THE ROLE OF ARTHROSCOPY IN THE MANAGEMENT OF DISORDERS OF THE KNEE

An Analysis of 200 Consecutive Examinations*

ROBERT W. JACKSON† and ISAO ABE,‡ TORONTO, CANADA

From the Division of Orthopaedic Surgery, Toronto General Hospital and the University of Toronto

The application of endoscopic techniques to the study of joint cavities began some fifty years ago. In 1918 Professor Takagi of Tokyo inspected the joints of cadavers with a cystoscope, and in 1920 used a specially constructed arthroscope to examine a patient's tuberculous knee (Takagi 1933). Bircher (1921, 1922) in the first publications on the subject of arthro-endoscopy, described his experiences with a laparoscope for the inspection of knee joints. He was followed by Kreuzer, who in 1925 devised his own instrument and issued a plea for the early recognition of meniscal injuries by this means. Whereas Takagi used physiological saline to distend the joint cavity, both Bircher and Kreuzer used air or nitrogen. In New York, Burman, Finkelstein and Mayer examined the knee as well as other joints and published their findings in several classic articles between 1931 and 1934. Nevertheless, with the exception of Hurter, who described a "new method of exploration of the knee" in 1955, enthusiasm gradually waned in the western world because the early instruments left much to be desired from a technical aspect.

In Japan, however, the prevalence of tuberculosis stimulated further development of the instrument, especially because an ankylosed knee prevented kneeling and squatting and was a serious social handicap. Professor Takagi and his successor Dr Watanabe persisted in their attempts to develop an arthroscope to aid the early diagnosis of tuberculous arthritis (Kawashima 1943). In 1957 Watanabe, Takeda and Ikeuchi published a small atlas of arthroscopy illustrated by an artist's drawings. In 1969 they published a second atlas, now profusely illustrated by actual photographs. Recently other writers have indicated the value of arthroscopy in the diagnosis of arthritis as well as internal derangements of the knee (Jayson and Dixon 1968; Robles Gil, Kátana and Barroso 1967; Casscells 1971).

The purpose of this article is to define the role of arthroscopy in the management of disorders of the knee, by critically analysing the first consecutive 200 out of 450 examinations made by the authors over a period of five years, using the Watanabe No. 21 Arthroscope.

WATANABE'S MODEL 21 ARTHROSCOPE

This instrument, specifically designed for the knee, is the twenty-first in a series of arthroscopes dating back to 1918 and has been in routine use since 1960 (Watanabe and Takeda 1960). It is basically a rigid, straight optical system contained in a tube 4.9 millimetres in diameter and 16.5 centimetres in length (Fig. 1). The wide angle lens gives a field of vision of 360 degrees, an angle of vision of 100 degrees and a depth of field from 1 millimetre to infinity. The tungsten light source is carried alongside the telescope and does not encroach on the field of vision. When in use, both the light and the telescope are nested within the

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† Assistant Professor, Department of Surgery, University of Toronto. Staff Surgeon, Toronto General Hospital. Markle Scholar in Academic Medicine.

‡ Research Associate, Orthopaedic Research Laboratory, Banting Institute, University of Toronto. Present address: Department of Orthopaedic Surgery, University of Tokyo, Japan.

sheath. Also available is a 90-degree side-view scope and biopsy forceps and scissors with which to operate through the instrument. The arthroscope must be sterilised by gas in order to avoid damage to the optical and electrical components.

TECHNIQUE OF ARTHROSCOPY

The examination is performed under aseptic conditions in an operating theatre. General or epidural anaesthesia is preferred, to ensure muscle relaxation and permit varus and valgus strains to be applied, but local anaesthesia is adequate for simple examination or for biopsy of the synovium of the suprapatellar pouch.

A pneumatic tourniquet is placed on the thigh before draping, but it is not inflated unless necessary. A needle of gauge 18 or larger is inserted into the suprapatellar pouch and any

FIG. 1

The number 21 Watanabe arthroscope half-size, showing a) the sheath, b) the light carrier, and c) the telescope.

effusion is aspirated. The joint is then distended with 75 to 100 millilitres of normal saline at room temperature.

The best site for insertion of the arthroscope is the joint line anteriorly just lateral to the patellar tendon. A 4-millimetre stab wound through skin and capsule permits entry of the trocar and sheath. A blunt obturator is then used to manoeuvre the instrument inside the joint without damaging the articular cartilage.

The antero-lateral approach facilitates examination of the medial compartment, the most common site of meniscal derangement. However, if the lateral compartment is suspect, an antero-medial approach may be more revealing, as one can then look across the joint. Entry to the suprapatellar pouch, either laterally or medially, gives ready access for synovial biopsy and examination of the patello-femoral compartment, but greatly restricts the view of the menisci.

When the tip of the sheath is lying in the suprapatellar pouch the light source and the telescope are successively nested within it. The examination is carried out under continuous gentle irrigation using normal saline at room temperature, which flows in through the instrument and out through a hypodermic needle or plastic cannula inserted into the suprapatellar pouch (Fig. 2). The saline medium serves three purposes; firstly to disperse heat from the tungsten light, secondly to wash away any blood, and thirdly to maintain distension of the joint. Sufficient hydrostatic pressure is obtained by suspending the bottle of saline a metre or more above the knee.

Inflation of the tourniquet is usually avoided so that one can more easily distinguish vascular synovium from avascular meniscus. Occasionally brisk bleeding demands use of the tourniquet to allow adequate examination. Photographs may be taken through a single lens reflex camera with a sterile attachment coupled to the eyepiece.

FIG. 2

To show the examination being performed under aseptic conditions. In this case a valgus strain is being applied to the knee for inspection of the posterior horn of the medial meniscus.

Upon conclusion of the examination, and if operation is not indicated, the stab wound is closed with a single stitch and an elastic bandage is applied. Otherwise the limb is again prepared and draped and the operation is carried out under the same anaesthetic.

If arthroscopy is not followed by operation, the patient is allowed to walk on recovery from the anaesthetic and usually goes home the same day. Excessive activity should be avoided for one to three days. Discomfort is usually minimal and can be relieved by a mild analgesic. Inhibition of the quadriceps has not been observed.

METHOD OF ANALYSIS

Clinical material—During the past five years a punch-card system has been used to cross-index all pertinent clinical and technical details for 450 knees. This analysis was confined to the first 200 consecutive cases and has allowed a follow-up of more than one year in all instances.

Most of the patients in this study were referred specifically for arthroscopy and came from general surgeons, rheumatologists or other orthopaedic surgeons. Some were referred

by lawyers for medico-legal reasons. This group of patients all presented with special problems in diagnosis, management or prognosis and will be called *referred cases*.

The remainder of the patients were sent by general practitioners or were admitted from the emergency ward or the out-patient clinic. This group comprised cases that might be found routinely in any orthopaedic practice and will therefore be called *routine cases*.

Qualitative assessment of the role of arthroscopy—An attempt was made to assess the value of the arthroscopic examination in the general management of each knee. An examination was considered *useful* 1) when unnecessary surgery was avoided, 2) when a biopsy was performed, 3) when a doubtful diagnosis was confirmed before operation, and 4) when it enabled the planning of treatment such as upper tibial osteotomy for osteoarthritis, or synovectomy for rheumatoid arthritis.

The examination was considered to be *very useful* 1) when a totally different and unexpected diagnosis was made which enabled the surgeon to modify a proposed operation or to avoid unnecessary surgery, 2) when significant economic or social benefits resulted for the patient from a correct diagnosis or accurate prognosis which would not otherwise have been obtained, for example, Workmen's Compensation Board benefits, and 3) when definitive treatment was carried out through the arthroscope, for example, the removal of loose bodies or fragments of meniscus.

The examination was considered *not useful* 1) when no additional information was gained, 2) when an error in interpretation led to wrong treatment, 3) when complications developed which were directly related to the arthroscopy.

Analysis of knees treated surgically—When indicated, arthrotomy was performed either immediately after arthroscopy or in some instances electively at a more convenient time for the patient. Most of the surgical procedures were carried out by the senior author, although some patients were referred back to their own surgeon. In most cases the indication for operation was established by the findings at arthroscopy. In some instances, however, surgery was obviously indicated before arthroscopy, for example, the removal of loose bodies seen in radiographs; in these cases the examination was carried out mainly to increase the examiner's experience.

We elected to analyse this group of cases not only in regard to the accuracy of the arthroscopic diagnosis but also qualitatively, to ascertain the usefulness of the examination in the surgical management of each case.

Analysis of knees in which surgery was deferred—Intra-articular surgery was deferred in a significant number of knees either because no pathology could be found, or because in our opinion surgery would not benefit the patient despite the presence of pathological changes. We thought it important to study the outcome of this group in some detail, because initially all these patients were candidates for surgery.

Accuracy of clinical diagnosis—In all cases a provisional diagnosis, based on the history, physical findings, radiographs and laboratory tests, was recorded before arthroscopy. This was compared with the arthroscopic diagnosis and confirmed or corrected either by arthrotomy or by follow-up in those patients in whom operation was considered not to be indicated.

Accuracy of arthroscopy in suspected meniscal disorders—All cases in which a meniscal derangement was strongly or even remotely suspected on clinical evidence were subjected to special analysis. This group included cases in which 1) a torn meniscus was the obvious diagnosis, 2) symptoms persisted or recurred after previous meniscal surgery, with the possibility of a retained fragment or a tear of a peripheral rim, 3) a torn meniscus might be contributing to the symptoms of degenerative change, and 4) the symptoms were mainly psychogenic, but possibly due in part to a meniscal lesion.

The cases were then divided into referred cases and routine cases as already explained. The accuracy of the arthroscopic findings was determined either by arthrotomy or by close follow-up examination for twelve months or more in those cases where surgery was deferred.

Comparison of arthrography with arthroscopy in the diagnosis of meniscal disorders—All cases which were initially examined by arthrography and later by arthroscopy were also subjected to special analysis. Although not all of the arthrograms were performed in our hospital, all films were reviewed by the authors and two radiologists with a special interest in the subject. The interpretation of the arthrogram was considered to be correct or incorrect by the evidence obtained at arthroscopy, reinforced in most instances by arthrotomy.

Analysis of technique—Various aspects of the 200 examinations were analysed to determine the best type of anaesthetic, the commonest site of insertion of the arthroscope, and the technical adequacy of each examination.

Analysis of complications—All complications in the 200 cases were reviewed, both those of the procedure itself and those following the examination or following arthrotomy.

RESULTS

Clinical material—One hundred and forty-one male (70.5 per cent) and fifty-nine female (29.5 per cent) patients were examined. The age range was from eight to sixty-nine years. Right (ninety-nine) and left (101) knees were almost equally represented. One hundred and thirty-one patients (65.5 per cent) were specially referred and sixty-nine (34.5 per cent) came through routine hospital channels.

TABLE I
ASSESSMENT OF ROLE OF ARTHROSCOPY IN 104 KNEES LATER TREATED SURGICALLY

Lesions	Totals	Very useful	Useful	Not useful
Torn menisci	51	14	27	10*
Retained posterior horn fragments	7	3	3	1
Loose bodies	8	1	2	5
Degenerative articular cartilage .	19	—	12	7
Synovial disorders	5	—	4	1
Miscellaneous	14	3	9	2
Total	104	21 20 per cent	57 55 per cent	26 25 per cent

* Includes 3 false-positives.

Qualitative assessment of the role of arthroscopy—Using the criteria as outlined, arthroscopy was found to be useful or very useful in 177 cases (88.5 per cent) and not useful in twenty-three cases (11.5 per cent).

Analysis of knees treated surgically—One hundred and four knees (52 per cent) were explored after arthroscopy. Table I lists the main post-operative diagnoses in this group, and outlines the value of arthroscopy in the management of each type of disorder. In 20 per cent, arthroscopy was considered to have contributed significantly. In a further 55 per cent it was considered useful, and in this group are included cases in which a doubtful clinical diagnosis was confirmed. In 25 per cent, arthroscopy did not contribute in any way to the management of the problem.

We concluded that arthroscopy was of definite benefit to 75 per cent of these patients, most of whom had been specially referred. It was most valuable in the diagnosis of lesions of the menisci, chondromalacia of the patella, and degenerative conditions affecting articular cartilage (Fig. 6).

Analysis of cases in which operation was deferred—Arthrotomy was deferred in ninety-six cases, of which seventy had been specially referred. Further surgery was therefore considered not necessary in 55 per cent of all referred cases, and 37 per cent of all routine cases. Table II lists the diagnoses made after arthroscopy and the outcome at follow-up.

No pathology detected—In sixteen patients no pathological changes could be identified and these knees were considered as normal (Figs. 3 to 5). Eight of these patients (age range from fourteen to twenty-six years) were considered to have functional complaints. Follow-up revealed that six markedly improved or became asymptomatic within a year, while two remained unchanged.

Six adult patients were believed to be malingerers. One was a prison inmate, and five were seeking financial recompense from Workmen's Compensation or through litigation. Two subsequently improved while four remained unchanged.

The remaining two patients were incorrectly diagnosed. A girl aged thirteen was initially thought to have functional complaints but later developed rheumatoid arthritis. A young woman aged twenty-four was found at operation to have a localised arteriovenous malformation in the synovium of the suprapatellar pouch which had been missed at the time of arthroscopy. Both these examinations were classified as false-negatives.

TABLE II
THE OUTCOME IN NINETY-SIX KNEES ON WHICH OPERATION WAS DEFERRED

A) No pathology identified	Totals	Better	Unchanged	Worse	Lost to follow-up
Functional knee pain (mostly adolescents)	8	6	2	—	—
Malingerers	6	2	4	—	—
Proven false-negatives	2	2	—	—	—
B) Pathology identified—not suitable for operation					
Degenerative changes and previous surgery	25	6	14	2	3
Degenerative changes but no previous surgery	18	6	6	—	6
Rheumatoid arthritis	5	2	2	—	1
Synovitis	17	10	2	—	5
Miscellaneous lesions	15	10	3	—	2
Total	96	44	33	2	17

Pathology detected—not suitable for operation—The second and larger group in which arthrotomy was deferred consisted of seventy-four patients in whom definite pathological changes could be demonstrated, but the lesions were not considered to be amenable to surgery.

Twenty-five of these patients had undergone previous operation and had varying degrees of degenerative change within the joint either as a result of the initial trauma or perhaps secondary to the surgery. At follow-up the majority were either unchanged or improved. Three patients were subsequently treated by high tibial osteotomy with significant improvement.

Eighteen patients with no previous operation also showed degenerative changes (Fig. 7b). Age or obesity or both were the probable etiological factors in six cases, while trauma was presumed to be the causative factor in twelve. At follow-up six were improved and six unchanged; six were not reviewed.

FIG. 3

Two views of the medial compartment of a normal knee. On the left the posterior horn of the meniscus is well shown, and on the right the middle and anterior horn regions are seen in their entirety. The articular cartilage on the femoral condyle is smooth and healthy. These views were obtained looking across the joint from a lateral approach.

FIG. 4

FIG. 5

Figure 4—A close-up view of the normal posterior horn of a lateral meniscus from the antero-lateral approach. Figure 5—The view of a normal anterior cruciate covered with a thin layer of vascular synovium. The insertion (*bottom of field*) is magnified due to the proximity of the arthroscope.

Monarticular rheumatoid arthritis was diagnosed in five patients on the basis of the appearances and synovial biopsy (Fig. 7a). Two improved with medical treatment, two remained unchanged and one was lost to follow-up.

Seventeen patients showed some degree of synovial inflammation which was not typical of rheumatoid arthritis. In eight cases enlarged synovial fronds could be seen in the intercondylar notch where they could conceivably be pinched or trapped between the anterior cruciate ligament and the inner aspects of the femoral condyles. Six of the eight were better

FIG. 6

Typical views of intra-articular pathology. *a*) Posterior horn tear of a medial meniscus. Note the small area of chondromalacia on the femoral condyle. *b*) Anterior horn region of a bucket-handle tear showing the displaced portion of meniscus rising towards the right. *c*) Chondromalacia of the patella. *d*) Osteochondritis dissecans.

after a year; the other two were lost to follow-up. These patients were all young (eighteen to twenty-four years) and might well have been considered as examples of functional disorder in the adolescent except for the evidence in favour of synovial entrapment. Whether or not trapped synovium is a symptom-producing entity will require further study. The remaining

nine patients had various types of synovial abnormality such as osteochondromatosis (Fig. 7*d*), pseudo-gout or chondrocalcinosis, psoriatic arthritis and post-traumatic synovitis.

Fifteen patients had miscellaneous lesions such as hypermobile meniscus, discoid lateral meniscus, parameniscal (peripheral) tears, anterior cruciate tears, avulsion of the origin of the popliteus tendon, post-immobilisation stiffness, Pellegrini-Stieda's disease and osteochondritis dissecans. Most of these patients improved solely with the passage of time. Two

FIG. 7

Typical views of the synovium in various forms of arthritis. *a*) Rheumatoid arthritis. *b*) Osteoarthritis. *c*) Pigmented villonodular synovitis. *d*) Synovial osteochondromatosis.

underwent operation at a later date and therefore might be considered as errors in initial judgment but not in arthroscopic diagnosis.

Although seventeen of the ninety-six patients were lost to follow-up, the initial diagnosis was subsequently proven to be wrong in only two cases.

Intra-articular surgery obviously would have been unnecessary in the forty-four patients who were improved at follow-up. One can speculate that surgery might have been beneficial in some of the patients who were unchanged, worse or lost to follow-up, but it is equally

possible to speculate that the additional trauma of surgery might have compounded the problems in this group.

Accuracy of clinical diagnosis—Our clinical diagnosis before arthroscopy was proven correct in only 68·5 per cent of the total series; in other words the rate of error was 31·5 per cent. We take some solace from the fact that the majority of the cases were “problem” knees and referred because other specialists had also experienced difficulty in establishing the correct diagnosis.

Accuracy of arthroscopy in suspected meniscal disorders—One hundred and twenty-one cases were suspected initially to have a meniscal derangement. This group was composed of eighty-six referred and thirty-five routine cases.

Referred cases—Operation was advised in fifty-six out of eighty-six cases. In all of these arthrotomy was carried out either immediately or shortly after arthroscopy.

Several different diagnoses were established and the conditions correctly treated as a result of arthroscopy. These included not only torn or degenerate meniscus, but also dislocating meniscus due to avulsion of the anterior coronary ligaments, retained posterior horn fragment, tear of the peripheral rim, torn anterior cruciate ligament, chondromalacia of the condyles or patella, avulsion of the origin of popliteus, and osteochondral fracture of a femoral condyle.

Operation was deferred in thirty of the eighty-six knees because we did not consider it would be of benefit. Although nine of the deferred cases were lost to follow-up, twenty-one cases were followed closely for one to four years.

Five errors were detected in this sub-group of referred knees. Three (false positives) were due to faulty interpretation of the appearances at arthroscopy and resulted in the removal of normal menisci. The fourth error (a false negative) occurred in the interpretation of the synovial appearances in a patient who later developed rheumatoid arthritis. The fifth error (a false negative) occurred in not identifying an arteriovenous malformation in the synovium of the suprapatellar pouch. There were no proven instances of menisci being interpreted as intact by arthroscopy and later proven to be torn (meniscal false negatives).

Routine cases—In these thirty-five cases we were unable to demonstrate any errors in arthroscopic diagnosis. In twenty-seven the meniscal lesion seen at arthroscopy was confirmed by arthrotomy. In the other eight the menisci appeared normal at arthroscopy and no other changes were found. Operation was therefore deferred, and at follow-up all eight patients were asymptomatic or markedly improved.

Comparison of arthrography with arthroscopy in the diagnosis of meniscal disorders—Sixty-three cases in which arthrography preceded arthroscopy were available for study. The interpretation of the arthrograph was proven correct in forty-three instances and incorrect in twenty (an error rate of 31·8 per cent), with an almost equal number of false positives and false negatives. The accuracy of arthrography in these cases therefore proved to be no better than our clinical assessment. It is important to note, however, that the diagnostic accuracy of our radiologists improved as experience was gained in the double contrast technique, and in the final twenty cases of the study their accuracy approached that reported in other series (Butt and McIntyre 1969; Nicholas, Freiburger and Killoran 1970).

In this group of cases there were no false negatives and only three false positives (an error rate of 4·7 per cent).

Analysis of technique—Nearly all our cases (99 per cent) were examined under general anaesthesia. Only two had local anaesthesia, and in both the examination was restricted to the suprapatellar pouch and the patello-femoral compartment.

A good view of the posterior horns of the menisci (or the posterior horn region in cases where a previous meniscectomy had been carried out) was possible in 82 per cent of cases. Failure could be due to several reasons: exuberant synovium, exceptionally “tight” joints after previous trauma or in older patients, the occasional anatomical variant of a markedly concave tibial plateau in which the condyles were deeply seated, bleeding too brisk to be

cleared by irrigation, and in the earlier cases in the series, inexperience on the part of the examiner.

With increasing experience, it was found that the antero-lateral approach at the joint line permitted an adequate examination of both medial and lateral compartments, as well as the patello-femoral and suprapatellar regions. It was also apparent that the posterior horn of the medial meniscus was slightly more difficult to see from the medial approach, whereas the posterior horn of the lateral meniscus could easily be seen with either approach. In only two cases (1 per cent) was it necessary to make both a medial and lateral insertion.

Considering only the technical aspects, good or excellent examinations were recorded in 179 cases (89.5 per cent). The poor examinations were due to light failure, excessive bleeding, poor irrigation or improper insertion of the arthroscope. All of the poor examinations occurred in the first eighty cases; nevertheless some information was usually obtained. As one would expect, increasing experience led to increasing satisfaction with the procedure.

Complications—Undoubtedly the most serious potential complication is infection. So far we have had no infection following arthroscopy alone, despite the difficulty in maintaining strict asepsis. Watanabe also reports no infection in more than 1,000 examinations (Watanabe *et al.* 1969).

In this series three patients operated upon immediately after arthroscopy later developed an infection, two of them superficial; the third was a joint infection after patellectomy. All responded to the appropriate therapy. Prophylactic antibiotics were not routinely used in this series. Thrombophlebitis occurred twice in patients operated on after arthroscopy, in one case with minor pulmonary embolism.

On one occasion a haemarthrosis developed after arthroscopy alone and 65 millilitres of blood were aspirated. On another occasion a bulb broke inside the joint when crushed between femoral condyle and tibial plateau by an inadvertent movement of the knee while the tip of the arthroscope was in that situation. The joint was opened immediately and the small fragments of glass removed. The patient had no apparent adverse effects when reviewed a year later. On another occasion a loose bulb caused a short-circuit which produced a powerful quadriceps contraction each time the light was turned on, but no harm resulted.

Although minor degrees of scoring of articular cartilage have been occasionally noticed at the time of examination, we have not recognised any long-term adverse effects from this.

DISCUSSION

Indications—Undoubtedly every surgeon has, on more than one occasion, been faced with a knee problem perplexing enough to evoke a desire to look inside the joint. In many such cases the surgeon is reluctant to perform an exploratory arthrotomy because of the associated morbidity. Here is the most obvious indication for arthroscopy. In this category are 1) adolescents (usually girls) with poorly localised pain as the only symptom, who may have local pathology but most likely do not, 2) the litigation-conscious patient or one with compensation benefits pending, 3) the patient with minimal or conflicting objective findings, 4) the patient who has had one or more operations but still has symptoms, 5) the professional athlete with a knee injury for whom an early diagnosis is an economic necessity, 6) the patient who is unable to communicate, perhaps from a language barrier, and 7) the patient where inspection of the interior of the joint would help prognosis or research. Arthroscopy is also useful in the conduct of monarticular arthritis, where inspection of the synovium plus biopsy may establish the diagnosis.

When operation is contemplated, arthroscopy under the same anaesthetic adds only thirty minutes to the operating time and may avoid an unnecessary operation or a poorly planned approach. With increasing experience such pre-operative examination should reduce to nil the incidence of removal of a normal meniscus.

Sometimes other conditions which might be called "meniscal mimics" are detected by

arthroscopy and lead to an altered plan of treatment. Frequently masquerading as meniscal lesions are chondromalacia patellae, torn anterior cruciate ligaments, chondral or osteochondral fractures, cartilaginous loose bodies, avulsion of the origin of popliteus, detached anterior horn of a meniscus, trapped synovial frond and other rare but definite entities.

There is also an increasing indication for arthroscopy in the arthritic joint referred for surgery. In osteoarthritic joints the state of the interior can be determined before a decision is made to perform an extra-articular procedure such as upper tibial osteotomy, or an intra-articular procedure such as meniscectomy, cartilage shaving or removal of loose bodies. In the rheumatoid patient, knowledge gained about the extent of damage of articular cartilage can enable the surgeon to make an informed decision regarding synovectomy or replacement arthroplasty of one type or another.

In certain limited instances, definitive treatment can be carried out through the arthroscope; small loose bodies or displaced portions of torn meniscus can sometimes be removed. Irrigation and drainage systems for the treatment of septic arthritis can be established with minimal surgical trauma, and soft adhesions can be broken down by manoeuvring the instrument within the joint. Also a beneficial effect as yet unexplained has been frequently observed following the irrigation of osteoarthritic knees; many patients have reported relief of symptoms for periods ranging from days to years.

A final indication for arthroscopy is to aid the assessment of previous treatment and establish an accurate prognosis. Most patients decline arthrotomy but willingly accept a minor procedure for this purpose. Perhaps the greatest overall value of arthroscopy lies in this area of research through long-term follow-up.

Contraindications—The contraindications are few. Stiffness of the knee from any cause precludes manoeuvring the arthroscope into its various compartments. A recent haemarthrosis is a relative contraindication as difficulty may be encountered in clearing the joint sufficiently to permit good visualization. Sepsis elsewhere is another deterrent.

General considerations—While it is possible to examine a knee under local anaesthesia, we consider it dangerous; breakage could easily occur if the conscious patient were to extend his knee with the arthroscope in the back of the joint. Full muscle relaxation also permits sufficient varus or valgus strain to be applied for a good view of the posterior horns of the menisci.

There are, of course, limitations. The popliteal fossa cannot be inspected and popliteal cysts cannot be identified. The postero-medial and postero-lateral attachments of the menisci can likewise not be seen and opinions on their integrity depend solely on the appearance and congruity of the inner borders of the menisci. Anterior horns and retropatellar fat pads are difficult to assess because of their proximity to the lens and the resultant magnification. Capsular and collateral ligament tears are also difficult to observe, as are lesions of the posterior cruciate ligament. However, these limitations can be compensated for by other diagnostic measures such as examination under anaesthesia, stress radiographs and double contrast arthrography.

We are convinced that once technical proficiency and experience have been gained, arthroscopy not only provides most of the information one can obtain from arthrography, but also provides additional information from inspection of the menisci, synovium and articular surfaces under both static and dynamic conditions. We feel therefore that it is probably the most informative special examination now available for the diagnosis of the "problem knee". The availability of arthroscopy, however, should not preclude the intelligent use of other methods of gathering diagnostic information.

We would stress that the technique, while relatively simple, requires time and patience to learn. Most of our errors in technique and interpretation occurred during the first year. Accuracy comes only with experience, and the "occasional arthroscopist" might well become discouraged. For this reason we advocate that the technique be put into the hands of one or two individuals in a medical community.

SUMMARY

1. A critical analysis of the findings in 200 knees examined by arthroscopy at least one year previously has been carried out to assess its value in the management of a wide variety of disorders.
2. Arthroscopy is a practical and valuable procedure with minimal associated morbidity or complications.
3. The increased accuracy of diagnosis helps to avoid unnecessary operations and to base methods of treatment on a better knowledge of the pathology.

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REFERENCES

- BIRCHER, E. (1921): Die Arthroendoscopie. *Zentralblatt für Chirurgie*, **48**, 1460.
- BIRCHER, E. (1922): Beitrag zur Pathologie (Arthritis deformans) und Diagnose der Meniscus-Verletzungen (Arthroendoscopie). *Bruns' Beiträge zur Klinischen Chirurgie*, **127**, 239.
- BURMAN, M. S. (1931): Arthroscopy or the Direct Visualization of Joints. *Journal of Bone and Joint Surgery*, **13**, 669.
- BURMAN, M. S., FINKELSTEIN, H., and MAYER, L. (1934): Arthroscopy of the Knee Joint. *Journal of Bone and Joint Surgery*, **16**, 255.
- BUTT, W. P., and MCINTYRE, J. L. (1969): Double-contrast Arthrography of the Knee. *Radiology*, **92**, 487.
- CASSCELLS, S. W. (1971): Arthroscopy of the Knee Joint. *Journal of Bone and Joint Surgery*, **53-A**, 287.
- FINKELSTEIN, H., and MAYER, L. (1931): The Arthroscope. *Journal of Bone and Joint Surgery*, **13**, 583.
- HURTER, E. (1955): L'Arthroscopie. *Revue de Chirurgie Orthopédique et Réparatrice de l'Appareil Moteur*, **41**, 763.
- JAYSON, M. I. V., and DIXON, A. St J. (1968): Arthroscopy of the Knee in Rheumatic Diseases. *Annals of the Rheumatic Diseases*, **27**, 503.
- KAWASHIMA, W. (1943): Arthroscopy of the Tuberculous Knee Joint in its Early Stage. *Journal of Japanese Orthopaedic Association*, **18**, 651.
- KREUSCHER, P. H. (1925): Semilunar Cartilage Disease; a Plea for the Early Recognition by Means of the Arthroscope and the Early Treatment of this Condition. *Illinois Medical Journal*, **47**, 290.
- NICHOLAS, J. A., FREIBERGER, R. H., and KILLORAN, P. J. (1970): Double-contrast Arthrography of the Knee. *Journal of Bone and Joint Surgery*, **52-A**, 203.
- ROBLES Gil, J., KÁTONA, G., and BARROSO, M. R. (1967): Arthroscopy as an Aid to Diagnosis and Investigation. *Excerpta Medica, International Congress Series*, **143**, I 6.
- TAKAGI, K. (1933): Practical Experiences using Takagi's Arthroscope. *Journal of Japanese Orthopaedic Association*, **8**, 132.
- TAKAGI, K. (1939): The Arthroscope. *Journal of Japanese Orthopaedic Association*, **14**, 359.
- WATANABE, M. (1949): Arthroscopy of the Ankle Joint of the Horse. *Journal of Japanese Orthopaedic Association*, **22**, 59.
- WATANABE, M., and TAKEDA, S. (1960): The No. 21 Arthroscope. *Journal of Japanese Orthopaedic Association*, **34**, 1041.
- WATANABE, M., TAKEDA, S., and IKEUCHI, H. (1957): *Atlas of Arthroscopy*. Tokyo: Igaku Shoin Ltd.
- WATANABE, M., TAKEDA, S., and IKEUCHI, H. (1969): *Atlas of Arthroscopy*. Second edition. Tokyo: Igaku Shoin Ltd.