

The International Knee Documentation Committee Score Indicates Midterm Patient Satisfaction with Outcomes after Meniscal Allograft Transplantation

Abstract

Background: This study aimed to identify the factors associated with patient satisfaction with the outcome of meniscal allograft transplantation (MAT). **Materials and Methods:** Patients treated with MAT from March 2006 to May 2009 were asked to complete a five-point Likert scale regarding satisfaction with the outcome of MAT, in addition to the following subjective outcome evaluation forms: the International Knee Documentation Committee (IKDC) subjective forms, Knee Society Score knee and function forms, and Lysholm Knee Scoring Scale. We collected radiologic data using X-ray and magnetic resonance imaging and assessed isokinetic muscle strength test using the Biodex System 3. We investigated whether these parameters were significantly associated with patient satisfaction. Statistical analysis was computed using univariate and multivariable logistic regression. **Results:** Among the 130 patients who underwent MAT, 49 participated in the interview and were included in this study. The mean followup period was 50.4 months. Mean patient age was 40 (± 9) years; 33 were male and 16 were female (33%). The lateral meniscus was transplanted in 13 (27%) patients, while the medial meniscus was involved in 36 (73%) patients. On univariate analysis, sex and isokinetic extension strength deficit at 60° and 180° as well as the IKDC, Knee Society, and Lysholm scores showed significant association with patient satisfaction regarding the outcome. On multivariable logistic regression, only the IKDC score showed a significant association, with $P = 0.04$. **Conclusions:** The study results support the importance of patient-reported subjective outcomes in terms of patient satisfaction following a surgical procedure. Regarding MAT, the IKDC outcome score reflects patient satisfaction. **Level of evidence:** Level III.

Keywords: Allograft, knee, meniscus, satisfaction

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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

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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.⁷ The goal of MAT is to achieve symptom-free activities of daily living and to conserve and extend biological knee function.⁸ It is imperative that patients should be forewarned of the possible failure and need for repeat surgery.^{6,8-11} Despite this, several authors reported that most patients (approximately 90%) are satisfied with the outcome after MAT.¹²⁻¹⁴

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.*¹⁵ Medial MAT was performed using a modified bone plug technique developed by the senior author,^{16,17} 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,¹⁸ 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.^{6,13} 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-quadiceps (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



Figure 1: Relative percentage of extrusion

HQ ratio was reported as percent. Hop ratio was defined as the distance recorded from the hop test of the MAT knee divided by the distance recorded from the hop test of the nonoperated knee, multiplied by 100 and expressed as percentage. The vertical jump ratio is expressed as the percentage of the vertical jump distance of the MAT knee compared to the vertical jump distance of the uninvolved knee. Vertical jump distance was measured using the u-town physical test system (InBody Co., Ltd InBdoy Bldg., 625, Eonju-ro, Gangnam-gu, Seoul, Korea).

Participants were asked to complete a five-point Likert scale regarding their satisfaction with the outcome of MAT. They were instructed to rate themselves as very dissatisfied, dissatisfied, neutral, satisfied, or very satisfied. They were also asked to complete the following subjective outcome evaluation forms: IKDC subjective forms, KSS knee and function forms, and Lysholm Knee Scoring Scale. According to the Likert scale, we compared the variable data between the satisfied and very satisfied group versus the neutral group.

Patient satisfaction with outcome was considered the dependent variable in this study. Statistical analysis was computed using univariate and multivariable logistic regression using SPSS version 18.0. (IBM Corporation, USA).

Results

A total of 49 patients were included in this study. Mean followup 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 followup 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 followup. 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

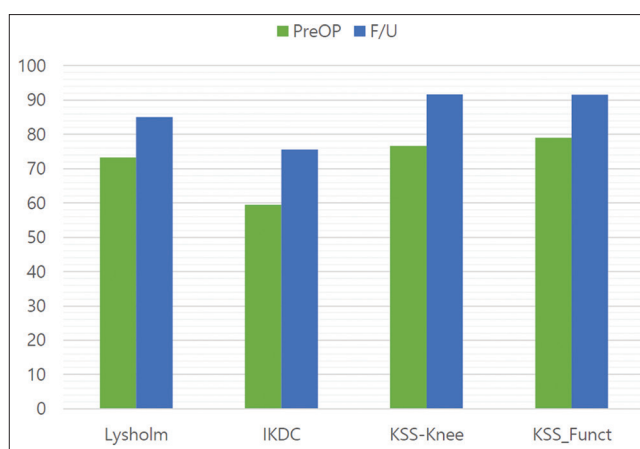


Figure 2: The outcome scores (Lysholm, International Knee Documentation Committee, Knee Society Score – knee, and Knee Society Score – function) at the final followup compared to that of the preoperative score

with patient satisfaction [Table 2]. Three outcome scores recorded during followup (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 followup 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 followup (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 followup 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.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.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 I: 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	7	14 (74%)
Female	2	3	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	2	3 (16%)
Long	2	2	4 (21%)
Ring	4	3	7 (37%)
Small	2	3	5 (26%)
Injury mechanism			
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

Table 4: Isokinetic muscle strength associated with patient satisfaction

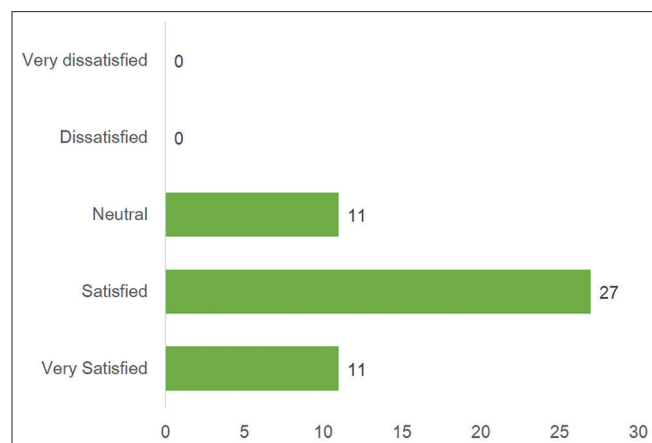
	Neutral (mean)	Satisfied and very satisfied (mean)	P
Isokinetic 60 Extension (% deficit)	35	20	0.092*
Isokinetic 60 Flexion (% deficit)	15	10	0.588
Isokinetic 180 Extension (% deficit)	30	15	0.056*
Isokinetic 180 Flexion (% deficit)	11	9	0.838
HQ ratio 60	59	55	0.458
HQ ratio 180	58	57	0.804
Hop ratio	82	86	0.576
Vertical jump ratio	68	76	0.476

*Statistical significance ($P<0.1$)

Table 5: A multiple variable logistic regression with coefficient of multiple correlation

	Regression coefficient (Exp (β))	P
Sex		0.154
Male	Ref	
Female	6.599	
Lysholm score	0.968	0.640
IKDC score	1.128	0.040*
KSS knee score	1.019	0.683
Strength 60° extension	1.031	0.644
Strength 180° extension	0.934	0.416

*Statistical significance ($P<0.05$)

**Figure 3: Graph about patient satisfaction**

ability to kneel, sit, rise from a chair, etc. These minor exclusions may explain why only the IKDC correlated with patient satisfaction. The KSS differs from IKDC, in that it requires an observer to measure objective parameters such as flexion contracture, extension lag, range of motion, alignment, and stability. This emphasizes the importance of patient-reported subjective assessment of symptoms and function, consistent with studies on patient satisfaction with surgical procedures in general.

The limitations of this study include selection bias; the sample population of this study included only patients available for interview out of the targeted group. Our results can only be generalized to midterm patients; followup

research to evaluate long term patient satisfaction may be useful. 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.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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