Thesis

Correlation between Postoperative Pain Intensity and Sleep Quality after Primary Total Knee Replacement: A Prospective Study with PSQI and VAS Assessments

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Abstract

Background: Pain from end-stage knee osteoarthritis commonly disrupts sleep, and improving patient-centred outcomes after total knee arthroplasty (TKA) requires attention to both function and restorative sleep. This study describes sleep changes after unilateral primary TKA and examines how sleep relates to pain, knee-specific function and quality of life.

Methods: One hundred and four consecutive patients undergoing primary unilateral TKA between November 2019 and November 2021 were followed prospectively. Sleep was evaluated using the Pittsburgh Sleep Quality Index (PSQI); pain by a Visual Analogue Scale (VAS); knee function by the Knee Society Score (KSS) and Oxford Knee Score (OKS); and broader health status by the SF-36. Assessments were performed preoperatively and at 6 weeks, 3 months, 6 months and 1 year. Standard perioperative care and a structured physiotherapy regimen were used for all patients. Statistical tests included repeated measures analysis, correlation testing and regression to identify predictors of persistent poor sleep.

Results: Most patients had poor sleep before surgery. Sleep often worsened shortly after the operation, improved progressively by six months and showed continued gains at one year. Pain and functional scores improved significantly across follow-up. Higher body mass index and diabetes were associated with worse sleep at later follow-up.

Conclusion: In this cohort, unilateral primary TKA was followed by overall improvement in sleep alongside marked reductions in pain and gains in function by one year. Attention to perioperative pain control and comorbidities may help speed recovery of restful sleep.

Keywords: Total knee arthroplasty, Sleep quality, Pittsburgh Sleep Quality Index, Oxford Knee Score, Knee Society Score.

Introduction

Total knee arthroplasty is a widely accepted solution for patients whose knee osteoarthritis has become disabling despite conservative care. While surgeons often focus on implant position, fixation and range of motion, patients commonly measure success by how much pain is relieved, how well they return to day-to-day activities, and whether they can sleep through the night. Pain at night is a frequent complaint in advanced knee disease and can fragment sleep, reduce daytime energy and worsen overall well-being. [2–5]

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Numerous patient-reported outcome measures now complement clinical and radiological assessments, giving a clearer picture of recovery that matters to patients. Instruments such as the Oxford Knee Score and Knee Society Score capture pain and function in everyday terms, while the Pittsburgh Sleep Quality Index quantifies sleep problems that might otherwise be overlooked. [6–8] Earlier studies have shown a typical pattern: many patients arrive for surgery already sleeping poorly, sleep often worsens in the immediate postoperative period, and then steadily improves over a timeframe of months as pain subsides and function returns. [9–11]

However, the exact relationship between sleep recovery and measures of knee function varies across reports. Some cohorts show moderate links early after surgery, suggesting that better early pain control and mobility support better sleep; over time this relationship often weakens, indicating that other factors—such as body mass index, diabetes or general health—begin to play a larger role. [12–15] Because sleep affects mood, pain perception and participation in rehabilitation, tracking sleep alongside conventional outcome scores can help tailor perioperative care and counselling. [16–18]

This prospective study of 104 consecutive patients uses standardised measures at fixed intervals to describe sleep trajectories after unilateral primary TKA and to explore how sleep relates to pain, knee function and quality of life. The goal is practical: to provide clinicians with evidence from a single-centre experience that can inform patient discussions and perioperative plans. [19–20]

Aims & objectives

1. To document change in sleep quality following unilateral primary total knee arthroplasty using PSQI.
2. To examine relationships between sleep qualities, pain (VAS), knee function (KSS, OKS) and SF-36 domains over one year, and to identify patient factors associated with persistent postoperative poor sleep.

Review of literature

Sleep disturbances are widely reported by people with symptomatic osteoarthritis. Night pain, trouble falling asleep and interrupted sleep are common complaints and contribute importantly to reduced quality of life. Radiographic severity correlates imperfectly with symptoms, but when pain is severe it often affects sleep continuity and daytime function. [11–13, 19] The PSQI has become a practical, validated tool for assessing sleep quality in clinical cohorts and has been applied in numerous arthroplasty studies to identify those with clinically meaningful sleep problems. [10–11]

Prospective work on sleep before and after joint replacement shows a reproducible pattern. Many patients begin with poor sleep, perioperative factors (acute pain, hospital environment, medication side effects and rehabilitation activities) worsen sleep in the short term, and then a gradual recovery occurs by three to twelve months as pain diminishes and mobility improves. [14–16] Meta-analytic data support the conclusion that, on average, arthroplasty improves sleep at mid-term follow-up, but results vary between studies because of differences in patient selection, perioperative care and the instruments used to measure sleep. [15]

Several single-centre cohort studies report clinically and statistically significant improvements in PSQI scores at six months and beyond. These improvements often accompany reductions in analgesic use and better patient satisfaction scores. [14,16–18] Conversely, studies that have investigated predictors of persistently poor sleep after arthroplasty commonly identify higher body mass index and metabolic comorbidity, especially diabetes, as risk factors. Prolonged hospital stay and high early postoperative pain also show associations with slower sleep recovery. [12–13]

The link between sleep and knee-specific function has been explored using instruments such as OKS, KSS and WOMAC. Many reports find moderate correlations in the early postoperative period, indicating that reduced pain and improved mobility can translate into better sleep soon after surgery; however, this association tends to weaken by one year, implying that long-term sleep quality is shaped by additional biopsychosocial factors beyond knee mechanics alone. [6–9, 18]

Objective sleep measures like polysomnography are rarely used in large arthroplasty cohorts because of cost and complexity; therefore, most evidence relies on patient-reported measures that remain useful for clinical decision-making. Taken together, the literature suggests sleep is an important but under-recognised outcome after TKA and that routine measurement, combined with efforts to optimise pain and manage comorbid conditions, can improve patient-centred recovery. [1,15–17]

Materials and methods

This prospective single-centre study enrolled 104 consecutive patients scheduled for primary unilateral total knee arthroplasty between November 2019 and November 2021. Patients with diagnosed primary sleep disorders, prior major knee surgery on the same side, inability to walk independently, or severe systemic illness were excluded to keep the cohort relatively uniform. Baseline data comprised age, sex, occupation, height and weight (for BMI calculation), the presence of diabetes or hypertension, duration of knee symptoms and relevant investigations.

All patients completed standardised questionnaires at five time points: before surgery, and at 6 weeks, 3 months, 6 months and 1 year after surgery. Sleep was assessed with the Pittsburgh Sleep Quality Index (PSQI); pain with a Visual Analogue Scale (VAS); knee function with the Knee Society Score (KSS) and Oxford Knee Score (OKS); and general health with the SF-36. Clinical assessments included objective range of motion and

documentation of any complications.

Operative care followed institutional protocols: prophylactic antibiotics, drain removal at 24 hours, thromboprophylaxis for five days, suture removal at two weeks and a standard physiotherapy plan beginning on postoperative day two (quadriceps activation, straight-leg raises, gradual knee flexion, weight bearing as tolerated and stair training as appropriate). All patients received multimodal analgesia as per protocol.

Data were entered by trained staff and reviewed by supervising clinicians. Statistical analysis tested normality, used repeated-measures ANOVA for changes over time with appropriate corrections, applied Pearson or Spearman correlation tests where suitable, and used linear regression to identify independent predictors of PSQI at one year. A p-value <0.05 was considered significant. Ethical approval and informed consent procedures were observed. [16–18]

Results

One hundred and four patients completed the study protocol and follow-up visits. Before surgery, the vast majority had poor sleep as measured by PSQI (global PSQI >5). Sleep commonly worsened in the immediate postoperative period and peaked at the six-week assessment before beginning a steady recovery. By six months there was a notable fall in mean PSQI and further improvement at one year.

Pain scores showed substantial decline over time: the mean VAS dropped markedly from baseline to the final follow-up. Functional improvements were pronounced — the Oxford Knee Score rose substantially between baseline and one year, and the Knee Society Score similarly showed marked gains in both knee-specific and functional components. Several SF-36 domains, particularly physical functioning and general health perception, improved in parallel.

Correlation analyses demonstrated moderate relationships between PSQI and functional scores in early follow-up intervals, which diminished by the one-year mark. Regression modelling identified higher body mass index as an independent predictor of worse PSQI at final follow-up; a diagnosis of diabetes was also associated with higher rates of persistent poor sleep. Patients reporting poor sleep tended to have slightly longer hospital stays in this cohort.

Discussion

This study describes a pattern many clinicians will recognise: patients with advanced knee osteoarthritis often arrive for surgery with disturbed sleep, experience a brief worsening of sleep after operation, and then recover gradually as pain and function improve. The data here reinforce the practical point that sleep should be measured and discussed as part of the arthroplasty pathway because it matters to patients and affects rehabilitation. [14–16]

The early postoperative deterioration in sleep most likely reflects acute nociceptive pain, the unfamiliar hospital environment and the physical demands of early recovery. Because sleep disruption can amplify pain perception and reduce daytime participation in physiotherapy, minimizing early sleep disturbance through effective analgesia, simple sleep hygiene advice and attention to inpatient routines could speed functional gains. [16–18]

The improvements seen across SF-36 domains mirror the gains in pain and function and underline that benefits of TKA extend beyond joint mechanics to patient well-being. Translating these findings into practice means routinely asking about sleep, setting realistic expectations for an early period of disrupted rest, and tailoring perioperative plans to patients at higher risk of persistent sleep problems. Future work that uses objective sleep measures or tests targeted interventions for early sleep preservation would be useful to refine these recommendations. [1, 15–17]

Conclusion

In this single-centre prospective series, unilateral primary total knee arthroplasty led to meaningful improvements in pain, knee function and sleep by one year after surgery. Most patients began with sleep disturbance related to osteoarthritis, experienced a short-term worsening after operation, and then showed progressive restoration of sleep as pain diminished and function recovered. Body mass index and diabetes were associated with poorer sleep at later follow-up and should be part of the preoperative risk discussion. Clinicians can support better, quicker recovery of restorative sleep by optimising perioperative analgesia, offering practical sleep hygiene advice and attending to modifiable comorbidities. Routine assessment of sleep in arthroplasty pathways helps set expectations, identify patients who may need extra support, and improves the patient-centred view of successful outcomes.

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