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Research Article

Early Clinical Outcomes Following Patient-Specific Visual Feedback Using Intraoperatively Recorded Knee Motion After Total Knee Arthroplasty

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ABSTRACT

Objective: This study aimed to evaluate the association between postoperative viewing of a video demonstrating the patient's own intraoperatively recorded knee motion and early clinical outcomes following total knee arthroplasty (TKA).

Methods: This retrospective study included 120 patients (47 men, 73 women; mean age, 67.0 years) who underwent primary TKA between 2020 and 2023. Patients were categorized into a video-based intervention group (n=60) and a control group (n=60) according to the time period of surgery. Patients in the intervention group viewed a postoperative video demonstrating their own intraoperatively recorded knee motion. The mean follow-up was approximately 92 days. Primary outcome measures included visual analog scale (VAS) pain scores and knee range of motion (ROM) assessed on postoperative days 45 and 90, patient satisfaction on postoperative day 90, and postoperative complications.

Results: Patients in the video group demonstrated significantly lower VAS pain scores than the control group on postoperative day 45 (3.2 ± 1.1 vs. 4.6 ± 1.3, *P*=0.0002) and day 90 (1.8 ± 0.8 vs. 2.9 ± 1.1, *P*=0.0003). Knee ROM was significantly greater in the video group at day 45 (95.6° ± 8.3° vs. 88.3° ± 9.1°, *P*=0.004) and day 90 (110.3° ± 7.5° vs. 102.7° ± 8.6°, *P*=0.006). Patient satisfaction was significantly higher in the video group (85% vs. 65%, *P*=0.004), whereas postoperative complication rates were comparable between groups (6.6% vs. 8.3%, *P*=0.68).

Conclusion: Postoperative viewing of a video demonstrating the patient's own intraoperatively recorded knee motion was associated with reduced pain, improved knee range of motion, and greater patient satisfaction during early recovery following TKA. Video-based visual feedback may be a useful adjunct to support early postoperative rehabilitation following TKA. Further prospective randomized studies are needed to better define its clinical role and permit causal inference.

Level of Evidence: Level III, Therapeutic Study.

Introduction

Total knee arthroplasty (TKA) is an effective surgical treatment for advanced knee osteoarthritis, aiming to relieve pain and restore function. Despite advances in implant design and surgical techniques, early postoperative recovery remains a critical determinant of patient satisfaction and long-term outcomes.[1,2] However, factors such as postoperative pain, limited confidence, and reduced motivation may negatively affect patients' engagement in rehabilitation and delay functional recovery.

Active participation in physiotherapy during the early postoperative period is essential for achieving adequate range of motion (ROM) and functional independence. However, psychological factors such as low motivation and kinesiophobia may reduce adherence to rehabilitation programs.[3] Therefore, adjunctive strategies that enhance patient confidence and participation in rehabilitation have gained increasing clinical interest.

Visual feedback methods have recently attracted attention as potential tools to support rehabilitation. Previous studies have demonstrated that visual and video-based interventions may improve patient understanding, reduce anxiety, and facilitate participation in postoperative exercises.[4,5] These approaches are thought to influence both cognitive and behavioral aspects of recovery by reinforcing motor learning and improving patients' perception of their physical capabilities.

However, most existing studies have focused on preoperative education or generalized visual materials, and the role of patient-specific visual feedback in the postoperative period remains insufficiently explored.[6,7] Whether personalized visual confirmation can reduce pain-related anxiety, enhance motivation, and facilitate early ROM improvements remains unclear.[8] In particular, the impact of showing patients their own knee motion following surgery on early clinical outcomes has not been adequately investigated.

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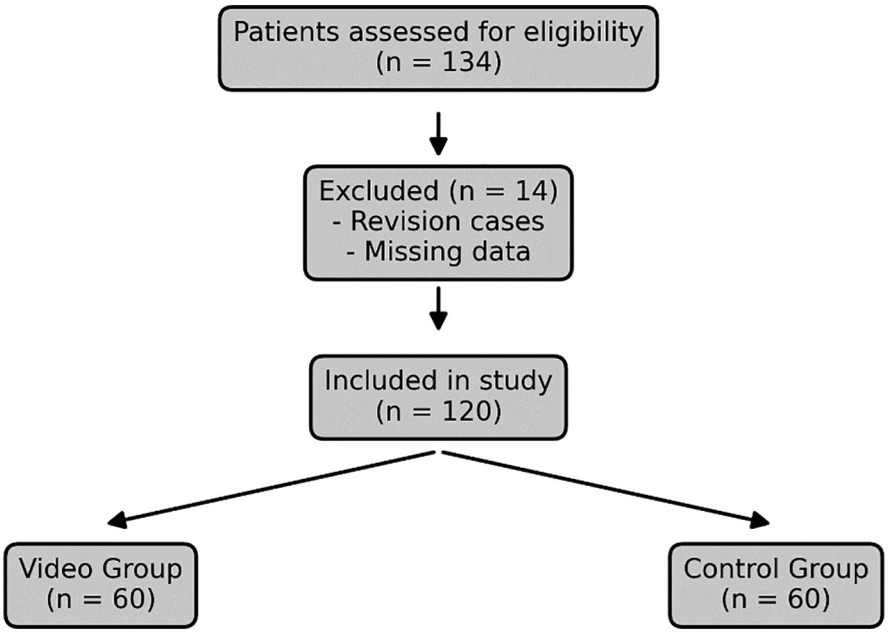

Figure 1. Study flow diagram demonstrating patient selection and group allocation.

The present study aimed to evaluate the association between postoperative viewing of a video showing the patient's own intraoperatively recorded knee motion and early clinical outcomes following TKA. It was hypothesized that patients exposed to this personalized visual feedback would demonstrate lower pain scores, greater ROM, and higher satisfaction during the early postoperative period compared with those receiving standard care.

Materials and methods

Study design and patient selection

This retrospective study was approved by the ethics committee of Malatya Turgut Özal University and conducted in accordance with the Declaration of Helsinki (Approval No.: 10-78, Date: 14.11.2023). The medical records of patients who underwent primary TKA between January 2020 and December 2023 were reviewed.

During the early phase of the study period, intraoperative video recording and postoperative video viewing were not part of routine clinical practice. Beginning in July 2021, a postoperative knee-movement video was incorporated into the clinical workflow as part of an internal quality-improvement initiative. Accordingly, patients treated between January 2020 and June 2021 constituted the control group, whereas those treated between July 2021 and December 2023 formed the video group. No randomization was performed, and allocation was purely time-based.

Patients aged between 50 and 80 years with a diagnosis of primary knee osteoarthritis who underwent unilateral primary TKA and had a minimum follow-up of 90 days were considered eligible for inclusion. Patients with a history of prior major knee surgery (such as osteotomy, ligament reconstruction, or fracture surgery), inflammatory arthropathy, bilateral simultaneous TKA, perioperative complications requiring immediate revision surgery, or incomplete follow-up data were excluded. A total of 134 patients (control group: n=68 and video group n=66) were initially assessed for eligibility. After excluding 14 patients due to revision surgery (n=8) or incomplete follow-up data (n=6), 120 patients (n=60 for both groups) were included in the final analysis. After applying the predefined exclusion criteria, 60 patients remained in each group. This distribution occurred naturally and was not the result of intentional matching (Figure 1).

Patients in the video group were shown a postoperative video demonstrating their own intraoperatively recorded knee motion, whereas patients in the control group received standard postoperative care without video viewing.

Sample size adequacy

Given the retrospective design of the study, a post hoc sample size adequacy analysis was performed. Based on previously reported differences in Visual Analog Scale (VAS) scores following TKA, an effect size of approximately 0.6 was assumed.[5] With a total sample size of 120 patients, the study was considered to have sufficient statistical power (approximately 80%) to detect clinically meaningful differences between groups at a significance level of α=0.05.

Surgical technique and perioperative care

All surgeries were performed by 2 senior arthroplasty surgeons using a standardized medial parapatellar approach under spinal anesthesia. A posterior-stabilized cemented implant (Vanguard Zimmer Biomet, Warsaw, IN, USA) was used in all cases. Tourniquet use and patellar resurfacing were performed according to routine institutional protocol.

Perioperative management was standardized across both groups. Tranexamic acid (1 g IV pre-incision and 1 g IV at closure) was routinely administered.[8] Postoperative analgesia (acetaminophen, NSAIDs, and

HIGHLIGHTS

- Postoperative viewing of intraoperatively recorded videos was associated with improved early postoperative knee range of motion.
- Video-based visual feedback may support patient motivation and encourage active participation in rehabilitation protocols.
- Patients in the video group demonstrated higher postoperative satisfaction scores.
- This study evaluates a simple and low-cost visual feedback approach in the early recovery period after total knee arthroplasty.

patient-controlled analgesia) and thromboprophylaxis (low-molecular-weight heparin) were standardized across both groups.[9]

A closed-suction drain was used selectively based on intraoperative assessment, with no systematic difference between the groups in its application.

Description of the video intervention

At the end of the surgical procedure, following wound closure and dressing application, a 20- to 30-second video was recorded demonstrating passive flexion and extension of the operated knee. The recording included only the externally dressed knee and its ROM, without any intra-articular or open surgical images.

On postoperative day 1, patients in the video group viewed this recording once using a tablet device. A brief standardized explanation accompanied the video, emphasizing that the knee was capable of safe movement, that early mobilization was expected, and that participation in physiotherapy could be performed with confidence. No additional video sessions or repeated viewings were provided.

Patients in the control group received routine postoperative care without any video-based visual feedback or additional structured visual instruction.

The standardized explanation was delivered by the operating surgeon using a consistent verbal framework.

Postoperative rehabilitation protocol

All patients followed the same rehabilitation protocol. Assisted standing and ambulation with a walker began on postoperative day 1. Active and passive ROM exercises, quadriceps strengthening, and gait training were initiated under the supervision of a physiotherapist. Outpatient physiotherapy continued 2-3 sessions per week for the first 4-6 weeks.[10] The content, frequency, and progression of the rehabilitation program were standardized and did not differ between the groups. No additional rehabilitation interventions were introduced in either group beyond the described protocol.

Data collection and outcome measures

Demographic data, including age, sex, body mass index (BMI), and comorbidities, as well as preoperative clinical variables such as baseline ROM, were obtained from patient records.

Postoperative pain was assessed using the VAS at rest on postoperative days 45 and 90.[11] All assessments were performed under standardized clinical conditions. Knee ROM was measured using a standard goniometer on postoperative days 45 and 90.[12] Measurements were performed by a physiotherapist who was not informed of group allocation to minimize observer bias. Patient satisfaction was evaluated on postoperative day 90 using a 5-point Likert scale (1=not satisfied, 5=completely satisfied). All categories were predefined in the study protocol to ensure consistency of responses.

Postoperative complications, including infection, thromboembolic events, wound problems, and stiffness, were recorded during the follow-up period and compared between groups. Patients who developed complications were not excluded from the analysis.

Statistical analysis

All statistical analyses were performed using SPSS, version 27 (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed variables were compared using the independent samples *t*-test, whereas non-normally distributed variables were analyzed using the Mann–Whitney *U*-test. Categorical variables were compared using the chi-square test. Effect sizes (Cohen's *d*) were calculated for the primary outcomes, including VAS and ROM, to provide additional information on the magnitude of differences between groups. A *P*-value of less than .05 was considered statistically significant.

Results

Baseline demographic and clinical characteristics are shown in Table 1. Age, sex, BMI, comorbidities, and preoperative ROM were comparable between groups (all $P > .05$).

Postoperative pain levels assessed using the VAS at rest were significantly lower in the video group at both follow-up points. On postoperative day 45, mean VAS scores were 3.2 ± 1.1 in the video group and 4.6 ± 1.3 in the control group ($P=.0002$; Cohen's $d=0.61$). On day 90, scores were 1.8 ± 0.8 versus 2.9 ± 1.1, respectively ($P=.0003$; Cohen's $d=0.59$). These results are presented in Table 2 and Figure 2.

Knee ROM was also significantly higher in the video group. On day 45, mean ROM was 95.6° ± 8.3° in the video group compared with 88.3° ± 9.1° in the control group ($P=.004$; Cohen's $d=0.54$). On day 90, ROM reached 110.3° ± 7.5° versus 102.7° ± 8.6°, respectively ($P=.006$; Cohen's $d=0.50$) (Table 2, Figure 3).

On postoperative day 90, patient satisfaction scores (5-point Likert scale) differed significantly between groups ($P=.004$). In the video group, 60% of patients reported a score of 5 and 25% reported a score of 4, while the corresponding rates in the control group were 35% and 30%, respectively. Mean satisfaction scores were 4.6 ± 0.7 in the video group and 4.0 ± 0.9 in the control group.

Complication rates were comparable between groups ($P=.68$). Four patients (6.6%) in the video group and 5 patients (8.3%) in the control group experienced complications. Details of individual complications are summarized in Table 3.

Table 1. Baseline demographic and clinical characteristics

Variable	Video group (n=60)	Control group (n=60)	*P*
Age (years)	67.2 ± 6.1	66.7 ± 5.9	.64
Gender (M/F)	22/38	25/35	.58
BMI (kg/m²)	29.1 ± 3.4	28.9 ± 3.6	.73
Operated side (R/L)	34/26	31/29	.68
Preop ROM (mean ± SD)	108.2° ± 9.6°	107.8° ± 10.1°	.74
Follow-up (days)	92.1 ± 5.6	91.7 ± 6.0	.77

BMI, body mass index; F, female; L, left; M, male; R, right; ROM, range of motion.

Table 2. Comparison of primary outcomes between groups

Outcome	Time point	Video group (n=60)	Control group (n=60)	*P*	Effect size (Cohen's *d*)
VAS (rest)	Day 45	3.2 ± 1.1	4.6 ± 1.3	.0002	0.61
VAS (rest)	Day 90	1.8 ± 0.8	2.9 ± 1.1	.0003	0.59
ROM (°)	Day 45	95.6 ± 8.3	88.3 ± 9.1	.004	0.54
ROM (°)	Day 90	110.3 ± 7.5	102.7 ± 8.6	.006	0.50
Satisfaction (Likert 1-5)	Day 90	4.6 ± 0.7	4.0 ± 0.9	.004	—

Values are presented as mean ± SD unless otherwise stated. Effect sizes are expressed as Cohen's *d*.
ROM, range of motion, VAS, Visual Analog Scale.

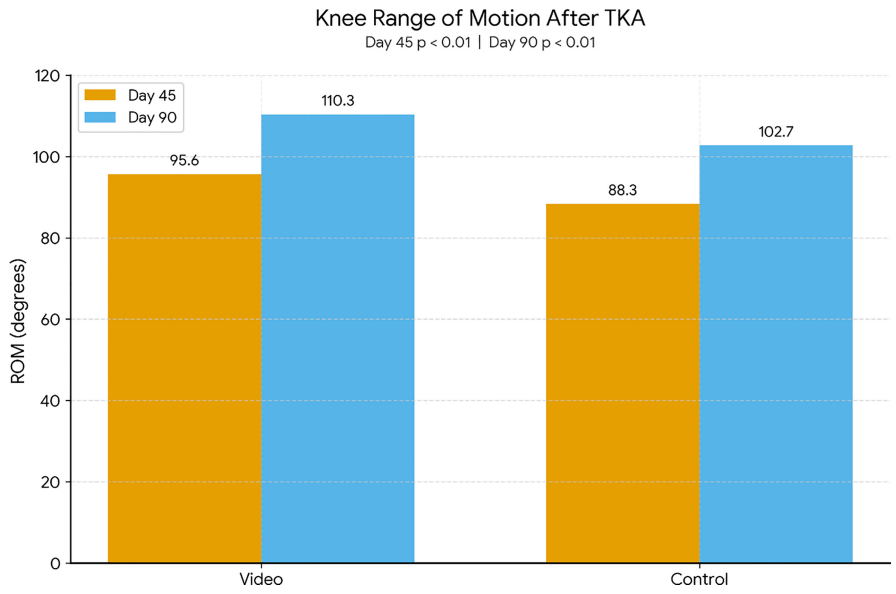

Figure 2. Comparison of Visual Analog Scale pain scores at rest between the video and control groups on postoperative days 45 and 90.

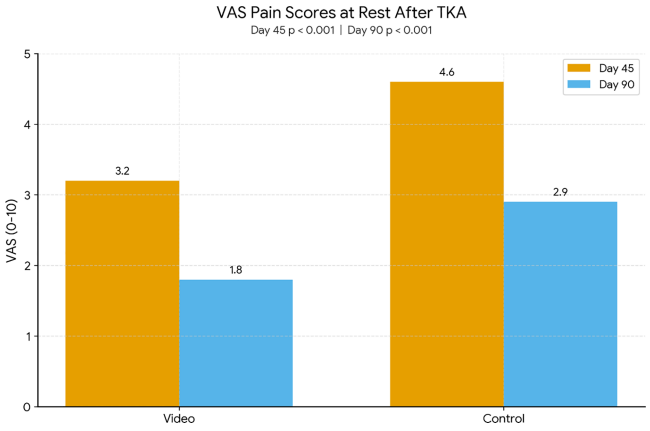

Figure 3. Comparison of knee range of motion between the video and control groups on postoperative days 45 and 90.

Discussion

In this retrospective study, postoperative viewing of intraoperatively recorded videos was associated with lower postoperative pain scores, greater knee ROM, and higher patient satisfaction following TKA. These findings support the hypothesis that early visual feedback may enhance patients' understanding of their postoperative condition and encourage more active participation in rehabilitation. However, given the retrospective and non-randomized design, these findings should be interpreted as associations rather than evidence of a causal relationship.

The lower VAS scores observed in the video group are in line with previous research suggesting that visual stimuli can influence postoperative pain perception by reducing anxiety and improving patients' confidence in surgical success. Studies in clinical psychology and rehabilitation have shown that visual cues may modify cognitive appraisal, help patients interpret postoperative sensations more accurately, and potentially reduce kinesiophobia (fear of movement).[13,14] However, evidence from randomized studies evaluating digital or video-based interventions has not been entirely consistent. For example, a randomized clinical trial reported that although digital rehabilitation interventions resulted in statistically significant improvements, these changes did not reach clinically meaningful thresholds.[15-17] These discrepancies may be explained by differences in study design, patient engagement, and the personalization of the intervention, as patient-specific visual feedback may have a greater psychological and behavioral impact than generalized educational content. Although the present study cannot establish a causal relationship due to its retrospective design, the observed association supports the notion that video-based feedback may contribute to a more positive pain experience in the early recovery period.

Greater ROM values in the video group further indicate that visual reinforcement may enhance patient engagement in rehabilitation. Prior studies have emphasized that early, motivated participation in postoperative exercises is one of the strongest predictors of functional recovery after TKA.[18,19] Visual learning theories suggest that observing a movement enhances motor planning and execution, and this mechanism may partially explain the improved ROM values in the video group.[5,18] Additionally, increased patient confidence and

Table 3. Postoperative complications by group

Complication type	Video group (n=60)	Control group (n=60)	Total
Superficial wound infection	2 (3.3)	3 (5.0)	5
Deep infection requiring re-intervention	0	0	0
Temporary postoperative thrombosis	2 (3.3)	2 (3.3)	4
Wound hematoma or prolonged drainage	0	0	0
Joint stiffness requiring additional physiotherapy	0	0	0
Other complications	0	0	0
Total complications	4 (6.6)	5 (8.3)	9

Values are presented as number (percentage).

reduced fear of movement may have contributed to better adherence to physiotherapy protocols. These findings are in line with the growing body of literature suggesting that visual or video-based strategies may support rehabilitation adherence. Given its simplicity, low cost, and ease of implementation, this intervention may serve as a practical adjunct to standard postoperative care.

Higher satisfaction scores in the video group suggest that visual feedback may contribute to a more reassuring postoperative experience. Satisfaction after TKA is influenced not only by clinical outcomes but also by expectations, understanding of the procedure, and perceived recovery trajectory.[20] Viewing their own knee movement immediately after surgery may reduce uncertainty and enhance trust in the treatment process. However, satisfaction is a multifactorial outcome influenced by both psychological and clinical variables, and the observed differences should be interpreted within this broader context.[4,14] Given the ordinal nature of satisfaction data, non-parametric effect size measures may provide additional insight and should be considered in future studies.

This study has several limitations. The retrospective, nonrandomized design introduces a risk of selection bias due to time-based allocation. Both patients and physiotherapists were unblinded to group assignment, increasing the potential for performance and detection bias. Intraoperative ROM values were not recorded, making it unclear whether both groups achieved similar motion intraoperatively. Rehabilitation adherence could not be objectively measured, and validated knee-specific patient-reported outcome measures, such as Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) or Oxford Knee Score, were not included. Pain and satisfaction scores are subjective measures and may be influenced by patient expectations. In addition, although baseline characteristics were comparable, residual confounding factors cannot be excluded. Finally, the follow-up period was limited to 90 days, preventing evaluation of long-term functional outcomes. Future prospective, randomized, longer-term studies are needed to confirm these findings and clarify the role of video-based visual feedback in postoperative rehabilitation.

In this retrospective study, postoperative viewing of a video showing the patient's own intraoperatively recorded knee motion was associated with lower postoperative pain scores, greater ROM, and higher satisfaction after TKA. These findings suggest that early video-based visual feedback may be associated with improved early postoperative recovery parameters. Given its simplicity and low cost, this approach may be considered a potential adjunct to routine postoperative care.

However, due to the retrospective design, these findings should be interpreted with caution, and causal relationships cannot be established. Prospective randomized studies with longer follow-up are needed to confirm these observations and to further define the role of visual feedback in postoperative rehabilitation.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Artificial Intelligence Usage Statement: The authors declared that no Artificial Intelligence tool was used in the preparation of the manuscript.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Malatya Turgut Özal University (Approval No.: 2024/432; Date: 14.11.2023).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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Declaration of Interests: The authors have no conflict of interest to declare.

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