Cartilage lesions are frequently observed during anterior cruciate ligament (ACL) reconstruction. Some of them are asymptomatic but it is currently unknown how they affect short-term clinical outcomes, return to sport or the risk of future osteoarthritis. It is not known if these lesions can change the short- and long-term outcome after ACL reconstruction. It is therefore not clear if these lesions should be treated during the same surgical procedure.

**EPIDEMIOLOGY**

It is important to note that cartilage lesions do not occur only in combination with ACL rupture. The overall prevalence of full-thickness focal chondral defects in athletes has been estimated at around 36%, according to a systematic review reported by Flanigan et al., including 931 subjects. Fourteen per cent of these athletes were asymptomatic at the time of the diagnosis. Therefore, when an ACL tear occurs, it is sometimes difficult to identify whether the cartilage lesion is recent or not.

The presence of cartilage and meniscal lesions in ACL tears is well recognised. Severe cartilage injuries combined with ACL tears occur in 16% to 46% of cases. Meniscal injuries present in 55% to 65% of cases. Rotterud et al. reported on the cartilage and meniscal lesions observed in 8476 knees registered in the Norwegian and the Swedish National Knee Ligament Registry from 2005 to 2008. They found that 27% of the patients had at least one cartilage lesion at the time of the ACL reconstruction. As a comparison, in the same population they found 43% had meniscal lesions, 20% of the patients had an International Cartilage Repair Society (ICRS) grade 1 to 2 cartilage lesion and 7% had a grade 3 to 4 cartilage lesion. These lesions were mostly at the medial femoral condyle (34% to 51%) and approximately half of the lesions had a surface area less than 2 cm².

Tandogan et al. found 19.1% of patients with an ACL tear had at least one chondral injury observed during an arthroscopy. Sixty percent were observed in the medial compartment, mainly on the weight-bearing area of the medial condyle and 67% of the chondral lesions were ICRS grades 1 and 2, while 33%, were grades 3 and 4. The mean surface area was 2.19 +/- 1.75 cm². There was a correlation between the presence of grade 3 or 4 lesions, age and the time between the injury and the arthroscopy.

Cartilage injury can occur both at the time of the initial trauma or, in chronic ACL injuries, as a consequence of a variety of factors, including alteration of tibiofemoral biomechanics and recurrent knee injuries resulting from episodes of instability. The
literature suggests that the incidence rate of cartilage lesions increases in chronic ACL cases in comparison with acute cases. Shelbourne found articular cartilage injury incidence to be more than double in chronic (54%) compared to acute (23%) ACL tears. Joseph et al. showed that both athletes and non-athletes are equally susceptible to long-term cartilage injuries if ACL reconstruction is not performed early. They found a significant increase in meniscal and cartilage injuries 1 year after an ACL tear, if a reconstruction wasn’t performed.

In Tandogan’s study, the odds of having a grade 3 or 4 lesion were 2.7 times greater if the time elapsed from injury was 2 to 5 years versus 1 year. These odds increased to 4.7 when patients delayed surgery for more than 5 years after injury. In this study, multivariate analysis suggested that time from injury and age were equally important predictors of grade 3 or 4 chondral lesions.

Yuksel et al. arthroscopically evaluated the type, localisation and prevalence of meniscal and chondral lesions accompanying complete rupture of the ACL in patients who elected not to restrict their daily activities after the initial trauma. They compared three groups according to time from injury until treatment: acute (0 to 6 weeks), subchronic (6 weeks to 12 months) and chronic (more than 12 months). Chondral lesions were noted to increase with delay to surgery, with rates of 8.9%, 25.9% and 69.9%, respectively, in each group.

Similarly, Michalitis et al., in a series of 109 consecutive patients with ACL rupture found an increased prevalence of high-grade cartilage lesions in ACL-deficient knees when reconstruction was performed more than 12 months after injury.

Anderson et al. found that delayed ACL reconstruction increased the risks of secondary meniscal and chondral injuries in a population of paediatric patients.

Bambrilla et al. found that ACL reconstruction within 12 months of injury can significantly reduce the risk of meniscal tears and chondral lesions. In their study, older age and increased BMI were risk factors for the occurrence of at least one associated lesion.

Therefore, attention should be paid to patients with an elevated BMI and older age when considering the timing of ACL reconstruction surgery if avoidance of cartilage injury is an aim.

Very few studies have evaluated the incidence of cartilage injuries in cases of ACL revision. Wyatt et al. showed in a case series of 261 patients that the prevalence of cartilage injuries increased from 14.9% at primary ACL reconstruction to 31.8% at revision ACL reconstruction. Interestingly, in the same series they observed that the prevalence of meniscal lesions decreased between the two surgeries.

**Cartilage injuries influence outcomes after ACL reconstruction**

Among the predictors of poor outcome 5 to 15 years after ACL reconstruction, cartilage damage is the most important, followed by medial meniscectomy and then lateral meniscectomy.

Rotterud et al. evaluated the effect of articular cartilage lesions on patient-reported outcome 2 years after an ACL reconstruction. They showed that concomitant full-thickness cartilage lesions (grade 3 to 4) in ACL reconstruction have negative effects on knee function (Knee Injury and Osteoarthritis Outcome Score – KOOS) at 2 years follow-up.

Janssen et al. conducted a prospective study of 100 patients who underwent an ACL reconstruction using four-strand hamstring tendon autograft. They showed that, at 10 years follow-up, radiological signs of osteoarthritis were present in 53.5% of the cases. They concluded that
the primary risk factors for osteoarthritis were meniscectomy prior or during the ACL reconstruction and cartilage lesions observed at the time of the ACL surgery.

In a study by Kowalchuk\(^4\) (402 subjects who had undergone primary single-bundle arthroscopic ACL reconstruction at a mean follow-up of 6.3 years) lower International Knee Documentation Committee (IKDC) score was correlated with chondral injuries observed at the time of ACL reconstruction.

Cox et al\(^5\), in a 6-year multi-centre cohort study, concluded that both articular cartilage injury (grade 3 and 4) and meniscus tears/treatment at the time of ACL reconstruction were significant predictors of lower IKDC and KOOS scores 6 years after ACL reconstruction.

However, other studies\(^7,16-18\) have found that cartilage lesions didn’t affect the outcomes after ACL reconstruction. Shelbourne\(^7\) found no difference after 8.7 years. Widuchowski\(^18\) showed that at 10 and 15 years follow-up the presence of a deep cartilage injury found during ACL reconstruction, left with no treatment, does not appear to affect the Lysholm, Tegner and IKDC scores after ACL reconstruction in comparison with a control group.

With the above discrepancy and the absence of consensus, it is difficult to define an accurate algorithm to guide the surgeon in the decision whether or not to repair cartilage lesions during ACL reconstruction. However, knowing that isolated grade 3 or 4 cartilage knee injuries can cause pain, effusion and affect return to sport, it is difficult to ignore cartilage lesions observed during an ACL surgery.

Despite this lack of supporting literature, it seems appropriate to manage high-grade focal chondral defects simultaneously with ACL surgical treatment, particularly if a meniscus lesion is present.

Figure 1: Microfracture and ACL reconstruction performed during the same surgical procedure. In this case, an acute grade 4 cartilage lesion was found on the weight-bearing surface area of the medial condyle (a) and the ACL had a proximal tear (b). A medial condyle microfracture procedure was performed after cartilage flap resection (c) and the ACL was reconstructed using hamstrings graft (d).
**Table 1**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0</td>
<td>Normal</td>
</tr>
<tr>
<td>Grade 1</td>
<td>Nearly normal Superficial lesions. Soft indentation and/or superficial fissures and cracks</td>
</tr>
<tr>
<td>Grade 2</td>
<td>Abnormal Lesions extending down to &lt;50% of cartilage depth</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Severely abnormal Cartilage defects extending down to &gt;50% of cartilage depth as well as down to calcified layer and down to but not through the subchondral bone. Blisters are included in this grade.</td>
</tr>
<tr>
<td>Grade 4</td>
<td>Severely abnormal Osteochondral injuries, lesions extending just through the subchondral boneplate or deeper defects down into trabecular bone.</td>
</tr>
</tbody>
</table>

Table 1: International Cartilage Repair Society grading system for cartilage defects.

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**Results of cartilage repair and ACL reconstruction**

Studies have shown that the treatment of cartilage injuries at the same time as ACL reconstruction has resulted in an acceptable outcome.

Imade et al. found no differences between IKDC scores in patients with concomitant ACL reconstruction and osteochondral lesions treated by drilling, or autologous osteochondral grafting at a minimum follow-up of 1 year, regardless of the differences in arthroscopic grading (using the ICRS classification), however, only 40 patients were included in this control study.

There is a potential for spontaneous healing after cartilage injuries. During ACL reconstruction, intra-articular enrichment in growth factors and progenitor cells might be involved in the repair processes of injured cartilage, as has been observed in meniscal repair. Nakamura et al. showed that at second-look arthroscopy, after ACL reconstruction without any intervention to the articular cartilage, there was significant recovery of chondral lesions by Outerbridge grading on both the medial and lateral femoral condyles. Conversely, there was no significant recovery of chondral lesions observed at the patello-femoral joint or tibial plateaus. They concluded that there was a location-specific difference in the natural healing response of chondral injury.

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**The literature suggests that severe cartilage lesions (grade 3 and 4) should be treated at the same time as the ACL reconstruction**

There is little evidence to indicate whether full-thickness cartilage lesions should be repaired at the time of ACL reconstruction. However, in Rotterud’s study, the difference in outcomes between absence of cartilage lesion, or partial lesion and full-thickness lesion suggests performing a cartilage repair at the same time as ACL reconstruction may be the best treatment option, especially in case of ICRS grade 3 or 4 cartilage lesions.

In addition, further cartilage injury can be prevented by shortening the time between injury and the ACL reconstruction to avoid any episode of instability which likely provokes cartilage lesions.

**Surgical indication — which cartilage lesions must be repaired at the time of ACL reconstruction?**

Patients should be informed at the time of ACL surgery about the possible outcome if there is a full-thickness cartilage lesion observed during the surgery, whether the treatment is conservative or not. It is particularly important in the athlete population where the expectations after ACL reconstruction may not be met if the cartilage lesion causes residual pain or swelling and prevents return to sport.

**CONCLUSION**

The presence of full-thickness cartilage injury in conjunction with ACL tear leads to worse outcomes after ACL reconstruction than those with absence of cartilage lesion or even partial thickness cartilage lesion. These results have been noticed from short-time follow-up and should be confirmed at longer follow-up. There is a lack of understanding concerning the benefit of cartilage repair combined with ACL reconstruction. However, the current literature suggests that a full-thickness cartilage injury observed during an ACL reconstruction should be treated at the same time. A microfracture procedure, chondrocyte implantation or the use of scaffolds are the current options available and are chosen depending on the experience of the surgeon and on the surface of the cartilage damage.

Currently there is no evidence to support the treatment of partial cartilage lesion (grade 1 to 2) during an ACL reconstruction and there are still some questions concerning the potential morbidity of this combined procedure.

The literature suggests that severe cartilage lesions (grade 3 and 4) should be treated at the same time as the ACL reconstruction. The results of these concomitant surgeries are encouraging and could hope to decrease the incidence of future osteoarthritis. More studies should be conducted in the future to evaluate the evidence so that recommendations for specific treatments and techniques can be made according to the type of cartilage lesions (depth, size and localisation).
CONCOMITANT SURGERY

References

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