Long-term survival of concurrent meniscus allograft transplantation and articular cartilage repair: A prospective 2 – 12 year follow-up evaluation

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Objectives

Loss of the meniscus generates increased forces on the knee cartilage and other joint structures and increases the risk of articular cartilage degeneration and development of arthritis[1,2]. The appropriate treatment for loss of the meniscus with unicompartmental knee arthrosis remains controversial[3,4]: with common treatment being osteotomy, unicompartmental (UNI) or total knee arthroplasty (TKA). Biologic treatment options, including meniscus allograft transplantation (**Figure 1**) and articular cartilage repair, can potentially slow the progression of arthritis without limiting a patient's option for joint arthroplasty in the future.

Meniscus Allograft Transplantation

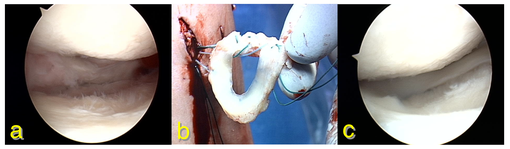

Figure 1. (a) Knee joint showing total loss of meniscus cartilage. **(b)** Surgical insertion of the meniscus allograft. **(c)** Knee joint post meniscus allograft transplantation.

Methods

One hundred nineteen meniscus allograft transplantations were performed in 115 patients with severe articular cartilage damage. All patients underwent an informed consent process as approved by an independent Institutional Review Board. Study inclusion criteria consisted of irreparable injury of the meniscus or loss (more than 50%) of the meniscus with pain and Outerbridge (OB) Grade III or IV changes in the respective compartment and knee range-of-motion of at least 90°. Microfracture was used to treat articular cartilage damage if the defect area was small (≤25 mm^2), if it was located far posterior, or if it was directly under the meniscus allograft transplant on the tibial side. Articular cartilage paste grafting[5] was used to treat accessible defects >25 mm^2. Patients consented to clinical examinations with subjective patient evaluations preoperatively and at 2, 3, 5, 7, and 10-year postoperative intervals. IKDC, WOMAC, and Tegner Index scoring methods were used to follow pain, activity, and function. Tegner Index represents the ratio of current Tegner score as compared with highest pre-injury Tegner score[6]. Procedure failure was defined as removal of allograft without revision, or progression to knee arthroplasty (UNI or TKA)[7,8]. Analysis of overall patient survival was achieved by the Kaplan-Meier survival analysis method. Multivariate analysis using the Cox proportional hazards model was carried out to assess the effect of confounding variables on allograft survival. Secondary analysis of patient reported subjective outcomes data was accomplished using the Wilcoxon rank-sum test for 2 independent non-parametric samples. Significance level was set at $\alpha < 0.05$. Results are presented as mean ± standard deviation. Ninety-five percent confidence intervals (CI), where given, are presented in brackets. Subjective patient outcomes were evaluated in cases with a minimum 2-year follow-up[9] (N = 101).

Results

One hundred nineteen meniscus allograft trans-plantations performed in 115 patients between March 1997 and March 2008 met study inclusion criteria. Patient demographics are shown in **Figure 2**.

Patient population (N = 119)

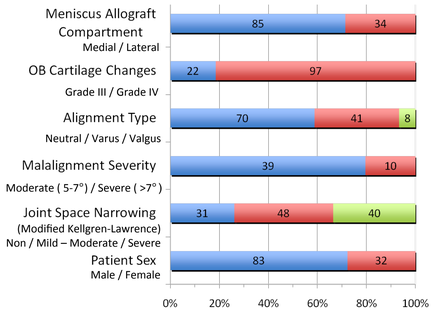

Figure 2. Study population descriptors (N = 119). Bars represent percentage of the total population with actual number of cases in each category superimposed.

Patients underwent an average of 5 concomitant procedures (range, 1-9 procedures). Average follow-up was 5.8 years (range, 2.1 months – 12.3 years). Forty-seven percent of cases required at least one subsequent non-failure related surgery. Kaplan-Meier estimated mean survival time was 9.9 ± 0.4 years (**Figure 3**). Twenty-five of the original 119 procedures failed (20.1%) with a mean failure time of 4.6 years (range, 2 months – 10.4 years); 18 of these cases progressed to knee arthroSplasty (**Table 1**). There was no significant difference in the number of concomitant procedures between those cases that failed (5.3 ± 1.6 procedures) and those that did not (4.9 ± 1.7 procedures), (p=0.333). Utilizing the Cox proportional hazards model, medial vs lateral allografts showed a non-significant hazard (p=0.848). Kaplan-Meier survival analysis showed mean survival times of 9.91 ± 0.46 years [9.02 , 10.80] for medial allograft cases (N = 85) and 10.17 ± 0.78 years [8.64 , 11.71] for lateral allograft cases (N = 34).

Survival distribution with 95% CI

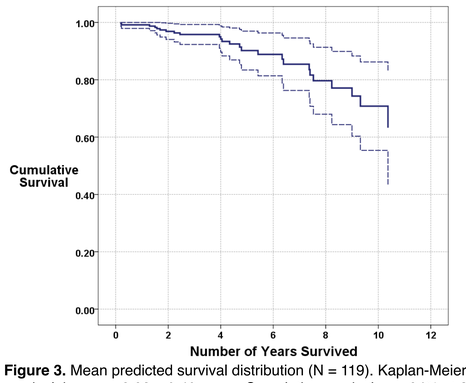

Figure 3. Mean predicted survival distribution (N = 119). Kaplan-Meier mean survival time was 9.93 ± 0.40 years. Cumulative survival was 94% at 2 years; 92% at 3 years; 84% at 5 years; 79% at 7 years; and 67% at 10 years.

Cox proportional hazards model showed significant factors on relative odds of allograft failure were patient age at time of meniscus allograft (p=0.006) and number of previous surgeries to the affected knee (p=0.026). The relative odds of failure between two patients who are equivalent in all factors except one year of age is h=1.061 [1.007 , 1.117]. Number of previous surgeries to the affected knee proved a negative hazard showing h=1.528 [1.133 , 2.065] times greater odds of failure between patients differing only by one more previous surgery.

Allograft failure surgical procedures

	Before 2 Years	2 – 5 Years	5 – 10.5 Years	Total Failures Per Type
Removal	3	2	2	7
UNI	2	3	3	8
TKA	2	3	5	10
Failures Per Time Period (N)	7	8	10	25

Table 1. Depiction of cases that failed before 2 years, between 2 and 5 years, and between 5 and 10.5 years. Failures are broken down by: removal of the meniscus allograft (Removal), unicondylar knee arthroplasty (UNI), and total knee arthroplasty (TKA).

IKDC, WOMAC, and Tegner outcomes are displayed in **Figure 4**. Aside from the Tegner Index score at the 7-year post-operative time interval, all patient-reported subjective outcomes scores showed significant improvement from baseline at all time intervals. Comparison between patient-reported subjective outcomes scores over the 2 – 12 years of follow-up showed no significant changes, indicating maintenance of improvement over time. Median Tegner Index score at the 7-year post-operative time interval showed a non-significant change from baseline (p = 0.076). It should be noted comparison of 7-year scores to baseline is based on a low number of reported scores (N = 21) and that no significant difference is seen when 7-year Tegner Index data is compared with the 2, 3, 5, or 10-year post-operative time intervals.

Patient-reported subjective outcome scores

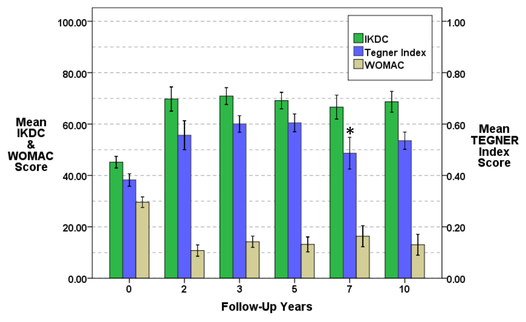

Figure 4. Patients showed significant improvements in IKDC (green) and WOMAC (blue) scores at all time intervals. Patients showed significant improvements in Tegner Index (tan) scores from baseline at all time intervals except 7-years post-operative (p = 0.076)*. No significant differences were found among Tegner Index scores over the course of follow-up. Error bars represent ± 1 Standard Error.

Conclusions

Severe arthritis is often considered a contra-indication for meniscus allograft transplantation. However, in this study of meniscus replacement combined with an articular cartilage repair in a heterogeneous patient population, improvements in pain, activity, and function occurred independent of the classic contraindications of age, severity of arthritis, joint space narrowing, and axial alignment. Due to concomitant procedures per-formed, it is difficult to narrow in on the isolated effect of the meniscus allograft. We speculate that these combined procedures may produce a soft-tissue interpositional arthroplasty, which accounts for some of the improvement. Meniscus allograft trans-plantation, when performed with articular cartilage repair, need not be limited to young patients with minimal articular cartilage damage as demonstrated by the results of this study, which represents the longest and largest evaluation of its kind. Biologic joint reconstruction, rather than bionic (artificial) replacement, may be an appropriate first step for many people with knee joint arthritis.

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For Further Information

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