Meniscal Preservation is More Likely When Performed with Acute Anterior Cruciate Ligament Repair Rather Than with Anterior Cruciate Ligament Reconstruction

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Abstract

Background

Rupture of the anterior cruciate ligament (ACL) often occurs in conjunction with meniscal tears. In this study we investigate the rates and outcomes of meniscal repair surgery performed with ACL reconstruction compared with acute ACL repair surgery.

Methods

Data was collected for all patients undergoing surgery for ACL ruptures between 2012 and 2018, including ACL reconstruction with hamstring autograft and primary ACL repair augmented with suture tape. Patients undergoing multiligament surgery was excluded. Meniscal injury was evaluated intra-operatively and the treatment determined by type of tear, reducibility, and quality of meniscal tissue. If possible, tears were repaired using all-inside anchors and all others were resected.

Results

There were 272 ACL reconstructions and 134 ACL repairs, mean age was 28 (± 9) and 35 (± 14) years respectively ($p < 0.01$). The mean Tegner activity score was 6.6 in both groups. The mean interval from injury to surgery was longer in the reconstruction group (26.2 v 1.3 months, $p < 0.01$). 55% of reconstructions and 43% of ACL repairs required meniscal surgery at the time of their ACL procedure. In the reconstruction group 123 (70%) were meniscectomies and 53 (30%) were meniscal repairs, compared to 31 (50%) of each in the ACL repair group. Meniscal repair was more likely to be possible when carried out as part of acute ACL repair surgery, $\chi^2(1, n=238)=7.94, p < 0.01$. The success rate of meniscal repair was 97% in both groups.

Conclusions

The rate of meniscal repair is 67% higher when performed early with ACL repair. When ACL reconstruction is performed, meniscal resection was more likely. Rates of post-traumatic osteoarthritis are high after ACL reconstruction when performed with meniscal resection. Furthermore, the success rate of meniscal repair in conjunction with ACL surgery is high (97%). Therefore, meniscal repair should be encouraged whenever possible to improve long term outcomes.

Level of Evidence: III

Introduction

Rupture of the anterior cruciate ligament (ACL) is a common injury associated with pivoting sports and often occurs in conjunction with meniscal tears [1, 2]. It is well understood that an ACL injury is associated with a high chance of developing osteoarthritis in that knee, despite reconstruction [3–5].

Meniscal injuries occurring either at the time of the ACL injury or subsequently increase the risk of osteoarthritis [6–8].

The treatment of meniscal injury at ACL surgery varies [2]. Rates of meniscal resection remain high when carried out with ACL reconstruction, despite concerns regarding its contribution to the development of osteoarthritis prompting a move towards meniscal preservation [9, 10]. Noyes and Barber Westin (11) performed a systematic review and identified that resection remains the most common treatment of meniscal injury in the ACL deficient knee undergoing reconstruction, occurring in 65% of knees with meniscal repair in only one third.

Pujol and Beaufils (12) demonstrated in a systematic review, outcomes in favour of leaving small lateral meniscal lesions untreated, rather than resection, during ACL reconstruction due to low failure rates. Whilst some authors have attempted to synthesise the literature regarding when to resect, repair or leave alone there remains no evidence-based consensus [13]. Despite that, improved understanding of the biomechanical function of the meniscus in conjunction with the wide availability of advanced arthroscopic repair techniques have made meniscal preservation more desirable and widely practised.

Outcomes of meniscal repair surgery performed at the same time as ACL reconstruction are superior to when performed in isolation [14, 15]. Any evidence which exists regarding outcomes of meniscal surgery with ACL surgery relates to ACL reconstruction. There is no literature regarding incidence of meniscal surgery and the outcomes associated with modern primary ACL repair techniques.

In this study we aimed to investigate the rates and outcomes of meniscal repair surgery performed with ACL reconstruction and compare with the rates when performed with acute ACL repair with internal brace surgery. We hypothesised that there would be no difference in rate of meniscal preservation surgery between ACL reconstruction and ACL repair.

Methods

Data was collected for all patients undergoing surgery with our group for ACL rupture between June 2012 and September 2018 and split into two groups: those having ACL reconstruction with hamstring autograft and those having primary ACL repair augmented with suture tape. The suitability for primary ACL repair surgery was determined by the surgeon intra-operatively depending on location of the ACL tear and quality of residual ACL tissue. Those with multi-ligament injuries were excluded. Meniscal injury was evaluated intra-operatively and the treatment determined by the surgeon based upon location and size of tear, reducibility of the displaced fragment and quality of meniscal tissue. Meniscal tears which met the criteria were repaired using an all-inside technique with anchors and the others were treated with partial meniscectomy. The hardware used for meniscal repair was either FiberStitch™ anchors (Arthrex, Naples, Florida, USA) or Fast-Fix™ (Smith and Nephew, Watford, UK). Patients were followed up directly for 6 months postoperatively and at the time of the study, were contacted and case notes reviewed to identify any further surgery to the knee. Information recorded were basic demographics, mechanism of injury,

Tegner activity score, interval between injury and surgery, the nature of any meniscal surgery performed and any further meniscal surgery.

Descriptive statistics were calculated to summarise the demographics and clinical characteristics and described with means and standard deviations for normally distributed data or median with ranges for non-normally distributed data. Normality was assessed using the Shapiro–Wilk test. Unpaired students t-tests or Mann-Whitney U tests were performed to compare variables between groups. Chi-squared tests used to identify differences in occurrence rates between groups and the significance level set a $p < 0.05$. Correlations were investigated using Pearson or Spearman correlation coefficient as appropriate. All analyses were performed with SPSS, version 27 (IMB, Chicago, IL, USA). Ethical approval for the study was granted by the University of Strathclyde ethics committee (UEC19/24).

Results

A total of 410 patients were included, with 4 lost to follow up leaving 272 (67%) who had ACL reconstruction and 134 (33%) primary ACL repair with internal bracing. The mean age for the reconstruction group was 28 (± 9) years and for repair was 35 (± 14) years ($p < 0.01$) and there were a higher proportion of males in the reconstruction group (82% versus 56%, $p < 0.01$). Pre-injury activity level was the same in both groups, median Tegner score 7 (range 1 – 10), and most injuries were sustained during sport with soccer, rugby and skiing contributing to approximately 70% overall. There was no difference in follow-up time, which was a mean of 5 years for both groups, with minimum follow-up period of 2 years postoperative. The median interval from injury to surgery was significantly longer in the reconstruction group (12 months v 1 month, $p < 0.001$) (Figure 1).

In total, 208 patients (51%) required meniscal surgery at the time of their ACL procedure, 55% of reconstructions and 43% of all ACL repairs. There was no difference between groups for which meniscus was injured (51% lateral meniscus) with a total of 238 meniscal surgeries performed. Of these, in the reconstruction group 123 (70%) were meniscectomies and 53 (30%) were meniscal repairs compared to 31 (50%) and 31 (50%) respectively in the ACL repair group. (Figure 2) A chi-square test of independence was performed which demonstrated that meniscal repair was more likely to be possible when carried out as part of acute ACL repair surgery, $\chi^2 (1, n = 238) = 7.94, p < 0.01$. Figure 3 shows the breakdown of specific meniscal surgery for each group.

There was an inverse correlation between repairability of meniscus and time interval from injury to surgery ($r_s = -0.27, p < 0.01$). Considering all meniscal tears, those which were deemed to be repairable had a significantly shorter median interval from injury to surgery (5 months) than those which were irreparable (12 months) ($p < 0.001$) (Figure 4). We grouped all patients, irrespective of ACL surgery type, by time intervals from injury to surgery (Figure 5). This shows a significant decrease in repairability rate of meniscal tears as the wait time increases from 0 to 3 months, to 4 to 6 months. After 6 months, the rate of meniscal repairability plateaus around 30%.

Patients undergoing meniscal repair rather than resection also tended to be younger, mean age 27 versus 32 ($p=0.003$). For those tears requiring partial meniscectomy compared to those which did not, there was a statistically significant difference in the time interval to surgery for medial tears ($p<0.001$) but not for lateral tears ($p=0.11$).

The success rate of meniscal repair surgery was not different between ACL treatment group, 96.3% for reconstruction versus 96.7% for ACL repair, and not influenced by time interval.

Discussion

The main finding of this study was that the rate of meniscal repair surgery is 67% higher when the surgery is performed early in conjunction with ACL repair surgery compared to conventional ACL reconstruction. When ACL reconstruction is performed in our group, meniscal resection is more likely.

It is well understood that following an ACL rupture, rates of early onset post-traumatic osteoarthritis are high, and not necessarily influenced by ACL reconstruction [9, 16–19]. Rates of osteoarthritis may actually be higher when ACL reconstruction performed, with or without meniscectomy [5, 16].

Furthermore, resection of meniscus is associated with a marked increase in the rate of development of osteoarthritis. Indeed, recent studies from registry data in the UK have demonstrated that young patients who have partial meniscectomy have a forty-fold increase in lifetime risk of requiring knee arthroplasty [9]. Therefore, retention of meniscal tissue by repair should be encouraged whenever possible. In fact, when carried out in conjunction with ACL surgery, the success rates of meniscal repair are known to be greater, as high as 94% [15]. This finding was re-enforced with the findings of this study, which showed a success rate of 96% for meniscal repair in conjunction with ACL surgery.

The main difference between the ACL treatment groups was the time interval between injury and surgery and it is this factor that likely contributed to the difference in repairability of meniscus, as supported by the correlation found in this study. Over time, the torn meniscal tissue quality deteriorates and is more difficult to reduce, rendering it irreparable. For this reason, early intervention should be encouraged, but is often not possible due to health service waiting times, or the desire to try conservative rehabilitation prior to surgery. For ACL repair surgery to be possible it requires to be performed within approximately three months, but as soon as possible after the acute trauma to the knee has settled. In this study, for all patients, the rate of meniscal repair was significantly highest when ACL surgery was performed within three months of injury, while rates were lowest after a six month delay, plateauing from that point on. From this data, we suggest that for the sake of meniscal preservation, surgery should be performed within three months, but no later than six months post-injury.

Slauterbeck, Kousa (20) demonstrated an increase in meniscal and chondral injury frequency and severity with increasing time to surgery. Theoretically, ACL surgery could prevent these injuries by stabilising the knee and preventing unpredictable episodes of knee giving way which place the structures at risk. Several authors have made recommendations for the timing of ACL reconstruction to avoid

further meniscal injuries, however they are contrasting; 3 months [20, 21], 6 months [22] and 1 year [23] have all been proposed. It is recognised that healthcare system constraints may be the limiting factor, despite an appreciation that delays may increase the likelihood of chondral or meniscal pathology [24].

A cross-sectional study by Tomihara et al. [25] set about identifying risk factors for irreparable meniscal injuries. Results showed a strong association between irreparable medial meniscal injuries and time from injury to ACL reconstruction surgery of more than 3 months. This finding was re-enforced by this study, which showed that the time to surgery was significantly longer in cases when irreparable medial meniscal tears were present.

In another study, de Roeck and Lang-Stevenson (26) found that over 10% of patients sustained meniscal tears during the time from diagnosis of ACL tear to time of reconstruction rather than at time of ACL injury. This is most likely because of the posterior horn of the medial meniscus having a significant contribution to stability of the ACL deficient knee [27, 28]. Furthermore, Millett, Willis (29) demonstrated a threefold increase in meniscal tears in chronic ACL injury cases of 36% at more than 6 weeks post-injury, compared to 11% in acute cases.

The main limitations of our study are that it was retrospective in its design and there was no randomisation into the two cohorts. Nonetheless, the findings of our study support early intervention for ACL surgery to prevent the development of irreparable meniscal tears, the resection of which is likely to markedly hinder long term outcome. These recommendations have previously been made in connection with early ACL reconstruction [30]. One concern often mentioned with regard to early intervention for ACL surgery is postoperative stiffness and arthrofibrosis, however the rate of post-operative stiffness in this study was low (1%) and not different between treatment groups.

Overall, there remains a distinct lack of high-level evidence with regards to the long term protective role of meniscal repair at time of ACL surgery, in contrast to meniscectomy. The results of this study show that there is an opportunity to explore this avenue further and to boost rates of reparability of meniscal tears by intervening early, in this case with acute ACL repair. This is in addition to the potential benefits that primary ACL repair might have, with rendition of native tissue and proprioceptive fibres [31]. This has the potential to help prevent the challenging problem of post-traumatic osteoarthritis in patients with an ACL rupture and associated meniscal injury.

Conclusion

This study shows that the rate of meniscal repair as an alternative to meniscal resection can be increased by 67% when carried out acutely in conjunction with ACL repair surgery, in comparison to delayed ACL reconstruction. The key factor for meniscal preservation is the time interval from injury to surgery, which should ideally be within three months but no later than six months. Higher rates of meniscal retention as well as retained native ACL tissue could potentially help to reduce long term risk of osteoarthritis.

Declarations

Ethical Approval: University of Strathclyde ethics committee (UEC19/24).

Consent to Participate: Obtained

Consent to Publish: Obtained

Author Contributions: WW & GH conceptualised study, CH & LO were involved in data extraction, WW performed data analysis and wrote the manuscript writing. MB, GH & GM reviewed and edited manuscript.

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Availability of data and materials: All available

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Figures

Figure 1

Boxplot demonstrating the time interval from injury to surgery for each treatment group

Figure 2

Graph showing type of meniscal surgery in each ACL group (%)

Figure 3

Chart showing proportion of meniscal surgery by type and location in each ACL treatment group (LMR= lateral meniscal repair, MMR= medial meniscal repair, PLM: partial lateral meniscectomy, PMM: partial medial meniscectomy)

Figure 4

Boxplot demonstrating shorter time interval from injury to surgery for meniscal tears which were repairable

Figure 5

Graph showing the rate of repair for all meniscal tears grouped by the time interval from injury to surgery