Introduction

Evaluation of patient satisfaction is an important tool for health-care providers, providing insight into the quality of treatment. Therefore, it is important to identify the determinants or factors affecting patient satisfaction.1,3 Determinants of patient satisfaction regarding outcomes after anterior cruciate ligament reconstruction were reported by Kocher et al.4 Using univariate and multivariable modeling, they identified subjective symptoms and functional factors that correlated with patient satisfaction. Symptoms of pain, swelling, giving way, locking, noise, stiffness, and limping showed strong correlations with dissatisfaction. There is a highly significant association between satisfaction and patients being able to walk, squat, run, cut, jump, ascend, and descend stairs and participate in sports activities, work activities, and activities of daily living without symptoms. Outcome scoring systems emphasizing subjective variables, including the International Knee Documentation Committee (IKDC) subjective forms and Lysholm Knee Scoring Scale, also significantly correlate with patient satisfaction.4

Meniscal tears are among the most common knee injuries, and partial meniscectomy is the most common treatment. A compromised meniscus is biomechanically nonfunctional, causing articular and subchondral damage, ultimately leading to osteoarthritis.5 Meniscal allograft transplantation (MAT) is the treatment of choice in symptomatic young patients who have undergone previous meniscectomy.6 Although the procedure has been available...
since the 1980s, the consensus on the role of MAT in preventing osteoarthritis is still debated. Literature shows that although MAT is not curative, the prolongation of time or bridging before arthroplasty may prevent patients from requiring a revision total knee arthroplasty in their lifetime. The goal of MAT is to achieve symptom-free activities of daily living and to conserve and extend biological knee function. It is imperative that patients should be forewarned of the possible failure and need for repeat surgery. Despite this, several authors reported that most patients (approximately 90%) are satisfied with the outcome after MAT.

To the authors’ knowledge, determinants of patient satisfaction with outcome after MAT have not been established. This study aimed to identify the determinants of patient satisfaction after MAT by evaluating the association between patient satisfaction and other parameters such as demographic data, preoperative status, postoperative parameters, and knee evaluation scores.

Materials and Methods

This study was approved by the institutional review board. From March 2006 to May 2009, a total of 151 patients who satisfied the inclusion criteria underwent MAT.

MAT inclusion criteria are (1) total meniscectomized state, (2) Outerbridge Grades I–II, (3) normal alignment within varus 5°, (4) intact ligament balance, and (5) age <45 years. The only contraindication for meniscal transplantation in this series was severe degenerative joint disease, as manifested by more than 3 mm of compartmental narrowing on 45° posteroanterior weight-bearing radiographs, or Grade IV femoral articular surface changes with wide surface area noted at arthroscopy.

Surgeries were performed by a single experienced senior surgeon who has performed more than 200 cases. Grafts were sized on anteroposterior (AP) and lateral radiographs with a scanogram for the correction of magnification, as described by Pollard et al. Medial MAT was performed using a modified bone plug technique developed by the senior author, in which the graft contains separate bone plugs attached to the horns, and the bone plug of the posterior horn is smaller than that of the anterior horn for easy passage. Lateral MAT was performed using the “keyhole” technique described by Wilcox and Goble, in which the graft contains a common bone bridge attached to both AP horns. In all cases, we used fresh-frozen allografts. All patients underwent a standardized rehabilitation protocol after MAT. We allowed full extension and partial weight bearing for 6 weeks postoperative and emphasized open-kinetic chain exercise. Active curl exercise was initiated after 6 weeks, and leg curl exercise was initiated after 12 weeks.

Among the 151 patients who underwent MAT, 49 were available for interview and included in this study, and mean followup period was 50.4 months (range, 48–72). We evaluated demographic data (age, body mass index [BMI], sex, and laterality), radiologic parameters using X-ray and magnetic resonance imaging (MRI), knee evaluation scores (IKDC score, Lysholm score, Knee Society Score [KSS], and Tegner score), and the isokinetic muscle strength test.

Extension weight-bearing AP radiography (AP view) and 45° posteroanterior flexion weight-bearing radiography (Rosenberg view) were used to evaluate joint space narrowing of the involved compartment. The Kellgren–Lawrence grade was used to grade the osteoarthritic status of the knee. All measurements were documented by two different orthopedic surgeons and a radiologist. The grades for which consensus was reached were used after discussion. Interobserver agreement was observed in 25–34 patients based on the MRI arthrosis grade and Kellgren–Lawrence grade on AP and Rosenberg views. The intraclass correlation coefficients for interobserver reliability ranged from 0.75 to 0.87.

MRI examinations were performed using 1.5-T cylinder-shaped equipment (Intera Achieva; Philips, Eindhoven, Netherlands). Meniscal extrusion was defined as the greatest distance from the most peripheral aspect of the meniscus to the border of the tibia, excluding any osteophytes on coronal images. It was measured to the nearest millimeter (mm) on coronal images (fast spin-echo intermediate-weighted image; repetition time/echo time, 2000–3800 ms/35–45 ms; 4-mm section thickness; 1-mm interslice gap) using an MRI-generated scale on each image by two different orthopedic surgeons and a radiologist, and average values were used. The relative percentage of extrusion, defined as the percentage of the width of extruded menisci compared with the entire meniscal width, was also measured. This method was developed to standardize the measurement for the knees of different sizes [Figure 1]. Cartilage status was evaluated according to the modified Outerbridge grading scale.

Bilateral lower extremity isokinetic muscle strength and the hamstring-quadriceps (HQ) strength ratio were assessed by measuring isometric concentric peak extension and flexion torques at angular velocities of 60° and 180°/s using the Biodex System 3 (Biodex Medical Systems, Inc. 20 Ramsay Road Shirley, New York, USA). Isokinetic muscle strength was reported as percent deficit, and the
Results

A total of 49 patients were included in this study. Mean follow-up time was 50.4 months (range, 48–72). The mean age of respondents was 40 (±9) years; 33 (67%) were male and 16 (33%) were female. Lateral meniscus was transplanted in 13 (27%) patients, and the medial side was involved in 36 (73%) patients. Mean BMI was 25.6 (±4.1).

For radiologic parameters, the mean joint space on AP was 2.3 mm, mean joint space on Rosenberg view was 1.3 mm, and mean extrusion on MRI was 47.8. There was no significant difference between the satisfied and very satisfied group versus the neutral group.

Outcome scores (Lysholm, IKDC, KSS knee, and KSS function) at the final follow-up improved significantly compared to preoperative scores \((P < 0.05)\) [Figure 2].

Regarding patient satisfaction, 11 respondents responded as neutral (22%), 27 as satisfied (55%), and 11 as very satisfied (22%) [Figure 3]. None were dissatisfied with the outcome of their MAT at the final follow-up. Based on the response to patient satisfaction, the patients were stratified into two groups: neutral \((n = 11, 22\%)\) and satisfied (includes those who answered satisfied and very satisfied, \(n = 38, 78\%\)).

Using the method of univariate analysis, results showed that among the demographic data, only sex had a significant association with patient satisfaction [Table 1]. No other preoperative parameter was found to have an association with patient satisfaction [Table 2]. Three outcome scores recorded during follow-up (IKDC, Lysholm, and KSS knee) showed a significant association with patient satisfaction [Table 3]. The objective radiographic and MRI findings did not show a significant association with patient satisfaction \((P > 0.05)\). Isokinetic strength deficit at 60° extension and at 180° extension at follow-up showed a significant association with patient satisfaction [Table 4].

The statistical significance factors were included in a multiple variable logistic regression with the coefficient of multiple correlation \((R^2)\) set at 0.476. Results showed that only IKDC at follow-up (post-IKDC) had a significant association with patient satisfaction \((P < 0.05)\) [Table 5].

Discussion

In this study, we identified the univariate and multivariate determinants of patient satisfaction with the outcome after MAT. Among demographic variables, sex showed a significant association with patient satisfaction. The remaining demographic variables were found to have no association with patient satisfaction \((P > 0.05)\). In previous studies, a common conclusion has been that the outcome of MAT is better in younger patients.6,10,11,19 However, in the current study, age was not associated with patient satisfaction \((P > 0.05)\).

Preoperative parameters (preoperative IKDC, Lysholm, KSS, and Kellgren–Lawrence grade) did not have a significant association with satisfaction \((P > 0.05)\). This may strengthen the findings that even patients with advanced preoperative chondral damage may show therapeutic benefits similar to that of patients with less severe disease.7,20

Patient-reported outcome scores (IKDC, Lysholm, and KSS) were markedly improved at follow-up compared to the preoperative scores. Postoperative IKDC, Lysholm, and KSS knee outcome scores showed a significant association
with patient satisfaction with outcome ($P < 0.05$). This emphasizes the importance of subjective outcome evaluation tools in assessing function and satisfaction in patients undergoing knee surgery. Our findings are similar to those of previous studies evaluating outcome and satisfaction after MAT. Saltzman et al. showed similar results, with high outcome scores and an 8.8 out of 10 average satisfaction rating in 22 patients treated with MAT evaluated after a minimum of 7-year followup.\textsuperscript{14} Cole et al. performed a 2-year prospective evaluation of 44 MAT procedures in 39 patients, showing significant improvement in outcome scores with 77.5% of patients satisfied with the procedure.\textsuperscript{12} The postoperative radiographic and MRI findings did not correlate with patient satisfaction.

Postoperative objective parameters – isokinetic muscle strength percent deficit at 60° and 180° of extension – also correlated with patient satisfaction with outcome ($P < 0.05$). These results indicate the importance of quadriceps strength for patient satisfaction.

On analysis of these factors by multivariable logistic regression, the authors found that only postoperative IKDC score showed a significant association with patient satisfaction ($P < 0.05$). This implies that among the determinants identified in this study, IKDC correlates directly with patient satisfaction with outcome. The IKDC subjective knee evaluation form is a ten-item survey focused on the symptoms and level of daily or sports activity. The Lysholm knee scoring scale is similar to the IKDC score, except that the latter has more items and expounds on the level of activity and function. For example, the Lysholm scale does not inquire on the frequency of pain nor does it ask questions regarding the

### Table 1: Demographic for patients (overall)

|                | Screw only (9) | Plate and screw (10) | Total (19) |
|----------------|----------------|----------------------|------------|
| Mean Age (range) | 39.1 (19–52) | 42.6 (25–64) | 40.9 (19–64) |
| Gender (%)       | Male 7 | Female 2 | Male 14 (74%) |
|                 | Female 3 | Female 5 (26%) | |
| Follow up period (Months) | 53 (13–132) | 38.2 (13–78) | 45.1 (13–78) |
| Injury of dominant hand | 3 | 7 | 10 (53%) |
| Injured finger | Index 1 | Long 2 | Ring 4 | Small 2 |
| Sports | 5 | 4 | 9 (47%) |
| Falling | 3 | 1 | 4 (21%) |
| Fight | 1 | 1 | 2 (11%) |
| Stuck in door | 0 | 1 | 1 (5%) |
| Twisted by machine | 0 | 2 | 2 (11%) |
| Motor vehicle accident | 0 | 1 | 1 (5%) |

### Table 2: Among the other preoperative parameters, none were found to have an association with patient satisfaction

|                | Neutral (mean) | Satisfied and very satisfied (mean) | $P$ |
|----------------|----------------|-------------------------------------|-----|
| IKDC outcome score | 61.2 | 59.2 | 0.809 |
| Lysholm score | 73.8 | 72.2 | 0.846 |
| KSS-Knee | 79.6 | 76.5 | 0.736 |
| KSS-function | 80.0 | 81.5 | 0.887 |
| K/L on AP Gr I/Gr II/Gr III | 1/6/2 | 7/22/1 | 0.153 |
| K/L on Rosenberg view Gr I/Gr II/Gr III | 0/5/4 | 6/19/5 | 0.124 |

IKDC, The International Knee Documentation Committee; KSS, The Knee Society Score; K/L, Kellgren-Lawrence grade; AP, anteroposterior view

### Table 3: Postoperative followup outcome

|                | Neutral (mean) | Satisfied and very satisfied (mean) | $P$ |
|----------------|----------------|-------------------------------------|-----|
| IKDC score | 63.7 | 76.6 | 0.008* |
| Lysholm score | 78.5 | 86.0 | 0.060* |
| KSS-Knee score | 84.3 | 93.8 | 0.022* |
| KSS-function | 88.9 | 92.3 | 0.413 |
| Tegner score | 4.6 | 4.5 | 0.818 |
| JS on AP | 2.3 | 2.1 | 0.736 |
| JS on Rosenberg view | 1.3 | 1.3 | 0.987 |
| POA/NPOA on AP | 4/5 | 17/13 | 0.395 |
| POA/NPOA on Rosenberg view | 4/4/1/0 | 18/12 | 0.327 |
| Extrusion in MRI | 47.8 | 51.2 | 0.634 |
| POA/NPOA in MRI | 6/1 | 16/7 | 0.638 |

*Statistical significance ($P<0.1$). JS, Joint space; AP, anteroposterior view, POA, progression of osteoarthritis; NPOA, non-progression of osteoarthritis. Progression is defined by two definitions by an increase of minimally 1 grade in Kellgren-Lawrence index or Outerbridge in MRI
Ha, et al.: Outcomes after meniscal allograft transplantation

Indian Journal of Orthopaedics | Volume 53 | Issue 3 | May-June 2019 435

As there is a myriad of other subjective evaluation methods such as the Knee Injury and Osteoarthritis Outcome Score, the Cincinnati Knee rating system, the Knee outcome survey, and the Short Form-36, among others, a larger study including these evaluation tools may further strengthen the findings of the present investigation.

Conclusions

Among the determinants of patient satisfaction identified in the current analysis, only the IKDC score showed a significant association with patient satisfaction with regard to outcome. For clinicians, the IKDC score can be used during followup of patients treated with MAT to indicate patients’ satisfaction with outcome.

Acknowledgement

This work was supported by Grant from Inje University, 2011.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Carr-Hill RA. The measurement of patient satisfaction. J Public Health Med 1992;14:236-49.
2. Hall JA, Milburn MA, Epstein AM. A causal model of health status and satisfaction with medical care. Med Care 1993;31:84-94.
3. Strasser S, Aharony L, Greenberger D. The patient satisfaction process: Moving toward a comprehensive model. Med Care Rev 1993;50:219-48.
4. Kocher MS, Steadman JR, Briggs K, Zurakowski D, Sterett WI, Hawkins RJ, et al. Determinants of patient satisfaction with outcome after anterior cruciate ligament reconstruction. J Bone Joint Surg Am 2002;84-A: 1560-72.
5. Rao AJ, Erickson BJ, Cvetanovich GL, Yanke AB, Bach BR Jr, Cole BJ, et al. The meniscus-deficient knee: Biomechanics, evaluation, and treatment options. Orthop J Sports Med 2015;3(10):2325967115611386.
6. Verdonk R, Volpi P, Verdonk P, Van der Bracht H, Van Laer M, Almqvist KF, et al. Indications and limits of meniscal allografts. Injury 2013;44 Suppl 1:S21-7.
7. Lee BS, Kim JM, Sohn DW, Bin SI. Review of meniscal allograft transplantation focusing on long term results and evaluation methods. Knee Surg Relat Res 2013;25:1-6.
8. Spalding T, Getgood A. Defining outcome after meniscal allograft transplantation: Is buying time a valid measure of success? Knee Surg Sports Traumatol Arthosc 2016;24:1424-6.
9. Ha JK, Jang HW, Jung JE, Cho SI, Kim JG. Clinical and radiologic outcomes after meniscus allograft transplantation at 1-year and 4-year followup. Arthroscopy 2014;30:1424-9.
10. Noyes FR, Barber-Westin SD. Long term survivorship and function of meniscus transplantation. Am J Sports Med 2016;44:2330-8.
11. Van Der Straeten C, Byttebier P, Eeckhoudt A, Victor J. Meniscal allograft transplantation does not prevent or delay progression of knee osteoarthritis. PLoS One 2016;11:e0156183.
12. Cole BJ, Dennis MG, Lee SJ, Nho SJ, Kalsi RS, Hayden JK, et al. Prospective evaluation of allograft meniscus transplantation: A minimum 2-year followup. Am J Sports Med 2006;34:919-27.
13. Verdonk PC, Verstraete KL, Almqvist KF, De Cuyper K, Veys EM, Verbruggen G, et al. Meniscal allograft transplantation: Long term clinical results with radiological and magnetic resonance imaging correlations. Knee Surg Sports Traumatol Arthrose 2006;14:694-706.
14. Saltzman BM, Bajaj S, Salata M, Daley EL, Strauss E, Verma N, et al. Prospective long term evaluation of meniscal allograft transplantation procedure: A minimum of 7-year followup. J Knee Surg 2012;25:165-75.
15. Pollard ME, Kang Q, Berg EE. Radiographic sizing for meniscal transplantation. Arthroscopy 1995;11:684-7.
16. Kim JG, Lee YS, Lee SW, Kim YJ, Kong DH, Ko MS, et al. Arthroscopically assisted medial meniscal allograft transplantation using a modified bone plug to facilitate passage: Surgical technique. J Knee Surg 2009;22:259-63.
17. Ha JK, Sung JH, Shim JC, Seo JG, Kim JG. Medial meniscus allograft transplantation using a modified bone plug technique: Clinical, radiologic, and arthroscopic results. Arthroscopy 2011;27:944-50.
18. Wilcox TR, Goble EM. Indications for meniscal allograft reconstruction. Am J Knee Surg 1996;9:35-6.
19. Vundelinckx B, Vanlauwe J, Bellemans J. Long term subjective, clinical, and radiographic outcome evaluation of meniscal allograft transplantation in the knee. Am J Sports Med 2014;42:1592-9.
20. Kempshall PJ, Parkinson B, Thomas M, Robb C, Standell H, Getgood A, et al. Outcome of meniscal allograft transplantation related to articular cartilage status: Advanced chondral damage should not be a contraindication. Knee Surg Sports Traumatol Arthrose 2015;23:280-9.