J. Phys. Ther. Sci. 36: 717–720, 2024

The Journal of Physical Therapy Science

Original Article

Relationship between preoperative and discharge evaluations in patients receiving around-the-knee osteotomy

Takashi Hasegawa, RPT, PhD[1)*], Keita Nishi, RPT, PhD[1)], Shinichi Matsumoto, RPT, MS[1)], Yuh Yamashita, RPT, PhD[1)], Takefumi Moriuchi, PhD[1)], Toshio Higashi, PhD[1)]

[1)] *Graduate School of Biomedical Sciences, Nagasaki University: 1-7-1 Sakamoto, Nagasaki 852-8520, Japan*

Abstract. [Purpose] This study aimed to determine the relationship between preoperative and discharge assessments in patients undergoing around-the-knee osteotomy. [Participants and Methods] We enrolled patients admitted to our hospital who underwent around-the-knee osteotomy. We measured knee joint range of motion, pain numeric rating scale, pain catastrophizing scale, hospital anxiety and depression scale, and 10-m walk time were measured preoperatively and before discharge. Pre-post comparisons and correlation testing were performed. [Results] A total of 18 patients were analyzed. Resting and exercise pain numeric rating scale, knee flexion and extension range of motion, and pain catastrophizing scale were significantly better during discharge. A significant correlation was observed between the preoperative pain catastrophizing scale total score and 10-m walking time, knee flexion and extension range of motion, pain catastrophizing scale total score, and hospital anxiety and depression scale-depression subscale preoperatively. [Conclusion] Appropriate postoperative rehabilitation after around-the-knee osteotomy improved physical function and cognitive/psychological evaluation at discharge. The correlation between the preoperative pain catastrophizing scale total score and 10-m walking time at discharge suggests that the prolonged walking pain that occurred preoperatively may have affected the cognitive and psychological evaluation of pain.

Key words: Around the knee osteotomy, Pain, 10-meter walk time

(This article was submitted Jul. 17, 2024, and was accepted Aug. 16, 2024)

INTRODUCTION

Osteoarthritis (OA) of the knee is one of the most common joint diseases, causing pain and loss of joint range of motion (ROM), and is often associated with chronic pain[1)]. The prevalence of this disease in Japan is high among middle-aged women, and its overall medical cost is approximately twice as high as that of hip OA[2, 3)], making it a societal issue that must be addressed. Pharmacological therapy with non-steroidal anti-inflammatory drugs and other drugs[3)], exercise therapy, and nerve blocks are often the treatment of choice in mild cases. In contrast, surgical treatments such as total knee arthroplasty (TKA) and around-the-knee osteotomy (AKO) are often indicated in severe cases in which conservative treatment does not provide sufficient pain relief. The prognosis of surgical treatment is relatively good, often improving the performance of activities of daily living (ADL) and quality of life. AKO is sometimes chosen as a joint-sparing procedure for relatively active patients[4)]. In the medial compartment, medial rotation alignment is often affected in the knee OA, and AKO is indicated to adjust this alignment[5)] and is an effective surgical treatment for young patients with knee ligament instability[6)]. However, the willingness to undergo surgery for end-stage knee OA in Japan is only 17%, compared to 32% in the U.S. and 38% in Europe[7)].

*Corresponding author. Takashi Hasegawa (E-mail: takashi_net184@yahoo.co.jp)

It has been reported that it takes 12 weeks for bone fusion to occur in AKO; there is some concern about early recovery from pain and gait disturbance[8], and the length of hospitalization for patients with knee OA in Japan is related to chronic pain and the timing of the start of rehabilitation[9]. As described above, postoperative pain may interfere with decision-making and affect the length of hospital stay, and it is estimated that 15% of patients with chronic postsurgical pain (CPSP) have prolonged pain that does not lead to an ideal outcome, although structural problems have been resolved by surgery. Patients with CPSP experience prolonged pain and less-than-ideal outcomes, although structural problems have been solved[10]. Chronic postsurgical pain is defined by the International Association for the Study of Pain as pain that persists for at least 3 months postoperatively and is associated with physical factors, such as muscle weakness and limited joint ROM, and cognitive and psychological factors, such as pain catastrophizing and anxiety[11]. In addition, there is a report[12] that preoperative cognitive and psychological factors are also involved; therefore, it is important to examine these indices before and after surgery.

However, many aspects of the relationship between AKO preoperative and discharge assessments remain unclear, and there is a lack of scientific data to provide an explanation for postoperative pain levels[13]. Therefore, this study aimed to determine the relationship between preoperative and discharge assessments in patients undergoing AKO.

PARTICIPANTS AND METHODS

This study was conducted using a prospective cohort study. Patients with AKO who were admitted to the hospital between September 1, 2022 and December 31, 2023 were included in the study. The inclusion criteria were as follows: patients who had undergone AKO at our hospital were ≥50 years old and were generally independent in ADLs preoperatively. Exclusion criteria were serious postoperative complications (pneumonia, deep vein thrombosis, wound infection, etc.), inability to provide consent, and dementia (Revised Hasegawa's Dementia Scale score ≤20). The sample size was calculated using a G-power (statistical power analyses for Windows and Mac, version 3.1.9.2) and a total of 26 participants obtained. The study was conducted in accordance with the Declaration of Helsinki, with consent obtained from the participants and approval from the Ethics Committee of the Wajinkai Hospital (permit number: Rh20240402).

Basic information (hospital stay, age, and body mass index) was extracted from medical records, and pre- and postoperative evaluations were conducted one day before surgery and seven days before discharge, respectively. Knee flexion and extension ROM were measured using a goniometer in the supine position. The degree of pain was evaluated using an 11-point numerical rating scale (NRS) ranging from "0 (no pain at all)" to "10 (worst possible pain)"[14]. The Pain Catastrophizing Scale (PCS) and Hospital Anxiety and Depression Scale (HADS) were measured as cognitive and psychological assessments of pain; the PCS was a 13-item questionnaire, with each item rated using a Likert scale with five categories ranging from "0 (not at all applicable)" to "4 (very applicable)". The scale comprises three sub-items: "Ruminating", "Helplessness", and "Magnification", with higher total scores indicating more catastrophic thinking[15]. Hospital Anxiety and Depression Scale was used to assess patients' states of anxiety and depression. It comprises 14 items, including seven anxiety and seven depression items, with four possible responses on a Likert scale of 1 (agree) to 4 (deny), and the corresponding scores were subtracted from 28 points (very high anxiety and depression) for each rating[16]. We measured the 10-m walking time as a physical function assessment. The 10-m walking time was measured twice, and the better time was used.

For statistical analysis, the Shapiro–Wilk test was used to test normality, the Wilcoxon signed-rank sum test was used to compare preoperative and before discharge parameters, and Spearman's rank correlation coefficient was used for correlation analysis between parameters. The significance level was set at 5% for all tests, and tests were conducted using SPSS for Windows 22.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Thirty-nine patients with AKO were admitted to Wajinkai hospital, 12 of whom had undergone surgery at other hospitals, eight patients with inadequate evaluation, and one patient with a vertebral fracture during hospitalization were excluded; 18 patients were ultimately included in the final analysis. We found significant improvements at discharge compared to preoperatively ($p<0.05$) in the NRS for pain at rest ($p<0.01$) and during exercise ($p<0.01$), knee flexion ($p=0.03$) and extension ($p<0.01$) ROM, and PCS total ($p=0.04$) and rumination scores ($p=0.03$) (Table 1). The results of the simple correlations between parameters are listed in Table 2. Significant correlations were found between the preoperative PCS total score and 10-m walking time at discharge ($\rho=0.567$, $p=0.02$), knee flexion and extension ROM, PCS total score, and HADS-D preoperatively and at discharge.

DISCUSSION

Regarding the correlation between the preoperative PCS total score and 10-m walking time at discharge, early postoperative irritability, immobility, and motor avoidance due to pain modulate the neural network[17]. It has also been reported that PCS is an independent predictor of chronic pain after TKA[18]. The results of this study support these findings, and we consider that by intervening while checking preoperative PCS and early postoperative pain, it is possible to predict the risk of developing chronic pain and contribute to improving long-term walking ability. The significant improvement at

Table 1. Preoperative-to-discharge comparison

	Preoperative		Discharge		
	Median	Interquartile range	Median	Interquartile range	
Length of hospital stay (days)	58	51.3 to 59			
Age (years)	61.5	58.3 to 68.5			
Body mass index (kg/m^2)	25.6	23.7 to 29.0			
Resting pain (NRS)	1	0.25 to 2	0	0 to 0	*
Exercise pain (NRS)	6.5	4.25 to 8.0	2	1 to 4	*
Flexion ROM (°)	135	125 to 140	133.5	130 to 148.75	*
Extension ROM (°)	−5	(−10) to (−3)	0	(−3) to 0	*
PCS total	25	16.25 to 31	15.5	11.25 to 23.75	*
PCS Ruminating	15	13 to 16	12	6 to 14.5	*
PCS Helplessness	6	5 to 7	3.5	1 to 5.75	
PCS Magnification	3.5	2 to 5.75	2	1 to 4.75	
HADS-A	6	4 to 8	4	3 to 6.5	
HADS-D	6	4 to 7	6	5 to 7.75	
10-m walking time (sec)	9.3	8.25 to 11.13	8.8	7.73 to 10.58	
10-m walking steps (steps)	18	16.25 to 18.75	17	15.25 to 18	

*p<0.05. HADS-A: Hospital Anxiety and Depression Scale anxiety subscore; HADS-D: Hospital Anxiety and Depression Scale depression subscore; PCS: pain catastrophizing scale; ROM: range of motion.

Table 2. Simple correlations between parameters

		Discharge							
		NRS (rest)	NRS (exercise)	Flexion	Extension	PCS total	HADS-A	HADS-D	10-m walking
Preoperative	NRS (rest)	−0.116	−0.098	−0.400†	0.020	0.080	−0.046	0.013	0.284
	NRS (exercise)	0.353	0.214	0.253	−0.383	−0.013	−0.221	−0.010	−0.140
	Flexion ROM	−0.204	0.196	0.815*	0.222	−0.070	0.034	0.353	−0.338
	Extension ROM	0.102	0.209	0.043	0.658*	−0.199	0.067	0.179	−0.036
	PCS total	0.002	0.104	−0.433†	−0.374	0.529*	0.094	0.093	0.567*
	HADS-A	−0.141	−0.036	−0.458†	−0.120	0.021	0.162	0.049	0.363
	HADS-D	−0.005	0.217	0.249	−0.018	0.016	0.188	0.568*	−0.182
	10-m walking	−0.100	−0.138	−0.010	0.030	0.065	−0.196	−0.026	0.301

*p<0.05, †p<0.1. HADS-A: Hospital Anxiety and Depression Scale anxiety subscore; HADS-D: Hospital Anxiety and Depression Scale depression subscore; NRS: numerical rating scale; PCS: pain catastrophizing scale; ROM: range of motion.

discharge in resting and exercise pain NRS, knee flexion and extension ROM, and PCS total and rumination scores suggest that surgery and postoperative rehabilitation were performed appropriately. Moreover, pain relief contributed to functional improvements, including improvement in joint motion. All other correlations were related to preoperative physical and psychological factors. Furthermore, there tended to be correlations between preoperative resting pain NRS, PCS total score, HADS-A, and knee flexion ROM at discharge, as it has been reported that knee patients with OA with abnormal pain control mechanisms have difficulty alleviating postoperative pain and anxiety and are associated with walking and exercise pain 3–4 years postoperatively[19, 20], which also supports previous studies. However, it has been reported that postoperative return to sports (87.2%) and return to work (84.5%) rates are high after AKO[21], and it seems that providing appropriate postoperative rehabilitation can help patients achieve high performance postoperatively. In applying these results to clinical practice, we need to not only confirm the degree of pain and walking ability before surgery, but also conduct cognitive and psychological evaluations of pain. We believe that if we can predict prognosis early and develop an approach that takes into account the postoperative fear-avoidance model, we can prevent persistent postoperative pain. A limitation of this study is that approximately 30% of the participants were not able to complete all assessments, and the small sample size may have influenced the results. A multiple regression analysis would have been valuable, but the current sample size made this difficult to implement. Moreover, we have not been able to make sufficient long-term observations to adequately determine the presence of CPSP. Therefore, we would like to conduct long-term observations in the future, including those in outpatient clinics. Finally, we believe major factor is the failure to reflect differences in surgical techniques in the results. In conclusion,

the preoperative PCS total score in patients with AKO correlated with the ability to walk at discharge, and the preoperative cognitive and psychological assessment of pain could predict the ability at discharge. Prospects are warranted to examine whether cognitive and psychological interventions implemented in the early postoperative period for patients with AKO with high preoperative PCS total scores will improve physical function at discharge from the hospital.

Conflict of interest

There are no conflicts of interest.

ACKNOWLEDGMENTS

We would like to thank all participants in this study.

REFERENCES

1) Brouwer GM, van Tol AW, Bergink AP, et al.: Association between valgus and varus alignment and the development and progression of radiographic osteoarthritis of the knee. Arthritis Rheum, 2007, 56: 1204–1211. [Medline] [CrossRef]
2) Sasaki E, Ota S, Chiba D, et al.: Early knee osteoarthritis prevalence is highest among middle-aged adult females with obesity based on new set of diagnostic criteria from a large sample cohort study in the Japanese general population. Knee Surg Sports Traumatol Arthrosc, 2020, 28: 984–994. [Medline] [CrossRef]
3) Ebata-Kogure N, Murakami A, Nozawa K, et al.: Treatment and healthcare cost among patients with hip or knee osteoarthritis: a cross-sectional study using a real-world claims database in Japan between 2013 and 2019. Clin Drug Investig, 2020, 40: 1071–1084. [Medline] [CrossRef]
4) Duivenvoorden T, van Diggele P, Reijman M, et al.: Adverse events and survival after closing- and opening-wedge high tibial osteotomy: a comparative study of 412 patients. Knee Surg Sports Traumatol Arthrosc, 2017, 25: 895–901. [Medline] [CrossRef]
5) Sharma L, Song J, Felson DT, et al.: The role of knee alignment in disease progression and functional decline in knee osteoarthritis. JAMA, 2001, 286: 188–195. [Medline] [CrossRef]
6) Ferrera A, Menetrey J: Optimizing indications and technique in osteotomies around the knee. EFORT Open Rev, 2022, 7: 396–403. [Medline] [CrossRef]
7) Fukui N, Conaghan PG, Togo K, et al.: Physician and patient perceptions of surgical procedures for osteoarthritis of the knee in the United States, Europe, and Japan: results of a real-world study. BMC Musculoskelet Disord, 2022, 23: 1065. [Medline] [CrossRef]
8) Brosset T, Pasquier G, Migaud H, et al.: Opening wedge high tibial osteotomy performed without filling the defect but with locking plate fixation (TomoFix™) and early weight-bearing: prospective evaluation of bone union, precision and maintenance of correction in 51 cases. Orthop Traumatol Surg Res, 2011, 97: 705–711. [Medline] [CrossRef]
9) Hara K, Kanda M, Kobayashi Y, et al.: Factors affecting the length of hospital stay for total knee arthroplasty in Japan: a retrospective study using the diagnosis procedure combination database. Eur J Med Res, 2024, 29: 122. [Medline] [CrossRef]
10) Hofmann S, Seitlinger G, Djahani O, et al.: The painful knee after TKA: a diagnostic algorithm for failure analysis. Knee Surg Sports Traumatol Arthrosc, 2011, 19: 1442–1452. [Medline] [CrossRef]
11) Hirakawa Y, Hara M, Fujiwara A, et al.: Consideration of cognitive and emotional factors that affect chronic postoperative pain. Pain Res, 2013, 28: 23–32. [CrossRef]
12) Blackburn J, Qureshi A, Amirfeyz R, et al.: Does preoperative anxiety and depression predict satisfaction after total knee replacement? Knee, 2012, 19: 522–524. [Medline] [CrossRef]
13) Van Genechten W, Van den Bempt M, Van Tilborg W, et al.: Structural allograft impaction enables fast rehabilitation in opening-wedge high tibial osteotomy: a consecutive case series with one year follow-up. Knee Surg Sports Traumatol Arthrosc, 2020, 28: 3747–3757. [Medline] [CrossRef]
14) Hawker GA, Mian S, Kendzerska T, et al.: Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care Res (Hoboken), 2011, 63: S240–S252. [Medline] [CrossRef]
15) Pedler A: The Pain Catastrophising Scale. J Physiother, 2010, 56: 137. [Medline] [CrossRef]
16) Mok LC, Lee IF, Lee IF, et al.: Anxiety, depression and pain intensity in patients with low back pain who are admitted to acute care hospitals. J Clin Nurs, 2008, 17: 1471–1480. [Medline] [CrossRef]
17) Barroso J, Branco P, Pinto-Ramos J, et al.: Subcortical brain anatomy as a potential biomarker of persistent pain after total knee replacement in osteoarthritis. Pain, 2023, 164: 2306–2315. [Medline] [CrossRef]
18) Burns LC, Ritvo SE, Ferguson MK, et al.: Pain catastrophizing as a risk factor for chronic pain after total knee arthroplasty: a systematic review. J Pain Res, 2015, 8: 21–32. [Medline]
19) Petersen KK, Graven-Nielsen T, Simonsen O, et al.: Preoperative pain mechanisms assessed by cuff algometry are associated with chronic postoperative pain relief after total knee replacement. Pain, 2016, 157: 1400–1406. [Medline] [CrossRef]
20) Kjær Petersen K, Lunn TH, Husted H, et al.: The influence of pre- and perioperative administration of gabapentin on pain 3–4 years after total knee arthroplasty. Scand J Pain, 2018, 18: 237–245. [Medline] [CrossRef]
21) Ekhtiari S, Haldane CE, de Sa D, et al.: Return to work and sport following high tibial osteotomy: a systematic review. J Bone Joint Surg Am, 2016, 98: 1568–1577. [Medline] [CrossRef]