Original Article

Meniscus Size Differs Between Patient and Donor Populations for Meniscus Allograft Transplantation

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Purpose: To determine the extent of variability in meniscus size and anthropometric data between donors (supply) and patients (demand), to evaluate potential factors that may contribute to size discrepancies, and to determine whether the discrepancies lead to longer patient wait times. **Methods:** Lateral and medial meniscal measurements, anthropometric data, and time to match a donor graft were extracted from a tissue supplier database. The frequency and distribution of meniscus size were analyzed. Body mass index (BMI), relative meniscus area, body mass to meniscus area index, and height to meniscus area index were compared between patient and donor pools via χ^2 tests and independent samples *t*-test. The effect of size on time to match was analyzed using analysis of variance and post-hoc Tukey test. **Results:** The lateral meniscus patient population showed a greater frequency of larger size requirements compared to the donor population ($P < .001$) and the medial meniscus patient population showed a higher frequency of smaller meniscus size requirements ($P < .001$). The medial meniscus analysis showed significantly smaller meniscus areas ($P < .001$) in the patient population contributing to the observed trend of an increased body mass to meniscus area index and height to meniscus area index. The time to match a donor meniscus was affected by the patient meniscus size. **Conclusions:** This analysis demonstrates variations in frequency of meniscus sizes between donor and patient populations. This variation is attributed to differences in anthropometric data between patient and donor populations. This work identifies a mismatch between demand and supply for certain patient sizes contributing to longer times to match. **Clinical Relevance:** This work associated donor and patient mismatches with longer wait times. This can be useful for patient counseling as well as provide a framework to determine whether there are solutions within the current meniscus donor pool that can be used to meet this clinical need.

Meniscus allograft transplantation is one of the few treatments available and effective for treating patients with symptomatic meniscus deficiency.[1,2] Adequate size matching of the donor meniscus allograft to the patient's native meniscus is a critical step that can impact a successful surgery and subsequent patient outcomes.[3] Meniscus-sizing methods that rely on imaging or anthropometric data[4] exist, with the Pollard method via radiograph or magnetic resonance imaging (MRI) being the gold standard.[1] Investigations that correlate anthropometric data, such as height, weight, and sex to meniscal measurements, also have been conducted and may serve as an alternative lower-cost approach for preoperative meniscus size matching.[5,6] Despite these methods to accurately match meniscus donors to patients, and while as-yet

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unpublished, there has been an observed phenomenon among meniscus transplant surgeons and tissue banks that certain meniscus sizes are more difficult to procure. At first glance, one would posit that with a large enough of a sample size (donors and patients) that there would be roughly equal distribution of meniscus sizes available. Thus, if there were difficulties in matching certain meniscus sizes, this suggests that these 2 groups are not equal with regards to meniscus size. Size discrepancies between patient and donor populations could explain the shorter supply and concordant longer wait times for patients with specific meniscus sizes and a surplus of donor menisci at other points along the spectrum. As a result, surgeons may also end up accepting a less-than-ideal meniscus transplant that could compromise patient outcomes.[3] A greater understanding of potential differences between meniscus transplant donor and patient populations is necessary if this issue is to be properly addressed.

The purposes of this study are to determine the extent of variability in meniscus size and anthropometric data between donors (supply) and patients (demand), to evaluate potential factors that may contribute to size discrepancies, and to determine whether the discrepancies lead to longer patient wait times. We hypothesized that variability in meniscus size would exist between donors (supply) and patients (demand) and that these discrepancies lead to longer patient wait times.

Methods

Data Collection and Analysis

This study was considered exempt from institutional review board approval due to the deidentified data that were analyzed. Meniscus length and width measurements as well as anthropomorphic data were collected and extracted from a large U.S. tissue bank database for both donor and patient pools from 2016 to 2019. Anthropomorphic data included sex, height, weight, and anatomic side. Body mass index (BMI) was calculated from height and weight data. Samples were included if meniscus size and anthropometric data were recorded. Donor and patient samples were removed from the dataset and analysis if the data were incomplete or incorrectly entered into the system. Donor and patient data were further segmented by medial and lateral meniscus to analyze whether distributions varied between patient and donors for lateral and medial menisci.

With regards to donor menisci and per-company protocol, the donor meniscus size (length and width) was measured directly using calipers in situ at the time of processing before harvesting. Meniscus length was defined as the anterior to posterior distance from the anterior most aspect of the anterior horn to the posterior most aspect of the posterior horn. Meniscus width was defined as the distance between the meniscus root and the medial or lateral most aspect of the body of the meniscus.

Patient meniscus size, height, weight, sex, and anatomic side were extracted and collected from meniscus requests, which are standard aspects of the forms filled out by physician offices when a meniscus transplant request is made. Patient meniscus measurements were determined using radiographs, MRI, or computed tomography scans and methods established by Pollard et al.[7] In summary, the width was calculated by measuring the distance from the peak of the medial or lateral tibial eminence to the medial or lateral tibial epiphyseal margin for the medial and lateral meniscus, respectively. The length was calculated using the lateral view by measuring 70% and 80% of the sagittal length of the proximal tibia that references the tibial tuberosity anteriorly and the posterior aspect of the lateral tibia plateau posteriorly for the lateral and medial meniscus, respectively.

The time to match a patient to a donor meniscus graft was extracted and calculated from the tissue bank company's database. The time to match was determined by the date of the initial patient request and the date of the first allocation or date a donor was matched to the request.

Distribution of Meniscus Size and Area

To determine whether the meniscus sizes varied between patient and donor groups, distribution plots were generated and analyzed. The meniscus size data for both length and width measurements were categorized and segmented by ±0.2 cm, the industry-allowable tolerance for matching meniscus sizes. The average length, width, and area were measured and compared between donor and patient populations. The meniscus area was estimated using the recorded length and width measurements for patient and donors and using the following equation:

$$\textit{Estimated meniscus area}\ (cm^2) = \pi \times \left(\frac{width}{2}\right) \times \left(\frac{length}{2}\right)$$

Body Mass to Meniscus Index (BMMI) and Height Over Meniscus Size Index (HMI)

To determine factors that may influence meniscus size and area discrepancies between donors and patients, anthropometric data including height, weight, BMI, sex, and laterality were compared between patient and donor populations. The BMI was calculated using the recorded weight and height in kilograms and meters, respectively. To understand the relative meniscus size, the ratio of the weight to estimated meniscus area (kg/cm^2), or BMMI, was measured and compared

Table 1. Overall Differences Between Donor and Patient Populations

Category	Donor	Patient	*P* Value
Male, n (%)	2,296 (72.1%)	294 (51.0%)	<.001*
Female, n (%)	889 (27.9%)	282 (49.0%)	
Left, n (%)	1,677 (52.7%)	271 (47.1%)	.013 *
Right, n (%)	1,508 (47.4%)	305 (53.0%)	
Lateral, n (%)	1,775 (55.7%)	285 (49.5%)	.006 *
Medial, n (%)	1,410 (44.3%)	291 (50.5%)	

*Defines statistical significant with a *P* value lower than .05.

between patient and donor pools. Size discrepancies were further investigated by measuring the height to meniscus size index (cm/cm^2). The ratio of HMI was measured and compared between donor and patient pools.

Time to Matching Evaluation

To determine the effect of patient meniscus size on the time to match a donor meniscus, the average time to match was calculated for each segmented meniscus size range (±0.2 cm). Sizes were segmented by increments of 0.2 cm. The time to match a donor meniscus to male and female patients were measured separately for both medial and lateral menisci. The time to match for each segmented size range was measured and analyzed to identify if specific size ranges take longer to match. In addition, the effect of laterality on time to match was measured and compared between medial and lateral meniscus groups.

Statistical Analysis

An a priori power analysis (power of 0.90 and α of 0.05) was performed to determine the sample size needed to detect a statistically significant difference in meniscus size between donor and patient populations. Using the observed means and standard deviations of pilot data samples, we determined that 40 samples per group was sufficient to distinguish differences in meniscus size between patient and donor populations.

All analyses were performed using JMP Pro 12 (SAS Institute, Cary, NC). Data are presented as mean ± standard deviation with $P < .05$ considered significant. All collected variables were analyzed using descriptive statistics including means, standard deviations, ranges, and frequencies. Meniscus size ranges were categorized in intervals of 0.2 cm and compared between donor and patient populations using chi-square tests. The average meniscus size (length, width, area) and relative weight and height to meniscus size was calculated and compared between donor and patient populations using independent 2-sample *t*-tests. Anthropometric data and laterality were compared between donor and patient populations using Fisher exact tests for categorial variables and 2-sample *t*-tests for continuous variables.

The effect of patient meniscus size on time to match a donor meniscus was determined using one-way analysis of variance for continuous variables and Tukey post hoc tests. In addition, the effect of patient sex, laterality, and medial versus lateral on time to match was determined using a 2-sample *t*-test, comparing the mean time to match between various factors (i.e., male vs female and left vs right).

Results

The database query identified 3,218 donor and 704 patient menisci. The final dataset analyzed after the removal of samples with incomplete or incorrect data included 3,189 donor menisci and 576 patient menisci. Overall differences in sex, laterality, and meniscus type were observed between donor and patient pools (Table 1). The frequency of male and female sex varied significantly between donor and patient pools ($P < .001$). The donor pool consisted of a significantly greater male frequency (72.1%) compared with the patient pool, which consisted of 51.0% male patients. The frequency of left and right meniscus and meniscus type (e.g., medial vs lateral) also significantly differed between donor and patient pools. The donor pool consisted of a greater available meniscus frequency

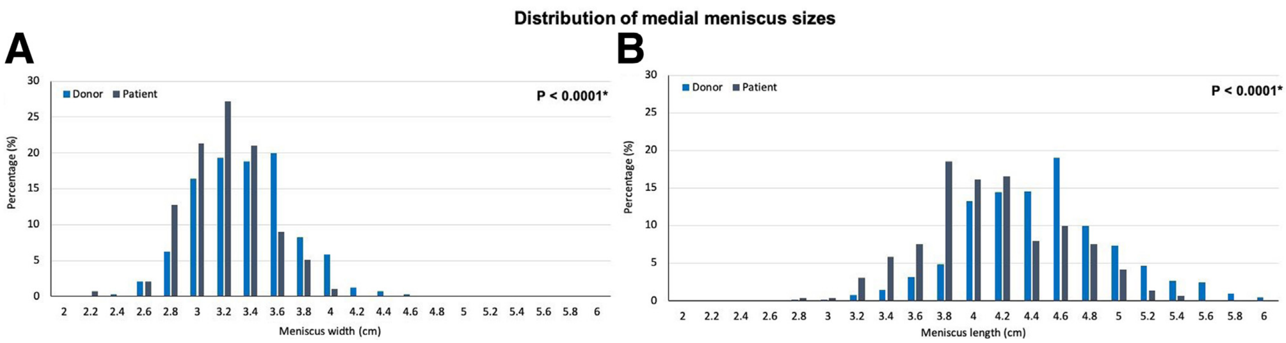

Fig 1. Distribution plots showing the mismatch between supply (donors) and demand (patients) for both male and female patients, with the smaller sized medial menisci being in greater demand and undersupplied. Plots show the frequency of donor (blue) and patient (gray) medial meniscus (A) width and (B) length.

Table 2. Medial Meniscus Comparison of Meniscus Size, Anthropometric Factors, and Anatomic Side

Medial Meniscus	Donor	Patient	*P* Value
Female medial meniscus			
Meniscus width, cm, mean ± SD	3.04 ± 0.3	2.96 ± 0.2	.002 *
Meniscus length, cm, mean ± SD	4.08 ± 0.4	3.83 ± 0.4	<.001*
Meniscus area, cm^2, mean ± SD	9.8 ± 1.8	9.0 ± 1.3	<.001*
Anatomical side, left, n (%)	210 (54.8%)	71 (51.0%)	.435
Anatomical side, right, n (%)	173 (45.2%)	74 (49.0%)	
Height, m, mean ± SD	1.63 ± 0.1	1.66 ± 0.1	<.001 *
Weight, kg, mean ± SD	73.5 ± 21.0	68.7 ± 20.5	<.017 *
BMI, mean ± SD, kg/cm^2	27.4 ± 7.4	24.8 ± 6.9	<.001 *
BMMI, kg/cm^2, mean ± SD	7.6 ± 2.1	7.8 ± 2.4	.474
HMI, cm/cm^2, mean ± SD	17.2 ± 2.8	18.9 ± 2.6	<.001*
Male medial meniscus			
Meniscus width, cm, mean ± SD	3.4 ± 0.3	3.3 ± 0.3	<.001*
Meniscus length, cm, mean ± SD	4.6 ± 0.5	4.3 ± 0.4	<.001*
Meniscus area, cm^2, mean ± SD	12.3 ± 2.2	11.2 ± 1.7	<.001*
Anatomical side, left, n (%)	557 (54.2%)	63 (43.1%)	<.012 *
Anatomical side, right, n (%)	479 (45.8%)	83 (56.9%)	
Height, m, mean ± SD	1.77 ± 0.1	1.79 ± 0.1	<.001 *
Weight, kg, mean ± SD	83.9 ± 22.9	87.6 ± 19.8	.039 *
BMI, mean ± SD, kg/cm^2	26.7 ± 6.7	27.0 ± 5.6	.455
BMMI, kg/cm^2, mean ± SD	6.9 ± 1.9	7.8 ± 1.8	<.001*
HMI, cm/cm^2, mean ± SD	14.8 ± 2.5	16.2 ± 2.6	<.001*

BMI, body mass index; BMMI, body mass to meniscus index; HMI, height to meniscus index; SD, standard deviation.

*Defines statistical significant with a *P* value lower than .05.

from the left knee and the patient pool showed a higher frequency of demand for a meniscus from the right knee.

Medial Meniscus (Donor Versus Patient Populations)

The distribution of medial meniscus size (Fig 1) was significantly different between patient and donor pools ($P < .05$). The patient population showed a significantly greater frequency/need of smaller medial meniscus width ($P < .001$) and length ($P < .001$) measurements compared with the donor population availability. In addition, the average patient meniscus length (Table 2) was significantly smaller (∼0.3 cm difference) in both the male ($P < .001$) and female patient population ($P < .001$) compared with the donor population, which further supports the distribution profile observed with a greater frequency of smaller patient meniscus sizes requested compared with donor size availability.

Sex-specific data for the medial meniscus between donor and patient populations are presented in Table 2. The most consistent and significant discrepancies seen were in meniscus length ($P < .001$), area ($P < .001$), and HMI ($P < .001$) for both male and female populations. Observed differences varied by sex. The male patient population BMMI was significantly greater compared with the donor BMMI ($P < .001$). The female population showed no difference in BMI or BMMI between donor and patient pools. The frequency of anatomic side (left vs right) was significantly different between the male patient and donor groups ($P = .012$ *) with an increase in frequency of the need for a right meniscus for the patient group and a reduction in right meniscus availability from the donor group. No difference was observed in the female population ($P = .435$).

Lateral Meniscus (Donor Versus Patient Populations)

The distribution of lateral meniscus size was significantly different between patient and donor populations for meniscus length ($P < .001$). Although discrepancies were observed between donor and patient populations for meniscus width, this measurement was not significant ($P = .084$). A greater patient demand (Fig 2 A and B) of larger lateral meniscus sizes were observed.

Sex-specific data for the lateral meniscus between donor and patient populations are presented in Table 3. Although meniscus width and length were significantly larger for female patients needing a meniscus ($P = .002$, .001), it was not as dramatic as

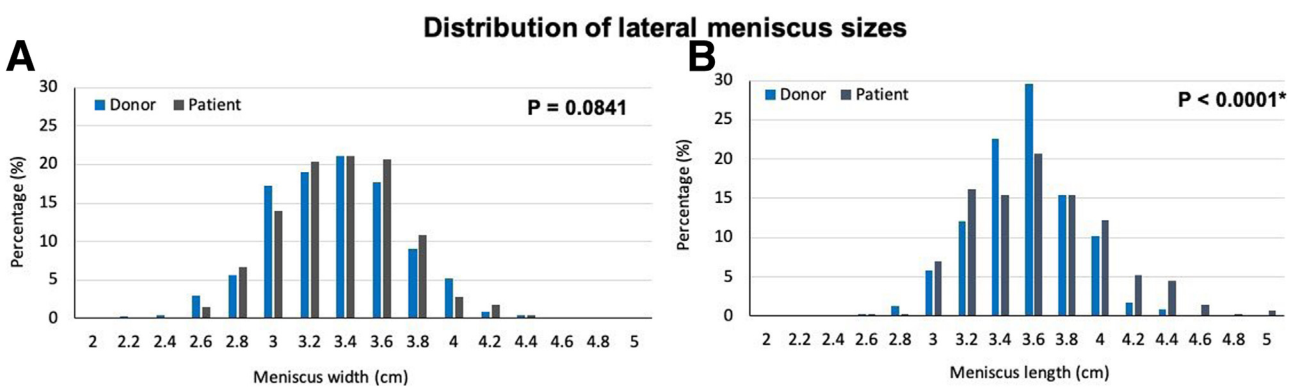

Fig 2. Distribution of donor (blue) and patient (gray) lateral meniscus sizes. Lateral meniscus width (A) and length (B).

Table 3. Lateral Meniscus Comparison of Meniscus Size, Anthropometric Factors, and Anatomic Side

Lateral meniscus	Donor	Patient	*P* Value
Female lateral meniscus			
Meniscus width, cm, mean ± SD	3.0 ± 0.3	3.1 ± 0.3	.002 *
Meniscus length, cm, mean ± SD	3.3 ± 0.3	3.4 ± 0.3	.001 *
Meniscus area, cm^2, mean ± SD	7.8 ± 1.1	8.2 ± 1.3	<.001 *
Anatomical side, left, n (%)	253 (50.0%)	71 (51.8%)	.705
Anatomical side, right, n (%)	253 (50.0%)	66 (48.2%)	
Height, m, mean ± SD	1.6 ± 0.1	1.7 ± 0.1	.121
Weight, kg, mean ± SD	73.9 ± 22.4	67.9 ± 20.3	.003 *
BMI, Mean ± SD, kg/cm^2	27.4 ± 7.8	24.8 ± 6.9	<.001 *
BMMI, kg/cm^2, mean ± SD	9.6 ± 3.0	8.4 ± 2.5	<.001*
HMI, cm/cm^2, mean ± SD	21.5 ± 3.0	20.5 ± 2.8	<.001 *
Male lateral meniscus			
Meniscus width, cm, mean ± SD	3.4 ± 0.3	3.5 ± 0.3	<.001*
Meniscus length, cm, mean ± SD	3.6 ± 0.3	3.8 ± 0.4	<.001*
Meniscus area, cm^2, mean ± SD	9.7 ± 1.5	10.5 ± 1.6	<.001*
Anatomical side, left, n (%)	657 (51.8%)	63 (42.6%)	.034 *
Anatomical side, right, n (%)	612 (48.2%)	85 (57.4%)	
Height, m, mean ± SD,	1.77 ± 0.1	1.80 ± 0.1	<.001*
Weight, kg, mean ± SD	83.3 ± 22.0	86.6 ± 25.2	.133
BMI, mean ± SD, kg/cm^2	26.5 ± 6.4	26.6 ± 7.2	.865
BMMI, kg/cm^2, mean ± SD	8.7 ± 2.3	8.3 ± 2.4	.047 *
HMI, cm/cm^2, mean ± SD	18.7 ± 2.5	17.4 ± 2.2	<.001*

BMI, body mass index; BMMI, Body mass to meniscus index; HMI, Height to meniscus index; SD, standard deviation.

*Defines statistical significant with a *P* value lower than .05.

the difference between male donors and patients ($P < .001$). Male patients were taller than their donor counterparts ($P < .001$), whereas female patients had a lower BMI ($P = .0002$) and BMMI ($P < .001$). The male patients had similar BMI to the donor males but lower BMMI ($P = .047$). Both male and female patients showed significantly lower HMI compared with the donor group. Consistent with the medial meniscus findings, the frequency of anatomic side was significantly different for the male population ($P = .034$) and similar for the female population ($P = .705$).

To further understand the conflicting HMI (greater average HMIs for patients needing a medial meniscus compared with donors vs lower average HMIs for patients needing a lateral meniscus compared to donors), findings between the medial and lateral meniscus, a scatter plot of meniscus area vs patient or donor height was generated (Fig 3). The medial meniscus plot (Fig 3A) demonstrated patients have a similar height distribution to donors but a smaller medial meniscus size. The lateral meniscus plot depicted similar height and meniscus size distributions for both donor and patient pools (Fig 3B).

Time to Match a Patient Request to Donor Graft

The effect of patient sex, and anatomic side on time to match a donor graft was analyzed for medial and lateral meniscus (Table 4). The anatomical site influenced the time to match for both medial and lateral meniscus. Sex had no effect on time to match.

The average time to match a patient lateral meniscus was influenced most greatly by the patient length measurement for both medial ($P < .05$) and lateral ($P < .05$) meniscus (Fig 4). The average time to match a lateral meniscus was significantly increased for larger meniscus lengths (>4.4 cm) (Fig 4B). The medial meniscus analysis showed a different effect where the smaller meniscus length (<3.0 cm) increased the time needed to match a donor graft (Fig 4A).

Discussion

The most important finding of this study is confirmation of the mismatch between donor and patient meniscus sizes. Outcomes from the lateral meniscus analysis showed a high patient demand for larger lateral meniscus sizes, which were not met by the donor population. Interestingly, the mismatch was converse for medial meniscus where greater patient demand for

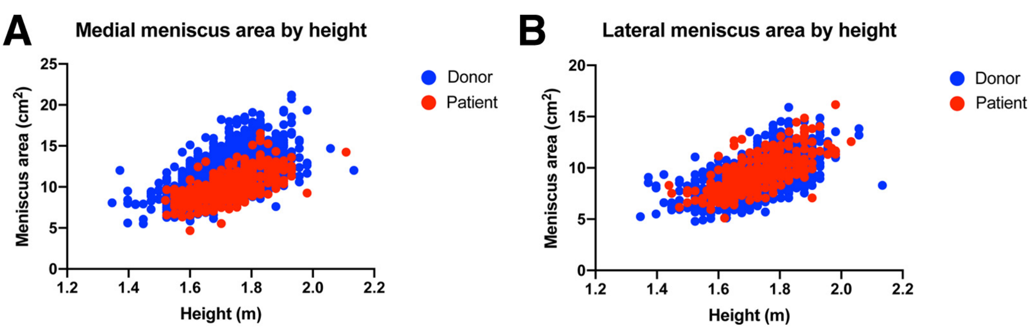

Fig 3. Scatter plot of meniscus area vs patient or donor height for (A) medial and (B) lateral meniscus.

Table 4. Effect of Sex and Anatomical Site on the Average Time to Match a Donor Graft

Category	Average Time to Match	*P* Value
Medial meniscus		
Sex, male, d, mean ± SD	40.0 ± 96.7	.230
Sex. female, d, mean ± SD	28.1 ± 54.9	
Anatomical site, left, d, mean ± SD	25.1 ± 56.8	.073
Anatomical site, right, d, mean ± SD	42.4 ± 94.0	
Lateral meniscus		
Sex, male, d, mean ± SD	35.9 ± 82.3	.208
Sex. female, d, mean ± SD	23.3 ± 71.2	
Anatomical site, left, d, mean ± SD	17.1 ± 55.4	.013 *
Anatomical site, right, d, mean ± SD	41.2 ± 91.4	

SD, standard deviation.
*Defines statistical significant with a *P* value lower than .05.

smaller meniscus sizes and a lower donor supply was identified. These data were further corroborated by the time to match where larger lateral meniscus and smaller medial meniscus sizes increased the patient wait time to identify a donor match. Further, there is significant sex differences between donors and patients and in laterality needs between sexes. Male patients compromised a dominant majority of the donor menisci pool (72.1%) while being only 51% of the population of patients who request a meniscus transplant. Male patients requested a significantly greater percentage of meniscus grafts for the right knee while there was much more availability of meniscus grafts from the left knee.

Adequate size matching of patient and donor meniscus before meniscal allograft transplantation (MAT) is an important factor that can influence biomechanics and patient outcomes.[3,8,9] Various sizing methods spanning models involving demographic data to techniques using radiographic and MRI have been developed to avoid size discrepancies and improve the matching of donor grafts to patients.[6,10] Although a number of studies have evaluated mismatch attributed to various sizing methods, there are no previous studies investigating how well the source donor meniscus tissue meets the demands of the patients with meniscal deficiencies. The mismatch in distribution between donors and patient meniscus sizes can impact the availability of grafts for patient care. This study identified a lateral meniscus mismatch, which could be attributed to a larger male patient subpopulation with meniscal deficiency who requires a large-sized meniscus graft. This larger male patient demographic is outside the normal distribution of typical donors leading to a lower frequency of grafts available to serve this patient demographic. Similarly, a high frequency of small medial meniscus grafts is in demand to meet the clinical needs for a smaller patient population, which is also outside the normal distribution of medial meniscus donors. This work identifies a clinical need for specific patient populations who have limited opportunity to obtain a donor match.

Anthropometric data (sex, laterality, height, weight) was analyzed to understand the factors that may contribute to the meniscus size discrepancy identified between donors and patients. Although this study did not investigate age differences between donor and patient pools, it is unlikely that age would introduce any bias into this study as prior literature reports that most patients who undergo MAT are between 18 and 50 years.[11-14] Overall differences in sex, laterality, and meniscus type were observed between donor and patient pools. The significantly greater male percentage identified in the donor pool is likely attributed to a large percentage of male donors that are more frequently trauma victims. Further investigation into the exact cause of death in our donor pool could confirm this assertation. Studies investigating organ and tissue donor characteristics have classified a number of deceased donors as trauma donors, or donors with cause of death that was not designated as natural causes.[15,16] Ackerman et al.[15] report the characteristics of trauma donors from 2007 to 2016.11 The majority of trauma donors identified in this study were male (74.3%) with a mean age of 31.1 years. The trauma donors comprised a younger and healthier population of donors compared with the nontrauma donor

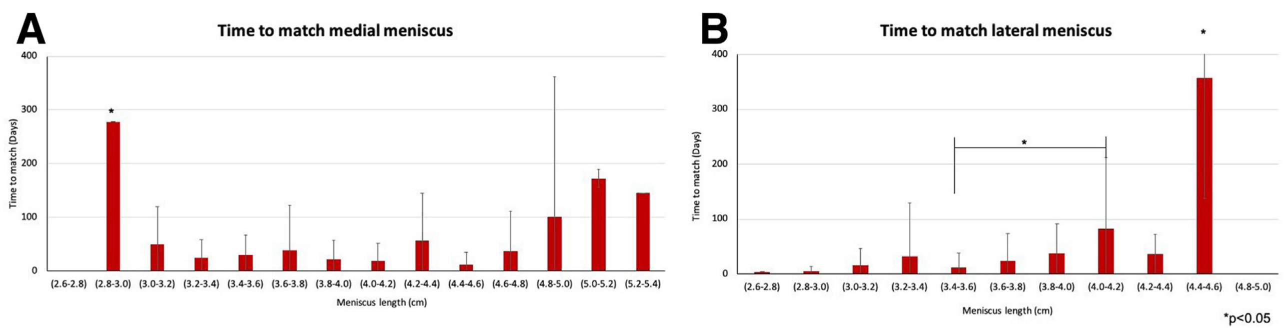

Fig 4. The effect of patient meniscus length on time to match a donor graft. (A) Medial meniscus time to match for various meniscus lengths. (B) Lateral meniscus time to match for various meniscus lengths. *$P < .05$.

counterparts.[15] In addition, the tissue bank providing the meniscus allograft data for this study defines specific donor criteria that influence the donors that will be included or excluded for meniscus allograft tissue. The tissue bank specifies donors between the ages of 12 and 45 years with healthy and intact menisci. Because of the age and meniscus tissue health requirements, trauma donors are likely the main source for meniscus allograft tissue. This was confirmed by the significantly greater proportion of male donors, 72.1%, identified by this study. The greater male proportion of donors may contribute to the mismatch observed for the medial meniscus, where the demand for smaller meniscus sizes outstripped the supply from the donor pool and in which the patient pool was nearly half female. The lower frequency of small meniscus sizes may limit the availability of meniscus donor grafts for female patients or skeletally immature patients.[17]

The mismatch in frequency of smaller-sized medial menisci between donor and patients was observed for both male and female populations. Sex-specific anthropometric data analysis was conducted to further understand the size discrepancy. Interestingly, the frequency of anatomic side played a role with the male population, but the not the female population. There was an increased demand for right meniscus grafts for the male patient group and a reduction in availability from the donors. This suggests leg dominance influenced both the demand and supply of the grafts. Male donors and patients both favor the right side creating a mismatch in availability. Another important factor potentially influencing the medial meniscus mismatch is the HMI. The HMI were significantly greater for both male and female patients compared with the donor population. This suggests that patients and donors have similar height distributions, but the patients have a smaller meniscus size leading to significantly greater HMI. Based on these findings, we hypothesized that individuals with a smaller medial compartment relative to their overall height or BMI are more susceptible to being symptomatic in the face of medial meniscus deficiency. This hypothesis was further supported by the scatter plot of meniscus area versus patient or donor height, which demonstrates patients both have a similar height distribution to donors but a smaller medial meniscus size.

The lateral meniscus size distribution findings differed from the medial meniscus. The mismatch between donors and patients was observed for larger meniscus sizes. The clinical significance of this mismatch is the limited availability of donor lateral meniscus allografts to meet the demands of larger patients. Anthropometric data were analyzed to understand factors that may contribute to this size discrepancy. Similar to the medial meniscus findings, the leg dominance factor was observed for only male patients. In addition, donor height played an important role in the mismatch observed. Patients were on average significantly taller than the donor pools. This is consistent with patient demographics reported for MAT. The HMI hypothesis, however, was not observed for the lateral meniscus. We believe the primary contributor to the lateral meniscus discrepancy is the difference in height distributions between patients and donors. Patients are skewed to taller heights, where donors have a normal distribution.

As evidenced in this study, the observed mismatches between patient and donor pools led to delays in treatment or longer wait times to identify a donor match. Larger-sized lateral meniscus and smaller-sized medial meniscus graft requests increased the time to identify a donor match. Although there is no immediate clinical action that can be taken to remedy this situation, this does provide treating physicians with information that can be used when discussing MAT with patients. Although most patients will be able to find a donor match in a reasonable amount of time, specific subsets of patients are at risk of extended wait times for a graft. However, while this work highlights shortages of certain meniscus sizes, there is a converse excess supply of other meniscus graft sizes, specifically smaller lateral meniscus and larger medial meniscus grafts. Given these observations, one strategy to overcome this limitation is to consider the use of a medial meniscus allograft for a lateral meniscus application or vice versa. To the extent of our knowledge, there are no published studies investigating the feasibility of using a donor medial allograft for a lateral meniscus recipient. Laboratory, animal, and clinical studies would be needed to justify the use of medial-to-lateral meniscus or lateral-to-medial-meniscus transplantation. Another option would be to consider segmental meniscus transplantation when the meniscus deficiency is not global. Early animal work in this area has been mixed repair outcomes but highlights that such a need exists.[18]

Limitations

We acknowledge several limitations of this study. First, this study did not analyze the age of donor and patient pools due to restrictions obtaining this information consistently from a database which could introduce potential bias. Another limitation involved the methods for meniscus size measurement. The patient meniscal measurements were determined by outside sources that used various imaging modalities including radiographs, MRI, or computed tomography scans whereas donor meniscus measurements were made directly with hand calipers. The various types of scans and lack of standardization for how measurements were taken for patients may lead to variability within the study. Lastly, it is possible that interobserver error may affect the donor meniscus measurements recorded using calipers in situ at the time of processing.

Conclusions

This analysis demonstrates variations in frequency of meniscus sizes between donor and patient populations. This variation is attributed to differences in anthropometric data between patient and donor populations. This work identifies a mismatch between demand and supply for certain patient sizes contributing to longer times to match.

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