Reconstruction of the anterior cruciate ligament in patients over 50 years

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The records of patients aged 50 years or over who underwent primary reconstruction of the anterior cruciate ligament between 1990 and 2002 were reviewed. There were 35 knees in 34 patients that met the inclusion criteria. The mean age of the patients was 57 years (50 to 66) and the mean clinical follow-up was for 72 months (25 to 173). A total of 23 knees were reconstructed with patellar tendon allograft, and 12 with patellar tendon autograft. The mean pre-operative knee extension was 1° (-5° to 10°) and flexion was 129° (125° to 150°) and at follow-up these values were 0° (-5° to 5°) and 135° (120° to 150°), respectively. Pre-operatively there were 31 knees (89%) with a Lachman grade 2+ or 3+. Post-operatively, 33 knees (94%) were Lachman grade 0 or 1+. The mean pre- and post-operative International Knee Documentation Committee scores were 39 (23 to 72) and 90 (33 to 100) respectively. The mean pre- and post-operative Lysholm scores were 50 (18 to 68) and 92 (28 to 100) respectively and the mean University of California Los Angeles activity scores were 8.5 before injury (4 to 10), 4.3 (3 to 6) after injury and 8.3 (4 to 10) post-operatively. There were three graft failures (8.6%) requiring revision.

We conclude that reconstruction of the anterior cruciate ligament in carefully-selected patients aged 50 years or over can achieve similar results to those in younger patients, with no increased risk of complications.

Many middle-aged and elderly people remain active; in 2004 the Federal Interagency Forum on Aging Related Statistics¹ noted that between the years 1997 and 2002, approximately 30% of people aged 45 to 64 years and 25% of people aged 65 to 74 years engaged in regular leisure activities. This has led to an increase in activity-related injuries in middle-aged and more elderly populations, and the problems of returning them to their pre-injury level of activity.²

Historically, reconstruction of the anterior cruciate ligament (ACL)-deficient knee was reserved for young and highly competitive patients with a complete tear of the ACL, either isolated or in conjunction with other ligamentous injuries.³ Patients over the age of 40 frequently received non-operative treatment consisting of modification of their activities, physiotherapy and functional bracing, often with satisfactory results.⁴⁻⁶ However, more recent data suggest that non-operative treatment results in a relatively high rate of re-injury when these patients return to moderate or higher levels of activity.^{4,7-11} Several studies have shown excellent results of ACL reconstruction in patients over the age of 40,

including a greater return to activity and a reduced incidence of re-injury and instability.^{6,12-23} This would suggest that the pre-injury level of activity and motivation for recovery are more important indications for considering ACL reconstruction than age alone.

There is a paucity of data about ACL reconstruction in patients aged 50 and over.^{16,24} Our hypothesis was that the results of ACL reconstruction in this patient group would be similar to those of reconstruction in younger patients. Thus, we retrospectively reviewed the results of ACL reconstruction in patients over 50 at the time of surgery.

Patients and Methods

The records of all patients at our institution aged 50 years or over who underwent ACL reconstruction between 1990 and 2002 were reviewed. Inclusion criteria were age 50 or over and primary ACL reconstruction. Patients with multi-ligamentous injury were excluded.

We identified 40 patients who met the inclusion criteria. Six were lost to follow-up (15%), leaving 35 knees in 34 patients in our study. There were 20 females and 14 males; 23 left knees and 12 right. The mean age of the

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Table I. Pre- and post-operative anterior cruciate ligament stability

Test	Pre-operative (%)	Post-operative (%)
Lachman*		
0	0 (0)	32 (94)
1+	3 (9)	1 (3)
2+	27 (79)	1 (3)
3+	4 (12)	0 (0)
Pivot shift		
0	0 (0)	30 (86)
1+	6 (17)	4 (11)
2+	25 (72)	1 (3)
3+	4 (11)	0 (0)

* only 34 knees were tested

patients was 57 years (50 to 66). The Mean clinical and radiological follow-up was for 72 months (25 to 173), and 39 months (3 to 94), respectively. The most common mechanism of injury (16 knees) was non-contact activities such as skiing, dancing, tennis, hiking and snow-shoeing. The remainder included falls in nine knees, non-sports related twisting/pivoting injuries in six, and motor vehicle accidents in two. The mean time between injury and surgery was 24 months (1 to 156).

The pre- and post-operative clinical and radiological records were reviewed. Clinical data included the range of movement, the Lachman test,²⁵ and pivot shift.²⁶ The range of movement was reported in degrees, where a negative value indicated hyperextension, and any value above zero was an extension lag. Pivot shift was graded as no shift, a value of zero, a pivot glide 1+, a pivot clunk 2+, and gross instability 3+.²⁷ All available pre- and post-operative anteroposterior (AP) weight-bearing radiographs were graded for osteoarthritis using the Kellgren and Lawrence score.²⁸

The functional outcome data were pre-operative subjective International Knee Documentation Committee (IKDC),^{29,30} Lysholm,^{27,31,32} University of California Los Angeles (UCLA)³³ and Tegner^{31,32} scores, based on each patient's reported activity level immediately prior to injury. Final post-operative subjective IKDC, Lysholm, UCLA and Tegner scores were obtained by review of the patient's chart and telephone interview. We also analysed the mechanism of injury, the length of time between injury and surgery, type of graft, and femoral and tibial graft fixation. Concomitant intra- and extra-articular knee pathology and its treatment, if any, was also documented.

All the operations were performed by one of five surgeons. An arthroscopically assisted single-incision technique was used in 26 of 35 knees (74%), and an arthroscopically-assisted two-incision technique in nine (26%). Graft sources included ipsilateral bone-patellar tendon-bone autografts in 12 knees, and bone-patellar tendon-bone allografts in 23 knees. Graft fixation in the tibia consisted of an interference screw alone in 23 knees,

an interference screw and a 'back-up' staple or screw post in nine, or suture and screw post or staple alone in three. Femoral graft fixation was achieved by an interference screw alone in 27 knees, an interference screw and a back-up staple or screw post in seven, and by staple alone in one.

Patients followed a standard post-operative rehabilitation programme, which consisted of early weight-bearing, with early progressive range of movement and strengthening exercises as tolerated.³⁴ Running was allowed at three months post-operatively as tolerated, and sports involving pivoting were permitted at six to nine months post-operatively, provided the patient had regained functional stability.

Wilcoxon's non-parametric tests were used to compare pre- and post-operative UCLA, IKDC, and modified Lysholm functional scores. Linear regression was used to analyse the effects of age, length of follow-up, interval from injury to surgery, pre-operative osteoarthritis, meniscal injury, chondral injury and graft type on outcomes. Significance was set at $p < 0.05$. The statistical analysis was performed using SAS Statistical Discovery JMP version 7.0 (SAS, Inc., Cary, North Carolina).

Results

The mean pre-operative extension and flexion of the knee were 1° (-5° to 10°) and 129° (125° to 150°), respectively and at follow-up they were 0° (-5° to 5°), and 135° (120° to 150°). Post-operatively five patients had a mean loss of flexion of 8° (5° to 15°).

Pre- and post-operative Lachman testing was documented for 34 of 35 knees (97%). Pre-operatively three knees (9%) were graded as 1+, 27 knees (79%) as 2+ and four (12%) as 3+ (Table I). Post-operatively, 32 knees (94%) were graded as 0, one (3%) as 1+ and one (3%) 2+ (Table I).

Pre- and post-operative pivot shift examination was documented for all 35 knees. Before surgery, all knees had a positive pivot shift: 1+ in six knees (17%), 2+ in 25 (72%) and 3+ in four (11%). Following surgery, 30 knees (86%) had a negative pivot shift, four (11%) were graded as 1+ and one (3%) as 2+ (Table I).

Standing anteroposterior (AP) radiographs were available for all 35 knees before surgery. A total of 25 (71%) had a Kellgren score of 0, and ten (29%) a score of one. No patient had a pre-operative Kellgren score > 1 . No patient had significant malalignment ($> 5^\circ$). Post-operative AP standing radiographs were available for 20 of 35 knees (57%) at a mean follow-up of 39 months (3 to 94). Of these, 12 knees had a minimum of 24 months' radiological follow-up (24 to 94). Of the 12 knees, eight (67%) had a Kellgren score of 0, two (17%) a score of one, one a score of two (8%), and one a score of three (8%).

Functional outcome data were available for all 35 knees. The mean pre- and post-operative subjective IKDC scores were 39 (23 to 72) and 90 (33 to 100), respectively, and the mean pre- and post-operative Lysholm scores were 50 (18 to 68) and 92 (28 to 100), respectively; $p < 0.0001$ (Table II).

Table II. Mean (range) pre- and post-operative functional outcome scores

Score	Pre-operative	Post-operative
IKDC*	50 (18 to 68)	92 (28 to 100)
Lysholm	39 (23 to 72)	90 (33 to 100)

* IKDC, International Knee Documentation Committee

Table III. Mean pre-injury, pre- and post-operative activity scores

Score	UCLA*	Tegner
Pre-injury	8.5 (4 to 10)	4.4 (2 to 7)
Pre-operative	4.3 (3 to 6)	1.9 (0 to 7)
Post-operative	8.3 (4 to 10)	4.3 (2 to 7)

* UCLA, University of California Los Angeles

Table IV. Effects of independent variables on outcomes

Effect tested	Post-operative outcome measures*			
	IKDC	Lysholm	Tegner	UCLA
Age	p = 0.23	p = 0.33	p = 0.25	p = 0.10
Clinical follow-up	p = 0.40	p = 0.56	p = 0.43	p = 0.11
Injury to surgery interval	p = 0.18	p = 0.61	p = 0.77	p = 0.15
Pre-operative Kellgren score	p = 0.49	p = 0.60	p = 0.18	p = 0.66
Chondral injury	p = 0.11	p = 0.31	p = 0.49	p = 0.58
Meniscal injury	p = 0.97	p = 0.77	p = 0.20	p = 0.06
Graft type	p = 0.79	p = 0.81	p = 0.63	p = 0.62

* IKDC, International Knee Documentation Committee; UCLA, University of California Los Angeles

Of the 35 knees, 30 (86%) were able to return to their pre-injury level of activity. The mean UCLA pre-injury score was 8.5 (4 to 10). Pre-operative scores decreased to a mean of 4.3 (3 to 6). Post-operative scores returned to near normal with a mean of 8.3 (4 to 10; $p < 0.0001$) (Table III).

The mean pre-injury Tegner score was 4.4 (2 to 7). Pre-operative scores decreased to a mean of 1.9 (0 to 7) and the post-operative score returned to near the pre-injury level with a mean 4.3 (2 to 7; $p < 0.001$) (Table III).

At the time of surgery, 15 of the 35 knees (43%) had meniscal injuries that required treatment: 11 patients had an injury to the medial meniscus, three to the lateral and one to both. Partial meniscectomy was performed in 13 knees, and repair in two (both medial). Using the Outerbridge classification,²¹ 31 knees (89%) had associated chondral injuries, including type I lesions in 18 patients (58%), type II lesions in 19 patients (61%), type III lesions in eight patients (26%), and type IV lesions in three (10%). All lesions were small ($< 2 \text{ cm}^2$), isolated, well contained, and were treated with simple debridement.

Age, the length of clinical follow-up, the interval from injury to surgery, pre-operative Kellgren score, the presence of chondral/meniscal injury at the time of surgery, and type of graft had no effect on the post-operative IKDC, Lysholm, Tegner, or UCLA score (Table IV).

Five knees required surgery for post-operative complications. Three (8.6%) required revision reconstruction for graft failure, secondary to trauma. Two (5.7%) required removal of symptomatic tibial hardware. No patient was treated for post-operative arthrofibrosis, infection, or deep-vein thrombosis (DVT).

Discussion

The results of this study support our hypothesis that the clinical and functional results of ACL reconstruction in patients over the age of 50 are similar to those in younger patients.

The population of the United States is ageing. According to the most recent Census Bureau data,³⁵ the number of residents aged 65 and older will reach almost 40 million by the year 2010. Previous authors have demonstrated that the results of ACL reconstruction in the middle-aged athlete are comparable with those in younger patients.^{7,12,13,15,17,18,22,23,36-39} The mean age for patients in these studies ranged from 43 to 46 years. At what point should age become a contraindication to reconstruction of a ruptured ACL?

As with previous studies, our patients aged 50 years or older presented with pain, swelling, giving way, and abnormal function with activity, following ACL injury. Ciccotti et al⁴ reported that 97% of conservatively-treated patients had Lachman values of 2+ or greater, and 67% treated non-operatively had a 2+ pivot shift. Buss et al⁵ reported a 52% failure rate among patients treated conservatively, using the Hospital for Special Surgery ligament scoring system.

In the present study, nearly all the patients achieved satisfactory clinical results after ACL reconstruction. To our knowledge, there are only two other studies in the literature that focus exclusively on ACL reconstruction in patients over 50 years of age.^{16,24} Blyth et al¹⁶ described 30 patients with a mean age of 55 years (50 to 66), whose functional outcomes were satisfactory as measured by Lysholm, IKDC and Tegner scores. Meniscal and chondral changes had a statistically negative effect on the results. Despite longer

mean follow-up, statistically significant effects of meniscal and chondral changes on the outcome were not found in our cohort. In a study by Stein et al,²⁴ 19 patients with a mean age of 54 years (49 to 64) were followed for a mean of 24 months (9 to 48). Statistical measures of improvement from the pre-operative status were not discussed. However, patients had satisfactory Lysholm scores, stability and range of movement at the final follow-up. Neither study commented on pre-operative limb alignment.

The presence of significant pre-operative osteoarthritis or limb malalignment may affect the results of ACL reconstruction. Patients in our series had minimal signs of arthritis or malalignment on radiographs prior to surgery, and post-operative functional scores were independent of their Kellgren-Lawrence scores. Although the majority of our patients had concomitant meniscal or chondral injuries pre-operatively, the functional outcomes were not statistically affected at final follow-up. However, two patients in our series who underwent revision did show final Kellgren scores of 2 and 3 after a further ACL reconstruction. The numbers in our study are not large enough to make definitive conclusions, but it is possible that revision surgery may be associated with an increased risk of degenerative change at follow-up.⁴⁰

The clinical and functional results of our study are comparable with those previously reported in young and middle-aged patients.^{7,12,13,15,17,18,22,23,36-39} For example, Plancher et al³⁹ reviewed patients aged over 40 years in whom 71 of 75 knees (95%) had post-operative Lachman values of 1+ or less. In a study by Brandsson et al,³⁶ two groups of patients aged < 24 years and over 40 years underwent ACL reconstruction. The two groups did not differ significantly in terms of IKDC, Lysholm (89 vs 91), or Tegner (5 vs 6) scores. Bohnsack et al¹² compared patients ranging in age from < 20 years to > 40 years, found the mean Cincinnati (91), Lysholm (90), and Hospital for Special Surgery (94% excellent/good) scores to be excellent, with no significant differences between age groups.

A reason for hesitation in performing ACL reconstruction in older patients might be anxiety about potential complications.^{16,39} We had no cases of arthrofibrosis, infection or thromboembolic complications. Reported rates of graft failure range from 0.7% to 10%.⁴¹⁻⁴⁷ Our failure rate of 8.6% falls in the upper part of this range. No patient required total knee replacement during the follow-up period.

The limitations of this study were that it was retrospective, included several surgeons and lacked a standardised surgical technique. The exact number of patients successfully treated by non-operative management at our institution during the same period was unknown. Thus, our operatively-treated patients could be compared only to historical controls.

We conclude that the clinical and functional results of ACL reconstruction in patients aged 50 and over are similar to those in younger patients with no increased risk of complications.

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