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Medial meniscal and chondral pathology at the time of revision anterior cruciate ligament reconstruction results in inferior mid-term patient-reported outcomes

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Abstract

Purpose Anterior cruciate ligament (ACL) injuries are frequently not isolated injuries and damage to the menisci and articular cartilage surfaces is common. The concomitant presence of meniscal and chondral damage has the potential to influence patient outcomes following ACL reconstruction surgery and especially following revision ACL reconstruction where these findings are more common. However, study results regarding the mid-term outcome have been inconsistent. The purpose of this study was to compare mid-term patient-reported outcomes and return to sport in patients with and without meniscal and chondral pathology at the time of revision ACL reconstruction surgery.

Methods A cohort of 180 patients (131 males, 49 female) with a mean age of 25.3 (SD 7.8) years participated at an average follow-up time of 4.6 (SD 1.3) years after revision ACL reconstruction surgery. All patients completed the IKDC Subjective, Marx Activity, KOOS-Quality of Life (QOL) and Single Numerical Assessment (SANE) scores. In addition, patients were asked to indicate the highest level of sport to which they had returned following their revision surgery. Any further injuries to either knee were also documented. Patients were grouped according to whether or not they had medial or lateral meniscal pathology at the time of revision surgery; and whether or not they had > 50% depth chondral damage (ICRS 3 or 4). All outcomes were compared between these groupings.

Results Patients with medial meniscal pathology had significantly lower Marx, KOOS-QOL and SANE scores than patients without. There were no differences in any outcome score between patients with and without lateral meniscal pathology. Patients with ICRS 3 or 4 chondral pathology had significantly lower scores on all patient-reported outcomes as well as a lower rate of return to the same level of pre-injury sport.

Conclusion The presence of more severe chondral damage at the time of revision ACL reconstruction has a negative impact on functional outcomes, activity levels and return to sport rates. In addition, the presence of medial meniscal pathology was associated with significantly lower functional and quality of life scores than patients without pathology. These findings provide important clinically relevant data on the outcomes following revision ACL reconstruction with concomitant chondral and meniscal injury.

Level of evidence III.

Keywords Meniscus · Cartilage · Revision anterior cruciate ligament reconstruction · Outcomes

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Introduction

Anterior cruciate ligament (ACL) injuries are frequently not isolated injuries and damage to the menisci and articular cartilage surfaces is common [13]. The concomitant presence of meniscal and chondral damage has the potential to influence patient outcomes following ACL reconstruction surgery. However, study results have been inconsistent. In terms of meniscal pathology, some studies have reported inferior patient-reported outcomes with concomitant ACL

reconstruction and meniscal treatment [8, 15, 27] while others have shown similar results both in short- to mid-term [18, 24] and in long-term follow-up [14, 20]. Results have been more consistent for chondral pathology, where inferior patient-reported outcomes have been recorded when chondral pathology is present at the time of reconstruction surgery [8, 25, 26].

The above referenced data are all in the setting of primary ACL reconstruction surgery, and there is considerably less information available regarding the impact of meniscal and chondral pathology on patient outcomes following revision procedures. This is despite the fact that the presence of meniscal and chondral pathology tends to be higher in the setting of revision surgery [33]. The MARS group recently published data on whether meniscal and cartilage pathology at the time of revision ACL reconstruction surgery predicted a range of outcomes at 2 years [12]. Results showed that lateral meniscectomy and grade 3–4 chondral change in the trochlea were associated with significantly more functional limitations and more pain and stiffness. Lateral meniscal pathology (either past or present) was shown to have a greater impact on outcomes than medial meniscal pathology. While the MARS cohort is a large multicentre initiative, a single surgeon series can tightly control operative decision making and add to the currently limited information regarding the impact of meniscal and chondral pathology in the setting of ACL revision surgery.

The purpose of this study was also to compare mid-term patient-reported outcomes and sport activity in patients with and without meniscal and chondral pathology at the time of undergoing revision ACL reconstruction, but in a single surgeon series. The authors hypothesised that the presence of meniscal and articular cartilage pathology would lead to poorer patient outcomes.

Materials and methods

Human Research Ethics Committee approval was obtained for this retrospective cohort study (La Trobe University S15-17 and Epworth HealthCare LR115-13). A list of patients who had undergone revision ACL reconstruction surgery was created from a surgical audit database. First time revision ACL reconstructions performed by a single experienced knee surgeon were included. Patients were excluded if they had additional knee ligament surgery at the time of primary or revision ACL reconstruction, or did not regularly participate in sport prior to their original ACL injury. Patients were minimum 2 years post-revision reconstruction surgery when invited to participate in the study.

Eligible patients were asked to complete a survey which included the IKDC Subjective, Marx Activity, KOOS-Quality of Life (QOL) and Single Numerical Assessment

(SANE) scores. Patients were instructed to complete these scales based on their current function. In addition, patients were asked to indicate the highest level of sport to which they had returned following their revision surgery relative to their pre-injury sport, with the options of same or higher level, lower level, or not returned. Any further injuries to either knee were also documented.

The survey was administered in an online format and patients were contacted via a mobile phone short-message service that directed them to a link to the survey. The survey was administered using Survey Monkey software [SurveyMonkey Inc (US)]. People who did not respond were subsequently contacted by telephone and a follow-up letter. Patients who received mail contact were sent paper copies of the survey and a reply paid return envelope.

Surgical details were obtained from the patient's medical record. Meniscal tears were classified according to location (medial or lateral) and pathology (tear or previous resection) at revision surgery. Patients were then classified as having or not having medial or lateral meniscal pathology (yes/no for each). Patients were also classified according to the severity of chondral damage at revision—less than or greater than 50% thickness cartilage damage (ICRS 0/1/2 or 3/4)—based on the most severe lesion present in the knee.

Statistical analysis

IKDC subjective, Marx Activity, KOOS-QOL and SANE scores were compared between patients with and without meniscal pathology (medial and lateral pathology were analysed separately), and also between patients with ICRS 0/1/2 or 3/4 articular cartilage changes using the Mann–Whitney U mean rank test, as all outcomes were not normally distributed. Sample size calculations determined that a total of 134 patients would provide 80% power to detect medium effect sizes at an alpha of 0.05. Contingency tables were used to determine whether returning to sport differed with having medial or lateral meniscal pathology, or ICRS 3/4 chondral damage at revision surgery. Data were analysed using SPSS statistics (Version 23 Armonk, NY: IBM Corp) software and significance was set at $p < 0.05$.

Results

There were 244 eligible patients identified of which 202 participated (83%). Of those who participated, data from 22 patients were not included in the analysis as complete follow-up data for all outcome measures were not available. The final cohort, therefore, consisted of 180 patients (131 males, 49 female) with a median age of 23 (range 16–55)

Table 1 Comparison of Marx, IKDC subjective, KOOS-QOL and SANE scores in patients with and without medial meniscal pathology

	Medial meniscal pathology ($n=93$)	No medial meniscal pathology ($n=87$)	p value*
Marx	7.0 (5)	9.2 (6)	0.004
IKDC	67.2 (14)	70.5 (13)	N.S
KOOS (QOL)	60.6 (21)	69.0 (21)	0.006
SANE	72.1 (22)	79.9 (15)	0.027

Values are mean (standard deviation)

N.S. non-significant

*Mann–Whitney *U* mean rank test

Table 2 Comparison of Marx, IKDC subjective, KOOS-QOL and SANE scores in patients with and without lateral meniscal pathology

	Lateral meniscal pathology ($n=63$)	No lateral meniscal pathology ($n=117$)	p value*
Marx	8.1 (5)	8.1 (6)	N.S
IKDC	67.8 (14)	79.3 (13)	N.S
KOOS (QOL)	63.6 (22)	65.20 (20)	N.S
SANE	74.5 (22)	76.7 (18)	N.S

Values are mean (standard deviation)

N.S. non-significant

*Mann–Whitney *U* mean rank test

Table 4 Number (percentage) of patients who returned to the same/higher pre-injury sport level according to the presence and absence of medial meniscal, lateral meniscal and ICRS 3/4 chondral pathology

	Pathology present	No pathology	p value*
Medial meniscus	38/93 (41%)	45/87 (52%)	N.S
Lateral meniscus	24/63 (38%)	59/117 (50%)	N.S
Chondral ICRS 3/4	16/47 (34%)	67/113 (59%)	0.05

N.S. non-significant

*χ^2 test

Return to same/higher pre-injury sport level

Although a lower proportion of patients with medial or lateral meniscal pathology returned to the same or higher pre-injury level of sport after revision surgery, the difference was not statistically significant. Return to the same or higher level of sport was significantly lower in patients without ICRS 3/4 chondral pathology (Table 4).

Further ACL injury

Nineteen patients suffered a graft re-rupture and had further revision surgery, while three patients with graft re-rupture chose not to undergo another revision procedure. Eleven patients had a subsequent contralateral ACL reconstruction.

Thirteen of the 22 (59%) patients who ruptured the graft had medial meniscal pathology at their first revision procedure compared to 80/158 (51%) who did not sustain further injury to the graft (n.s.). Only 4 (18%) patients who ruptured the graft had lateral meniscal pathology compared to 59 (37%) patients who did not sustain a further graft injury (n.s.).

Discussion

The main finding of this study was that patients with more severe chondral pathology at the time of revision ACLR had significantly lower patient-reported outcome scores

years. The median follow-up time after revision ACL reconstruction surgery was 4.4 years (range 2–8 years).

IKDC subjective, Marx, KOOS-QOL and SANE scores

Patients with medial meniscal pathology at revision surgery had significantly lower scores for Marx, KOOS-QOL and SANE scores than patients without pathology (Table 1). There was no significant difference in IKDC subjective scores between patients with and without medial meniscal pathology. There were also no differences in any outcome score between patients with and without lateral meniscal pathology (Table 2). Patients with ICRS 3/4 chondral pathology had significantly lower scores on all four patient-reported outcomes (Table 3).

Table 3 Comparison of Marx, IKDC subjective, KOOS-QOL and SANE scores in patients with ICRS 3/4 chondral pathology and those with ICRS 0/1/2 changes

	ICRS 3/4 ($n=47$)	ICRS 0/1/2 ($n=133$)	Z score	p value*
Marx	6.2 (6)	8.8 (5)	− 2.7	0.008
IKDC	63.2 (15)	70.8 (13)	− 3.0	0.003
KOOS (QOL)	57.6 (24)	67.1 (20)	− 2.4	0.015
SANE	66.8 (25)	79.1 (16)	− 3.2	0.002

Values are mean (standard deviation)

*Mann–Whitney *U* mean rank test

compared to those with no or less severe changes at a mean follow-up of 4.6 years. In addition, those patients with medial meniscal pathology at the time of revision surgery had significantly lower functional and quality of life scores than patients without pathology. Interestingly, no difference was found in any outcome score between patients with and without lateral meniscal pathology.

The incidence of meniscal and chondral pathology at the time of revision ACLR has been found to be higher than at primary ACLR [33]. Although the rates are variable between studies, they are typically high, with ranges between 36 and 75% for meniscal pathology and 24–67% for chondral lesions [9, 19, 21, 22, 32]. In the current study, the incidences of medial and lateral meniscal pathology at the time of revision ACLR were 52 and 35%, respectively, consistent with previous reports. In this study, a distinction was made between more severe chondral changes and lesser or no changes. The incidence of more severe chondral damage was 26%, at the lower end of the range of the incidence of any chondral change reported in previous studies, but consistent with the findings of a systematic review focusing on the outcomes following revision ACLR [33]. The authors noted that grade 3 and 4 articular cartilage changes were present in 21% of cases, while grade 1 and 2 were much more common and were present in 78.9% of cases [33]. In a study of the Swedish National Register, Kvist et al. noted that all KOOS subscales were lower in revision patients compared to primary ACLR [17]. The increased rates of articular cartilage damage in the revision group were presumed to be associated with the worse patient-reported outcomes at 5 years. These results correlate with the present study, which demonstrated that in addition to KOOS (QOL), IKDC, and SANE scores were significantly lower in the patients with chondral pathology at a mean of 4.6 years following revision ACLR.

Further evidence of the negative effect that chondral and meniscal pathology on functional results and patient-reported outcomes following revision ACLR can be found from the Multicenter ACL Revision Study (MARS) Group [12]. In a cohort study of 1205 patients who underwent revision ACLR, the MARS group determined that prior lateral meniscectomy and grade 3–4 chondral damage of the trochlea, classified according to the modified Outerbridge system, were associated with worse outcomes in terms of decreased sports participation, more pain, more stiffness, and more functional limitation at 2 years [12]. The MARS results reflect data from 83 surgeons at 52 different institutes. The results of the current study represent a single surgeon series followed up over a mean of 4.6 years and reveal similar results, albeit that the presence of medial meniscal pathology rather than lateral meniscal pathology was associated with a poorer functional

outcome and quality of life scores. To explain the difference in these results, it is important to consider that in the current study the presence of meniscal pathology was recorded and not the treatment intervention performed at the time of surgery. Shelbourne et al. have previously reported that lateral meniscal tears are a common finding at the time of primary ACLR and can be treated successfully with abrasion and trephination or by being left in situ [28, 29]. The policy of the treating surgeon to be minimalist with the treatment of tears to the lateral meniscus, particularly partial tears of the posterior root, which may explain why the presence of lateral meniscal pathology had less of an impact on any outcome scores. No difference in any outcome score was found between patients with and without lateral meniscal pathology.

Meniscal lesions are present in over 60% of knees with an ACL ruptures [1, 3, 7, 16, 31]. In the setting of acute ACL rupture, lateral meniscal tears occur with slightly greater frequency than medial meniscus tears, with a mean incidence of 56–44%, respectively [30]. However, in the setting of chronic ACL deficiency, medial meniscus tears have been reported to be more common [30]. This was also the case in the present study. Patients with medial meniscal pathology at revision surgery, whether as a result of a previous meniscectomy or a new tear, had significantly lower scores for Marx, KOOS-QOL and SANE scores than patients without medial meniscal pathology. Although the MARS group found that the impact of a medial meniscectomy on patient-reported outcomes was not as great as that of a lateral meniscectomy, there was nevertheless a significantly increased odds ratio of pain, stiffness and symptoms, which would be in keeping with the findings of the present study [12]. However, in contrast to the MARS group findings, in the current study the KOOS (QOL) was significantly reduced in patients with medial meniscal pathology. One possible explanation for this is the longer follow-up time in present study—mean 4.6 years compared to 2 years in the MARS group [12]. Neither study identified a statistical difference in subjective IKDC in patients with or without medial meniscal pathology.

The normal kinematics of the knee relies upon the integral link between the ACL and the menisci [23]. Papageorgiou et al., in a cadaveric biomechanical study focusing on the important relationship between the ACL and the medial meniscus, determined that in the setting of ACL deficiency the forces on the medial meniscus when moving from full extension to 90° knee flexion were doubled compared to the intact knee [23]. Likewise, the in situ forces in the ACL graft increased between 33 and 50% after medial meniscectomy [23]. This may go some way to explaining the high incidence of meniscal pathology seen at revision ACLR. However, no statistical difference was found in the incidence of medial meniscal pathology between

those who had a further rupture of the revision ACL graft (13/22–59%) and those that did not sustain further injury (80/158-51%). The same was also true for lateral meniscal pathology.

Return to pre-injury sport at the same or a higher level compared was significantly greater in patients with less severe or no chondral changes, but was not significantly affected by the presence of medial or lateral meniscal pathology. Return to sport rates following revision ACLR have been found to be consistently lower than those of primary ACL reconstruction [2–6, 10, 11]. In a systematic review, Andriolo et al. reported that 57% of patients did not return to the same pre-injury level of sport activity [3]. Grassi et al., in a similar study, reported that while 85.3% of patients returned to some level of sport activity, only 53.4% of patients returned to pre-injury sport levels [11]. Unfortunately, an assessment of the chondral or meniscal status was not included in these studies. Anand et al., in a study of 109 revision ACL reconstruction patients reported a return to pre-injury level of sport rate of 46% and found that patients with < 50% articular cartilage thickness lesions at the time of revision surgery were more likely to return to their pre-injury level of sport [2]. The current study of 180 patients found return to sport was significantly greater in patients with no or less severe chondral pathology compared to those with more severe damage. Although a lower proportion of patients with medial and lateral meniscal pathology returned to the same or higher pre-injury level of sport after revision surgery, the difference was not statistically significant.

The authors acknowledge that there are potential limitations related to this study. The presence of meniscal pathology was recorded and not the treatment intervention performed at the time of surgery. This was done on the basis that any damage to the meniscus probably affects its function. In addition, the specific location of the cartilage lesions was not identified, merely the grade of the cartilage lesion. This was done to provide meaningful data in terms of statistical analysis. This study did not include the objective clinical data related to the patient cohort but focused on the functional outcome, activity levels, and return to sport rates.

It crucial for surgeons to set realistic expectations for patients prior to surgery; this is especially pertinent in the setting of revision surgery. The findings of the current study are important to enable surgeons to counsel patients on the expected outcomes of surgery based on the intra-articular pathology present at the time of revision ACL reconstruction. This may potentially include recommendations for activity modifications and cessation of high-risk activities in the setting of severe chondral or meniscal damages.

Conclusion

The presence of more severe chondral damage at the time of revision ACL reconstruction has a negative impact of functional outcomes, activity levels and return to sport rates. In addition, the presence of medial meniscal pathology was associated with significantly lower functional and quality of life scores. These findings provide important clinically relevant data on the outcomes following revision ACL reconstruction with concomitant chondral and meniscal injury.

Compliance with ethical standards

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