were still relatively rare with an overall incidence of 9.3%. This data is worrying with the rates of resistant infections; however, the differences between healthcare systems highlight the importance of antimicrobial stewardship and public health interventions, with those countries that placed emphasis on infection control and antibiotic stewardship generally faring best. Of course, the flip side is that there are relatively few

arthroplasties reported from single institutions in each nation and as such it is unlikely that this represents a true snapshot of the national situation.

Success rates of debridement, antibiotics, and implant retention in 230 infected total knee arthroplasties: implications for classification of periprosthetic joint infection

This honest paper from **Auckland (New Zealand)** tells it how it is with their report of 230 infected total knee arthroplasties (TKAs).[4] The authors undertook a comprehensive 15-year multicentre retrospective cohort review with the aim of establishing the success rate of a debridement, antibiotics, and implant retention (DAIR) procedure for infected TKAs. They undertook a comprehensive records review with the aim of establishing not only the expected success rates of the DAIR procedure for infected TKAs, but also those factors that are important in predicting which are likely to be successful and which are not. One of the difficulties with this kind of debridement and antibiotic treatment, whether used as an operative strategy in peri-implant infection or in bone and soft tissues, is that it is never clear until years later if a cure or a suppression has been achieved. Accordingly, the strength of this paper really is in its follow-up, with the authors reporting outcomes out to an average of 6.9 years. The overall success rate of DAIR with this long follow-up was 53.9%. On receiver operating characteristic analysis, three months (area under the curve (AUC) = 0.63) and one-year age (AUC = 0.66) of implant cut-offs was similarly predictive of outcomes suggesting that DAIR can be used as an equally successful strategy up to a year following implantation. On multivariate survival analysis, DAIR was successful in 64% of "early" periprosthetic joint infections (PJIs; implant < one year) versus 38% of "late hematogenous" PJIs (implant > one year; odds ratio 1.78). The authors also established that the presence of *Staphylococcus aureus* and Gram-negative infections were also risk factors for failure of later DAIR. It would seem that given the higher failure rate after a year, and in particular with these two infections, that this approach should be reserved for other infections at less than a year of follow-up, which are essentially those in which it is more likely to be successful.

Does disease coding affect comorbidity in total knee arthroplasty: International Classification of Diseases 9 versus 10

In today's data-driven society, many decisions are made from large population data registries — either surgeon-generated or healthcare-payer-generated. These so-called 'big data' sources are fast becoming the final say on what is worth funding and which individual surgeon outcomes are within the 'normal' range and which are not. It is therefore essential that datasets are comparable and that any change in coding system does not result in a change in perceived or actual outcome. This paper from **Durham (North Carolina, USA)** sets out to establish what the effect of the transition to the International Classification of Diseases (ICD)-10 will have on the ability to measure temporal patters in comorbidities and complications.[5] By undertaking a coding study pre- and post-transition between ICD-9 and ICD-10 the authors aimed to establish if the transition to ICD-10 codes was associated with any change in the reporting of comorbidities and medical complications. Not unreasonably, they hypothesized that the presence of an apparent discontinuity or slope change in reported rate of comorbidities and medical complications would represent a transitional effect in the coding system and have significant implications for reporting of these metrics, and particularly for looking for trends between the two coding systems. The study revolves around the Elixhauser comorbidities and medical complications which were identified using the Premier Healthcare database (2011 to 2018). The authors segmented the data to allow for different regression models to examine the changes in complication incidence and trends over the transition period. In this large study, the authors report on the outcomes of 2,006,581 patients who underwent primary THA or TKA with an average age of 66. The authors established that congestive heart failure, hypertension, and obesity had a statistically significant but clinically small discontinuity, while of the complications pneumonia (odds ratio (OR) = 0.66), acute respiratory failure (OR = 1.88), sepsis (OR = 2.54), and urinary tract infection (OR = 1.79) exhibited apparent discontinuity across the transition. In terms of trends, alcohol abuse and paralysis reversed from increasing to decreasing prevalence across the transition while metastatic cancer, weight loss, and AIDS switched from decreasing to increasing prevalence. Although a somewhat dry topic, this is essential information to be in the public domain and here at *BJ360* we congratulate the authors for doing such a thorough job of exploring the subtle differences between these two apparently similar coding systems.

Tibial component and femoral component coronal alignment affect patient-reported outcome measures and survival in unicompartmental knee arthroplasty

The exact importance of component alignment in total joint replacement outcomes is always slightly difficult to unpick. It stands to reason that precise mechanical alignment (to whichever of the alignment models the surgeon ascribes to) will at least give the most reliable result with minimal variation in terms of survival and patient-reported outcome measures (PROMs). The difficulties are that there are several different approaches towards alignment — at the broadest end of the spectrum there are the kinematic and anatomical approaches, but there are also much more subtle variations. One of the arthroplasties with the most variable reported outcomes is unicompartmental knee arthroplasty (UKA), with

some of the best and most variable results reported between series and within registries. It is generally felt that the UKA is one of the least forgiving prostheses and that this may account for variation along with significant variations in operative volumes. In this nice paper from **Singapore**, the authors set out to see if they can establish the tibial femoral component coronal angles that associated with the best outcomes (both PROMs and survivorship) in their series of 264 UKAs.[6] This study is driven by data collected as part of their instructional registry at six months, two years, and ten years where the Knee Society Scores, Oxford Knee Scores, and 36-Item Short-Form Health Survey scores were collected. They collected the full range of radiological measures and survival, and built multivariate regression models including covariate interactions. Partial residual graphs were generated to identify angles associated with the best outcomes. Kaplan-Meier analysis was used to compare implant survivorship between groups. The authors established significant two-way interacting effects between tibial and femoral coronal plain alignments. Once adjusted for each other a tibial coronal angle of 2° to 4° and femoral coronal angle of 0° to 2° were established in this cohort to yield the best postoperative knee scores and a significant survival benefit at 15 years compared with the remainder of the cohort (100% vs 92%). While this cohort is both small and probably applies only to the fixed bearing cemented UKAs used by the authors of this study, they do have the strength of a well-followed up cohort over a long period of time. The authors are to be commended on selecting a suitable statistical model and a clinically important question of coronal alignment. Perhaps not earth-shattering for some, but it seems to us that there is an important message that patients undergoing UKA are best with a near 2° tibial and femoral alignment in the coronal plane.

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Sports

Allogeneic platelet-rich plasma versus corticosteroid injection for the treatment of rotator cuff disease X-ref

The use of platelet-rich plasma (PRP) remains highly controversial in orthopaedics and sports medicine, with the treatment of rotator cuff disease being an area of interest. The gold standard for treatment of this condition by injection remains corticosteroid, and this interesting study from **Seoul (South Korea)** reports a randomized controlled trial of two groups with blinded assessors to compare safety and efficacy of injection of allogeneic PRP compared to corticosteroid into the subacromial space of patients with rotator cuff disease.[1] Overall, 60 patients with clinical and structural rotator cuff disease were randomized to one of the intervention arms: either allogeneic PRP or corticosteroid (40 mg/ml triamcinolone acetonide with lidocaine) using ultrasound guidance. Primary outcomes were safety and Constant scores at one month from injection, with the usual variety of secondary outcome measures. The authors report no adverse events, and the Constant scores at one month were not significantly different between the groups. At six months, there were also no significant differences between the groups except that in the PRP group, the secondary outcome measures of Disabilities of the Arm, Shoulder and Hand (DASH) score, overall function, and external rotation were improved. Generally, pain measurements, strength, and outcome scores improved slowly after injection over six months from pre-injection values, with the corticosteroid group responding fastest. The authors concluded that allogeneic PRP injections are safe but not superior to corticosteroid injections with respect to pain relief or functional improvements over the six-month course of the trial. While the PRP injections reduced pain and improved function steadily from the time of injection, and corticosteroid effects were observed after only one month, there were no significant differences at six months between the two groups. It should be noted that while there was an a priori power analysis for this investigation, no negative control or placebo treatment was used for comparison, and both groups were also treated with physical therapy. While this study does not support any superiority of PRP over the standard corticosteroid injection, it may underline the importance of physical therapy as part of the treatment for rotator cuff disease.

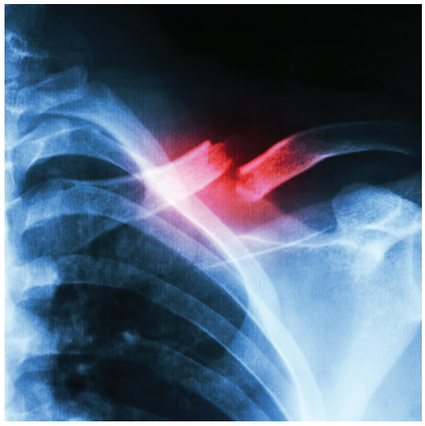
Arthroscopic single-row repair of rotator cuff tears augmented with marrow vents

The controversy regarding single- versus double-row rotator cuff repairs continues with sensible-sounding arguments on both sides of the table. This study from **Van Nuys (California, USA)** sought to evaluate the gold standard for single-row repair.[2] They report the MRI integrity and clinical outcomes of medium to large rotator cuff tears treated with arthroscopic single-row repair using triple-loaded anchors augmented with marrow vents. They retrospectively reviewed 64 males and 27 females with full-thickness medium to large (2 cm to 4 cm) rotator cuff tears repaired by four surgeons with a minimum of 24 months follow-up. The repair technique focused on a single row of medial anchors to minimize

tension and used triple-loaded anchors with the repair augmented by laterally placed marrow vents. MRI was obtained at a minimum of 24 months to assess repair integrity, and subjective outcomes were obtained. The mean age of patients in this series was 59.7 years, with a mean tear size of 2.6 cm in the anteroposterior dimension, treated with an average of 2.2 anchors. Overall, 91% of patients were completely satisfied with their outcome, and the median Western Ontario Rotator Cuff score was 95.2% of normal. There was a significant difference between those who had an intact rotator cuff repair (95.9%) compared to those who had a full-thickness recurrent tear (73.8%). Postoperative MRI showed intact repairs in 92% of those treated, with full-thickness defects being considered failures. The authors concluded that using triple-loaded anchors for medially based single-row rotator cuff repairs augmented with lateral marrow vents resulted in a 92% healing rate when evaluated by MRI at a minimum of 24 months after surgery, and excellent patient-reported outcomes. While this was a level IV retrospective case series that lacked a control group, outcomes of rotator cuff repair performed in this manner were highly successful.

Platelet-rich plasma versus hyaluronic acid for knee osteoarthritis

The use of both platelet-rich plasma (PRP) and hyaluronic acid (HA) for knee osteoarthritis (OA) remains controversial, with variable support in the literature from limited investigations. There are plenty of public and private sports and arthritis clinics offering both options, and a fair number that are shying away from anything other than the traditional steroid injections. In an attempt to clarify the outcomes for these injectables in knee osteoarthritis, authors from **Aurora (Colorado, USA)** performed and reported their own systematic review of level 1 studies to determine the efficacy and safety of these treatments, specifically for OA of the knee.[3] The review authors identified studies of knee OA where the investigators compared HA and PRP interventions. They also undertook a prespecified subgroup analysis of leucocyte-rich and leucocyte-poor PRP. A total of 18 level 1 studies were identified, which included 811 patients having PRP injection (mean age 57.6 years) and 797 having HA injection (mean



age 59.3 years). The mean follow-up was 11.1 months in both groups. Results demonstrated that mean improvement was significantly higher in the PRP group (44.7%) compared to HA (12.6%) in Western Ontario and McMaster Universities Osteoarthritis Index score, and in the 11 studies that used visual analogue scale for pain, six reported that patients who got PRP injections had significantly less pain. Of the six studies that used International Knee Documentation Committee (IKDC) score, three reported patients receiving PRP had significantly better scores. Within the confines of the available data it also appeared that leucocyte-poor PRP also gave significantly better IKDC scores than leucocyte-rich PRP. The authors concluded that patients with knee OA can expect improved clinical outcomes with PRP injections, compared to HA. Additionally, leucocyte-poor PRP may be superior to leucocyte-rich PRP. However, further investigation of specific PRP formulations is warranted, and the use of the gold standard (corticosteroids) as a control for effectiveness of these injections was not required for inclusion in this review.

Efficacy of subacromial decompression versus diagnostic arthroscopy for shoulder impingement

The efficacy of subacromial decompression has been questioned, and recent literature has suggested that this procedure may not improve clinical outcomes in some settings. However, a single study does not put a procedure to bed, and there are so many combinations of indications and comparisons that it is rare that a single study will be relevant to all circumstances and indications. We were delighted to see that a team from **Helsinki (Finland)** have reported the five-year outcomes of their randomized, placebo surgery trial of arthroscopic subacromial decompression compared to a diagnostic arthroscopy.[4] This was a multicentre randomized controlled superiority trial that included 210 patients aged between 35 and 65 years who had symptoms consistent with shoulder impingement lasting longer than three months. Impressively, at the long-term outcome reporting for this trial a follow-up rate of 83% (n = 175) was achieved. In the primary intention-to-treat analysis, no differences were demonstrated between the groups that exceeded the minimally clinically important difference at five years of follow-up between the groups that had arthroscopic subacromial decompression or diagnostic arthroscopy. There were also no significant differences between the groups with regards to secondary outcomes or adverse events. The authors concluded that arthroscopic subacromial decompression provided no benefit over diagnostic arthroscopy in patients presenting with shoulder impingement syndrome at five years of follow-up.

Randomized controlled trial of hard-soled shoe versus short leg cast for fifth metatarsal base avulsion fracture

X-ref

Controversy exists in the literature regarding the correct treatment of fifth metatarsal base avulsion fractures and whether they are better treated with casting or a hard-soled shoe. These authors from **Seoul (South Korea)** undertook a noninferiority randomized controlled trial of 96 patients who were randomized into the hard-soled shoe (46) or short leg cast (50) group who were then assessed by visual analogue scale (VAS) at six months from injury.[5] Patients were assessed by both intention-to-treat analysis and per-protocol analysis. Results demonstrated that at six months from injury, there were no significant differences in VAS between the groups, but the patients treated with the hard-soled shoe returned to normal activity significantly faster than the casting group. There were no nonunions in either group. The authors concluded that weight bearing as tolerated in a hard-soled shoe was not inferior to cast treatment for fifth metatarsal base avulsion fractures using VAS pain scales at six months from injury, but the time to return to normal activity was shorter in those treated with a hard-soled shoe. This may

indicate that more aggressive mobilization has benefits when treating these fractures.

Functional outcomes of sesamoid excision in athletes
X-ref

Hallux sesamoids increase the mechanical advantage of flexor hallucis brevis by increasing the moment arm, act as a platform on which the metatarsal head rolls and glides, and protect the tendon from injury by reducing friction. Various pathologies exist such as fractures, stress injuries from repetitive overuse, osteochondrosis/avascular necrosis, and arthritis and may be associated with foot deformities such as cavus foot and hallux valgus. Sesamoidectomy is a described treatment option when nonoperative measures fail. This study from **Eagan (Minnesota, USA)** is one of the only reports of a large series of patients that have undergone sesamoid excision including competitive athletes.[6] This retrospective study observed 82 patients who had a mean age of 45 years, the majority (88%) of whom were female, and one-third of whom were competitive athletes with a mean follow-up of 31 months. A total of 54 patients had the medial sesamoid excised, 18 had the lateral, ten had both excised, and in half (n = 42) the aetiology was osteochondrosis. Patients were instructed not to actively or passively dorsiflex the great toe for the first two weeks and a graphite plate and a stiff-soled shoe were used to limit dorsiflexion for the first six weeks. All patients underwent a structured postoperative protocol. The entire study group reported significant improvement in the 12-Item Short Form Health Survey, Foot Function Index-Revised, visual analogue scale, and Single Assessment Numeric Evaluation scores, and an average of 93% postoperative satisfaction. There was no significant difference in any of the outcome scores or return to sports based upon the location of the excised sesamoid (medial vs lateral) or aetiology. Among competitive athletes, 67% reported that they returned to sports at the same preoperative level or higher, 13% returned at a lower level, and 20% did not return to sports. Among patients who were able to return to initial sporting activities, the average time to return was 4.5 months. One patient developed reflex sympathetic dystrophy, chronic pain, and instability, and required a great toe metatarsophalangeal joint fusion. Two patients developed symptomatic hallux valgus deformities that required surgical repair, both of which were early in the study period, resulting in a change in the operative repair. Importantly, the authors report that there were no cock-up deformities. This is the largest series examining outcomes after excision of the sesamoid bones. Following sesamoid excision 80% of athletes returned to some form of sport, there were no cock-up deformities, and three (3.7%) required further surgery for iatrogenic hallux valgus or painful toe. The authors recommend removing the sesamoid with the least possible disruption of the surrounding plantar plate structures, followed by a very structured rehabilitation programme in order to obtain such encouraging patient-reported outcomes with a minimal risk of complications.

Gait biometrics at five years following anterior cruciate ligament injury
X-ref

While the majority of surgeons who offer, and patients who have undergone, anterior cruciate ligament (ACL) reconstruction are supporters of the technique for return to normal function, current objective evidence does not uniformly support the significant promotion of surgery as the preferred intervention for ACL injury in active individuals that is seen in surgical and patient circles. This may be due to perception of surgery as 'fixing' what is broken, or perhaps more likely the wrong outcomes having been evaluated. We were delighted to come across this interesting study here at *BJ360* on the gait of comparative groups of patients with ACL injuries treated either nonoperatively or operatively. The patients were matched for age and activity levels prior to their ACL injury; patients who had other significant concomitant ligament or meniscal injuries were excluded from the study. The research team in **Newark (Delaware, USA)** set up an excellent study which recruited 40 athletes treated operatively and 17 athletes treated nonoperatively at five years' follow-up after an isolated ACL injury.[7] The athletes underwent an objective assessment of their medial compartment joint contact forces using a validated musculoskeletal model with electromyography measurements. Additionally, knee joint contact forces, angles, and moments were compared between the operative and nonoperative groups. Although the authors also had access to knee radiographs there were no observable differences between the two groups. After five years, this gait analysis-based study revealed that patients treated nonoperatively after ACL injury demonstrated greater medial compartment contact forces and peak knee adduction moments. This is important as it may have implications regarding the development of post-traumatic knee osteoarthritis and does add some evidence to the often-reported complaint from patients that their knee 'did not feel right' until they had had the ACL reconstruction surgery.

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Foot & Ankle

X-ref *For other Roundups in this issue that cross-reference with Foot & Ankle see: Children's orthopaedics round-ups 5 & 6; Research round-ups 1 & 2; Sports round-up 4; Trauma round-up 11.*

Complications and outcomes are no different in older patients after first metatarsophalangeal arthrodesis for hallux rigidus

Degenerative arthritis of the first metatarsophalangeal (MTP) joint is a common affliction, with MTP joint fusion remaining the gold standard surgical treatment option. Although it is a good option for the young and active population, providing a permanent solution to the stiff painful joint, the complications and outcomes in the older patient population group have not been widely investigated. In this single-centre prospective series from **Atlanta (Georgia, USA)**, the authors assessed the differences in pain, mobility and independence, and improvements of the physical and emotional quality of life following first MTP fusion in patients aged ≥ 65 years compared to younger patients.[1] Composite outcomes were assessed including the 36-Item Short Form Health Survey, Life-Space Assessment survey, and visual analogue scale for pain at six months and one year, as well as complications. Over the three-year period of the study, 143 patients underwent first MTP fusion, of whom 79 were younger patients. Female patients were significantly more common in the older cohort, as were cardiovascular comorbidities; however, operative details were similar. Both groups of patients reported significant improvements in the patient-reported outcome scores, with maximum improvement noted by six months and maintained over one year. There was no difference in the reported outcome between the two groups. Complication rates were between 20% and 25%, and no different between the two groups. Deep infection requiring debridement was high in this series (4% to 5%), but no different between the two cohorts. There was no incidence of venous thromboembolism (VTE) and revision surgery, although more common in the younger cohort, was not significantly different (3/79 in the younger cohort and 1/64 in the older cohort). The authors undertook a prospective study and carefully recorded several outcome measures, as well as important patient characteristics including smoking and diabetes. Their study suggests that

older patients have as much to gain from first MTP fusion compared to younger patients. It also shows a low incidence of VTE, as well as low risk of revision up to a year after this procedure in expert hands. The study would not have been adequately powered to detect a significant difference in complications between the two groups, but does indicate a low risk of complications in general. The loss to follow-up at one year was unfortunately very high (45%); however, the results do have broad external validity and would help contribute to shared decision-making when discussing the risks and benefits of surgery in the older patient.

Is it necessary to offload the forefoot after hallux valgus surgery?

Along with the evolution in surgical technique for the correction of hallux valgus deformity, the postoperative regimen has also gone through changes over the years. While plaster immobilization is rarely practised, most surgeons would offload the forefoot in a post-surgical shoe in the immediate postoperative period, until the bony union of whichever correction has been performed. This is deemed necessary because the first metatarsal joint bears more than the body weight during the push-off phase of gait. Forefoot off-loaders come with reverse camber and are not comfortable to mobilize with; they may also affect balance. There has been limited evidence in the recent literature that would suggest that flat surgical shoes may be safely prescribed in this group of patients without adversely affecting the surgical outcome. This study from **Girona (Spain)** has contributed further evidence to this debate with their cadaveric study.[2] The authors used 20 adult fresh-frozen cadaveric feet. The researchers placed pressure sensors under the first metatarsal head and the heel of the feet. Progressive loads were applied up to 60 kg. Mean pressure over the heel and the first metatarsal was compared between barefoot, foot shod with stiff-soled double-padded shoe, and the forefoot off-loader. Both heel and first metatarsal pressure were significantly higher in the barefoot group compared to the shod group. The heel pressure was higher and the first metatarsal pressure lower for the flat sole group. However, the difference was not significant. The results would suggest that if weightbearing is allowed following hallux valgus surgery, the foot should be protected with surgical shoes. However, flat sole double-padded surgical shoes do not increase the pressure over the first metatarsal compared to forefoot off-loaders and may in fact reduce it. The obvious limitation is that this was a cadaveric study and may not have reproduced physiological gait, nor considered torque forces generated during normal walking. However, the results are in line with previous studies that suggest that forefoot off-loaders may not be necessary following hallux valgus correction.

The subtle cavus foot may not be a risk factor for chronic ankle instability

The term "subtle cavus foot" (SCF) has crept into common parlance in recent years, and is used to define a group of patients who have mild varus deformity of the heel and plantarflexed first ray. It has been the received wisdom that patients who have SCF are at higher risk of developing chronic ankle instability (CAI). Although now widely used, there have been precious few attempts to define SCF or the actual association with CAI. This study from **Deokyang-gu Goyang-si (South Korea)** was conceived by the authors in an attempt to define the relationship between SCF and CAI.[3] A series of 261 patients undergoing lateral ligament reconstruction between 2005 and 2016 for CAI were identified, with 116 patients

included after exclusions. The intervention group was matched with 105 patients in a control group, who visited the hospital for minor soft-tissue surgery, or medical conditions such as cellulitis or contusion, but did not have any documented history of CAI. All patients had standing lateral radiograph of the foot. Standing arch height, calcaneal pitch angle, Meary's angle, and position of fibula relative to the distal tibia were assessed by two observers. Observations were repeated after two weeks. The radiographs were classified into three groups: cavus, SCF, and others. SCF was identified if a radiograph met any of the following criteria: 1) calcaneal pitch angle is between 25° and 30°; 2) Meary's angle is between 0° to 5°; 3) difference in the heights of the first and fifth metatarsal bases is between 10 mm and 15 mm; and 4) fibular position is between 0.6 and 0.7. Patients were well-matched for age and sex in the two groups. Both the intra- and interobserver reliability of measuring the radiological outcomes was good to excellent. The authors reported the incidence of SCF as fairly common in this population at nearly 20%. There was no significant difference in radiological parameters (calcaneal pitch, Meary's angle, fibular position, and first to fifth metatarsal position) between the two groups. Each observer also made a subjective assessment of the presence or absence of SCF in the images. Again, there was no significant difference in the proportion of SCF between the two groups. Unfortunately, authors did not include hindfoot alignment view, which would have helped with radiological measurement of the heel position. They also excluded patients who required heel correction. Since patients with CAI and concomitant SCF are often offered heel correction it is probable that excluded patients may have included those with CAI and SCF. Even allowing for the limitations, it does appear that the role of SCF in CAI may not be as prominent as previously thought. The results indicate that SCF may not be a risk factor for CAI and may be a rather common association in the population. The study also emphasizes the lack of a rigorous definition of SCF, as well as the absence of scientific evidence investigating its association with CAI. Clearly, in light of these results we should pause for thought before ascribing SCF as the cause of CAI.

Variations in syndesmotic anatomy in the normal ankle X-ref

The improvement in our understanding of the incidence of syndesmotic malreduction and the consequences thereof has spurred increasing interest in the study of the "normal" syndesmotic anatomy. Several radiological parameters have been proposed to define the limits of satisfactory syndesmotic reduction following injury. However, we do not really know how variable the syndesmotic anatomy is, and how well these parameters fare when compared against bilateral uninjured ankles. In this simple study from **New York (New York, USA)**, the investigators evaluated the radiological criteria for syndesmotic malreduction against the anatomy of uninjured bilateral ankles.[4] The authors retrospectively reviewed CT scans of bilateral lower limbs of 1,107 patients, of which 213 scans were suitable for final analysis. Scans were excluded if patients were not skeletally mature, there was history of trauma to tibia, foot, or ankle (or previous surgical procedures thereof); or if they had congenital neuromuscular syndromes. The following radiological parameters were assessed: anterior syndesmotic distance, posterior syndesmotic distance, central syndesmotic distance, fibular rotation, sagittal fibular translation, and syndesmotic area. Incisural asymmetry was defined as the difference between the anterior and posterior tibiofibular distances. The mean age of patients was 43 years, and the majority were female (n = 133, 62%). Femoroacetabular impingement was the commonest indication for bilateral CT scanning (n = 110), followed by rotational assessment (n = 92). Previously reported reduction thresholds were then applied to each radiological study and the incidence of patients with variation outside the previously defined limits calculated. Unilateral CT revealed incisural asymmetry of > 2 mm in almost all ankles (87% to 90%). Bilateral CT measurements revealed that the highest prevalence of malreduction was 15% (n = 33) in posterior syndesmotic difference and the lowest prevalence in fibular rotational difference 6% (n = 12). More than one-third of patients had at least one parameter outside of the "normal" defined limits. It is an important study and highlights our limited understanding of the normal variation in syndesmotic anatomy. Although all these patients had uninjured ankles, application of currently agreed radiological parameters of syndesmosis reduction in this cohort would have resulted in a sizable chunk being labelled as "malreduced". This would suggest that the definition of clinically relevant syndesmosis malreduction requires further study. These images were non-weightbearing. Weightbearing CT scans are becoming increasingly commonplace in the investigation of lower limb abnormality, and it is valid to argue that the results might be different if repeated in weightbearing views. Finally, only one observer rated most of the images, and although authors claim to have used this protocol after confirmation of a reliable inter- and intraobserver reliability in measurement of the radiological parameters, the findings would have been more robust with multiple observers and repeated attempts at measurement.

Clinical outcome of distal tibiofibular arthrodesis with plate fixation for the treatment of chronic frank syndesmosis instability

Sticking with the theme of syndesmosis, another worthwhile paper from **Beijing (China)** concerns the management of chronic syndesmosis instability.[5] While acute syndesmosis instability is commonly associated with Lauge-Hansen pronation-external rotation or pronation-abduction ankle fractures, and occasionally supination-external rotation fractures, there is precious little concerning management of chronic instability. It has been shown that misdiagnosis and failure to reduce and stabilize the disrupted syndesmosis is associated with poor outcomes, leading to chronic instability. According to the description of Edwards and Delee, syndesmosis instability was divided into "latent" and "frank" to differentiate dynamic instability from radiographically-obvious instability. For the treatment of frank syndesmosis instability, especially for those with ankle fractures, numerous surgical techniques were reported, including solely syndesmotic fixation with screws, different ways of syndesmosis reconstruction with autologous tendons, arthroscopic repair, and syndesmotic arthrodesis. Distal tibiofibular arthrodesis was commonly referred as a salvage operation only for patients with low demand or advanced ankle degeneration. However, the evidence is a little to the contrary, with several small case-series achieving satisfactory results with arthrodesis for the treatment of chronic syndesmosis instability. Among these small case-series, trans-syndesmotic screw fixation was used for early stabilization. The present study reports on the clinical and radiological outcomes of patients with symptomatic, chronic syndesmosis

instability treated by distal tibiofibular arthrodesis using a specially contoured plate. Their inclusion criteria were the presence of swelling and tenderness on the anterolateral aspect of their affected ankle and the presence of significant diastasis of the distal tibiofibular syndesmosis on radiographs and CT. As would be expected for such a niche indication, only eight patients met the inclusion criteria and follow-up was to a respectable 58 months (12 to 99). Clinical outcomes were evaluated using the American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot score. All patients could tolerate full weightbearing three months after surgery. The mean visual analogue scale pain score and the AOFAS ankle-hindfoot score were significantly improved at the last follow-up, with seven patients returning to sports. From an objective perspective, four patients had mild limitation of ankle range of motion compared with the unaffected side. The investigators concluded that the good clinical short-term outcome observed in this case-series supports the view that distal tibiofibular syndesmosis arthrodesis for the treatment of chronic frank syndesmosis instability can be a successful treatment in selected groups of patients. Syndesmosis arthrodesis with plate and screw stabilization can provide good results and could help to shorten the period of patients' return to full weightbearing activities.

Surgery for the accessory navicular: get it right first time

The presence of an accessory navicular within the tibialis posterior (TP) tendon can cause symptoms due to stress at the synchondrosis between itself and the navicular. This may necessitate excision of the accessory bone and re-attachment of the tendon to the navicular from a medial to a more plantar orientation, known as the Kidner procedure. A group from the Hospital of Special Surgery in **New York (New York, USA)** has presented the largest case-series on recurrent pain following the Kidner procedure and investigate the cause of recurrent pain, as well as the surgical outcomes of the revision surgery.[6] This is a retrospective study of 21 patients who underwent revision surgery for recurrent pain and who were unable to perform a single leg heel raise for six months following the Kidner procedure. All patients were male, aged between 29 and 41 years, and a minimum follow-up of one year (14 to 26 months) was achieved. Using radiological criteria, 95% of patients had a form of valgus heel alignment prior to revision surgery (planovalgus, n = 11; hindfoot valgus only, n = 9) on the affected side. On the non-surgical side, 17 of 21 (81%) patients had a form of valgus heel alignment and no significant differences radiologically to the involved side. Here at *BJ360*, we agree with the authors that the deformity on the involved side was more likely due to a pre-existing unaddressed deformity at the time of initial surgery, rather than the result of a failed Kidner procedure. The TP tendon was explored in all cases as definitive assessment with an MRI not being possible, despite being performed due to surgery-related artefacts. Simple debridement of scar tissue was performed in 12 cases, debridement with additional reattachment with suture anchors was carried out in six cases when improper healing of the tendon-navicular interface was suspected, and in three cases where the TP tendon appeared to be sutured too tightly with nonabsorbable suture at the proximal portion, the stitch was removed to reduce tension. All of the patients had medial displacement calcaneal osteotomy through a lateral oblique incision. In patients with heel cord tightness, gastrocnemius recession was also performed (11 cases), as well as one case of plantarflexion first metatarsal osteotomy and one case of talocalcaneal coalition excision. Clinically, there was significant improvement in both patient-reported outcomes measures (Foot and Ankle Outcome Scores and visual analogue scale for pain). All patients were able to perform a single heel raise at final follow-up with no incidence of recurrent pain following revision surgery. Postoperatively, there was significant improvement in radiological parameters such as talonavicular uncoverage and hindfoot alignment moment, no improvement in Meary's angle, and worsening of the calcaneal pitch. The authors note that the excursion of TP tendon is 2 cm, and by excising the accessory navicular and advancing the TP to the undersurface of the navicular to close the gap, this may create excessive tension to the reattachment site, especially in patients with concurrent malalignment/hindfoot valgus that will cause persisting pain. It is therefore suggested that in patients with recurrent pain following the Kidner procedure, malalignment should be assessed and corrected, but more importantly all patients with a symptomatic accessory navicular should be scrutinized for foot malalignment prior to undergoing an isolated Kidner procedure, and correct this as necessary during the index procedure.

Correlation of MRI and weightbearing CT for the assessment of progressive collapsing flatfoot deformity

A recent consensus group meeting[7] has suggested changing the nomenclature of posterior tibial tendon deficiency (PTTD) or adult acquired flatfoot deformity (AFFD) to progressive collapsing flatfoot deformity (PCFD), along with a new classification system following recent advances and to better characterize a complex 3D deformity. MRI has been the imaging of choice and more recently the popularized weightbearing CT in order to characterize this multiplanar bony deformity with tendinous and ligamentous insufficiencies in a physiological loading condition. This study from the Hospital of Special Surgery in **New York (New York, USA)** investigated the correlation between weightbearing CT (WBCT) markers of pronounced peritalar subluxation (sinus tarsi impingement, subtalar joint subluxation, and subfibular impingement) and MRI findings of degeneration of medial soft-tissue structures (posterior tibial tendon (PTT), superomedial and inferior spring ligament, interosseous talocalcaneal ligament, anterior superficial deltoid ligament, plantar navicular-medial cuneiform ligament, and the plantar medial cuneiform-first metatarsal ligament) in patients with flexible progressive collapsing foot deformity (PCFD).[8] A total of 54 patients (55 feet) were included in this simple but important study; 17 were male (31%) and 36 (65%) left-sided with a mean age of 51.5 years (20 to 76). For assessing the subluxation of the posterior facet of the subtalar joint (SJ), the amount of lateral uncoverage of the calcaneal articular surface of the posterior facet was measured and the value divided by the total width of the same articular facet. A value of more than 5% of joint uncoverage was used as a threshold value for subluxation; direct contact between the talus and the calcaneus in the sinus tarsi, as well as between the distal fibula and the calcaneus, suggested sinus tarsi impingement (STI) and subfibular impingement (SFI), respectively. Indirect signs of impingement, such as focal sclerosis, osteophyte, and/or cystic formation were also considered. The pathology of the soft-tissue structures on MRI were graded on a five-part scale: grade 0 (an

intact ligament with uniformly hypointense signal intensity); grade I (degeneration, with increased signal intensity involving less than 50% of the cross-sectional area of the ligament/tendon on axial images); grade II (degeneration of more than 50%); grade III (a partial tear with discontinuity of less than 50% of the fibres, with increased signal intensity and abnormal morphology); and grade IV (same features, but with a tear of more than 50% of the cross-sectional area). STI was present in 73% of the patients, SJ subluxation in 69%, and SFI was less prevalent in only 9% of patients, suggesting that in the development of a PCFD, SFI is a later finding. They also found that 96% of the patients had mild or no (grade I or zero) degeneration of the plantar navicular-medial cuneiform ligament and the plantar medial cuneiform-first metatarsal ligament, while 83%, 43%, 26%, 25%, and 24% demonstrated mild or no degenerative findings of the inferior spring, posterior tibial tendon, superomedial spring, interosseous talocalcaneal, and superficial deltoid ligaments, respectively. This shows that the usual suspects of inferior spring and posterior tibial tendon seem to be less frequently and severely involved than some other structures. The only MRI finding to correlate with STI was PTT degeneration ($p = 0.040$), and patients with grades III or higher degeneration had increased prevalence of STI (89.5%) than patients with grade II or lower involvement (63.9%). The presence of SJ subluxation was influenced by the involvement of the inferior component of the spring ligament ($p = 0.01$). When the grade of degeneration was equal or higher than grade II all patients had signs of SJ subluxation when compared to 62.2% of patients with grade 0 or I. The occurrence of SFI was only influenced by the involvement of the talocalcaneal interosseous ligament ($p = 0.02$) and 20% of patients with grades III or higher degeneration of the interosseous ligament demonstrated SFI, and no patients when the interosseous ligament involvement grade II or lower. The associations that have been identified between WBCT markers of peritalar subluxation and MRI findings of soft-tissue degeneration may allow surgeons to estimate the extent of PTS when assessing MR images. Unfortunately, the authors have not looked at signs of sinus tarsi and subfibular impingement, or any subtalar subluxation on MRI that is more accessible, and whether those correlate with WBCT markers. According to their findings, the authors recommend that the surgical treatment options in the presence of SJ subluxation should include spring ligament assessment, repair or reconstruction, and even a SJ fusion. In the presence of SFI, reconstruction of the interosseous ligament or SJ fusion may be considered.

Is the anatomical axis of the tibia good enough to assess tibiotalar alignment?

The answer to the above question is yes, but only if there is no deformity of the tibia or more proximally where the mechanical axis of the tibia or the whole limb should be used. Despite this, assessment of the tibiotalar alignment (TTA) is usually performed on weightbearing radiographs by measuring the angle between anatomical axis of the tibia and the talar articular surface. Proper tibiotalar alignment is important when performing reconstructive procedures that involve the ankle and hindfoot joints such as osteotomies, fusion, or arthroplasty, otherwise that could result in edge-loading of a prosthesis and early failure or predisposition to neighbouring joint arthritis due to abnormal stresses. A study from the Royal National Orthopaedic Hospital in **London (UK)** investigated whether coronal TTA using the mechanical axis of the limb (MAL) would differ from the TTA measured using the anatomical axis of the tibia (AAT) in a group of patients with symptomatic ankle arthritis prior to their total ankle arthroplasty.[9] In all, 61 ankles were included in this retrospective analysis (64% males) with a mean age of 63.8 years (29 to 82). Weightbearing long leg anteroposterior radiographs were used to measure the MAL (centre of the femoral head to centre of the ankle joint), the mechanical axis of the tibia (MAT) (centre of the knee joint to centre of the ankle joint), the AAT (line drawn connecting the tibial shaft centre to a point located 10 cm above the surface of the ankle joint), and a line along the talar articular surface. The alignment of the ankle joint was calculated in two ways; first as the angle between the mechanical axis of the limb to talar articular surface angle (MAL-TA), and second as the 'classical' TTA, defined as the angle between the AAT and the TA (AAT-TA). In this series of patients, the difference between MAL-TA and AAT-TA ranged between -8.1° and 7.8°, and was greater than 2° in 42% and 3° in 18% of the cases. In five patients, the difference was greater than 5°, and in two patients greater than 8°. The group has also correlated the angle between MAL-MAT with the difference between MAL-TA and AAT-TA, and demonstrated a perfect correlation, suggesting that the greater the more proximal deformity the greater the discrepancy between the anatomical axis of the tibia and mechanical axis of the limb though both variables in the correlation share a common variable (MAL). Reading this paper will refresh your understanding on the principles of mechanical axis of the whole limb, mechanical axis of the tibia, and anatomical axis of the tibia. It also demonstrates that tibiotalar alignment should be based on the mechanical axis of the limb, rather the anatomical axis of the tibia, since in a surprisingly high proportion of patients, discrepancies may arise affecting long-term outcomes of realignment procedures.

Limited plantar incision for flexor digitorum longus tendon transfer

Transfer of flexor digitorum tendon (FDL) to the navicular can be part of the reconstruction process in cases of progressive collapsing flatfoot deformity (PCFD). Access to the FDL for harvest is traditionally via distal extension of the medial incision for the approach to the tibialis posterior tendon. This approach requires the surgeon to enter the correct plane dorsal to the first muscular layer (abductor hallucis (AH) and flexor digitorum brevis (FDB)) and identification of the knot of the region where flexor hallucis longus (FHL) and FDL cross each other. This places the plantar nerve and artery in the surgical field and at risk of damage, along with perforating veins connecting the plantar venous plexus to the saphenous vein. In addition, it does not offer maximal length of the FDL tendon and attachment to the navicular relies on use of interference screws. This study from **London (UK)** describes the authors' experience and outcomes of using a limited plantar incision for harvesting the FDL tendon, rather the traditional extended medial approach.[10] It is a retrospective study of 24 patients who underwent 25 flat foot reconstruction operations under the care of a single surgeon for a symptomatic stage II flat foot that failed nonoperative means. The cohort had a mean age of 54 years, mean final follow-up of 26.4 months (20.3 to 32.6), and 18 patients were female. Initially, the FDL tendon was identified proximally through an incision from medial malleolus to navicular. The distal and plantar exposure to the FDL was based on the surface anatomy bisecting a longitudinal

line between the most posterior part of the plantar heel skin to the proximal plantar skin crease at the base of the second toe and two-thirds from the lateral border of the foot, as originally described by Panchbhavi in a cadaveric model. An incision of approximately 15 mm length was made, the plantar fascia was split, the flexor digitorum brevis muscle was separated in the line of the incision, and the FDL tendon located beneath. The FDL was divided and withdrawn through the proximal incision while holding the hallux straight at the interphalangeal joint. The FDL was passed from plantar to dorsal through a 4.5 mm drill hole in the navicular tuberosity and sutured onto itself side-to-side with additional suture fixation performed from the FDL to periosteum at the drill hole entry and exit points. All patients had a medial displacing calcaneal osteotomy, and 12 patients had additional procedures. There was significant improvement of various clinical, patient-related, and radiological outcome measures. Three patients required a course of oral antibiotics for superficial wound infections postoperatively, but there is no mention whether this was related to the plantar incision. The FDL was identified in all cases at the plantar location without the requirement to extend the incision or surgically release any FHL-FDL interconnections. In the original cadaveric series, interconnections were identified in 11 out of 83 (13.25%) feet. This appears to be the largest reported series of FDL tendons harvested via a limited plantar incision, and confirms the technique to be reliable and relatively risk-free. However, caution should be exerted on the presence of interconnections between FDL-FHL, and the need for those to be divided and possibly extending the incision.

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Wrist & Hand

Base of thumb osteoarthritis current practice

The way in which many health systems are structured has changed greatly in recent decades, with an increased focus on the management of costs and clinical effectiveness. This has had significant implications for the way in which musculoskeletal disorders are managed. In the NHS, it appears that the traditional model of GP referral directly to surgeons in secondary care has been superseded by a model which involves interface services between primary care and surgeons. While healthcare funders would argue that this is to ensure patients have appropriate rehabilitation and nonoperative or invasive interventions prior to more invasive interventions, others have seen this extra layer as a form of rationing and argue that it just adds costs and introduces a barrier between doctor-to-doctor referrals. This study from **Oxford (UK)** relating to base of thumb osteoarthritis is therefore of interest given how little we know about structure and setup of these interface musculoskeletal services.[1] Specifically, this study sought to assess and ascertain disease burden, referral pathways, service structure, and management pathways at 32 interface centres in the UK. Of the 32 centres studied, 21 were community-based and 11 were hospital-based, with the hospital-based centres being more likely to involve occupational therapists as part of the team. The majority of centres took self-referrals and GP referrals, with most patients being treated with analgesics only prior to their first interface appointment. General non-surgical management was standardized across the centres, consisting of education (100%), joint protection (100%), range of motion exercises (84%), strengthening exercises (88%), splintage (100%), and use of assistive devices (78%). However, the use of injections was variable, with none of the centres routinely offering a steroid injection at the first appointment, and no centre had a specific threshold of symptoms on which to base the offer of an injection. Injection delivery was variable between the centres in terms of guidance, dose, steroid type, and the local anaesthetic combination. Overall, these findings raise specific questions relating to steroid injections; for example, should they be offered early as an adjunct to initial treatment and rehabilitation or should they be reserved for those who fail to respond to other interventions? When delivered, how should steroid injections be delivered in terms of guidance and dose? The lack of evidence in this area provides a strong justification for future clinical trials in order to improve and streamline the treatment of this relatively large patient group.

Factors affecting return to work after surgical treatment of trapeziometacarpal joint osteoarthritis

Sticking with degenerative disease at the base of the thumb, we were delighted to come across this succinct and useful paper shedding light on the factors involved in return to work following surgical treatment of trapeziometacarpal joint osteoarthritis (OA). The age of onset of

degenerative diseases is variable between individuals, and is particularly challenging to treat when patients are of working age, and this is often the case with base of thumb arthritis with known spikes in working age males. It is important to consider if the treatments we recommend will return patients to economic activity and, if so, what their capability will be. This cohort study from **Rotterdam (The Netherlands)** included 627 patients, all of whom were in paid employment and treated surgically for trapeziometacarpal joint OA.[2] All of the patients in the series underwent trapeziectomy and ligament reconstruction with tendon interposition and their outcomes, as well as effects on employment, were recorded. Overall, time to return to work was measured through online questionnaires and analyzed using survival analysis at six weeks and three, six, and 12 months after surgery. Three levels of occupational intensity were defined as light physical work, such as an office job, medium physical work, such as general shop work, and heavy physical work, such as building or construction. The key findings of this study were that 78% of patients had returned to work at one year, with the median time being 12 weeks. The overall return to work was 87% for light, 76% for medium, and 70% for heavy physical labour. The overall return to work rate was the same in males and females. In all, 25% of the patients performing light physical work returned to work within the first three weeks, compared with 7% and 5% for medium and heavy physical work, respectively. When corrected for other patient characteristics, the occupational intensity of the patient's work remained associated with return to work. This meant that the return to work within the first year after surgery was relatively 46% lower when performing medium physical labour, and 50% lower when performing heavy physical labour compared with light physical labour. These results are potentially very useful when consenting working patients for base of thumb surgery, as they demonstrate that a significant proportion do not return to work and that this is influenced by the physicality of the job.

Chronic pain one year after operative management of distal radius fractures: a secondary analysis of a randomized clinical trial

This study was a secondary analysis of data relating to patients treated surgically as part of the Wrist

and Radius Injury Surgical Trial (WRIST), which was a randomized controlled trial led out of **Ann Arbor (Michigan, USA)**.[3] This report specifically focuses on the participants progress to a year and, in particular, their 12-month pain outcomes in terms of ongoing pain. WRIST was a randomized clinical trial of treatment for displaced extra-articular distal radius fractures in patients aged 60 years or older who were recommended for surgical fixation by participating surgeons, based on clinical examination and radiographs, and randomized between closed reduction percutaneous pinning, external fixation or internal plate fixation. The Michigan Hand Outcomes Questionnaire (MHQ) pain domain was administered at baseline before surgery and 12 months after surgery; this is scored from 0 to 100, with higher scores indicating more severe pain. The presence of chronic pain was defined as an MHQ pain score difference greater than 0 between the injured and uninjured hand one year after surgery. The mean patient age was 68.9 years, 87.6% were female, and 63.7% were retired. Chronic pain was present in 87 patients (59.6%) and absent in 59 patients (40.4%) at one-year follow-up. A one-week delay in surgery was associated with more than triple the odds of developing chronic pain (odds ratio (OR) 3.65; 95% confidence interval (CI) 1.48 to 9.00), and each ten-point increase in preoperative pain was associated with a 17% increase in the odds of experiencing chronic pain (OR 1.17; 95% CI 1.02 to 1.34). Internal fixation was associated with decreased odds of developing chronic pain compared with external fixation and percutaneous Kirschner wires (OR 0.29; 95% CI 0.10 to 0.90). The most interesting findings are the associations between pain at 12 months, and both the one-week delay in surgery and the mode of surgical fixation. Although the study does not explore why the delay increases the odds of pain at a year, this adds weight to current guidance which supports prompt surgery for distal radial fractures. One significant problem with this study, however, is the way chronic pain has been defined and dichotomized. As the authors acknowledge, a degree of pain and dysfunction after distal radius fracture is very common at 12 months, and if this pain is very mild then it is unlikely to be of any great meaning to patients. The failure to describe the severity of pain and dysfunction at one year is an issue here, and represents a significant methodological weakness. It would be very interesting to know If there was a clinically meaningful different in pain or dysfunction at one year between those whose surgery was not delayed versus those who were delayed; after all, if there were no clinically meaningful difference then these results are not really of any great meaning.

Venous thromboembolic events in hand surgery

The impact of venous thromboembolic (VTE) events is difficult to deduce from the published literature in any area of orthopaedic practice, but it is particularly tricky in hand surgery. Quoted incidence in the background population varies from 13.7 to 145 per 100,000 for deep venous thrombosis, and 20.8 to 69 per 100,000 for pulmonary embolism in the USA. The role of lower limb orthopaedic surgery and treatments is well established in the aetiology of VTE events. However, there are no large epidemiological studies for VTE events following hand surgery and few for upper limb surgery in general. The benefit of chemical thromboprophylaxis in reducing mortality following VTE events has not been robustly established. However, a team from **Leicester (UK)** reviewed national hospital data for a two-year period covering England.[4] By merging datasets, VTE event data for both elective and trauma hand surgery could be ascertained, and VTE risk factors identified. The authors also reviewed the rate of VTE events in their own institution, mapping specific hand surgery procedures to a potential VTE event if occurring within 90 days ~~post operatively.~~ The datasets yielded data on 332,211 hand surgical procedures

over the two years; 71,062 were trauma cases, of which there were no recorded cases of deep vein thrombosis (DVT) and a single case of pulmonary embolism (PE), and 262,149 were elective with 13 recorded DVT events and 26 PE events. The mean annual incidence in this group was calculated as 0.004% for DVT and 0.008% for PE. There were 245,532 patients with no recorded risk factors, in whom there were no VTE events. In the 82,192 patients with a single risk factor, there were 11 DVTs and 25 PEs. There were two cases of DVT and two PEs in the 6,456 patients with two risk factors, and no cases of VTE in the 31 patients with three risk factors. The VTE events and hand surgical procedures are not temporally linked in the databases and the events may be unrelated. Interrogation of the local database demonstrated six VTE events, of which one had occurred preoperatively and the remaining five had all occurred more than one year postoperatively. Thus, the authors concluded a causative association was unlikely, based on their own 1,499 elective hand surgery procedures. The authors calculated an annual presence of 1.94 for DVT and 4.04 for PE in the hand surgery cohort, which interestingly is lower than that observed in the general population. Interestingly, the minor procedures such as carpal tunnel or trigger finger release were more commonly associated with a VTE event comprising 33 of the 40 VTE cases, with few associated with intermediate procedures, and none in the major procedures group. As such, it seems that surgical time alone may not be such a risk factor in mobile hand surgery patients. These findings should be interpreted with caution as no causative relationship can be determined from this study. Furthermore, the low occurrence of VTE events makes comparisons between the surgical groups and conclusions about the role of risk factors fraught with difficulty. However, the conclusion that the rate of VTE events following and attributable to hand surgery is likely to be very small is important. A better understanding of comorbidity instead of surgical factors may aid in stratifying those patients most at risk.

The impact of hospital, surgeon, and patient characteristics on digit replantation decision

Approximately 45,000 traumatic digit amputations occur each year in the USA, disproportionately affecting young, active workers. The relative indications for replantation are well described but subjective, and as such there likely exists variability in treatment between centres. Authors in **Taoyuan (Taiwan)**, a world-renowned centre of excellence for microsurgery, sought to determine the epidemiology of traumatic finger amputations and the incidence of replantation attempts, and to establish patient, surgeon, and hospital factors which contribute to surgical decision-making.[5] They hypothesized that higher earning individuals with minimal comorbidities, treated by experienced surgeons, in a hospital with a higher case load or teaching level status were more likely to undergo replantation. The National Health Insurance Research Database of Taiwan was utilized and contains medical data for 99% of the Taiwan population, with contributions from 97% of hospitals and 90% of clinics. The database was interrogated for all finger amputations over a 15-year period, and data on all cases of replantation and revision amputation were collected to estimate the rate of replantation. Hospitals were classified as low volume if they had fewer than five annual traumatic digit amputations, five to 29 was reported as medium volume, and high volume was deemed to be over 29 cases when averaged over the 15-year period. In total, there were 68,202 traumatic hand injury events recorded; of these, 10,521 were excluded as they were second events occurring within six months of a previous encounter. A further 8,212 were excluded due to missing information for demographics and treatment factors, thus there were complete data on 4,609 patients from low-volume hospitals, 17,285 from medium volume hospitals, and 27,575 patients from high-volume hospitals. The majority of patients (78%) were aged between 18 and 54 years, 77% were male, and 85% had no comorbidities. Thumbs were the least commonly injured digit at 15.4%. Replants were most commonly performed by plastic surgeons, and there was a significant increase in replantation rate from the low volume centres at 5% to higher volume centres at 36%. The mean surgeon volume was, as would be expected, greater in the high-volume hospitals at 4.5 cases versus the medium volume hospitals at 2.0 cases and low volume at 0.7 cases. The overall replantation failure rate in the low, medium, and high-volume centres was 11.1%, 19.7%, and 13.8%, respectively. Regression modelling showed a reduced likelihood of replantation with increasing age, female sex, higher income, or multiply injured digits. This model remained when hospital factors were included. However, when surgeon factors were included in the model, increasing surgeons case volume and experience resulted in a greater likelihood of replantation. Even when the "absolute" indications for replantation of thumb injury and age less than 18 years were examined, there was still an increase in replantation rate with the larger volume hospitals. The variability of replantation rate with increasing seniority and case volume, as well as the increased rates in younger and fitter patients are not surprising. However, that the variability continued for those patients with absolute indications for replantation is surprising. This large study demonstrates the failure rate of replantation surgery, even in the best but not necessarily the most experienced, is between 11% and 20%. This paper should help our decision-making around replantation surgery, as well as informing the consent process.

Dislocations of proximal interphalangeal joints: a systematic review

Here at *BJ360,* we recognize the difficult treatment dilemma that acute fracture dislocations of the proximal interphalangeal (PIP) joint represent; unforgiving soft tissues and technical difficulty in fixation techniques make these injuries a challenge. As they are rare, a good evidence-base is lacking, so authors from **Derby (UK)** performed a systematic review to determine whether an optimal solution could be found.[6] Studies of surgical and non-surgical treatments of adult patients who sustained an acute PIP joint fracture dislocation with both physical outcome measures and adverse event recording were included. Studies reporting on less than ten patients or digits, open injuries, and pilon fractures of the middle phalanx were excluded. The primary outcome measure was active range of movement, with secondary outcome measures of pain, grip strength, patient-reported outcome scores, return to work or pre-injury activity, complications, secondary procedures, and radiographic evidence of joint narrowing or osteoarthritis. Overall, the authors identified 502 abstracts, but after screening, only four studies were deemed as suitable and included in the primary analysis. However, heterogeneity in the study design, treatments, and outcomes were noted, and, as such, meta-analysis of these papers was not possible. Inclusion criteria were widened to include skeletally mature patients aged between 15 and 18 years, and studies were categorized into those evaluating nonoperative techniques, minimally-invasive

techniques such as closed reduction and Kirschner wire fixation, formal open reduction and internal fixation (ORIF), and other studies such as volar plate arthroplasty. The primary analysis of the four original articles demonstrated a wide range of reported outcome, and the literature supports our anecdotal clinical findings that these injuries can either result in a very poor or reasonable clinical outcome, with a reported active range of movement at the PIP joint of between 20° and 110°. The secondary analysis included an additional seven studies, four using closed reduction and extension block pinning, and three performing ORIF. Range of movement (ROM) at the PIP joint was consistently reported, with the best results recorded after using lag screws and temporary K-wire fixation of the PIP joint, and the poorest results were following fixation with mini hook plates. The tertiary analysis reported results on 103 patients undergoing closed reduction and minimally invasive techniques, and 62 patients undergoing open reduction and internal fixation. The primary outcome measure of ROM at the PIP joint was similar between the two cohorts at 83° versus 82°, respectively, with better pain scores, grip strength, and patient-reported outcomes noted in the closed reduction group. That said, at final review, 40% of this group had radiographic osteoarthritis, compared to 7% of the ORIF group. This systematic review gives us food for thought. Although the data on which it is based somewhat flawed, the authors of this review have made the most of the available data. Often these injuries are clumped together when reported in the literature, and given our lack of understanding about risk factors for subluxation and how the proportion of the joint surface involved in the fracture contributes to the overall outcome of the injury, this seems illogical. Firm conclusions are therefore hard to draw, and there is an urgent need for improved research in this field. While a randomized controlled trial is unlikely to be feasible, prospective cohort studies carefully reporting fracture pattern, treatments, and patient-reported outcomes are essential.

A cost-utility analysis of open A1 pulley release for the treatment of trigger finger

Trigger finger will affect approximately 2% of the population over their lifetime. Both corticosteroid injections and surgical treatment are viable options, with the latter obviously being more expensive. Authors from **Edinburgh (UK)** sought to determine the cost utility of trigger finger surgery in their cohort of adult trigger finger patients.[7] Cost utility balances (the cost of a procedure against the measured improvement in quality of life and subtly different to cost-effectiveness) take a more patient-centred approach. The team prospectively included all patients undergoing trigger finger surgery over a five-year period in their tertiary regional hand unit. Initially, all patients were offered a steroid injection as the primary treatment; those with refractory or recurrent symptoms were counselled regarding the relative risks and benefits of conservative management, repeat steroid injection, or surgery. All surgeries were performed under local anaesthesia via a transverse palmar incision either by or under the direct supervision of a specialist hand surgeon. The EuroQol five-dimension five-level questionnaire (EQ-5D-5L) quality of life measure was recorded preoperatively and one year postoperatively. The raw scores were converted to an index score between -1.0 (a state worse than death) and +1.0 (perfect health). Costing for surgery was defined as the national tariff of £840 and the cost per quality-adjusted life year (QALY) was calculated. Overall, 272 patients underwent trigger finger release surgery and full preoperative and postoperative data was available for 192 patients (71%) at a mean follow-up of 13.2 months. The mean age was 63 years and 61% were females. There were no documented complications nor any recurrences. The median preoperative EQ-5D-5L index value was 0.77, improving to 0.80 postoperatively, which was a strongly significant difference. The mean improvement in EQ-5D-5L index score was 0.026, albeit with the 95% confidence interval crossing zero. The mean life expectancy was 21 years (5.7 to 51.7). Over the course of the patient's lifetime, the mean number of QALYs gained was one per patient. At one year postoperatively, the mean cost per QALY was £32,308 per patient. This decreased to £16,154 at two years postoperatively. Over the remaining life expectancy, the cost per QALY was £1,537. This simple study is strengthened by the large cohort, good rate of follow-up, and standardized treatment pathways. Given an accepted threshold of £20,000 to £30,000 per QALY for effectiveness and assuming the benefit of trigger finger surgery is maintained for two years postoperatively (which anecdotally seems likely given the low rate of observed recurrence and complication rate), trigger finger surgery can be considered cost-effective. In an era when both improvement in quality of life and cost-effectiveness underpin decision-making around service provision, the demonstration of significant improvement in quality of life and comparable cost utility are importantly demonstrated in this article.

Functional outcomes of trigger finger release in non-diabetic and diabetic patients

The same authors from **Edinburgh (UK)** continue with their trigger finger theme, this time reviewing their functional results in diabetic and non-diabetic patients, presumably in part in the same prospectively collected cohort.[8] All patients were initially treated with a corticosteroid injection administered in the clinic. Patients were also included if they had treatment for concurrent pathology provided the prime complaint was trigger finger. Along with the EuroQol five-dimension five-level questionnaire (EQ-5D-5L) questionnaire, they also recorded the abbreviated version of the Disabilities of the Arm, Shoulder and Hand questionnaire (QuickDASH), and patient satisfaction scores. This cohort of 192 patients had a mean follow-up of 14 months (11 to 40) postoperatively. There were 143 patients with 143 trigger fingers without diabetes, and 49 patients with 49 trigger fingers with diabetes. There were no statistical differences in the age or sex distribution between the groups. Patients with diabetes reported a significantly poorer baseline (preoperative) QuickDASH, as well as a significantly poorer postoperative score, when compared to non-diabetic patients. However, the overall improvement in QuickDASH scores was comparable between the two groups. The proportion of patients who reported an improvement in QuickDASH was similar in the two groups at 59% in the diabetic and 62% in the non-diabetics. On multiple regression analysis, diabetes was not found to be an independent predictor of change in QuickDASH. Although diabetic patients also reported a significantly worse quality of life preoperatively as measured by the EQ-5D-5L, there were no differences in either the postoperative score. There were no differences in patient's satisfaction as measured using a simple visual analogue scale of "satisfaction with surgery" and the net promoter score as a determinant of the patient's likelihood of recommended the surgery to a friend or family member. There were no complications reported in either group. That diabetic patients report a

poorer health-related quality of life is perhaps not a surprise; however, the difference observed in the QuickDASH is potentially more interesting. Although it is recognized that the DASH questionnaire is counterintuitively not specific to upper limb pathology, this difference may be accounted for by the greater likelihood of concurrent upper limb pathology in diabetics. The authors also postulate that the disease process of triggering may differ between diabetics and idiopathic trigger fingers. It is thought that diabetes causes abnormal cross-linking of collagen within the flexor sheath causing localized hypertrophy, differing from the metaplastic changes in the flexor sheath observed in idiopathic trigger finger. The authors also comment on the low complication rate observed in the diabetic group, often cited as a potential barrier to surgical intervention. They report no complications, and although the diabetic cohort is relatively small, this reflects the experience of the team at *BJ360*. Overall, this paper succinctly demonstrates the safety and effectiveness of trigger finger surgery in diabetics using robust prospectively collected routine data. Large cohort studies of this design can be useful in assessing the impact of our more common procedures.

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Shoulder & Elbow

X-ref ***For other Roundups in this issue that cross-reference with Shoulder & Elbow see: Children's orthopaedics round-up 7 & 8; Research round-up 2; Sports round-up 1.***

Not all humeral shaft fractures are the same

Recent studies have questioned the routine teaching that primary nonoperative management is suitable for the vast majority of humeral diaphyseal fractures, with randomized trials suggesting superior union rates and better early functional outcomes following acute surgical management of these injuries; again the UK leads the way in the HuFix trial from Edinburgh and Humeral Shaft fracture trial (HUSH) from Oxford, both of which are currently underway. But what is known about the epidemiology of these injuries and has it changed over the past few decades? In this retrospective study from **Edinburgh (UK)**, the authors aimed to define the epidemiology of humeral diaphyseal fractures and to determine any variations in patient and injury characteristics with respect to fracture location in the diaphysis.[1] Over a ten-year period, the authors identified 900 fractures, of which 800 (89%) were acute typical fractures, and of the remainder of 75 were pathological and 25 periprosthetic. The overall incidence was consistent with previous studies at 12.6/100,000 per year and the mean age for typical fractures was 56 years, with a bimodal distribution in men and unimodal in older women. The rate of open fractures was 2.3%, with a radial nerve palsy rate of 6.7%. Interestingly, the authors found that fractures involving the proximal- and middle-thirds of the diaphysis were more likely to occur in older patients, females, those with multiple comorbidities, and after a fall from standing height. Proximal-third fractures were also associated with a background of alcohol excess and were more likely to be AO-OTA type B or C injuries. This study includes a large consecutive series of patients from a centre with a defined catchment population and highlights important differences in patient and injury demographic details in relation to humeral diaphyseal fracture location. The authors suggest that proximal- and middle-third fractures should be considered as fragility fractures, which was consistent with their findings of an increase in the mean age at the time of injury and the proportion of those aged over 50 years sustaining these injuries. Although this study cannot give guidance on the management of these injuries, it does provide valuable and current epidemiological data that need to be considered not only when determining the optimal management for these patients, but also when designing futures studies in this area.

One or two incisions for distal biceps tendon repair?

Surgical management of distal biceps tendon ruptures can be an area for debate, with the majority of patients documented to have a good or excellent outcomes. However, some have advocated nonoperative management due to the rare but severe complications associated with surgery, some of which can be potentially life-changing. Problems associated with the single incision technique relate to potential neurological injury, while the double incision technique is felt to be associated with an increased risk of heterotopic ossification (HO). The aim of this systematic review and meta-analysis from the team in **Catanzaro (Italy)** was to compare the single and double incision techniques in terms of functional outcome and complications.[2] The study was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and from an initial 606 records identified, 13 comparative studies (consisting of one level I, one level II, and ten level III) met the inclusion criteria with the methodological quality assessed using the Newcastle-Ottawa Scale. Outcomes analyzed included range of motion, Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), and complications, which were defined as neurological or non-neurological. A total of 2,622 patients

were identified, of whom 1,825 had a single incision repair and 797 had a double incision repair. No differences were found in terms of the DASH score and while the single incision technique was associated with a significantly increased flexion at a mean difference of 3° and pronation at a mean difference of 4°, it would seem unlikely these were clinically significant differences. The double incision technique was associated with a significantly reduced risk of injury to the lateral antebrachial cutaneous nerve, notwithstanding the fact that there were only nine unresolved or persistent cases overall, and the single incision technique was associated with a significantly reduced rate of HO and reoperation. Although there are limitations to the analysis related to data heterogeneity and the lack of level I randomized studies, this work does provide useful information when comparing these two approaches for distal biceps tendon repair. Despite the interesting findings presented in this study, here at *BJ360* we would suggest that a key research question for these injuries would be to compare operative and nonoperative management.

Manipulation under anaesthesia has a role in arthroscopic cuff repair

Untreated stiffness has the potential to compromise the outcome of operatively managed rotator cuff tears. In the presence of a true frozen shoulder, many surgeons may be reluctant to offer rotator cuff surgery due to the perceived risk of poor outcomes. In this study from **Singapore,** the authors prospectively studied a consecutive series of patients undergoing a primary arthroscopic repair for small and medium rotator cuff tears to investigate the effect of preoperative stiffness.[3] Patients were considered surgical candidates if they had failed nonoperative management for a minimum of six weeks and were divided into one of two groups: "stiff" and "not stiff". Stiffness was defined as less than 100° of forward flexion; these patients underwent a standardized manipulation after the induction of anaesthesia and prior to arthroscopic rotator cuff repair. Those in the "not stiff" group underwent the arthroscopic rotator cuff repair alone. All patients were treated by a single senior surgeon and then assessed at six, 12, and 24 months postoperatively with the visual analogue pain scale (VAS), the Constant Murley Score (CMS), the original reverse scale Oxford Shoulder Score (OSS), range of motion, and

strength measured by dynamometer. At the final study endpoint, fewer than 10% of patients were lost to follow-up, balanced between the two groups. In total, 46 stiff and 77 not stiff shoulders were available for analysis, with patient demographic details and tear size well-balanced between the groups. Patients with a stiff shoulder had significantly worse preoperative scores in terms of VAS, CMS, and OSS. Both groups demonstrated improvements in excess of accepted minimally important clinical differences for all of the reported outcome measures, and there was no difference in pain, function, or strength between stiff and non-stiff shoulders at any of postoperative timepoints. Patients with a preoperatively stiff shoulder made considerably greater gains than those in the not stiff group, although the final achieved function was not significantly different. Given that many patients with rotator cuff disorders will present with some degree of coexisting stiffness or capsular restriction, this study provides helpful reassurance that these patients can still respond well to operative intervention and if a decision has been made to intervene surgically for the rotator cuff tear, there may be no need to delay this treatment. The usual caveats apply to the generalizability of this study since, while well conducted, it represents a single centre and surgeon experience and suffers the usual risks of bias inherent in observational studies. Shoulder stiffness represents a wide spectrum of pathology and it is not clear whether there was a specific underlying pathology for patients in the stiff shoulder group. One question that is perhaps not addressed by this paper is how important the rotator cuff repair component was in patients with a stiff shoulder and whether the manipulation could be the more important therapeutic component of the procedure. Given the increased risk and cost profile associated with rotator cuff repair, this should be carefully considered.

A single dose of tranexamic acid reduces blood loss after reverse and anatomical shoulder arthroplasty: a randomized controlled trial

X-ref

Despite the wide use of tranexamic acid (TXA) in hip and knee arthroplasty, its utility in reducing blood loss and complications following shoulder arthroplasty remains unproven. This group from **Sydney (Australia)** has conducted a double blind randomized controlled trial of 60 patients in order to compare blood loss and complications following the use of TXA during primary anatomical and reverse shoulder arthroplasty. In this admittedly small study, 31 patients received 2 g TXA dose at induction with 29 patients in the placebo group, and there were no apparent differences in arthroplasty type between the groups.[4] Surgical drains were routinely used and drain output, blood loss, haematoma formation, transfusion requirement, length of hospital stay, and pain scores were all recorded with patients followed up for 12 weeks to assess for complications. The TXA group had significantly less blood loss during surgery and from drains at a mean of 94 ml versus 226 ml at 24 hours post-surgery. Surrogate markers of blood loss such as changes in haemoglobin were also significantly better in the TXA group at a mean drop of 1.7 g/dl versus 2.3 g/dl. In terms of secondary outcomes, however, there was no significant difference in pain scores between the two groups or length of hospital stay, and there were no patients who required a blood transfusion. This trial demonstrated that TXA significantly reduced blood loss following shoulder arthroplasty, and it would be interesting to see if the results are reproducible in a purely trauma patient group. Ameliorating the blood loss from surgery is surely advantageous in theory, but the clinical consequence of this reduced blood loss remains uncertain due to the lack of difference in secondary outcome measures demonstrated. Here at *BJ360* we would use this trial as evidence to support the use of TXA routinely, especially given the wealth of evidence in other large joint arthroplasties. It is important

to remember, however, that the lack of adverse events is as important here as the positive findings and larger studies are required.

Subacromial decompression versus diagnostic arthroscopy for shoulder impingement: a five-year follow-up of a randomized, placebo surgery-controlled clinical trial

In October 2018 we reported the two-year outcomes of the Finnish FIMPACT study of the benefits of subacromial decompression. Subacromial decompression is one of the most commonly performed shoulder surgeries, and many high-quality studies have demonstrated that surgery offers no additional advantage to placebo, or other treatments such as physiotherapy, in terms of short-term pain relief or function. However, Cochrane reviews have highlighted a need for long-term evidence with low risk of bias to clarify efficacy or otherwise over this period, so we are interested to see the long-term results of this study from the original study group in **Helsinki (Finland)**.[5] FIMPACT was a multicentre, three group, randomized controlled superiority trial. Patients aged between 35 and 65 years with impingement symptoms for over three months were randomized to either a subacromial decompression, sham diagnostic arthroscopy, or exercise therapy. The two-year results showed that both arthroscopic subacromial decompression (ASD) and the diagnostic arthroscopy placebo resulted in significant improvements in pain and functional outcomes with no difference in the incidence of adverse events, but the patients assigned to ASD had no superiority over those assigned to diagnostic arthroscopy. Furthermore, at two years although a statistically significant benefit of ASD over exercise therapy was found in both the primary outcome measures, this did not exceed the prespecified minimal clinically important difference. The five-year data include 83% of the initial study participants and again demonstrate no difference between the groups in the primary outcome of pain at rest or activity, which was assessed using a minimally important difference in the visual analogue scale scores. Similarly, there were no differences in secondary outcomes or differences. This randomized controlled superiority trial demonstrated that the lack of benefit demonstrated persisted at five years. Here at *BJ360*, our experience among the shoulder surgeons remains unchanged, with subacromial decompression as a standalone procedure extremely infrequently performed, and only in chronic cases resistant to conservative measures where appropriate counselling has been performed, or where false-positive imaging for rotator cuff tears is encountered on-table.

Arthroscopic Bankart repair with and without arthroscopic infraspinatus remplissage in anterior shoulder instability with a Hill-Sachs defect: a randomized controlled trial

Uncertainty remains about the optimal surgical management of osseous shoulder defects to prevent recurrent instability, and whether arthroscopic remplissage confers significant benefits. Surgeons from **Winnipeg** and **Ottawa (Canada)** have conducted a very valuable randomized controlled trial to evaluate whether undertaking an arthroscopic remplissage during Bankart repairs for patients with engaging Hill-Sachs defects significantly improved outcomes.[6] The authors reported outcomes in terms of clinical scores, dislocation, and revision rates. In terms of inclusion criteria, patients were 14 years of age or older with anterior instability and engaging Hill-Sachs defect confirmed on cross-sectional imaging. Importantly, glenoid defects were limited to 15% of glenoid width and the indication for surgery was that the surgeon thought the patient could benefit. Overall, 108 patients were recruited to and randomized into the trial; 54 to a Bankart repair only and 54 to a Bankart repair plus a remplissage. The study reports no significant differences in clinical and patient-reported outcome scores including Western Ontario Shoulder Instability Index, Simple Shoulder Test, and American Shoulder and Elbow Surgeons score, shoulder function, or complications. The additional remplissage group had significantly lower recurrent instability at 4% and no revision surgery required at two years compared to the Bankart repair-only group, who had 18% recurrent instability and 12% required revision. Higher re-dislocation rates correlated to Hill-Sachs defects that were greater than 20 mm in width or 15% of the humeral head. We at *BJ360* were surprised at the finding that shoulder function was equivalent between the groups given the restriction in external rotation usually introduced by the remplissage process. Questions also remain over the longer-term instability rates and other complications of remplissage, such as osteoarthritis. That only one of the six patients who did not initially undergo remplissage but underwent revision surgery was subsequently revised with a remplissage indicates that the performing surgeons may not have believed this to be a key component of the procedure. Judging Hill-Sachs lesions to be engaging preoperatively solely on the basis of imaging is difficult too. Here at *BJ360*, we believe remplissage has a role in the toolbox of instability management, but we are not ready to deploy it on a blanket basis.

More evidence to support the nonoperative management of rotator cuff tears

Despite the possibility of persistent pain and loss of function, the surgical repair of rotator cuff tears, particularly in the elderly patient, continues to be debated. Studies have looked at the role of nonoperative management, subacromial decompression alone, and surgical repair, with some suggesting superior longer-term outcomes in operatively managed patients. A meta-analysis we discussed recently at *BJ360* suggested that surgery for degenerative rotator cuff tears in older patients did give significantly better results than nonoperative or subacromial decompression alone, although a bespoke approach to management was recommended as the differences reported were below the minimal clinically important difference. The primary aim of this systematic review and meta-analysis led from **Nashville (Tennessee, USA)** was to determine the efficacy of nonoperative treatment options for patients with a massive irreparable tear of the rotator cuff.[7] Unusually for a systematic review, the authors helpfully also went on to attempt to develop a nonoperative treatment protocol based on the best evidence available. The study was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and from an initial 308 records identified, ten studies - consisting of one level III and nine level IV - met the inclusion criteria. The authors found an overall success rate of nonoperative management at 32% to 96%, with significant improvements in functional outcome scores, range of motion, and strength. In terms of the development of a nonoperative protocol based

on the current data, the authors determined that this should include supervised physiotherapy for three months or more, with anti-inflammatory medications and steroid injections potentially of benefit. There are notable limitations with this data including the quality of the studies and the associated selection bias, as well as the limited follow-up for some of the papers. However, here at *BJ360* we would suggest that these data add to a growing body of evidence to suggest that nonoperative management can be employed in a majority of patients with massive rotator cuff tears, with surgery reserved for specific or refractory cases. We are sure the debate will continue.

Reducing opioid requirements after shoulder surgery

Awareness of the opioid epidemic has increased over the past few years, with the crisis continuing to evolve worldwide. The importance of chronic opioid use in orthopaedic surgery is also better appreciated. and there are an increasing number of studies looking at both risk factors and potential strategies for reducing these risks. In this prospective, double blind randomized controlled trial from a group in **Indianapolis (Indiana, USA)**, the authors aimed to compare three interscalene block regimes in order to determine the effect on postoperative pain and opioid consumption on patients undergoing outpatient arthroscopic rotator cuff repair.[8] The three groups of 26 patients each consisted of: 1) a control group using normal bupivacaine and dexamethasone; 2) a group using liposomal bupivacaine (LB) with normal bupivacaine; and 3) using liposomal bupivacaine with dexamethasone (LBD) and normal bupivacaine. The theory behind the use of LB was related to its longer-acting properties. The primary outcome measure was postoperative narcotic use which was converted to morphine milligram equivalents, with the secondary outcome a pain visual analogue scale (VAS). These were both recorded every eight hours daily, from the day of surgery to postoperative day four. A sample size calculation determined 22 patients per group were needed for an effect size of 0.3 and a power of 80%. The mean age of all patients included was 58 years and the baseline characteristics of the groups were well matched, with only two patients in the LB group being lost to follow-up. The authors reported that postoperative narcotic usage was reduced at every timepoint in the LB group when compared to the control group. The control groups also reported narcotic usage that was significantly higher on postoperative days two and three when compared to the other groups. No other differences in usage were found and the VAS pain scores were comparable throughout. The authors concluded that LB should be considered in interscalene nerve blocks for these patients. Although there are limitations to this study, related to the relatively small sample size and the lack of a cost analysis, it does provide high-level evidence in a much-needed area and is another useful addition to the literature on methods to try and limit opioid use following orthopaedic surgery. Clearly, further research is required on how to identify and best manage those patients at risk of developing opioid dependence.

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Spine

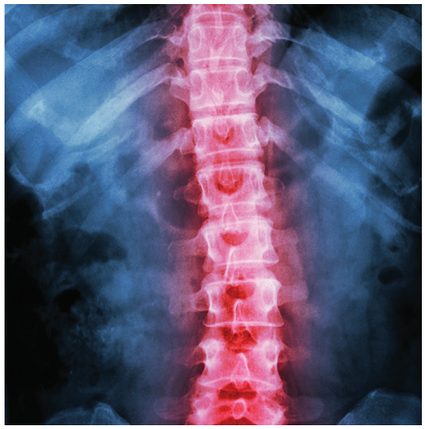
Semitendinosus tendon augmentation for prevention of proximal junctional failure

Proximal junctional kyphosis (PJK) can complicate multilevel instrumented fusions performed for adult spinal deformity, and often requires revision surgery. Mechanically, it is thought to be caused by a modulus mismatch between the fused segments and the overload of the most proximal segment. The reported incidence is up to 40% and risk factors include ageing, fracture, instrumentation failure, disc degeneration, facet violation, or disruption of the posterior ligamentous complex (PLC). In this retrospective cohort study, a group from **Los Angeles (California, USA)** has looked at the role of reinforcing the PLC to soften the transition from fused to flexible segments and reduce the risk of PJK, thereby distributing the excess motion over a number of motion segments.[1] Patients who underwent long segment spinal fusion with semitendinosus allograft reconstruction (suturing the tendon between the spinous process one level above the upper instrumented vertebra to one to two levels below) were compared to those without tendon reconstruction. Outcome measures included radiological spinopelvic parameters and the proximal junctional sagittal Cobb angle, as well as the Oswestry Disability Index (ODI). PJK was defined for the purposes of this study as a postoperative increase in proximal sagittal Cobb angle of greater than 20˚. If revision surgery was required, it was termed proximal junctional failure. There were 49 patients in the reconstruction group and 34 patients in the control group. The

pre- and postoperative demographic, operative, and spinopelvic characteristics were similar between the groups. The study revealed that while proximal junctional kyphosis occurred to a similar extent in both groups (33% vs 32%, p = 0.31), PJK did not occur in the allograft group in contrast to the control group (six patients (18%), p = 0.01). The postoperative ODI scores were significantly better in the allograft group (p = 0.007). This a small, retrospective study and the authors acknowledge that the indications for PLC augmentation were based on timing and that patients tended to be in the latter half of the study period. Nevertheless, this technique should be further evaluated as there is the potential to reduce a significant complication in a complex cohort of patients.

Presurgical short-term halo-pelvic traction for severe rigid scoliosis: a two-year follow-up review of 62 patients

Historically, halo-pelvic traction was a mainstay of treating spinal deformities; however, more recently, there has been a trend for large deformities to be treated with three-column osteotomies and instrumented fusion. With large curves that require substantial correction, there is an associated risk of neurological, vascular, and pulmonary complications. A group from **Beijing (China)** has investigated the effectiveness of using preoperative halo-pelvic traction to reduce the curve size prior to definitive surgery.[2] This approach may offer the advantage of easier corrections, and potentially a lower complication profile if less aggressive correction is needed. The group devised a halo-pelvic external fixator system that provided distraction over a four- to six-week period for use in patients with rigid deformities and utilized it in patients with deformities exceeding 120° prior to definitive correction and fusion. Curves that were very stiff (30 patients) in this series underwent a vertebral column resection (VCR), whereas less stiff curves (32 patients) underwent posterior facet-based osteotomies and then instrumentation. The group achieved 50% angular corrections in both groups after traction, rising to 65% after surgery. Halo-pelvic traction is an involved process which is both uncomfortable and inconvenient for the patient and family, with an in-patient stay exceeding a month prior to surgery. The study showed that complications in this series included infected pelvic pins, four cases of brachial plexus palsy,



dysphagia, and a case of atlantoaxial joint subluxation. All these complications improved once traction was stopped and there were no permanent neurological deficits reported. This study highlights the importance of halo-pelvic traction for large curves that can simplify subsequent surgery, potentially avoiding a three-column osteotomy. For many paediatric units, the equipment and clinical skills will need to be redeveloped and patients should be made aware of the potential treatment complications. In order for this treatment to re-emerge as a standard of care, it would really need clear evidence demonstrating that the complication profile associated with the halo-pelvic traction was less significant than that associated with the three-column osteotomies.

Preoperative opioid weaning before major spinal fusion: simulated data, real-world insights

There is an 'opioid epidemic' in the developed world, and patients with chronic back pain are often prescribed these drugs in the long term, despite evidence showing that long-term use is ineffective and associated with increased morbidity, mortality, and healthcare-related costs. In patients who are due spinal surgery, there is clear benefit in reducing opioids as patients have better outcomes and fewer complications in the preoperative work-up period. This practice is becoming more accepted and the evaluation of the benefits or otherwise of reducing opioid dependence in the preoperative period, in terms of longer-term outcomes, are not yet fully evaluated. The authors of this study from **Columbus (Ohio, USA)** have analyzed the influence of preoperative weaning on long-term postoperative opioid use using a retrospective analysis of insurance company data.[3] The study involved the results of 17,643 patients, of whom 3,590 were deemed to have had chronic preoperative opioid use. The patients were divided into three groups based on the timings of their opioid prescriptions: no gap (NG), > two months gap (2G), and > three months gap (3G) prior to surgery. The study groups were somewhat small, with 41 patients (1.1%) in the 3G group, 106 (3.0%) in the 2G group, and with the majority of patients having no gap. In the 2G group, 53.8% of patients were able to stop their opioid use compared to 27.8% in the NG group (p < 0.001). Interestingly, only 40.9% of patients in the 3G group were able to stop opioids. It may be just a consequence of a small cohort of patients, but these relationships need to be investigated further to see if there is an optimum weaning period. The study has several limitations in addition to different sized cohorts, including confounding risk factors for opioid use such as anxiety, depression, substance abuse, the effect of other medication, and the possibility of non-prescription opioid use. Further prospective studies in this field would be useful so that patients can derive the most benefit from an enhanced recovery programme.

Surgical interventions for cervical radiculopathy without myelopathy

As degenerative changes in the cervical spine progress, patients can present with myelopathy, radiculopathy, or both. The favoured surgical strategy for a single-level, centrally herniated disc in the cervical spine is an anterior approach; however, there is conflicting evidence regarding the most effective surgical technique for isolated lateral compression of the cervical nerve root, but plenty of literature available from which to form an opinion. A group of authors from **Groningen (The Netherlands)** have set out to fill this evidence gap through conducting a meta-analysis of randomized controlled trials (RCTs) that investigate the effectiveness of surgery via an anterior or posterior approach compared with other interventions for patients with cervical radiculopathy.[4] Outcomes were success rates, complication and reoperation rates, work status, disability, and pain. The authors were able to identify 21 RCTs suitable for inclusion in their review; between these 21 studies, the results of 1,567 patients are reported and were available for inclusion in the

review. For all outcomes among all surgical techniques, only one pooled estimate showed a significant effect on success rate in favour of anterior cervical discectomy with fusion compared with anterior cervical discectomy without an intervertebral spacer. Complication rates were higher when autologous bone graft from the iliac crest was used as an intervertebral spacer related to donor-site morbidity. Overall, this meta-analysis demonstrated consistent clinical outcomes for pure cervical radiculopathy among all studied interventions. Complication and reoperation rates were also similar, with the exception of higher complication rates in patients in whom autologous bone grafts were used. On the basis of clinical outcomes and safety, the authors concluded that there is no evidence to support one surgical intervention as superior for pure cervical radiculopathy.

Anatomical gradients in the microbiology of spinal fusion surgical site infection and resistance to surgical antimicrobial prophylaxis

Surgical site infections (SSIs) have traditionally been attributed to gram-positive skin flora, and, as a result, current infection prevention measures in spine surgery predominantly target these. However, it has been reported that the microbiology of SSIs in instrumented spine surgery may be more complex. To develop more effective infection prevention strategies in spine surgery, a detailed understanding of the microbial epidemiology and burden of antibiotic-resistant infections in modern surgical practice is required. In this study from **Seattle (Washington, USA)**, the authors conducted an analysis of 308 postoperative spinal infections at a single high-volume referral centre.[5] The group identified that 55.2% of infections were monomicrobial, 43.5% were polymicrobial, and 1.3% were culture-negative. Among the monomicrobial infections, 79.4% were caused by gram-positive cutaneous flora and 20.6% were caused by enteric species. Among polymicrobial infections, 22.4% involved a mixture of cutaneous organisms, 44.8% involved only enteric organisms, and 32.8% involved a combination of both cutaneous and enteric species. Gram-negative infections were more likely to be polymicrobial and present earlier than gram-positive infections. A transition from gram-positive skin commensals in the cervical spine to a predominance of gram-negative enteric organisms in the lumbosacral spine was observed, with the transition being at about T4. The correlation coefficient between caudal vertebral level and infection with one or more enteric flora was 0.94, and given the increase in gram-negative infection with the caudal extent of the surgical field, a posthoc analysis showed that the inflection point between gram-positive and gram-negative infections lies near the thoracolumbar junction. Susceptibility to the prophylactic agents administered during the index procedure was reliably determined for 97.4% of isolates. Overall, 57.5% grew at least one organism resistant to the prophylaxis administered during the index procedure. The resistance of SSI isolates to prophylaxis also varied across the length of the back. A total of 58.4% of discordant infections were from cefazolin-resistant enteric species and 38.9% of discordant infections were methicillin-resistant gram-positive infections, occurring predominantly in the cervical and upper thoracic regions. This study concludes that individualized infection prevention strategies tailored to operative level are needed in spine surgery as the microbiology of spinal fusion SSI transitions from gram-positive to gram-negative infection on the cranio-caudal axis. This simple paper has a clear and important message that should be translated into clinical practice rapidly.

Trabecular CT attenuation measurement in predicting osteoporotic compression fracture

Osteoporosis is usually diagnosed by dual x-ray absorption (DXA) of the lumbar spine and hip which, while being non-invasive, quick, and safe, can also be inaccurate. This may be due to positioning of the patient or degenerative changes such as osteoarthritis, fracture, and endplate sclerosis. Previous studies have shown that trabecular range of interest (t-ROI) attenuation measurements of the lumbar spine in chest and abdominal CTs are effective for bone mineral density screening. However, there is no study on the relationship between osteoporotic compression fractures, which is generally sufficient for diagnosing osteoporosis, and simple t-ROI attenuation of the lumbar vertebra. The aim of this study from **Goyang (South Korea)** was to do just that.[6] In all, 181 patients who underwent spinal DXA and lumbar CT were included in this study and were followed up for between three and 99 months. A total of 71 patients did not experience a compression fracture during this time (non-compression group) and 110 patients did (compression fracture group), of which 66.3% had one fracture and 33.7% had two or more fractures. The mean T score of L1 to L4, excluding the compression fracture level when necessary, was -1.2 (standard deviation (SD) 1.5) in the non-compression fracture group and -2.2 (SD 1.1) in those with a compression fracture. The mean t-ROI was 107.5 (SD 43.6) in patients without a compression fracture and 62.8 (SD 27.8) in those with a fracture. DXA T-score and the simple mean t-ROI attenuation between the two groups showed a statistically significant difference. Furthermore, when the t-ROI of each lumbar vertebra was analyzed to establish diagnostic cut-offs between the two groups the receiver operating characteristic (ROC) curves indicated that the L4 t-ROI attenuation is the most relevant measurement for predicting osteoporotic compression fractures. The optimal cut-off point of the L4 t-ROI attenuation was measured at 90.5 Hounsfield unit (HU) with 88.8% sensitivity and 60% specificity. In conclusion, this study suggested that simple t-ROI CT attenuation is an accurate measurement tool in predicting osteoporotic compression fractures, and that the value of L4 t-ROI attenuation is the most relevant measurement for predicting osteoporotic compression fractures.

Local tranexamic acid in elective spine surgery: a prospective randomized controlled trial

Excessive blood loss in spinal surgery is a complication often encountered in multilevel fusions caused by lengthy operating times, extensive dissection, and decortication of bone for achieving fusion. Blood loss may lead to anaemia, prolonged hospital stays, transfusion requirement, and an increased incidence of wound infection, thereby negatively affecting patient outcome. Tranexamic acid (TXA) is an antifibrinolytic drug which prevents clot breakdown and improves impaired platelet function in acute haemorrhage. Intravenous TXA was popularized through the CRASH-2 trauma trial and it is now widely used, including in spine surgery. The benefits of topical TXA have also been established in arthroplasty procedures, but the consensus regarding its usage in spinal surgery has not been clearly established. This prospective randomized controlled trial performed in **Guntar (India)** evaluates the efficacy of TXA in reducing blood loss in

elective spine surgery.[7] Overall, 104 cases of single- or dual-level lumbar fixation with a single-level interbody fusion were performed for degenerative grade 1 or 2 spondylolisthesis. Patients were randomly divided into four groups: ivTXA (single dose 1 gm one hour prior to surgery); tTXA (1 gm of TXA in 100 ml saline poured into the surgical wound and allowed to sit for five minutes before removing it prior to wound closure); loTXA (1 gm TXA administered bilaterally into the paraspinal muscles prior to incision); and a control group (10 ml of 2% lidocaine and adrenaline administered bilaterally into the paraspinal muscles prior to incision). Overall, 26 patients were allocated to each group; the mean intraoperative blood loss was 344 ml in the loTXA group, 256 ml in the ivTXA, 223 ml in the tTXA group, and 311 ml in the control group. Postoperatively, blood loss was least with tTXA followed by ivTXA, loTXA, and controls, with a 67% reduction in the need for blood transfusion with tTXA, a 55% reduction with ivTXA, and 33% reduction with loTXA when compared to the control group. Shorter hospital stays were observed in the TXA groups, but this was not significant when compared with the control group. This study suggests that intravenous and local administration of TXA were similarly effective in reducing intraoperative blood loss in instrumented spine surgery, and that topical TXA is effective in reducing postoperative bleeding.

Predictors of failure for nonoperative management of spinal epidural abscess

The incidence of spinal epidural abscess reported in the literature has doubled in the last 50 years. It is a potentially rapidly progressing condition which, if left untreated, can result in severe neurological sequelae, sepsis, and death. The symptoms of a spinal epidural abscess are described as a classic triad of back pain, fever, and neurological deficit; however, the early diagnosis of this condition is not necessarily straightforward and delays in diagnosis are common. Treatment of spinal epidural abscesses is dependent on a number of factors, and nonoperative treatment with antibiotics and close clinical observation needs to be balanced with the timely identification of patients likely to benefit from surgery. The aim of this study from **Hamilton (New Zealand)** was to identify factors associated with failure of nonoperative management for spinal epidural abscesses.[8] In all, 58 patients diagnosed with a spinal epidural abscess were treated nonoperatively. Following diagnosis, 38% showed worsening neurology, 33% radiological progression, 19% a clinical deterioration, and 10% failed to improve. Overall, around one-third (36%) progressed to surgery. The classic triad of presenting symptoms was only seen in 7% patients; back pain was present in > 65% patients, 77% had a fever, and 43% had neurological symptoms. The authors report that 76% had positive blood cultures, with *Staphylococcus aureus* being the most common causative organism (58%). In terms of anatomical location, 31% had abscesses in the lumbar region, 17% in the thoracic region, 10% cervical, and 19% spanning multiple levels. Abscess location was predominantly dorsal (> 70%). Maori ethnicity, high white cell count, and multifocal sepsis were identified as significant predictors of failure of nonoperative management of spinal epidural abscesses. This study concluded that 36% of patients with spinal epidural abscesses will fail nonoperative management. The failure rate was significantly increased in patients with multifocal sepsis, in patients with an elevated white cell count, and patients with Maori ethnicity. Given the high failure rate reported here and the risk of morbidity associated with failure to rapidly treat, we do wonder if the thresholds for operative management should generally be lower – especially in those with risk factors.

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Trauma

X-ref ***For other Roundups in this issue that cross-reference with Trauma see: Children's orthopaedics round-ups 6, 7 & 8; Foot & Ankle round-up 4; Hip & Pelvis round-ups 1, 2 & 4; Research round-ups 1 & 6.***

Is immediate weightbearing safe after single implant fixation of elderly distal femur fractures?

There has been an almost wholesale move towards early weightbearing in as many fractures as possible, pushed by a safe complication profile, the potential for better eventual outcomes, and a wish to allow patients to return more rapidly to independent living. This is never more pressing than in the elderly, where long periods of restricted or limited weightbearing can have a negative effect on outcomes. In this retrospective cohort study of 135 patients treated at a level 1 trauma centre in **North America,** the authors set out to establish if it is reasonable to weightbear in distal femur fractures treated with a single implant in the elderly.[1] This paper acknowledges that although there is a persistent reluctance to weightbear in the frail elderly, particularly where extramedullary fixation has been used, there are significant problems associated with immobility. The authors report their series of either early weightbearing or touch weightbearing. Although the study text tantalizingly suggests that the authors set out to review the clinical and patient-reported outcomes, the latter does not actually feature in the final report.

There was a preponderance of nails in the weightbearing as tolerated group (only 10% had plates), while in the touch weightbearing group nearly 70% had plates. This is likely because the study was retrospective and the instruction was based on surgeon preference. Overall, the authors reported no difference in the rate of complications with either the instruction to weightbear as tolerated or touch weightbearing. They also used their data for a power calculation and estimated that 574 patients would be required to answer the question. Unfortunately, there is neither patient-reported outcome data nor any estimate of the rate of compliance with instruction. This is likely to be poor in the elderly population unless they were on bed rest, as other studies have ably demonstrated that older patients are not really able to restrict their weightbearing voluntarily. The authors' conclusion was that permissive weightbearing does not compromise early clinical, radiological, or functional outcomes. This is the same message as the paper from the Orthopaedic Trauma Society in 2015 in the same journal. It serves to highlight that although the latter was published over five years ago, a significant proportion of surgeons still favour restrictions, however impractical these are in the frail elderly population. It also suggests that there is a continuing push to be less restrictive and to remove that burden from the ancillary care givers who also look after these patients. The next study question should be: is there any evidence to support restriction of weightbearing in these patients?

Greater trochanteric fracture decision-making using MRI
X-ref

While not the commonest injury, every centre across the world is presented with a steady stream of greater trochanteric (GT) hip fractures. As there is an increased tendency to scan these patients with either MRI or CT to aid in decision-making, we were delighted to see this paper from **San Diego (California, USA)**.[2] Although there are plenty of opinions as to what one should do with these patients and which ones should be fixed, there is precious little data to support these opinions. This paper specifically questions whether the isolated GT fracture extends and whether it should be fixed. Perhaps unsurprisingly, the numbers are small in this retrospective series, with 17 patients identified over a seven-year period who had a GT fracture

on radiograph and an available MRI scan for review. In all cases, the MRI scan confirmed that there was extension into the intertrochanteric (IT) region. The authors excluded two patients who did not have radiological follow-up, leaving 15 patients in the final analysis. The key take home message is that all 15 patients healed their fractures. Of these, 93% had IT extension of 50% or less with a single patient having an initial extension of 60%. No patients were treated operatively and in the period of follow-up none went on to require operative intervention. This is a simple paper with a simple message that will be enormously helpful in managing these patients, and confirms that the practice of nonoperative management, which is usually undertaken with some anxiety, is likely to be the correct initial course of treatment.

Conservative treatment of hip fracture yields high morbidity and mortality
X-ref

COVID-19 has pressured hospital services in all healthcare systems like never before. Trauma operating time has become increasingly restricted, giving way for staff sickness and in many cases the use of operating theatres to ventilate COVID-19 patients. In overwhelmed healthcare systems, it has reopened the question of whether it is reasonable to manage selected hip fractures nonoperatively – a question that, with the possible exception of occult fractures, has not been raised for years. The authors of this meta-analysis from **Rotterdam (The Netherlands)** screened 4,317 studies to find 25 eligible for inclusion in this useful review.[3] These studies reported a total of 2,615 nonoperatively managed hip fracture patients. The reasons given for nonoperative management were predominantly the decision that patients were unfit for surgery or had a very low baseline function. The mortality rate reported at 30 days (36%) and one year (60%) reflected this, although it was lower in those who were mobilized early (20% at six months). The authors reported in-hospital complications in one-third of patients and almost 20% suffered from pressure sores and ulceration. The length of stay was, on average, 12.2 days and is likely a reflection of availability. Attention was drawn to analgesia, particularly the use of block, and to mobilization as having better outcomes across the studies. The paper discussed the lack of knowledge when it comes to nonoperative treatment and provides very useful insights. Although not the assurance that many will seek during the COVID-19 pandemic, it does provide a very practical guide where this is necessary: pay attention to analgesia (particularly the use of blocks), mobilize early, and try to repatriate the patients out of the acute beds. The authors point out that nonoperative management of hip fracture patients is associated with terrible results. Some of the findings in terms of blocks and sitting out are useful in overburdened systems where patients may wait longer than usual for treatment. For us here at *BJ360*, however, this helpful review underlines the importance of treating these patients operatively.

"Cement disease" in hip fracture patients – fact or fiction?

On a slight tangent from the randomized trials normally discussed here at *BJ360*, this paper from **Canada** brought together three respected senior orthopaedic trauma surgeons to comment on the use of cemented or uncemented hemiarthroplasty in the frail elderly with a hip fracture.[4] This paper is interesting in that it does not pretend to be anything other than expert opinion (that old chestnut of 'level 5') evidence. However, for controversial topics and weighing up the balance of risks and benefits, sometimes this is the best option. They outline a fairly common scenario and discuss the merits of uncemented hemiarthroplasty when there is a risk of so-called 'bone cement implantation syndrome'. Clearly this is something that continues to bother the orthopaedic community, even more so now when the latest wave of the

COVID-19 pandemic is pressuring services, particularly higher acuity beds and expertise. The paper offers a reasonable synopsis of the literature and although Dr Stephens presents the British perspective very well, the pitch seems relatively stacked towards the uncemented hemiarthroplasty as one would expect from a North American faculty. The discussion will no doubt continue in orthopaedic circles, but this article highlights that to focus simply on orthopaedic implants in a complex system that requires a consistent multidisciplinary approach is unlikely to resolve the issue. There is scant mention of alterations in anaesthetic technique and resuscitation prior to surgery, factors that are liable to diminish the risk of this catastrophic outcome as has been shown in elective hip arthroplasty. For now, this problem seems to belong with arguments on both side of the table, and clearly it is defensible to undertake either option.

Effect of surgery versus functional bracing on functional outcome among patients with closed displaced humeral shaft fractures

Ever since Sarmiento published and publicized his series of functional bracing for humeral shaft fractures, it has resulted in some controversy. The converted argue that the complication profile for bracing is low, that there are large studies demonstrating a high union rate and safety in both isolated humeral shaft fractures, and those with radial nerve compromise. The counter-argument of course is that the nonunion rates are higher in bracing than surgery, and that the majority of cohort series published have a very high rate of loss to follow-up. What has, until relatively recently, been sorely missing from this discussion is some high-quality data comparing the two outcomes of treatment. In this prospective randomized study from **Helsinki (Finland)** while is perhaps not the 'definitive' study that is needed, given the small size of the trial, it does go some way to plugging the evidence gap.[5] The investigators compared open reduction and internal plate fixation to non-surgical treatment with functional bracing of closed humeral shaft fractures in 82 adult patients. The primary outcome was Disabilities of Arm, Shoulder and Hand (DASH) score at 12 months, and the study was conducted at two institutions in Finland over a four-year period. At 12 months, the authors reported that there was no clinically important difference in the mean DASH score between the two treatment groups (8.9 in the plate fixation group and 12.0 in the bracing group). A total of 13 (30%) of the patients randomized to functional bracing underwent surgery during the 12-month follow-up period to promote healing of the fracture. There were 11 patients (25%) randomized to functional bracing who developed a fracture nonunion. Three patients (8%) randomized to surgery developed a temporary radial nerve palsy. The investigators concluded that internal fixation did not significantly improve functional outcomes compared to fracture brace treatment. However, they cautioned that the substantial amount of treatment crossover from nonoperative to surgical treatment should be considered when interpreting the trial results. It is also of course important to look at the precision and power in a study like this. If the outcome of interest is avoiding nonunion, then this study does not have the required power to conclude one way or another.

Methicillin-resistant *Staphylococcus aureus* in hip fracture

Methicillin-resistant *Staphylococcus aureus* (MRSA) infection continues to be a significant challenge in orthopaedics, particularly in the frail elderly. Previous work has shown that treating deep infection with MRSA carries a burden of comorbidity, costs, and excess deaths. A number of interventions have been attempted to reduce the incidence of MRSA infection in surgical patients, many of which have been introduced as a 'common sense' approach, with supporting evidence to follow. Two such interventions might include screening of surgical patients and meticulous staff hand hygiene. Investigators from **Nottingham (UK)** set out to identify whether these two preventative initiatives were effective at reducing MRSA surgical site infection (SSI) in the hip fracture population.[6] With a longitudinal cohort study design and an auto-regressive integrated moving average (ARIMA) time series analysis, they were able to group 6,189 hip fracture patients who presented before the introduction of routine MRSA screening, and 7,314 who presented thereafter. In these patient cohorts, the investigators identified significantly more MRSA SSIs in the group who were not screened for MRSA; 69 versus 15 cases respectively ($p < 0.001$). Using statistical modelling, they demonstrated that screening did reduce MRSA SSI in hip fracture patients ($p < 0.043$), but the improved staff hand hygiene initiative 'clean your hands' did not have an effect on reducing MRSA SSI. Over the duration of the study period (17 years), the SSI rate fell (2.4% to 1.5%), but deep infection increased slightly (0.89% to 1.06%). This study presents evidence in favour of screening admissions for MRSA, which significantly reduces the rate of MRSA SSI. Other staff hand hygiene initiatives were not shown to affect SSI in this population. This paper underlines the importance of both surveillance and evaluation of infection control measures, as prevention remains better than cure.

The global burden of trauma during the COVID-19 pandemic: a scoping review

The COVID-19 pandemic and ensuing lockdown measures have had a significant effect on the type of orthopaedic trauma presenting. While this topic is in danger of being 'done to death' with multiple small studies in the literature, there is also the danger that important information is being lost in the melee of COVID-19 research. With people less able to travel, play sports, and do other work or recreational activities associated with typical orthopaedic trauma, the pattern of orthopaedic trauma has changed, so we were delighted to see this paper from **Cambridge (UK),** wherein the authors set out to quantify the effect of the COVID-19 pandemic on changes in orthopaedic trauma practice.[7] They used a scoping review technique to identify 17 studies, all of which involved orthopaedic trauma patients who presented during the pandemic. All ages were included. Together, these studies reported the outcomes of 29,591 patients. They were able to extract data and make two interesting observations: 1) there was a reported reduction in the volume of orthopaedic trauma, ranging from 20.3% to 84.6%; and 2) that different mechanisms of injury were seen during the pandemic. They demonstrated an increase in interpersonal violence, deliberate self-harm, and falls from a height, as well as a decrease in road traffic collisions, sports injuries, and trauma occurring outdoors. They also reported that the rates of operative treatment were the same as pre-pandemic and that few orthopaedic trauma patients

presenting during the pandemic were COVID-19-positive. This study has demonstrated both a reduction in the volume of orthopaedic trauma and changes in the nature of the injury mechanism. The increased incidence of trauma related to interpersonal violence, deliberate self-harm, and falls from a height is of particular concern because of the mental health ramifications. This evidence suggests that close collaboration of orthopaedic trauma with mental health services may be of heighted importance during the COVID-19 pandemic.

Acetabular fractures: how does heterotopic ossification prophylaxis affect complications?

Heterotopic ossification (HO) is a known complication of acetabular surgery, particularly posterior approaches. This can cause problems with stiffness, pain, and local compression symptoms for those affected. Several methods are available to mitigate the risk of development of HO, including radiation (XRT), indomethacin, and intraoperative techniques such as gluteus minimus debridement. These authors from **Birmingham (Alabama, USA)** report their experience of a recent study of 473 operatively treated patients (average follow-up 13 months) who sought to evaluate rates of infection and complications in those who received XRT (7-8 Gray with abductors as the target), indomethacin, and no prophylaxis.[8] Overall, the groups did not differ in injury type. The study also excluded non-compliance with indomethacin. The authors' findings showed no difference in overall infection rates between the groups. For overall risk of non-infectious wound complications, however, XRT posed a worse risk of 20%, compared to 7% in indomethacin and 5% in no prophylaxis group. The duration of indomethacin treatment (one or six weeks) made no apparent difference to the outcomes. There were also no differences reported in hospital complications, except for wound issues. These were mostly ongoing wound drainage up to three days needing wound vacuum dressing treatment, and a third of these patients needed to undergo further surgery to address the complication. While this study has multiple inherent biases because of its retrospective nature, the finding of non-infectious wound complications with XRT is important and clinically relevant, because although it is not infectious in nature, it still poses a potential risk of return to the operating theatre. Logically, it makes sense that radiation therapy early in the wound healing phase can disrupt appropriate healing, and therefore early intervention such as incisional vacuum dressing or similar may be indicated for those patients undergoing radiation for HO prophylaxis.

Acetabular fractures: a new technique for decreasing heterotopic ossification?

In a second paper on the topic of heterotopic ossification (HO) worthy of comment this month in *BJ360*, these authors again focused on the prevention of HO in acetabular surgery, in this case looking at operative techniques, particularly in the posterior approaches. A recent study introduced an intraoperative intervention - injectable thrombin (Surgiflo) - to help prevent HO in patients undergoing the Kocher-Langenbeck approach. The idea behind this is that since a decrease in plasmin causes calcification, and thrombin stimulates fibrin, which stimulates plasmin, the intervention will cause more plasmin to be produced, which decreases HO risk. This study, again originating from **Birmingham (Alabama, USA)**, was performed with a prospective comparative study design in two trauma centres, one using Surgiflo and the other not.[9] The authors were able to report on a total of 328 patients, with 126 in the intervention group and 202 in the control group. Patients receiving other forms of HO prophylaxis, including indomethacin and XRT, were excluded. The study found a 21% rate of HO of any type with thrombin versus 43% without, and severe HO (Brooker 3 or 4) in 3% with thrombin versus 17% without. The risk of HO was lowered by 50% and 83%, respectively. The results were also adjusted for age and factors such as traumatic brain injury, and the differences held. This study is important because indomethacin has been associated with nonunion in some studies, and radiation therapy is expensive (200 times more so than indomethacin). A simple intraoperative intervention, local to the site and easily administered, would be useful to fracture surgeons. A randomized trial is the best next step to eliminate some of the confounding factors present in this study. Additionally, the amount of Surgiflo to be injected remains unclear, and evaluation of different levels would be helpful as variables in the randomized trial arms.

Does the fascia iliaca block have a meaningful impact in hip fracture outcomes?

With the growth of the hip fracture population, it is important for hospitals to create standards of care for geriatric hip fracture patients that decrease complications and improve outcomes such as pain and length of stay. The focus on interventions for improving outcomes in terms of survival has resulted in the improvements in survival seen over the past five years in nearly every major healthcare system. The thing about hip fracture patients is that, when asked, they rarely refer to longevity as a desirable outcome – but more commonly return to function, and quality rather than quantity of life. One recurring theme in patient focus groups is that pain control is particularly important, and as polypharmacy and delirium is often present in this vulnerable population, regional anaesthesia is an attractive option. A recent randomized trial investigating the effect of a fascia iliaca block (FIB) in low-energy hip fracture surgery patients has been reported from **El Paso (Texas, USA)**.[10] The block was performed with 45 ml to 60 ml 0.375% ropivacaine, either preoperatively (88%) or immediately postoperatively in the post-anaesthesia care unit (PACU). Patients were excluded if they received another type of regional block besides FIB or had FIB performed by someone other than the anaesthesia team. Outcome measures reported included the visual analogue scale (VAS) score, morphine milligram equivalents consumed, and postoperative ambulatory distance in feet. As-treated and per-protocol (excluding crossover patients) analyses were performed. The study randomized 57 patients to FIB and 40 to the control. Patient age ranged from 47 to 96; the groups were otherwise similar. Crossover to the other group occurred in 18 and 12 patients, respectively, and the group that crossed over to the FIB group rated their pain as being greater than the group that crossed over to the control group. In the intent-to-treat analysis, the FIB group consumed 4 less MEq of morphine preoperatively, had lower VAS scores, and walked further (25 feet vs 2 feet). Discharge to home occurred in 51% of the FIB group, and 32% in the control. None of these results were significant, except morphine and discharge, which came close to non-significance. There were no differences in the as-treated or per-protocol analyses, except that the latter in the FIB group walked a longer

distance (30 feet vs 10 feet). Although this is a small trial, the results show clinically important findings regardless of statistical significance. While 4 MEq of morphine is not vastly important, 25 feet versus 2 feet and discharge disposition have significant clinical relevance – a patient who can walk across a large room versus one who can barely walk has a great impact on outcome. A larger trial may better elucidate some of these differences. In addition, in this study, the patients and staff were not blinded, and the results may have been better if a placebo injection were performed. Overall, if delivered without delay, a FIB may help improve outcomes with a relatively low risk profile in hip fracture patients, and should be taken into consideration after a discussion with the anaesthesiologist.

Ankle fractures: does the way we suture matter?

X-ref

Wound healing is an important parameter in outcomes for lower extremity surgery, particularly when treating patients with compromising medical conditions such as diabetes. A recent prospective study from **Burlington (Vermont, USA)** randomized ankle open reduction internal fixation (ORIF) patients to one of five suture patterns (15 patients per group).[11] The patterns were simple stitch, vertical mattress, horizontal mattress, Allgower Donati, and running subcuticular sutures. The authors' main question was which pattern enables best perfusion, as seen by indocyanine green laser angiography. Although the numbers were small for a precise but surrogate outcome measure like this, it is reasonable. The authors measured perfusion at a mean of ten points along the incision and measured impairment, which was the perfusion difference between the incision and the skin next to it. Scar assessment scoring was also performed. The study evaluated only lateral or posterolateral ankle wounds, the majority of which (80%) were lateral. Comorbidities such as diabetes were not excluded. The authors found that running subcuticular sutures provided both better overall perfusion, and better mean perfusion impairment. There was no difference in scar assessment between the patterns. While this study is interesting, and indocyanine green laser angiography has been used in various trials to assess perfusion in normal and compromised skin, it may not have major clinical relevance. There was no difference in infection despite poorer perfusion in the other patterns. However, likely because of the low patient numbers in each group, a larger powered study for clinical infection would be needed to know for sure if the observed effect is clinically relevant. In this paper the overall infection rate was very low (only one deep and two superficial, all in simple stitch group). A larger trial may help determine whether these perfusion findings translate to a clinical relevance that is beyond being purely academic.

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Oncology

Validation of nomograms to predict sarcoma-specific death and disease progression

Nomograms may have fallen a little out of favour; however, they can be useful ready reckoners to predict complex outcomes with little fuss. In this study from **Birmingham (UK)**, the team have sought to develop and validate nomograms that predict the measures of cumulative incidence of sarcoma-specific death (CISSD) and disease progression (CIDP) in patients with localized high-grade primary central and dedifferentiated chondrosarcoma using clinical and pathological data from two international collaborative hospitals.[1] The dataset used to construct the nomograms were 391 patients who had undergone definitive surgery for a localized high-grade (histological grade II or III) conventional primary central chondrosarcoma or dedifferentiated chondrosarcoma. A second, independent cohort of 221 patients from three additional hospitals was used for external validation. The two nomograms were then internally and externally validated. Age at diagnosis, grade, and surgical margin were found to have significant effects on CISSD and CIDP in multivariate analyses. Maximum tumour diameter was also significantly associated with CISSD. Interestingly, tumour location (axial tumours) was not associated with either CISSD or CIDP on multivariate analysis. The nomograms performed well on internal and external validation, and can provide a new tool with which clinicians can assess and advise individual patients about their prognosis in a simple and

easy-to-use format. While thankfully only relevant to a small number of patients, this is a very useful study and we congratulate the team in Birmingham on their simple approach.

Incidental long bone cartilage lesions: is any further imaging workup needed?

Investigating incidental lesions can be a challenging exercise in many ways, often with little pre-work up. In this interesting study from **Baltimore (Maryland, USA)**, a team has looked at the results of 73 patients being investigated to determine the rate of chondrosarcoma in incidentally discovered painless long bone cartilage lesions, and to determine if any further imaging was needed.[2] The average age of the included patients was 59.4 years, and mean follow-up was 47 months (2 to 196). In all, 11 of 73 patients (15%) turned out to have long bone chondrosarcomas, which were identified subsequent to the incidental finding. This incidence rate in itself clearly warrants further imaging. However, when the authors undertook a retrospective review of medical records and imaging studies, this went on to show that only 1/73 patients (1.4%) with an initial incidentally discovered painless lesion was later diagnosed as an atypical cartilage tumour. All chondrosarcoma patients had pain and aggressive imaging findings. Overall, tumour size enchondromas averaged 3.9 cm (1.4 to 11.5) and chondrosarcoma cases averaged 7.7 cm (3.0 to 19.7). This straightforward study reveals that the rate of chondrosarcoma in incidentally found painless chondroid lesions without aggressive features in long bones is low, and that imaging follow-up may be needed only in the setting of new symptoms.

The incidence and diagnostic relevance of pathological fracture in conventional central chondrosarcoma

One of the more commonly seen presenting complaints in chondrosarcoma is pathological fracture; however, the incidence and relevance of this presentation in patients with chondrosarcoma is not fully appreciated. In general, those patients presenting with fracture will present to their local trauma unit rather than to the central orthopaedic oncology unit. Presentation to a

variety of peripheral units means the importance of this as a presentation may not be fully understood. In order to understand these relationships, a group from **London (UK)** carried out a retrospective review of patients diagnosed with conventional central chondrosarcoma (CC-CS).[3] Overall, 317 patients with mean age 55.8 years with CC-CS diagnosed between January 2007 and December 2019 and referred to their unit were included in the study. The diagnosis was confirmed with either surgical resection or needle biopsy. In terms of those factors associated with pathological fracture as a presenting complaint, the authors established that the mean age of those patients presenting without pathological fracture was significantly lower than that of those with fracture (54.4 years vs 62.9 years). Pathological fracture found presentation in 51 (16.1%) cases, with the femur, humerus, and acetabulum representing 74% of cases. Following multivariate analysis, both older age and histological grade were independently significant factors. The authors concluded that pathological fracture in the femur, acetabulum, and humerus likely indicate a higher grade of tumour, and perhaps these could be seen as flags that indicate a more guarded prognosis.

Outcome satisfaction in long-term survivors of oncological limb salvage procedures

In a well-conceived study from **Singapore,** the authors reviewed every patient in the country who underwent joint preservation surgery for treatment of orthopaedic oncological diagnoses between 1978 and 2008 to evaluate their overall health and satisfaction following these large procedures.[4] Overall, 256 survivors were identified from the national records, of whom 92 males and 70 females were available to the study group. The average age at surgery was 38 years, with a mean follow-up of 9.1 years. Mental health scores and activities of daily living performance were similar to a control group taken from the general population. When treated with joint preservation techniques, physical health scores significantly exceeded those found in arthroplasty patients, though there was no significant difference when it came to comparing amputees with arthrodesed and joint-replaced individuals. Biological reconstructions scored significantly better than artificial reconstructions and dissatisfaction correlated with chronic postoperative pain. The authors concluded that amputations were equally as satisfactory as arthrodeses and arthroplasty surgery, but that joint salvage was superior to all. While not an original study design, the present study is national and spans a 30-year patient experience. Singapore being a smaller country with good patient traceability provides a unique opportunity to study a representative sample of patients that may have implications for Asian populations.

Malignancy in giant cell tumour of bone in the extremities

The malignant transformation of giant cell tumour of bone (GCTB) is found at sites of previously treated GCTB, though it is fortunately rare. This is in contrast to primary malignant GCTB, where benign cells are found mixed with high-grade sarcoma. A study from **Beijing (China)** looks to assess the characteristics that distinguish patients with malignant GCTB, define the interval for secondary malignant transformation of GCTB and treatment outcomes, and identify the factors which influence outcomes.[5] Between 1998 and 2016, 12 patients were treated for primary malignant GCTB and 20 for secondary malignant GCTB at the authors' centre. Of those included in the study, 15 were osteosarcomas, four pleomorphic sarcomas, and there was one fibrosarcoma. The mean latent period for secondary malignant GCTB was found to be 7.9 years and the median recurrence-free survival 61.5 months. The five-year survival rate was 40% compared to 56.2% in primary malignant GCTB. Overall, 69% of patients showed pulmonary metastases, with chemotherapy being associated with a longer pulmonary disease-free survival. The authors make the important observation that secondary

malignant transformation should be considered in patients presenting with recurrence, particularly after four years. This study is an important addition to the literature as it details a relatively large number of patients with a rare variant of an uncommon tumour managed at a single centre.

Primary versus secondary conventional pelvic chondrosarcoma

While chondrosarcoma most commonly affects the pelvis, it has a varied course. Like all pelvic tumours, presentation is often late as patients are usually delayed in presentation as symptoms do not begin until tumours have grown sizeably. In this study from **Beijing (China)**, the authors have investigated the differences in the characteristics and prognostic factors in primary and secondary chondrosarcoma in order to inform orthopaedic tumour surgeons in their diagnosis and treatment.[6] In another useful but small case series from a single centre, the authors aimed to establish what the differences were in presentation and prognosis of primary versus secondary pelvic chondrosarcoma. Overall, 54 primary and 26 secondary cases of chondrosarcoma were identified and included in the analysis. Patients with secondary chondrosarcoma were younger, with larger soft-tissue masses. The incidence of local recurrence was similar in the two groups, though these came sooner in those with primary tumours than those with secondary disease. Furthermore, primary disease was found to be associated with a lower survival rate. Lastly, initial tumour grade was identified as an independent risk factor for overall survival. This is a useful study which compared outcomes between primary and secondary chondrosarcoma pelvis, confirming that the grade of the tumour matters most. Unfortunately, despite treatment at one of the largest centres in the world, the local recurrence rate remains high at 35%.

Chondrosarcoma in the cancer registry of a Norwegian cohort

Chondrosarcoma is a common diagnosis and one that, to date, has been thoroughly investigated. Staying with the theme of evaluating the more unusual presentations of chondrosarcoma, authors from **Oslo (Norway)** used the Norwegian national cancer registry to answer some questions that are less explored.[7] The team has identified that the association between local recurrence and risks of metastases and death in central conventional chondrosarcoma of bone in a modern population by analyzing 180 patients with non-metastatic disease from a national registry. In all, 40 cases of local recurrence were identified and this was associated with an increased risk of metastases with a hazard ratio (HR) of 4.1, and death with a HR of 9.3. A higher risk of local recurrence was associated with a soft-tissue component to the lesion, an axial site, and grade 2 malignancy, but interestingly not with atypical cartilaginous tumours, curettage patients, intramedullary, or grade 1 lesions or extremity locations. Lastly, and perhaps most importantly, the group found that 50% of recurrences were asymptomatic and found on routine follow-up alone. The is a useful study which confirms the worse prognosis for local recurrence in higher-grade disease. Looking back to 50 years ago, it was appreciated that there was 'one bite at the cherry' to cure chondrosarcoma, and this continues to be confirmed by recent studies. The carefully curated national cancer registries in northern European countries are starting to pay dividends with large enough cohorts with long enough follow-up to definitively answer such questions.

Myxofibrosarcoma and undifferentiated pleomorphic sarcoma: do surgical margins matter?

It is long established that a negative margin around a lesion after excision of almost any solitary lesion correlates to event-free survival. However, the effect of this in soft-tissue sarcoma is as yet incompletely defined. In this study from **Birmingham (UK)**, the team has looked to investigate the effect of the tissue type, quantity, and quality of the excised margin on the local control of myxofibrosarcoma (MFS) and undifferentiated pleomorphic sarcoma (UPS).[8] The group identified a healthy number of 278 eligible patients and characterized the margin into five types: type 1 (pseudocapsule/reactive zone); type 2 (fat/fibrofatty tissue); type 3 (muscle); type 4 (fascia); and type 5 (periosteum). They found that the five-year local recurrence rate was 22% in patients with positive margins, 13% in those with 0.1 mm to 9.9 mm margins, and 3% in those with ≥ 10 mm margins. In patients with margins between 0.1 mm and 9.9 mm, type 4 and 5 margins, the authors were able to establish that the risk of local recurrence was less than 5%, and about the same as those with a 10 mm margin. On further analysis, it became clear that the local recurrence risk in patients with margins between 0.1 mm and 9.9 mm without facia or periosteum was 11 times higher than those with the same depth or margin but with fascia or periosteum, or with margins greater than 10 mm. The authors concluded that margins should exceed 10 mm or, if they are shallower, should include fascia and periosteum. This work confirms that the quality of the margin is as important as the distance; presumably, this is due to the excision up to the edge of the compartment that is represented by fascia or periosteal excision.

Oncological outcomes in primary extremity soft tissue sarcoma: a multistate model including 6,260 patients

Orthopaedic surgeons will understand that age is associated with a higher likelihood of a poor outcomes, regardless of pathology. However, the exact nature of this relationship is seldom completely understood. Nonetheless, a group from **Lieden (The Netherlands)** has sought to understand how age influences survival and disease progression, controlling for disease characteristics and treatment protocols in patients with high-grade extremity soft-tissue sarcoma using a large cancer registry.[9] The group compared 6,260 young, middle-aged, and elderly adults identified from a retrospective multicentre database who were treated surgically with curative intent in the 16 years up to and including 2016. Analysis of their database established that young adults presented usually with deep tumours after inadvertent 'whoops' procedure, where residual disease was left behind following resection or with deep seated tumours. Older patients were found to present more often with grade 3, larger lesions. The hazard ratio for survival in middle-aged populations was found to be 1.47 and in the elderly 3.12 when compared to young adults, though the authors comment that other causes of mortality are incompletely controlled for here. This article confirms other studies that describe how older age is a poor prognostic factor in soft-tissue sarcomas; however, the reason for this association remains unclear.

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Children's orthopaedics

X-ref *For other Roundups in this issue that cross-reference with Children's Orthopaedics see: Research round-up 3.*

Distal tibial guided growth for anterolateral bowing of the tibia: fracture may be prevented

Congenital pseudoarthrosis of the tibia (CPT) is generally associated with neurofibromatosis type I and is a rare but challenging condition to treat. It involves the development of a nonunion at the apex of an area of dysplastic bone, and has a precursor of anterolateral bowing of the tibia or congenital tibial dysplasia presenting as a fracture by the age of two or three years. The biomechanics of the dysplastic tibia drive the nonunion development and it stands to reason that treatment is likely to improve outcomes following fracture, or that correction of the abnormal biomechanics may even prevent fracture. The challenges of poor biology and biomechanics mean that the fractures generally fail to heal which, even with resection, frequently leads to chronic nonunion, progressive deformity, and multiple surgical procedures. In some situations, amputation is performed to provide the child with a limb with which they can mobilize. There is a school of thought that treatment at an early stage of development of the anterolateral bowing may prevent a pseudarthrosis forming and so we are very interested to see this paper from **Saint Paul (Minnesota, USA)**, examining ten cases where guided growth was used to treat toddlers with tibial dysplasia.[1] Consecutive cases of anterolateral bowing, or congenital tibial dysplasia that had not yet developed a pseudarthrosis, over a six-year period were included in this study retrospectively. They were treated surgically with the eight-plate guided growth system; distal tibia and orthotic use was typically recommended at least until satisfactory alignment was achieved. The mean age at diagnosis was 11.9 months and at first surgical treatment was 2.6 years; 60% of the cohort had neurofibromatosis type I and 80% were male. Mean follow-up following the index procedure was 5.1 years and at this stage no patients had developed a tibial fracture or pseudarthrosis, but two were undergoing treatments for fibula pseudarthrosis and one who had had 2.9 years of follow-up was still undergoing treatment. Overall, 60% of patients required plate exchange with one requiring a second exchange. Alignment outcomes were good with mean residual tibial diaphyseal angular deformity at final follow-up being 4.3° of varus and 8.4° of deviation in the sagittal plane, while importantly only one patient had a clinically important leg length discrepancy. Radiological bone quality appeared improved. The authors should be commended on a well-conducted study and we hope they are now collecting prospective data. This is obviously a rare condition and so numbers are low; as the paper states, follow-up to maturity would be advantageous for these promising early results.

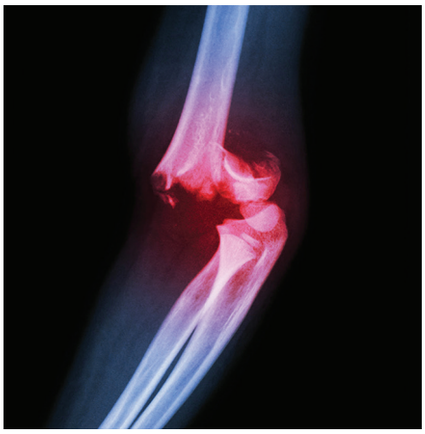
Day-case pelvic osteotomy for developmental dysplasia of the hip

Reducing admissions and encouraging day-case surgery is the focus of many quality and service improvement projects. This is especially true given the current pandemic, with COVID-19 placing pressures on inpatient beds; a reduced duration of exposure to the healthcare environment is therefore desirable. This paper from **Dublin (Ireland)** examined the feasibility of day-case pelvic osteotomies, which is certainly not something many of us in paediatric orthopaedics will have considered an option; and possibly not the most obvious first choice for paediatric day-case initiatives.[2] The authors report a prospective cohort study of all patients residing within 50 km of the hospital who underwent Salter or Pemberton osteotomies for developmental dysplasia of the hip over a three-year period. Inpatient resource use analysis and a financial cost analysis were performed. In total 84 cases were performed over the study period; 35 of these met the inclusion criteria for day-case procedure with an estimated reduction of 70 inpatient bed days reported. Costs of a standard two-night admission were calculated as €5,700 versus €2,600 for a day case, and a saving of over €100,000 was therefore made in this centre over a three-year period. Intraoperative analgesia consisted of Diclofenac, clonidine, and a caudal epidural injection or fascia iliaca block augmented with magnesium sulphate. Postoperative analgesia standardized with regular paracetamol and ibuprofen for 48 hours, and the date of oral morphine in the morning for the first three days with rescue doses, were also issued. To ensure acceptable pain relief a detailed information leaflet with instructions was given to parents, with a nurse-led telephone call on day one to ensure satisfactory progress. Three patients scheduled for the day-case pathway were kept in hospital overnight and discharged the following day, while a further four re-attended on the second postoperative day due to inadequate pain control, which was stated to be due to non-compliance. All other patients reported adequate pain relief

at the six-week follow-up with no difference in clinical and radiological outcomes reported between the day-case and inpatient groups. This process does require some infrastructure such as early outpatient follow-up, parent education, and access to emergency admission being streamlined if required. Furthermore, many surgeons in general would advocate close observation of these patients in the first 24-hour postoperative period due to the rare but serious sudden blood loss which may occur from occult pelvic vessel injury. However, the demonstration of feasibility in such major surgery does raise the question of whether more paediatric orthopaedic procedures should be performed as a day case, or at least 24-hour stay, and there are certainly financial benefits to this.

A comparison of conventional and minimally invasive multilevel surgery for children with diplegic cerebral palsy

Single-episode multilevel surgery has been shown to result in better outcomes in the cerebral palsy population in comparison to multiple surgeries done at intervals. Conventionally, the procedures were performed as open surgery frequently involving osteotomies of the femur and tibia and fractional lengthening of the musculotendinous junction. More recently to avoid the extensive soft tissue dissections involved, closed corticotomy and minimally invasive percutaneous muscle lengthening have been advocated to avoid periosteal disruption and reduce morbidity. In order to assess this perceived advance in practice, experts from the gait laboratory in **Oxford (UK)** compared the conventional technique with patients treated via the minimally invasive protocol.[3] Overall, 55 patients were retrospectively reviewed having undergone treatment over a 14-year period; 19 treated conventionally at a mean age of 12 years five months and 36 via the minimally invasive approach at a mean age of ten years seven months. Gait was analyzed to study the walking speed and gait profile score (GPS) preoperatively and at six-month intervals to two years following surgery; adverse events and further surgeries were also recorded. Both groups underwent a median of ten procedures per child as part of the intervention. GPS significantly improved from the preoperative level to the six-month follow-up and these gains were maintained subsequently. Walking speed, however, only regained



preoperative levels at 12-month follow-up. Progress in GPS and walking speed was essentially similar over time when comparing the conventional and minimally invasive techniques; surgical complications occurred with similar frequency between the two groups at 37% and 36% respectively. The authors should be commended on a detailed study of a sizeable cohort of patients which adds to the sparse evidence supporting minimally invasive surgery performed on patients with cerebral palsy. Clearly there are some advantages to minimally invasive multilevel surgery in terms of patient and carer acceptability, pain, and tolerance for the patients, and ease of after-care for carers. Here at *BJ360,* this seems like a no-brainer, and we hope other units will follow in the footsteps of Oxford in this important and under-investigated area.

Can rapid progression in nonambulatory cerebral palsy scoliosis be predicted using humeral head ossification?

X-ref

Neuromuscular scoliosis can progress rapidly during peak growth due to the rapid lengthening of the spine with the soft tissues often lagging behind; identifying the correct point to intervene is therefore challenging. Too early and this may pre-empt a condition which may not then progress, with subsequent unnecessary morbidity caused by surgery. Too late and the deformity may have progressed significantly, incurring higher surgical risks. It is difficult both to predict rapid deterioration and screen at the correct time, and there is no current gold standard. Various predictors have been used, including radiological markers such as Risser scoring from pelvic radiographs, and physical metrics such as growth and the development of secondary sexual characteristics. Radiological assessments of the axial skeleton obviously involve significant irradiation and should be limited where possible; as such surrogate markers of skeletal maturity linked to scoliotic progression are welcome. This paper from **Philadelphia (Pennsylvania, USA)** examines the use of the proximal humeral physis as one such surrogate marker.[4] The maturation of the proximal humeral physis is often visible on whole spine radiographs and so the authors retrospectively reviewed the radiographs of this appearance in their nonambulatory paediatric patients with cerebral palsy scoliosis over a nine-year period in their centre. All patients were reviewed regardless of intervention undertaken, but those who had prior spine surgery or who were skeletally mature at their initial consultation were excluded. Overall, 86 patients were included and proximal humerus radiographs were graded with a maturity staging system from the anteroposterior projection; it was hypothesized that this may be used to identify a period of rapid curve progression. Curve measurements were plotted for each maturity stage as detailed in the paper. Major curves increased significantly by 18.9° between maturity stages one and two, and also between stages three and four by 14.8°. Survival curves were plotted for deterioration to a curve of greater than 60° or 70° and the largest drop was found to be between stages three and four. The authors recommend that a discussion regarding surgical intervention or a shortened follow-up interval is recommended for patients in this group with curves of greater than 40° and a humeral head at maturation stage 3. It seems the authors have identified an interesting adjunct to the current methods of predicting curve progression. This simple and low radiation dose approach could be easily implemented in the majority of paediatric orthopaedic clinics without many difficulties, and seems to us at *BJ360* to offer a sensible and pragmatic approach to the difficult topic of tailored screening in scoliosis.

Characteristics and reoperation rates of paediatric tarsal coalitions

X-ref

By the time symptomatic tarsal coalitions reach the attention of secondary care, they are usually quite symptomatic, have been subjected to a

range of interventions, and not infrequently undergo surgical intervention. There are a number of options open to the surgeon after conservative management has been exhausted, including resection of the coalition with interposition, arthrodesis, corrective osteotomy, or a combination of these treatments. The published literature is generally short-term and smaller case series and outcomes seem mainly positive, but limited data are available to support long-term outcomes. We were therefore interested to see this longer-term study from surgeons at the Mayo Clinic in **Rochester (Minnesota, USA)** who present a larger long-term population-based study around the durability of surgical management in paediatric patients.[5] A database capturing the records of a full county in the USA were used to identify patients under the age of 18 years over a 54-year period treated for tarsal coalitions. This resulted in 58 patients with 85 coalitions which were available for inclusion in the study. Of these, there was a representative sample with 46 calcaneonavicular, 30 talocalcaneal, and nine others; predominantly talonavicular. Overall, 46 of these were treated surgically with arthrodeses and the remainder resected, while the other 39 patients were managed non-operatively. Overall follow-up records were available to a median of 14.4 years and showed an overall reoperation rate of 8.7%. As may be expected in a series which, although large by literature standards, is still relatively small, there was no identified statistical difference when examining reoperation rates for the type of coalition, type of surgery, or when differentiating osseous or fibrous aetiologies. The surgical group did report fewer persistent symptoms at final follow-up than the nonoperative group, at 33% versus 67%. Although retrospective and with the usual disadvantages of big data studies, this is a well conducted analysis of a seemingly good quality database, and does seem to be the first published population-based study on the durability of the surgical management of paediatric tarsal coalitions with a long-term follow-up.

Suture stabilization of open physeal fractures of the great toe distal phalanx (Seymour fracture)

X-ref

Following on from the article featured in the February 2021 issue of *BJ360* on Seymour fractures of the toes, we were interested to see this article detailing the experience of a group of paediatric specialists in a level I trauma centre in treating this injury. The authors from **Providence (Rhode Island, USA)** presented a small but interesting series of five patients who underwent operative treatment for a Seymour fracture, namely an open distal phalanx fracture with associated nail bed disruption.[6] Injuries to the great toe only were included over an eight-year period; two of these patient's injuries were initially missed. The team describes their suture-only repair technique which avoids the need for Kirschner (K-)wire transfixation of the physis and interphalangeal joint. This essentially involves corner incision and retraction of the eponychial fold, removal of the nail plate, and interposed nail bed with a Freer elevator, then nail bed repair. Absorbable horizontal mattress sutures from the intact skin are then passed proximally and distally into the nail plate using this as a tension band-type splint of the physeal injury which is then treated with a below-knee cast with footplate; an excellent technique guide is illustrated in the paper. The five patients undergoing the procedure had a mean age of 10.3 years, a mean time to surgical treatment of 2.6 days, and a median follow-up of two months. Osteomyelitis and growth arrest can be problematic complications of this injury, but none were reported in this series; although the follow-up is admittedly short. However, as discussed in the previous issue of *BJ360*, it is not entirely clear if all these injuries need surgical fixation at all – nonetheless we would advocate intervention especially in displaced fractures and, as the authors point out, in the hallux where the consequences of complications are greater. We are attracted to this simple technique which does obviate need for K-wire fixation.

Mid-term outcomes after open arthrolysis for post-traumatic elbow stiffness in children and adolescents

X-ref

Elbow stiffness is a not uncommon sequela of trauma, and is often seen and studied in adult patients. However, this complication is less well recognized in the paediatric population. Previous studies have highlighted the challenges of paediatric management and variable outcomes following surgical intervention. This group from **Shanghai (China)** evaluated their experience of children and adolescents who underwent open elbow arthritis in order to ascertain their outcomes and prognostic factors.[7] Overall, 31 patients treated with open arthrolysis for elbow stiffness over a four-year period were studied and all had a minimum follow-up of four years. Contractures resulting from neurological issues, burns, or synovitis were excluded. The group included 20 patients with a mean age of 15 years. Index injury in three patients was a simple elbow dislocation with the remaining patients all experiencing an elbow fracture. Outcome measures included range of motion and the Mayo Elbow Performance Index (MEPS), as well as postoperative complications. The surgical technique almost universally involved both medial and lateral approaches to the elbow with a column procedure combined with anterior release. Those elbows found to be unstable then had a hinged external fixator applied, following which the medial and lateral collateral ligaments were reconstructed if required. There was a significant improvement in the MEPS from 67 to 93 points and the active flexion and extension arc also increased significantly from 49° preoperatively to 108° postoperatively. The mean flexion achieved was 120° and extension was 15°. Unsurprisingly, those with extra-articular fractures had better outcomes than those with intra-articular injuries and, interestingly, older patients seem to have better outcomes. At final follow-up, eight patients had recurrent contracture with heterotopic ossification formation. In terms of complications, two patients had postoperative pain, one had ongoing elbow instability and one patient had ulnar neuropathy. The authors correctly recognize that patient engagement with postoperative rehabilitation programmes may be critical to outcomes. The results here seem good but not excellent, highlighting that this is a difficult patient group to treat.

Are post-cast removal radiographs and a second follow-up necessary in the treatment of nondisplaced supracondylar humerus fractures?

X-ref

In light of the COVID-19 pandemic, and for a multitude of other good reasons, we are increasingly under pressure to justify the utility of clinic follow-up appointments and investigations. Although relatively inexpensive on an individual

basis, due to the large number of patients, follow-up radiographs present a sizeable societal cost and a significant level of radiation exposure. Many radiographs are probably obtained for the reassurance of surgeons and parents and also as part of a culture of defensive medicine which, while entirely understandable, may not be in the patient's best interest. To add ammunition to the case of those who wish to reduce the workload of their follow-up practice, a team from **Buffalo (New York, USA)** published an interesting single-centre review of children sustaining non-displaced supracondylar humerus fractures over an eight-year period.[8] The records were studied for a change in management which was defined as the need for further cast treatment, operation, or a change in mobilization strategy. Essentially all but two of the 489 included patients over the study period had routine radiographs performed after cast removal and, unsurprisingly, no patients had a change of management based on these radiographs. Some may argue that a further appointment is beneficial following removal of cast in order to verify that range of motion has returned to normal, but of the 290 patients who returned for a further outpatient appointment at this stage 95% were discharged again with no change to management. Of the 5% whose management changed at this visit, the vast majority (86%) were due to schedule a further range of motion evaluation. There were 13 patients who returned on an unscheduled basis with three-quarters of these visits due to a secondary injury. There is something to be said for the reassurance of the doctor-patient contact, or the patient confidence instilled by radiological review, but in financially pressurized times this may be seen as a luxury. Here at *BJ360,* we would suggest that in areas with good physiotherapy services these patients can almost certainly be discharged primarily to their care, and even this may not be necessary as other areas have ably demonstrated there is significant reassurance associated with a wellbeing call which is quicker, cheaper, and would likely be able to flag the 1:20 patients needing a review for stiffness.

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Research

X-ref ***For other Roundups in this issue that cross-reference with Research see: Shoulder & Elbow roundup 4.***

Prospective randomized evaluation of local injection of allogeneic growth factors in plantar fasciitis
X-ref

Plantar fasciitis (PF) is a common cause of heel pain, and as yet, no single treatment option has proven to be universally successful. In this study from **Benha (Egypt)**, a group of investigators have carried out an randomized controlled trial (RCT) to assess the efficacy and safety of local injection of allogeneic growth factors compared with placebo injection in patients with PF.[1] In this well conducted RCT, the authors enrolled 150 adults with a mean age of 40 years with a diagnosis of PF who failed conservative treatment for at least six weeks. In terms of exclusions, those with haematological or other conditions around the ankle were excluded. The blinded groups received either a single injection of allogenic growth factors or normal saline. The authors report the visual analogue scale pain score, which was similar between the groups at baseline; however, this significantly diverged by three months but was no better thereafter. The same trend was observed concerning the Foot Function Index-Revised short form score with a significant difference noted at three months. Overall, 92% of patients were satisfied in the treatment group versus 78.2% in the control group. There are a few points to consider when generalizing the findings of this study. First, patients only had 12 weeks of conservative treatment. Second, PF is self-limiting in a majority of the patients, reflected in finding that the control group recorded an improvement in symptoms. Third, the compliance of participants with stretching exercises after the first two weeks of injection therapy this was not reported. Nonetheless, it may be that allogenic growth factors injection is safe and has a role in managing refractory PF. The clear question here relates to health economics; if there are no differences between the groups by 12 weeks, what is the cost per quality-adjusted life-year and does it make economic sense to use growth factors, or to just wait?

What is the performance of novel synovial biomarkers for detecting periprosthetic joint infection in the presence of inflammatory joint disease?
X-ref

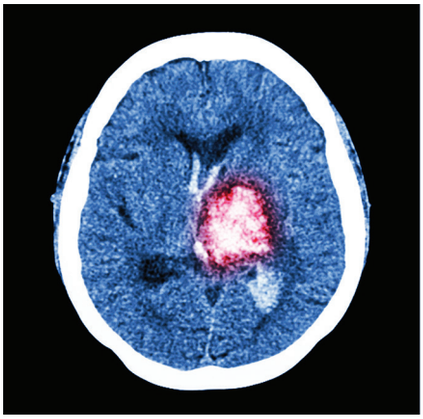
Diagnosing periprosthetic joint infection (PJI) with confidence is one of the central challenges to arthroplasty practice. Synovial markers that can be easily collected and analyzed; however, despite their tantalizing early results, the holy grail of a highly accurate assay remains elusive. With regards to some of the newer biomarkers, however, the accuracy for these of diagnosing PJI in cases of patients presenting with inflammatory joint disease (IJD) remains unknown. In this investigation from **Beijing (China)**, the team aimed to evaluate the accuracy of ten promising synovial biomarkers (bactericidal/permeability-increasing protein (BPI), lactoferrin (LTF), neutrophil gelatinase-associated lipocalin (NGAL),

neutrophil elastase 2 (ELA-2), α-defensin, cathelicidin LL-37 (LL-37), human β-defensin (HBD-2), human β-defensin 3 (HBD-3), D-dimer, and procalcitonin (PCT)) for the diagnosis of PJI, and to investigate whether IJD activity affects their concentration in synovial fluid, and thereby the likely diagnostic accuracy.[2] The results from this study revolved around 50 synovial fluid samples from patients with (n= 25) and without (n = 25) confirmed PJI from an institutional tissue bank were compared with 22 synovial fluid samples aspirated from patients with active IJD. BPI, LTF, NGAL, and ELA-2 all showed an area under the receiver operating characteristic curve of 1, and α-defensin 0.998. The other markers (LL-37, HBD-2, D-dimer, PCT, and HBD-3) had limited diagnostic value. Concentrations of the five highest performing markers were elevated in patients with IJD. The investigators concluded that of those markers testing BPI, LTF, NGAL, ELA-2, and α-defensin were all useful for diagnosing PJI, though all had the potential to be misleading in patients with IJD. In this select subgroup, we should employ higher thresholds for making diagnosis of PJI, though what those are remain to be uncovered.

The point of epiphyseal penetration affects rotational stability of screw fixation in slipped capital femoral epiphysis: a biomechanical study

X-ref

Slipped capital femoral epiphysis (SCFE) remains a classic diagnosis in paediatric orthopaedics, though one which a surgeon may only see a few times during their career. Nonetheless, an understanding of the challenging anatomy in the area indubitably leads to improved outcomes. In this study from **Dallas (Texas, USA)**, the authors have conducted a biomechanical study which shows that placing a transphyseal screw into the epiphyseal tubercle in a stable SCFE confers less stability than a central screw.[3] Interestingly, the authors used 3D-printed proximal femurs in three stages of proximal femoral development (young, median, and mature), representing three stages of regression of the epiphyseal tubercle seen with increasing age and increased epiphyseal cupping. The authors reported decreased rotational stability if the screw fixation went through the epiphyseal tubercle in the young patient model (i.e. a robust epiphyseal tubercle and minimal epiphyseal cupping),



whereas in older patients this was not the case. This study suggests that screw fixation of a SCFE in a younger patient should aim for a more central location to confer maximal rotational stability. Although many of us may never tackle such a case, it may be that this subtle appreciation of proximal femoral development plays a role in managing other paediatric hip conditions. Certainly, this mode of biomechanical investigation is an interesting use of 3D printing, a technique coming increasingly to the fore.

Factors influencing US physician and surgeon suicide rates

Sadly, it is true to say that physician suicide is increasing across the world. It may be that these are preventable, and so understanding the trends may uncover key influences that can be addressed in the workplace prior to catastrophe. This study from **Miami (Florida, USA)** used data from the Center for Disease Control and Preventions National Violent Death Reporting System to identify some of these factors.[4] A disturbing 905 suicides of physicians and dentists were analyzed over the study period, representing around 65 deaths a year, with orthopaedic surgeons representing 28% of cases (the highest proportion). Some ethnic variation was uncovered; however, a history of mental health diagnoses brought a 363% increase in the risk of suicide, as were alcohol use (not dependence) and civil or legal issues all being associated with a greatly increased risk. Our profession is, by its nature, fundamentally challenging and demands everything of each of us. To ignore this is to invite disaster. With increasing awareness of wellbeing on the back of COVID-19, we are each obliged to understand this problem amongst our friends and colleagues just as we do the diagnoses of our patients. It seems that the solution to this problem is not left to individual doctors, but a system that supports doctors throughout the hospital without question.

Association between type 2 diabetes status and osteoarthritis in adults aged ≥ 50 years

The ratio of osteoarthritis (OA) in hip and knee joints is unknown across the population. Although many aetiological theories abound, with evidence for both environmental, mechanical, and genetic factors, one association which repeatedly is hypothesized is type 2 diabetes. The difficulties with all the epidemiological studies on the topic is always both power and confounders. In this study from **Zhejiang (China)**, the team have carried out an analysis of 7,781 patients to define any association between type 2 diabetes and OA of large joints, and have the advantage of large sample sizes and high fidelity data.[5] The group used a multivariate logistic regression analysis, with stratifications for age, sex, BMI, and ethnicity to adjust for potential confounders. A significant positive association was identified between type 2 diabetes and arthritis after adjusting for the available covariates; however, the association disappeared when controlled for BMI. The authors make the straightforward conclusion that diabetes and OA have no causal relationship, and that the anecdotally observed relationship is due to confounding with BMI. It may be that a complex relationship does exist, but the mechanism has yet to be identified. Clearly there is the potential here for a better understanding of any relationship, and in reality this is likely to come not from yet larger studies but from using results like this to inform questions of the large biobanks.

Hounsfield units and failure of femoral neck fracture fixation

X-ref

Despite algorithms and clinical practice guidelines, the optimal primary surgical procedure for patients aged 60 to 70 years with stable or non-displaced femoral neck fractures remains controversial. In this study from **Madison (Wisconsin, USA)**, the investigators examined the impact of quantified bone quality on fixation failure rates in these younger patients treated with internal fixation.[6] The team retrospectively analyzed the Hounsfield unit (HU) measurements in 114

patients who underwent surgical fixation of intracapsular femoral neck fracture. Using axial sections, the cancellous bone density in the high, middle, and low femoral head was measured, and cancellous bone density in the femoral neck was measured on coronal sections. Postoperative screw penetration, femoral neck shortening >5 mm, and revision surgery were identified from the images. The investigators found that HU measurement of the femoral head was significantly associated with screw penetration and femoral neck shortening, but not revision surgery. Patients with middle femoral head HU measurements < 146 had 17-times increased odds of screw penetration. Greater than 5 mm shortening was seen in patients with HUs < 212.5 in the low head section by an odds ratio of 7.8. These data suggest that assessment of CT scan HU measurements in the femoral head and neck may be useful in deciding whether to treat a nondisplaced femoral neck fracture with internal fixation or arthroplasty.

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Registry Review

A review of registry research

In this edition of Registry Review, we present a selection of recently published articles that use data from registries around the world and that we feel are of interest either clinically or methodologically.

HIP AND KNEE

In the world of total hip (THA) and knee arthroplasty (TKA), the first paper worthy of discussion is an important study from the **London (UK)** School of Hygiene and Tropical Medicine, and was published in *The Bone and Joint Journal* in January. The authors set out to investigate the impact of comorbidities on outcomes following THA and TKA.[1] This is a contentious issue in areas of the world, where central funded healthcare systems are restricting access to joint replacement for some patients. This currently involves parts of the UK, as well as Canada and New Zealand, where the restriction of access to arthroplasty procedures is based on a range of different patient factors. Previous studies have used the National Joint Registry (NJR) to assess the impact of BMI on outcomes following THA and TKA. However, this study uses the national patient-reported outcome measures (PROMs) database linked to the Health Episodes Statistics (HES) database to investigate the outcomes of length of stay, mortality, and PROMs from the NJR in the UK.[2-4] The population consisted of patients who underwent elective primary THA or TKA in the NHS between April 2009 and November 2016. The intervention was the primary THA or TKA, and the comparator groups were made up of the 11 comorbidities reported on the self-completed questionnaire (arthritis was excluded as it is an indication rather than a comorbidity). The outcomes were hospital length of stay (LOS), 30-day readmission rate and mortality, and clinical effectiveness measured by the change in Oxford Hip Score (OHS) or Oxford Knee Score (OKS) and EuroQol five-dimension (EQ-5D) health-related quality of life (HRQoL) between preoperative and six-month postoperative score. Linear regression was used adjusting for age, sex, ethnicity, and socioeconomic status (index of multiple deprivation) in all but the mortality analyses (as the number of events was too low). Overall, 640,832 patients were included in LOS, readmission, and mortality analyses, with 479,632 patients included in the PROMs analyses because of missing data. The authors observed an association between the presence of comorbidities and slightly higher LOS, mortality, and readmission rates, as well as slightly lower improvements in OHS and OKS. No association was observed between comorbidities and change in EQ-5D. The differences in most outcomes varied between different comorbidities, and as would be expected the authors report a cumulative effect of multiple comorbidities.

Although small differences were observed between patients with and without comorbidities, it is important to look at the minimal clinically important differences and in particular absolute change in PROMs rather than relative change. The authors conclude that while in some groups there is a relatively increased risk of LOS, mortality, and readmission in patients with comorbidities, these are offset by the gains made in OHS, OKS, and EQ-5D. As with all observational studies, there are limitations of residual confounding, responder bias, and missing data. In both the design and interpretation of the study, it is also hard to account for the fact that there is a risk of a healthy-surgical patient effect, in that only patients who were selected for surgery can be included in this study, and so by definition they have passed a preoperative anaesthetic and surgical assessment.

In summary, this is an important and extensive study of a large routine database, and it does not support the practice of restricting access to THA and TKA based on the presence of comorbidities. It appears from these data that on a population level, the current process of assessment of suitability for surgery results in reproducible and clear gains for the patient after six months with only slightly increased risk of complications.

September 2020 saw the publication, in *PLoS Medicine*, of the **Bristol (UK)** collaboration with the **Exeter (UK)** Hip Unit that investigated what factors may explain why one unit sees "better than expected" survival results in the NJR following THA.[5] One common (and well-founded) criticism of studies comparing cemented and cementless arthroplasties is the inherent selection bias that may determine which patients routinely receive each type of prosthesis. The fact that the Royal Devon & Exeter NHS Foundation Trust exclusively uses the same cemented stem in all routine primary THAs, regardless of age, meant that this selection bias issue can be minimized. We (the authors) compared survival results from this unit to those seen in the rest of the country. After controlling for age, sex, and ASA grade, we saw no evidence of a difference in survival after 14 years between all patients in the NJR and those operated on in Exeter, when analyses were restricted to those who received the same implants. This suggests that the improved survival is likely to be a result of implant choice rather than patient or unit factors.

There were, of course, limitations to this study. It is impossible to know whether implant choice is independent of surgeon skill, and we used revision as the only outcome, which could miss unhappy patients who are not revised or periprosthetic fractures managed with fixation,

for example. There are other units within the NJR that achieve "better than expected" survival results, and they do not all use the same implants as Exeter or do so with the same consistency and this warrants further investigation. This also leads us to believe that it is not the choice implants used in Exeter that are the driving factor for arthroplasty survival, but rather the use of implants with documented evidence of good survival.

The message linking implant choice with survival outcomes was also seen in a study by Penfold et al[6] published in the *Journal of Arthroplasty* in October 2020. A common question at the NJR regional roadshows is, "how do I avoid being an NJR outlier?" and this study goes some way to answering that. The authors adopted a time-matched case-control design to look for differences between surgeons who had been identified as a potential outlier by the NJR and those who have not, in both THA and TKA. In both hips and knees, the over-riding association was between the use of greater number of different prostheses (THA odds ratio (OR) per additional implant 1.12 (95% confidence interval (CI) 1.06 to 1.18); KR odds ratio per additional implant 1.35 (95% CI 1.17 to 1.55)). The analyses undertaken are somewhat complex and nuanced regarding knee arthroplasties and the use of unicompartmental TKA, although this is also addressed in a sensitivity analysis. The authors discuss the limitations at length, including the challenge that implants put in well before being identified as a potential outlier may contribute to that surgeon being identified as a potential outlier. Despite this, the overall message is consistent with that from the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) is that the use of a greater variety of prostheses may increase the number of revisions, and above that what is expected for an individual surgeons case mix.[7]

December 2020 saw the publication in *The Bone and Joint Journal* of an interesting article by Khan et al[8] from **Nottingham (UK)** regarding mortality following revision for femoral periprosthetic fracture around THAs. This is an area of importance and increasing interest. The authors used an extract of the NJR dataset between 2003 and 2015 to investigate patient mortality following revision surgery, and to compare different subgroups of age, sex, and ASA grade. The population reported was for all primary THAs performed between 2003 and 2015 for any indication that were subsequently linked with a further revision. The outcome reported was death at 90 days, one year, and five years, which was captured by linkage to the Office for National Statistics (ONS) database. The comparator groups were sex, age of under 75 years or 75 years and over, and ASA grades of 1 or 2 compared to grades 3, 4, or 5. Overall, there were 74,223 first revisions identified, of which 6,131 were for periprosthetic femoral fracture. The authors did not present an overall mortality for the whole group, but broke it down into subgroups defined above. Mortality at 90 days (calculated by cumulative incidence function (with further revision as a competing risk) varied from 0.55% (95% CI 0.39 to 0.71) in females aged under 75 years with a low ASA grade, to 8.69% (95% CI 7.53 to 9.84%) in the highest risk group (males aged ≥75 years, ASA ≥ 3). This highlights the potentially devastating impact that periprosthetic femoral fractures may have with nearly one in ten patients in the highest risk group dying within the first three months of revision for this indication. Unsurprisingly, mortality rose in all groups after five years with nearly 60% of patients in the highest risk group dying within five years. As the authors clearly state, the use of the NJR on its own (without linkage to other national datasets such as HES) to answer questions regarding periprosthetic fracture remains challenging, as it will not capture patients treated conservatively or with internal fixation. It was not clear whether fractures in the first month following primary were included or not, as these are likely to represent unidentified intraoperative fractures and may display a different mortality. One technical criticism of this study is that the authors chose to handle age as a categorical variable (aged under 75 years or 75 years and over), rather than as a continuous variable. The 75 year age cut off was chosen a priori; however, in reality it seems unlikely that a patient aged 74 year would experience grossly different outcomes to one aged 76 years. We do recognize that presentation of results with age as a continuous variable becomes more complex and harder to interpret, and feel that although a technical criticism, given the other limitations the authors had to contend with, the use of age as a categorical variable is unlikely to impact the overall message of the study. This interesting study highlights the fact that, at the moment, no one can tell us the incidence of, factors that predispose to, or outcomes following all periprosthetic fracture after THA; information we eagerly await the answer to from studies currently underway.

UPPER LIMB

In February 2020, Brown et al[9] published their analysis on the effect of operating volume on revision rates in shoulder arthroplasty. This paper builds on the more established analysis of lower limb arthroplasty that has highlighted the importance of the volume-outcome relationship. In many healthcare systems, the centralization of services to ensure arthroplasties are performed by surgeons with appropriate experience. Analysis of this nature is for the shoulder is therefore likely to be highly valuable when considering resource allocation and centralization of services. The authors utilize the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR), with its 11-year follow-up data to quantify cumulative percentage revision (CPR) between arbitrary volume groups of mean annual shoulder arthroplasties (< ten per year, ten to 20 per year, and > 20 per year). These subdivisions were applied to primary total shoulder arthroplasty (TSA) and revision TSA (rTSA) with secondary exploration of the effect of prosthesis type. There was a significantly higher CPR for stemmed TSA for the < ten per year compared to > 20 per year for the first 1.5 years only (hazard ratio (HR) 1.36 (95% CI 1.08 to 1.71)). For rTSA performed for osteoarthritis, there was a significantly higher CPR for the < ten per year compared to >20 per year for the first three months only (HR 2.58, 95% CI 1.67 to 3.97), but for rTSA for cuff arthropathy, the significantly higher revision rate between these groups extended throughout the follow-up period. There were no observed differences for the primary diagnosis of fracture. Analysis of prosthesis type was limited due to the predominance of three implants within each shoulder arthroplasty type. No clear differences between these implants were identified, but in both the TSA and rTSA groups, implants classified as 'other' had significantly higher CRPs were identified.

This study used revision as it only endpoint; it is often the pre-eminent feature of registry analysis, which although a highly important outcome metric, the authors do recognize that patient-focused analysis would be additive. The categories of arthroplasties performed was somewhat arbitrary as there is limited data available on the effect of operating volume in shoulder arthroplasty; furthermore, the authors identify that, although the number of surgeons and number of procedures has increased six-fold and 17-fold respectively between 2007 and 2017, 78.2% of surgeons perform fewer than

ten per year. One wonders what the proportion of surgeons performing fewer than five per year would be, akin to pervious analysis of unicompartmental knee surgery in the NJR. With the increasing use of shoulder arthroplasty internationally, this is a valuable analysis and paves the way for further exploration of volume outcome and learning curve analysis.

Although registry reports on elbow arthroplasty are in their infancy, despite the overall low volumes, some of the older registries how have enough worthwhile data that publications are beginning to emerge. In April 2020, Viswanath et al[10] published their work on the comparative outcomes of two elbow replacement implants from the New Zealand National Joint Registry. They compared the revision rate of the Coonrad-Morrey (Zimmer Biomet, USA) and Latitude (Wright Medical Group, USA) prostheses, which in their series were the two most commonly used implants. Their analysis of 468 implants over an 18-year interval remains small in registry terms; however, they found a lower revision rate in the Coonrad-Morrey compared to Latitude with a HR of 0.29 (95% CI 0.13 to 0.62). The crude difference in revision rates was 17/346 Coonrad-Morrey and 9/58 Latitude implants. Further analysis of four subdivisions of Latitude implant configuration (linked or unlinked, each with or without a radial head implant) found that the increase in revision rate persisted across all groups, although event numbers with this level of granularity were very low. Patient demographics, indication, and surgeon volume were not associated with outcome, although we note that only one surgeon in New Zealand performs more than five elbow arthroplasties annually.

Interestingly, a similar analysis on the Australian registry (AOANJRR) performed in 2019,[11] which included a similar number of specified implants, did not find a difference in implant related revision. The most striking aspect of this analysis is the limited number of cases for analysis. This differential between elbow arthroplasties and the more common considerations of these effects in THA and TKA of such a great magnitude and is likely to persist even as registries mature. As we look forward, collaborative efforts for multinational registry analysis may be required to draw firm conclusions on these lower volume procedures.

CONCLUSION

In this article, we summarize several studies using routine and registry data with important clinical messages. While all studies (in particular observational studies) have their limitations, the authors have been clear in stating what these are and criticism in this article is to provoke debate rather than to cast doubt on the conclusions. As always, we recommend readers to seek out the original articles for further detail where required.

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