Meniscal Allograft Transplantation: Results and Indications

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53.1 Introduction

It is now recognised that menisci are important structures in the knee. Their primary role is load distribution, which is achieved by increasing the congruency of the tibio-femoral joint [6, 12, 29]. In the loaded knee, the lateral meniscus transmits 70 % and the medial meniscus 50 % of the load through the respective compartments of the knee [28]. The menisci have also been shown to provide secondary constraint to the knee [15, 16, 18].

Meniscal tears are common; a recent review of NHS knee operations in the UK found that the yearly incidence of meniscus-related surgery was 35 per 100,000 population [10]. Throughout the last century, treatment has shifted from complete excision to meniscal-preserving surgery where possible [2, 8]. Despite this, many tears are irreparable and there is a high failure rate of repaired tears [22]. The consequences of meniscectomy are now well understood. Biomechanical studies have shown that meniscectomy decreases the tibio-femoral contact area by 50–75 % and increases the peak contact pressure by 200–300 % [3, 20, 40]. Clinical studies have shown a high risk of OA following meniscectomy, with a recent meta-analysis finding a mean prevalence of knee OA of 53.5 % (range 16–92.9 %) at 5–30 years following meniscectomy [24].

Meniscal allograft transplantation was first performed in the 1970s as part of an osteochondral allograft resurfacing procedure in patients with post-traumatic osteoarthritis following tibial

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plateau fractures [17, 41]. Free meniscal allograft transplantation was performed in 1984 and it has since been advocated for the treatment of patients with a symptomatic knee following a meniscectomy [21]. Since then, it has undergone a number of refinements and a large number of studies have been published in recent years.

This chapter presents, firstly, the indications for meniscal transplant and, secondly, the published clinical outcome results and data on the chondroprotective effect to support the advised indications.

53.2 Indications

The primary indication for meniscal allograft transplantation is a patient with a symptomatic knee and a history of meniscectomy in the symptomatic compartment. Symptoms may range from exercise-related pain to constant pain, swelling and/or stiffness. The upper age limit is usually 50–55 years of age but has occasionally been performed in older people [32]. It is generally agreed that alignment and stability of the knee should be normal or corrected at the time of surgery [32]. The amount of articular cartilage damage or OA is controversial, with the majority of surgeons reporting moderate or severe degeneration to be an exclusion criterion [32]. However, this is not universal, and some studies have reported reasonable results in these patients. Stone et al. reported a failure rate of 22.4 % of 49 patients with moderate to severe articular cartilage damage, with a mean follow-up time of 8.6 years [35]. Kempshall et al. found a higher failure rate in patients with exposed bare bone at the time of transplantation compared to preserved articular cartilage, although patient-reported outcome measures (PROMs) in patients that didn't fail were similar in both groups [11].

53.3 Patient-Reported Outcomes

Virtually all case series evaluating meniscal allograft transplantation reported in the literature show an improvement in PROMs at latest follow-up [32, 39]. The Lysholm score [36] has been the most commonly used PROM to evaluate the outcome following meniscal allograft transplantation [32]. In 2015, a systematic review showed a pooled baseline score of 55.7 and latest follow-up score of 81.3 (out of 100), across 25 studies [32]. The mean follow-up length for the papers in the systematic review was 5.1 years. The same systematic review also found a weighted mean IKDC subjective knee scores [9] of 47.8 and 70 (across 12 studies) and Tegner scores [36] of 3.1 and 4.7 (across 10 studies) at baseline and final follow-up, respectively. Similar scores have been found in other recent systematic reviews, although some different studies were included, depending on the research question of the paper [26, 39]. Most studies report PROMs at short- to midterm follow-up. One study with one of the longest follow-up periods (mean 13.8 years) showed a baseline Lysholm score of 36 (range 5–86) and latest follow-up of 61 (range 21–91) [37]. One systematic review ordered PROMs by length of follow-up, showing a trend towards worsening PROM scores with time, although still higher than baseline scores [7].

53.4 Return to Sports

It is not universally agreed whether patients should be allowed to return to full sporting activities following meniscal allograft transplantation. Some surgeons place lifelong limits on pivoting/cutting sports due to stress on the transplant and potential risk of failure. However, in published studies, it is more common for surgeons to allow return to full sporting activities by 6–12 months [32]. One study specifically analysed whether return to sporting activities resulted in increased complications or failure, finding no correlation [34]. A limited number of case series have reported return to sports in elite and professional athletes, finding that the majority were able to get back to preoperative sporting levels [27].

53.5 Radiological Outcomes

There have been relatively few studies reporting the radiological outcome following meniscal allograft transplantation. The most commonly

reported outcome is change in joint space width. A recent systematic review found 16 studies (428 knees) that had reported change in joint space width over a mean of 4.5 years [33]. They found a weighted mean narrowing of 0.03 mm over the entire follow-up period. Other studies that used the contralateral knee for comparison found no significant differences, although sample sizes were usually small [25, 30].

A limited number of studies have looked at other radiological tools of OA progression, including the Kellgren and Lawrence classification, IKDC radiological scores and Fairbank classification, showing variable outcomes from limited to advanced OA progression [33]. A few studies have reported changes in articular cartilage on MRI scans following meniscal allograft transplantation [33]. Verdonk et al. reported changes on patients at an average follow-up of 12.1 years, finding no further progression of articular cartilage degeneration on the femoral condyle and tibial plateau in 47 % and 41 % of patients, respectively, including 35 % of patients with no progression on both sides of the joint [38].

Graft extrusion has been extensively reported following meniscal allograft transplantation, although there are wide variations in the timing, method of measurement and measures themselves. A recent systematic review on meniscal transplant extrusion found 23 studies (814 transplants) reporting graft extrusion but were unable to draw conclusions due to the variability of reporting within these studies [23]. Another systematic review reported that in studies reporting absolute extrusion, the mean extrusion was between 1.7 and 5.8 mm [33]. Where studies had reported the relative percentage extrusion, the rates were between 19.4 and 56.7 %.

A number of studies have looked for a correlation between clinical scores and the amount of extrusion, with most studies finding no correlation [33]. Other studies have reported correlations between graft extrusion and other measures: Lee et al. found a more anterior allograft placement correlated with the degree of extrusion [14]; Abat et al. found a suture-only technique resulted in higher extrusion compared to bone plugs [1]; Choi et al. found an association with meniscal extrusion to increased lateral positioning of the bone bridge [5]. However, the clinical relevance of these findings is not known.

53.6 Complications and Failures

Reporting of complications is highly variable across reported case series. The weighted mean complication rate has been reported as between 11 and 14 % following meniscal allograft transplantation, but this is likely to be an underestimate of the true complication rate [26, 32]. A recent large case series of 172 meniscal allograft transplantations reported a reoperation rate of 32 %, which may reflect a more accurate complication rate [19]. The most common complication is retear of the allograft; other complications include synovitis or effusion and superficial infection.

Failure rates, defined as conversion to arthroplasty or removal of the allograft following a tear or failure to integrate, also vary considerably, with the weighted mean failure rate across case series being reported as 10.9 % at 4.8 years [32]. A recent large case series reported a 95 % survival at a mean of 5 years [19]. Case series with longer follow-up show less promising results, with a 33–36 % midterm failure rate being reported across a number of studies [13]. This is also supported by Verdonk et al. who found a 70 % survival at 10 years to be supported by current evidence [39]. It is difficult to know the survival past 10 years, especially as changes in graft type, operative technique and rehabilitation make inferences from historical studies difficult. One of the studies with longest follow-up reported a 29 % failure rate at a mean of 13.8 years following 63 open transplantations [37].

53.7 Discussion

The high risk of symptomatic OA following meniscectomy has been consistently shown over the last few decades in many publications. Meniscal allograft transplantation has been

shown to at least partially restore normal contact forces across the knee, suggesting that it may be able to restore knee biomechanics [20]. Case series have consistently shown that patients have an improvement in PROMs at all follow-up time points, although there is a lack of controlled studies in the literature. These results are encouraging in a patient group with otherwise very limited treatment options. The retear and failure rates are not low, but they must be considered in the context of the severity of symptoms and the lack of effective alternative treatment options.

It is scientifically plausible that meniscal allograft transplantation is chondroprotective, but direct evidence of this is currently limited [31]. The negligible loss of joint space width reported across a number of studies is encouraging. Although direct comparisons to the native knee cannot be made, the relative risk for OA has been shown to be low in patients with joint space narrowing of less than 0.7 mm over 3 years [4]. However, it is not known what effect the allograft itself has on the joint space measurement. Animal model studies have shown meniscal allograft transplantation to be chondroprotective, but these studies have not been replicated in humans to date.

From this data, the evidence appears to justify the stated indication for meniscal allograft transplantation – pain and symptoms in the affected compartment in a young patient with a meniscal-deficient knee. This indication seems to be universal. It is also commonly accepted that alignment and stability should be normal or corrected at the time of surgery. From the evidence, it is not clear whether patients should be offered meniscal allograft transplantation in the presence of moderate or severe articular cartilage damage. It is likely that the success rates are lower, but in the absence of alternative treatments, meniscal allograft transplantation may be a reasonable treatment option for these patients.

Conclusion

Meniscal allograft transplantation is an effective treatment for patients with a symptomatic meniscal-deficient knee. At present, there is not enough evidence to determine whether it is chondroprotective, although some studies support this hypothesis. Whilst alternatives such as tissue engineering may supersede meniscal allograft transplantation in the future, it currently provides the best chance of a functional improvement in carefully selected patients.

Take-Home Messages

- Free meniscal allograft transplantation has now been performed for over 30 years.
- Based on current evidence in the literature, meniscus allograft transplantation is a safe procedure with an acceptable complication rate.
- Current evidence clearly quantifies the clinical benefit observed after MAT, but evidence for the chondroprotective effect remains indirect.
- The evidence supports meniscal allograft transplantation as the treatment of choice for the symptomatic post-meniscectomy knee not responding to conservative therapy.

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