Editorial Commentary: Restoring Native Meniscal Anatomy With Medial Meniscus Allograft Transplantation and Augmentation of the Meniscotibial Ligament May Decrease Meniscal Graft Extrusion

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Abstract: While studies have shown significant clinical improvement after medial meniscus allograft transplantation (MMAT) with good long-term graft survivorship, progression to osteoarthritis still occurs, even in the presence of intact grafts. Several factors can potentially explain the lack of chondroprotection despite graft survivorship, including meniscal degeneration, tearing, and remodeling after the initial procedure. A major factor contributing to progression of osteoarthritis is meniscal extrusion, which is seen in up to 60% of patients and seems to be more of an issue in medial meniscus transplantation compared to lateral and is present even immediately postoperatively. Grafts without extrusion provide protective effects similar to the native meniscus, while greater than 3 mm of extrusion leads to nearly complete loss of the protective effects. A reconstruction of the meniscotibial ligament, in addition to standard MMAT, may significantly decrease meniscal extrusion. Optimization of graft size, quality, and meniscal root positioning is best to prevent extrusion and restore native biomechanics.

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Meniscus deficiency leads to increased cartilage contact pressures, resulting in pain, disability, and accelerated progression to osteoarthritis. Medial meniscus allograft transplantation (MMAT) is a viable treatment option for medial meniscal deficiency in younger patients who do not already have significant arthritic changes in order to improve symptoms and function.[1] A wide variety of techniques are used for MMAT, including suture-only fixation of the meniscal allograft and various bone-bridge and bone-plug techniques.[1] MMAT has been shown to result in improvement of symptoms and function at long-term follow-up.[2] However, studies have shown that there is still progression to significant joint arthritic changes despite good long-term survivorship of the graft.[3]

Several factors can potentially explain the lack of chondroprotection despite graft survivorship, including meniscal degeneration, tearing, and remodeling after the initial procedure. A major factor contributing to progression of osteoarthritis is meniscal extrusion, which is seen in up to 60% of patients undergoing meniscus allograft transplantation.[4,5] Meniscal extrusion seems to be more of an issue in medial meniscus transplantation compared to lateral meniscus transplantation and is present even immediately postoperatively.[6] A recent clinical study evaluating the chondroprotective effects of meniscus transplants showed that grafts without extrusion provided protective effects similar to the native meniscus, while greater than 3 mm of extrusion led to nearly complete loss of the protective effects at long-term follow-up.[7] The findings of this study highlight the importance of preventing meniscal extrusion in order for MMAT to have a long-term chondroprotective effect.

The question of using MMAT augmentation to decrease meniscal graft extrusion was investigated by Condron, Knapik, Gilat, Vadhera, Farivar, Shewman, Yanke, Chahla, and Cole with a biomechanical cadaveric study, "Concomitant Meniscotibial Ligament

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Reconstruction Decreases Meniscal Extrusion Following Medial Meniscus Allograft Transplantation: A Cadaveric Analysis".[8] The experimental set-up in this study was well designed to determine meniscal extrusion under different loading conditions after MMAT with and without meniscotibial ligament reconstruction. The results of the study showed that reconstruction of the meniscotibial ligament in additional to standard MMAT significantly decreased meniscal extrusion based on ultrasound measurements under certain loading conditions. Although the authors should be commended for addressing an important issue following MMAT and providing a potentially promising solution, the limitations of this study must be considered when thinking about the clinical application of the findings. Given that this is a time-zero cadaveric biomechanical study, it does not take into consideration the effect of graft healing and remodeling after cyclical loading, which will significantly affect the final biomechanics of the graft in vivo. Additionally, the differences between the meniscal extrusion with and without meniscotibial ligament reconstruction, while statistically significant, were less than 0.5 mm, which is within the user error of ultrasound measurement and may not be clinically significant for knee function or potential prevention of osteoarthritis in the long term.

Overall, the most important factor in reducing meniscal extrusion following MMAT is restoration of native meniscal anatomy as much as possible. Graft size mismatch has been shown to be significantly correlated with graft extrusion and failure.[9] Similarly, a recent study showed that meniscal graft extrusion was correlated with the amount of change in the meniscal graft root positions from the native meniscal root positions.[10] Thus, optimization of meniscal graft size/quality and meniscal root positioning allows for the best ability to prevent meniscus extrusion and restore native knee biomechanics. The augmentation technique described by Condron et al. in this study also follows the principle of restoring native anatomy by using peripheral meniscocapsular graft tissue to reconstruct the native ligament that stabilizes the meniscus.[8] Ultimately, augmentation techniques used with MMAT, such as the one performed in this study, may help with the issue of meniscal extrusion, but it is important to keep in mind that recreating the native anatomy is key for successful outcomes regardless of what technique is used. While there is currently no clear clinical evidence to support augmentation of MMAT to prevent meniscus extrusion, this study highlights the need for well-designed higher-level studies to determine whether there is a distinct advantage to graft augmentation in the short and long term.

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