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## Foot Pain is Common, But Frequently Improves 1 Year After Total Knee Arthroplasty

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## ABSTRACT

**Background:** Osteoarthritis frequently affects multiple joints through the lower limbs. This study sought to examine the incidence of foot pain in subjects undergoing total knee arthroplasty (TKA) and determine if foot symptoms improved following surgery.

**Methods:** Six hundred ten subjects undergoing TKA completed patient-reported outcome measures preoperatively, and at 6 and/or 12 months after surgery including the incidence and severity of foot or ankle pain, Knee Injury and Osteoarthritis Outcome Scores (KOOS) Joint Replacement, Oxford Knee Scores (OKS), EQ5D, and satisfaction.

**Results:** Foot or ankle pain was reported in 45% before, 32% at 6 months, and 36% at 12 months after TKA. Of those with preoperative foot pain, 42% at 6 months and 50% at 12 months reported no foot pain after TKA, and the Visual Analog Scale severity reduced from a mean of 4.0 before to 1.7 after surgery. Those with preoperative foot pain had lower baseline KOOS ( $P = .001$ ), OKS ( $P = .001$ ), and more depression/anxiety ( $P = .010$ ), but experienced equivalent postoperative KOOS, OKS, and satisfaction with surgery, compared to those without foot pain.

**Conclusion:** Foot or ankle pain was reported by nearly half of TKA subjects, but resolved after surgery in 50%. Those with preoperative foot pain experienced at least equivalent improvement in knee-related symptoms and mobility compared to those without foot pain. The presence of foot pain should not be a deterrent to TKA.

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Osteoarthritis is a systemic disease that commonly presents with lower limb pain. It affects multiple joints in the lower limb, both large and small, and often affects multiple joints at once. The

most common cause of arthritis in knee is osteoarthritis [1]. As many as 25% of patients presenting with symptomatic knee arthritis describe a concurrent ipsilateral foot pain, which has been shown to reduce health and function [2].

There are a number of causes for foot pain concurrent with knee osteoarthritis. Knee osteoarthritis is commonly associated with lower limb malalignment which alters the biomechanics of the knee, resulting in a transfer of abnormal mechanical load and stressors to the ankle, and altered foot posture [3,4]. Reduction in knee range of motion has been shown to reduce ankle sagittal motion by approximately 7% but increase coronal motion up to 50%

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[1]. The contact pressure in the foot of those patients suffering from osteoarthritis has been shown to be wider, with a longer contact time during stance phase, lower pressure on heel and toes, and shorter range of longitudinal contact pressure through the foot [2]. Patients with medial compartment arthritis are associated with an increased eversion and internal rotation of the hindfoot, and inversion of the forefoot [3]. Furthermore, reduced toe grip strength has been associated with knee osteoarthritis [5] which may alter the transfer of force through the forefoot and midfoot.

Another known cause of foot pain is referred pain. As a result of hyperexcitable neural pathways and activation by inflammatory mediators, pain generated in the knee may be perceived in the foot [6]. Although poorly understood, referred pain may improve with improvement in knee symptoms and reduction in the chronic inflammatory process associated with arthroplasty.

As a result, proximal malalignment, reduced mobility, or referred pain patients with knee osteoarthritis can present with a range of foot symptoms. Performing lower limb realignment surgery in the form of total knee arthroplasty (TKA) was shown to improve ankle pain in a small series of 76 subjects, and improve hindfoot deformity in a series of 195 subjects [7], but has not been adequately studied in a large series [8].

This study sought to examine the incidence of foot pain in a large series of subjects undergoing TKA and determine if foot symptoms improved following surgery.

## Materials and Methods

### Study Design and Participants

The study was performed at the North Sydney Orthopedic & Sports Medicine Center at The Mater Hospital, Sydney on a consecutive series of patients undergoing primary TKA. Subjects undergoing TKA under the care of the investigating surgeons were invited to participate in a prospective registry and complete a series of patient-reported outcome measures (PROMs) preoperatively, and at 6 and 12 months after surgery. The routine data collection includes numerous demographic and operative variables. The database has approval from a local hospital human research ethics committee.

Eligible patients were all adults undergoing primary elective knee arthroplasty under the care of one of the investigating surgeons between January 2019 and December 2020 ( $n = 697$ ). Patients were required to provide written informed consent to participate. Exclusion criteria were those who did not complete the foot pain question before surgery ( $n = 45$ ), and those who died during the follow-up period ( $n = 2$ ). Of the remaining 652 subjects, foot pain questions were completed at 6 months postoperatively by 533 subjects (82%) and 550 subjects (84%) at 12 months.

### Patient-Reported Outcome Measures

Subjects were asked “Please indicate your average pain in your FEET over the last 7 days” on a 100-point Visual Analog Scale (VAS), anchored by “no pain at all” and “worst pain imaginable.” PROMs also included the disease-specific short-form Knee Injury and Osteoarthritis Outcome Score (KOOS) Joint Replacement [9] and Oxford Knee Score (OKS) [10]. The EuroQol (EQ5D) [11] was selected as a widely used generic measure of health status, measuring mobility, self-care, activity, pain, and anxiety [12]. The subdomains of the EQ5D were dichotomized to any problems or no problems for each variable. Satisfaction was assessed after surgery with 4 additional questions: would they have the same surgery again under the same circumstances (Yes/No/Unsure), grading satisfaction with the results of surgery on a 5-point Likert scale

from “very disappointed” to “very satisfied,” and grading “overall, how the problems are now with your hip or knee on which you had surgery, compared to before you had your operation?” (much better/a little better/about the same/a little worse/much worse).

Statistical analysis was performed using SPSS version 24 software (IBM, Armonk, NY). Descriptive statistics are presented as means and standard deviations for continuous variables such as mean patient-reported scores, and counts and percentages for categorical variables. Means were compared over time using repeated measures analysis of variance with Bonferroni post hoc tests, assessing the between-subject factors of preoperative foot pain, and within-subject variables of OKS and KOOS over time. Means were compared between groups with independent  $t$ -tests. Effect size was assessed with Cohen’s  $d$ . Cohen suggested that  $d < 0.2$  be considered a small effect size, 0.5 a medium effect size, and 0.8 a large effect size. Difference in proportions of patients between groups was assessed with the chi-squared test. Binary logistic regression was used to assess the relative influence of BMI, gender, and lower limb alignment on preoperative foot pain. Statistical significance was set at  $P < .05$ .

## Results

Between 2019 and 2020, 651 subjects who underwent primary TKA completed PROMs including foot pain questions before surgery. Postoperative PROMs were repeated at 6 months in 529 subjects and 12 months in 550 subjects. In total, 610 subjects (94%) completed both preoperative PROMs and either 6-month or 12-month PROMs, or both and formed the study group for analysis. The subjects were 48% female ( $n = 290$ ), had a mean age of 69 years (range 33–92), and had a mean BMI of 30.4 (range 17–56). The diagnosis was osteoarthritis in 592 subjects (97%), inflammatory arthritis in 7, avascular necrosis in 4, and not specified in 43. The preoperative alignment was classified by the surgeon at the time of TKA as varus in 423, neutral in 22, valgus in 122, and unspecified in 42.

Before TKA 293 subjects (45%) reported any foot or ankle pain in the prior week. After TKA any foot or ankle pain was reported by 172 (33%) subjects at 6 months and 197 (36%) at 12 months. Of the 276 subjects who reported any preoperative foot pain, 42% reported no foot pain at 6 months and 50% reported no foot pain at 12 months after TKA (Fig. 1). Of those with preoperative foot pain, the VAS severity reduced significantly from a mean of 4.0 before surgery to 1.5 at 6 months ( $P = .001$ ) and 1.7 at 12 months ( $P = .001$ ) after surgery (Fig. 2). There was no significant change between 6 and 12 months in the mean VAS for those with foot pain preoperatively ( $P = .476$ ). The incidence of those with foot

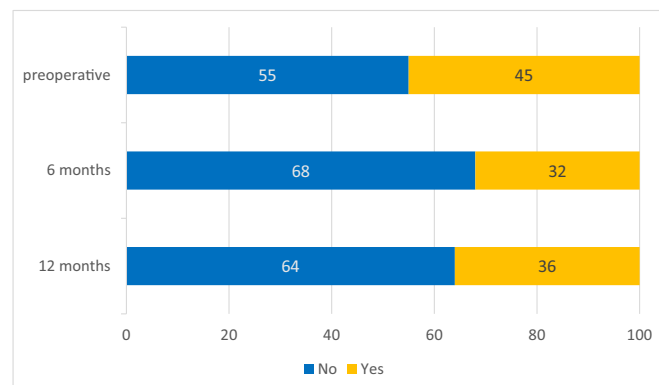
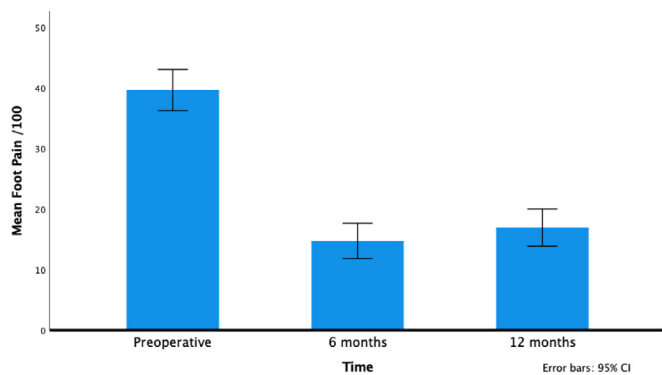


Fig. 1. Proportion of patients with foot or ankle pain before and after TKA. TKA, total knee arthroplasty.



**Fig. 2.** Mean foot pain intensity of those with any foot pain preoperatively (n = 276) over time. Error bars represent 95% confidence intervals. CI, confidence interval.

pain VAS or 4 or more decreased from 23% (n = 152) before to 10% (n = 51) at 6 months and 11% (n = 60) at 12 months after surgery.

The demographics and PROMs are compared between those with and without preoperative foot pain in Table 1. There was no difference in gender distribution, mean BMI, or age between subjects with and without foot pain preoperatively. On binary regression analysis preoperative foot pain was not significantly associated with BMI ( $P = .873$ ), gender ( $P = .164$ ), or lower limb alignment ( $P = .616$ ). Those with preoperative foot pain had lower mean preoperative KOOS score ( $P = .001$ ), OKS ( $P = .001$ ), a higher incidence of depression or anxiety ( $P = .019$ ), and poorer self-reported general health ( $P = .001$ ), compared to those without foot pain.

At 12 months, those with preoperative foot pain had lower mean Oxford score ( $P = .049$ ), and a trend to greater mean improvement in Oxford score from baseline (0.06). The mean Oxford scores over time are shown in Figure 3. The mobility score and general health score were lower in the foot pain group, compared to the no foot pain group at 6 and 12 months, but the margins were small. There was no difference in the proportion satisfied with surgery, or the proportion reporting improvement between the foot pain and no foot pain group at 6 or 12 months. There was a lower proportion in those who reported that they would undergo the same procedure again under the same circumstances in those with preoperative foot pain, compared to those without preoperative foot pain at 6 months ( $P = .013$ ), but there was no difference at 12 months ( $P = .626$ ) (Table 2).

## Discussion

Foot pain is a common symptom experienced in patients with osteoarthritis of the knee, found in nearly half of all subjects

undergoing TKA in our study. Foot pain was associated with worse preoperative knee symptoms, depression or anxiety, and poorer general health. The incidence and severity of foot pain dropped significantly after TKA. Of those reporting preoperative foot pain, this was resolved after knee arthroplasty 50% of subjects.

In this study, before knee arthroplasty, 45% of subjects reported any foot pain and 23% reported foot pain intensity of 4 or more on VAS. In comparison, a population-based study by Hill et al [13] found a 17% incidence of foot and ankle pain in the general population over 18 years of age, and Paterson et al [2] showed that 25% of subjects over 45 years reported foot pain, aching, or stiffness in either of their feet in association with arthritis of the knee. The incidence of foot pain in our study dropped significantly after knee arthroplasty to 36%. Of those who reported any preoperative foot pain, half (50%) reported no foot pain at 12 months after TKA, and the VAS severity reduced from a mean of 4.0 before surgery to 1.7 after 1 year, with no significant change between 6 and 12 months ( $P = .476$ ). It is encouraging that improvements in both foot and knee pain were seen after knee arthroplasty for the majority of patients with foot pain, with resultant improvement in mobility.

Those with and without foot pain before TKA demonstrated a significant improvement between preoperative and postoperative PROMs on KOOS and Oxford scores, and general mobility (Table 2). The improvement in Oxford scores was significantly higher in those with preoperative foot pain, compared to those with no preoperative foot pain, but the magnitude and effect size was small (Cohens = 0.2) [14]. Those with preoperative foot pain had slightly poorer KOOS and Oxford scores, and demonstrate a slightly greater improvement after TKA, but the authors are cautious to avoid over-emphasizing the improvement difference between the groups given the small effect size. Regardless, it is noted that the presence of preoperative foot pain did not appear to negatively impact the outcome of knee arthroplasty.

This case series demonstrated a distinct correlation between knee and foot pain in both the incidence of the condition and the rate of symptom resolution. The interplay between knee and foot pain is complex [15,16], integrating both physical characteristics of malalignment and psychological characteristics in the perception of pain.

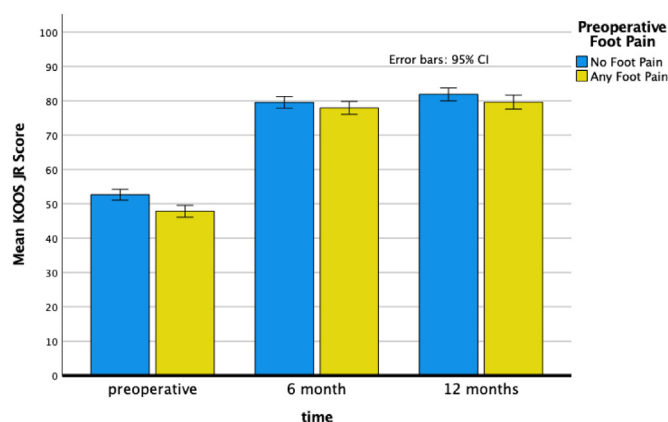
The increased prevalence of depression and anxiety among patients with foot pain in association with knee arthritis (45% vs 55%) is one that highlights the complex interplay between the physical and psychological effects of arthritis. Others have reported that depression is an independent factor in predicting poorer outcomes after TKA [17]. Depression and anxiety should be recognized as factors for the prediction of improvement when guiding patient decision to proceed with knee arthroplasty, but the presence of foot pain per se should not be a deterrent to TKA.

This complex interplay is also reflected in the fact that 24% of patients at 4 months and 25% of patients at 12 months reported foot pain in the group that had none preoperatively. Analysis showed

**Table 1**  
Baseline Characteristics of Patients With and Without Preoperative Foot Pain.

Baseline Characteristic	No Preoperative Foot Pain (n = 333)	Any Preoperative Foot Pain (n = 277)	P Value
Age (y), mean	68.5	68.7	.847
Female gender, n (%)	152 (46%)	140 (51%)	.228
Body mass index (kg/m <sup>2</sup> ), mean	30.4	30.4	.940
Varus preoperative alignment, n (%)	238 (76%)	186 (73%)	.374
KOOS JR score, mean	52	47	.001
Oxford score, mean (SD)	25 (7.5)	22 (7.6)	.001
Any depression or anxiety (EQ5D), n (%)	151 (45%)	152 (55%)	.019
Problems with mobility (EQ5D), n (%)	316 (95%)	264 (95%)	.815
General Health Score (EQ5D), mean (SD)	71 (18)	64 (21)	.001

KOOS JR, Knee Injury and Osteoarthritis Outcome Score Joint Replacement; SD, standard deviation.



**Fig. 3.** Mean and 95% CI for Oxford Knee Score over time in those with and without foot pain before surgery.

that 90% of these had a VAS < 4, however needs further study into the exact nature and resolution of long-term impact. This is a similar proportion to other literature (15%–22%) and has been associated with large corrections, especially varus, and pre-existing but asymptomatic disease [18–21].

Polyarticular arthritis is common in those considering arthroplasty [22] and when considering arthroplasty in a patient with concurrent ipsilateral hip and knee arthritis, it is generally accepted that the hip should be addressed before the knee. The logic behind this is to reduce compromising rehabilitation by starting with the more proximal joint, reducing the proximal restriction in motion and due to the propensity for pain to radiate from proximal to distal, some resolution in knee pain may be seen with hip replacement [23]. The current study suggests that a similar

principle may be applied to those with foot pain and knee osteoarthritis, that knee arthroplasty may be considered primarily, and may result in an improvement in foot symptoms for the majority of patients. Of course, this needs to be taken as a single factor in a host of other considerations when assessing surgical management of polyarticular arthritis.

Those with preoperative foot pain reported they were less likely to undergo the same procedure again at 6 months (92% vs 85%), but no difference was observed at 12 months. It is not clear why there is a disparity between the groups, whether the incidence of higher depression, poorer reported general health, misaligned expectations, or other unrecognized factors lead to poorer perceptions of the therapeutic process. Despite this, patient-reported improvements and satisfaction with surgery were equivalent and over 90% in both groups at 6 and 12 months.

This data illustrates a broad overview of the interplay between foot pain and osteoarthritis, but did not seek to clarify the exact nature of foot pain, nor the exact anatomical location. A further area for focus in future studies would be beneficial in isolating the specific areas patients experience pain so as to predict which pain, if any, reliably improves and which does not. This would give further insight into the etiology of the arthritis-associated foot pain and allow for the formulation of solutions to address these concerns. We did not actively seek to exclude patients with known ankle arthritis or pre-existing foot and ankle conditions in this study as it was a consecutive series of patients, and that there is a paucity of data relating to the exact nature of the perceived pain or conditions. There are explanations for both the resolution and persistence of pain related to ankle arthritis in the setting of knee replacement, in that the realignment may off-load symptomatic areas of ankle arthritis and thus improve symptoms, or the ankle arthritis will remain symptomatic and, with the improvement in knee pain, become a more prominent focus. In some patients, the

**Table 2**  
Comparison of Postoperative PROMs in Those With and Without Preoperative Foot Pain.

Postoperative PROM	No Preoperative Foot Pain (n = 333)	Any Preoperative Foot Pain (n = 277)	Cohen's <i>d</i>	<i>P</i> Value
Foot pain, n (%)				
6 mo (n = 529)	67 (24%)	105 (42%)		.001
12 mo (n = 550)	77 (25%)	120 (50%)		
KOOS score, mean (SD)				
6 mo (n = 512)	79 (14)	77 (13)	0.149	.093
12 mo (n = 499)	82 (14)	80 (14)	0.137	.130
Change from preop to 12 mo	30 (17)	32 (17)	−0.144	.111
Oxford score, mean (SD)				
6 mo (n = 531)	40 (6)	39 (7)	0.161	.065
12 mo (n = 547)	41 (6)	40 (7)	0.170	.049
Change from preop to 12 mo	16 (9)	18 (9)	−0.164	.060
Any depression or anxiety, n (%)				
6 mo (n = 533)	65 (23%)	54 (22%)		.671
12 mo (n = 549)	71 (23%)	72 (30%)		.050
Any problems with mobility, n (%)				
6 mo (n = 533)	99 (35%)	116 (46%)		.009
12 mo (n = 549)	93 (30%)	98 (41%)		.006
EQ5D General Health Score, mean (SD)				
6 mo (n = 509)	81 (16)	75 (21)	0.28	.002
12 mo (n = 530)	80 (18)	76 (20)	0.18	.037
Satisfied with surgery, n (%)				
6 mo (n = 532)	261 (93%)	226 (90%)		.239
12 mo (n = 545)	283 (92%)	216 (91%)		.757
Same surgery again, n (%)				
6 mo (n = 532)	258 (92%)	212 (85%)		.013
12 mo (n = 546)	276 (90%)	207 (87%)		.626
Better after surgery, n (%)				
6 mo (n = 532)	271 (96%)	236 (94%)		.188
12 mo (n = 546)	299 (97%)	227 (95%)		.294

PROM, patient-reported outcome measures; KOOS, Knee Injury and Osteoarthritis Outcome Score; SD, standard deviation.

radiological changes in foot and ankle arthritis have been known to progress [19,21]. This is an area for future investigation, and outside the goals of this study.

The outcomes demonstrated here can give clinicians assistance in decision-making when presented with a patient who reports symptoms of osteoarthritis in both the knee and foot/ankle. The majority of those patients with foot and knee pain can expect an improvement in these symptoms following TKA, as well as at least equivalent improvement in knee-related symptoms and mobility compared to those without foot pain. The presence of foot pain should not be a deterrent to TKA.

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