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Citation

Malkus, J. B., Piekaar, R. S. M., Benard, M. R., Gademan, M. G. J., Vlieland, T. P. M. V., & Verdegaal, S. H. M. (2024). Foot complaints pre-operative to primary total hip or knee arthroplasty. *Current Orthopaedic Practice*, 35(3), 99-104. doi:10.1097/BCO.0000000000001255

Version: Publisher's Version

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Note: To cite this publication please use the final published version (if applicable).

Foot complaints pre-operative to primary total hip or knee arthroplasty

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ABSTRACT

Purpose of the Study:

Aim of the study was to determine the prevalence of foot and ankle complaints and radiographic abnormalities, and their association in patients planned for total joint surgery.

Methods:

A cross-sectional cohort study of 183 patients, planned for total hip or knee arthroplasty (THA, TKA). Assessments included recording of polyneuropathy, previous trauma, foot deformities, and ankle range of motion (ROM); self-reported foot and ankle complaints; and radiographic severity of the foot and ankle joints OA.

Results:

In patients planned for THA and TKA, the proportions of patients with risk factors or using bespoke footwear ranged from 21-41%, whereas the proportions with clavus, hammertoes, and/or hallux valgus or rigidus varied between 1-17%. Although the mean foot function scores were good (median FAOS >93 and FFI-5pt 0), up to 24% of patients had a low score on one or more of the subscale scores. Prevalence of patients with signs of radiographic OA in foot and ankle were lower in THA than TKA patients, respectively. For the TKA group, we found an association

between radiological scores and both self-reported measures of foot and ankle complaints.

Conclusion:

About a quarter of patients undergoing THA and TKA report some foot complaints, whereas 32-45% have signs of radiographic OA of foot and/or ankle. Since foot and ankle complaints have shown to have a negative effect on outcome of THA and TKA surgery, pre-operative optimisation concerning the foot complaints should be considered to support a more favourable outcome.

Key Words

arthroplasty, hip, knee, foot, ankle

INTRODUCTION

Hip and knee osteoarthritis (OA) are amongst the most common causes of global disability. The global age-standardized prevalence of hip and knee OA are, respectively, 1% and 4%.^{1,2} In patients with OA, a significant portion has multiple joint OA (MJOA). The estimated prevalence of MJOA in literature ranges between 7-34%.^{3,4}

Concerning the lower limb, foot and ankle OA has been reported to range from 1% to 25%.^{5,6} This wide range may be attributed to differences in populations, but it can be expected that foot and ankle OA are common in a substantial number of patients with hip or knee OA.

However, literature is scarce concerning the prevalence of foot and ankle OA in patients with end-stage hip or knee OA. The biomechanical changes in foot and ankle joints affected by OA can have a detrimental effect on hip and knee joints,^{4,7-11} and it has been reported that ankle pain is associated with knee OA and knee pain.¹² Knowledge on the prevalence of foot and ankle complaints can be valuable for the treatment of patients with end-stage hip or knee OA. To the best of our knowledge, no data are available on self-reported foot function in end-stage knee and hip patients. Furthermore, it is unclear if radiological OA of the foot and ankle is related to the occurrence of complaints of foot and ankle in these patients, and if this is different for end-stage hip or knee OA patients.

Financial Disclosure: The authors declare no conflicts of interest.

R.S.M.P. collected the patient data. R.S.M.P., J.B.M. and M.R.B. analyzed the patient data. M.G.J.G., T.P.M.V.V. and S.H.M.V. supported with conception and design of the study, analyzing and interpreting the data. R. S.M.P. and J.B.M. wrote the manuscript. All authors helped write the manuscript and have read and approved the final version.

This study was reviewed by the Medical Ethics Committee of Leiden University Medical Center (P.16.069), who determined that the study was not subject to the Dutch Medical Research Involving Human Subjects Act. The board of directors of the Alrijne Hospital (Leiderdorp, the Netherlands) approved the study.

All patients in this study provided written informed consent authorizing the use and disclosure of their protected health information.

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The aim of this study is therefore to determine the prevalence of self-reported foot and ankle complaints in patients with end-stage hip and knee OA, and to compare this between these groups. Radiologic foot OA, as well as the association between radiologic OA and self-reported foot and ankle complaints will also be studied.

METHODS

Setting

This study is a cross-sectional study in patients with end-stage OA who were scheduled for primary total hip arthroplasty (THA) or total knee arthroplasty (TKA) in our hospital from July 2016 until September 2017. The study received a waiver from the Medical Ethics Committee of Leiden University Medical Center (P.16.069), who determined that the study was not subject to the Dutch Medical Research Involving Human Subjects Act. The study was approved by the institutional review board.

All patients who were above the age of 18, scheduled for primary one-sided THA or TKA, had a sufficient understanding of the Dutch language, and were able to complete the questionnaires, were eligible and were approached for participation. Exclusion criteria were incomplete questionnaires or missing radiographs. All participants provided written informed consent according to the Helsinki Declaration.¹³

Assessments

During a preoperative visit to the hospital 6 wk prior to arthroplasty, age, sex, and body mass index (BMI) were recorded, and a physical examination took place. All assessments were done by one researcher (RP). Participants were asked to fill out a set of questionnaires one week prior to surgery and radiographs of the feet and ankles were preoperatively obtained.

Physical Examination

During the physical examination, the presence of polyneuropathy or a previous trauma, the use of orthopedic insoles or bespoke footwear, the presence of clawus, hammertoes, and hallux valgus were recorded. Range of motion (ROM) of passive dorsal and plantar flexion of the ankles was measured using a standardized analog goniometer as described by the AAOS (American Academy of Orthopaedic Surgeons).¹⁴ Normal range of motion was used as described in literature.¹⁵ All variables were recorded for the ipsilateral and contralateral side.

Patient Reported Foot and Ankle Complaints

Foot complaints were assessed with the Foot and Ankle Outcome Scale (FAOS) and the Foot Function Index (FFI-5pt). The FAOS assesses the patient's opinion on a variety of foot and ankle related problems.^{16,17} It consists of 5 subscales: symptoms, pain, activities of daily living (ADL), sport, and quality of life (QOL). All questions are answered on a five-point Likert scale (0-4). Participants were asked to take the prior week into consideration when scoring the FAOS. For all subscales scores range from 0 to 100, with 0

indicating extreme problems and 100 indicating no problems. For the FOAS ceiling effects have been reported above 19% in all subscales thus ceiling effects will also be reported.¹⁸ The FFI-5pt assesses the impact of foot pathology on function in terms of pain, activity restriction, and a mean total score.¹⁹ The FFI-5pt is a validated patient-administered questionnaire which consists of 15 questions related to foot and ankle complaints. All questions are answered on a five-point Likert scale (0-4). Aggregated scores range from 0 to 100 for pain, activity and total; the higher the score, the more limitation or pain is present. For the FOAS floor effects have been reported up to 10%, thus floor effects will also be reported.²⁰ To the best of our knowledge, no cut-off scores for the FAOS or FFI-5pt have been published. Therefore we report the number of patients in the bottom half of the scores (i.e. <50 for the FOAS (most problems) and >50 for FFI-5pt (most pain or activity restriction)).

Radiographic Osteoarthritis

Radiographic imaging of the feet consisted of basic foot and ankle radiographs of the ipsilateral and contralateral foot (antero-posterior view, lateral view, and Mortise view; image 1-3). Radiographs were scored using the Kellgren and Lawrence classification, where grade 0 is the absence of radiological changes of osteoarthritis, and grade I-IV is minimal up until severe radiological osteoarthritis with osteophytes, narrowing of joint space and bone deformity.²¹ The joints that were scored were the first metatarsophalangeal joint (MTP I), the talocrural joint, the subtalar joint and the midfoot joints (scoring the midfoot joints as one joint). The scoring was performed by a radiologist (ABV) in our hospital. For the association of OA with the self-reported foot and ankle complaints, only the MTP I was analyzed, as this joint is often reported on in literature.^{22,23}

Statistical Analyses

All analyses were done separately for the THA and TKA group. Continuous data are presented as mean and standard deviation or median and range, depending on the distribution. Nominal and categorical data are presented as numbers and percentages. K&L scores of the different foot joints were compared between the ipsilateral and contralateral side, and between THA and TKA using a chi-squared test. The association between radiological outcome of different joints was studied using Spearman's ρ . The association between the FFI and FAOS (dependent) and the KL scores of the ipsilateral MTP1 (independent) were studied using linear regression with age, gender and BMI entered in the model as possible confounding factors, and after assumptions were assessed for linear regression. Since the FOAS and FFI-5pt are bilateral, these tests were performed for the ipsilateral side only. All statistical analyses were performed in IBM SPSS Statistics for Windows, Version 26. The level of significance was set at $P \leq 0.05$.

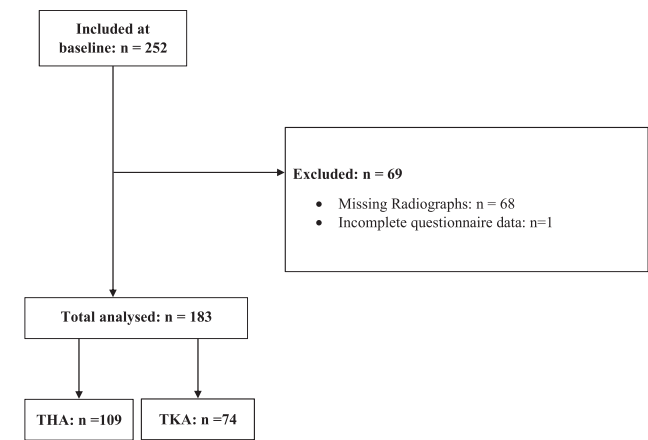


FIGURE 1. Flow-chart for the inclusion and exclusion of patients.

RESULTS

Population

In the recruitment period 252 patients were selected, of whom 146 were planned for THA and 106 were planned for TKA. (Figure 1). Of these patients, 69 patients were excluded for the analysis due to missing radiographs (n=68), or incomplete questionnaires (n=1), see {Citation} Figure 1. This resulted in a total of 183 patients, 109 planned for THA and 74 planned for TKA. Characteristics of the study participants are shown in Table 1.

Physical Examination

Table 1 shows the results of the physical examination variables. In the THA group 21% (n=23) and in the TKA group 36% (n=27) used bespoke footwear including insoles. In the TKA group 12% (n=9) had ipsilateral clavus versus 3% (n=3) in the THA group, for contralateral clavus these proportions were respectively 14% and 4%. In both groups a substantial number of patients had hammertoes (12-14% in THA and 15-20% in TKA) and/or hallux valgus (15-17% in THA and 11-14% in THA). The median ROM of dorsiflexion and plantarflexion was within normal range for both THA and TKA patients (i.e. dorsiflexion respectively 15° [0°30°] vs. 15° [0°30°], and plantarflexion respectively 40° [10° 70°] vs.

40° [10° 70°]). The number of outliers from the normal dorsiflexion and plantarflexion ROM were, respectively, 3 and 6 in the THA group, and 1 and 4 in the TKA group. There were no participants who had a ROM lower than the normal ROM described in literature.¹⁵

Self-reported Foot and Ankle Complaints

The self-reported foot and ankle complaints measured with the FAOS and FFI-5pt are shown in Table 2. On average, the scores of patients in both THA and TKA groups were relatively high for all FOAS subscales, with the median FOAS subscale scores being above 92. In both groups, and all scales ceiling effects occurred, where the percentages of subjects scoring 100 was 32% or more. On average, according to all FFI-5pt subscales, foot function was good in both the THA and TKA groups, with median scores of 0 on all subscales. However, in both groups and all subscales floor effects occurred, with the proportions of subjects scoring 100 being 53% or more. For both FAOS and FFI-5pt there was a substantial number of participants (up to 24%) who had lower scores for one or more of the subscales of the FAOS and FFI-5pt. It appeared that these numbers were somewhat higher in the TKA group, e.g. FOAS sport (24% vs. 14%), and FFI-5pt disability (11% vs. 5%).

Radiological Scores Foot and Ankle

The preoperative K&L scores of the different foot joints in the ipsilateral and contralateral foot are shown in Figure 2. No differences were seen for the K&L between the ipsilateral and contralateral joints. In the TKA group relatively more patients had signs of foot and ankle OA (i.e. K&L grade I-IV) compared to the THA group (45% vs. 32%), with MTP I as the most common location (66% in ipsilateral TKA and 57% in the ipsilateral THA).

Concerning the association between K&L scores of ipsilateral MTP I and self-reported foot complaints, β coefficients and the 95% confidence intervals are shown in Table 3. The sign of the coefficients was in line with what is expected for the scales, i.e. negative for FAOS and positive for FFI-5pt, denoting more functional disability or complaints in patients with more radiographical abnormalities. For the THA group there was no association between radiological score and both self-reported

TABLE 1. Sociodemographic characteristics, foot and ankle deformations, the use of bespoke shoes and insoles, and range of motion in patients planned for THA or TKA

	Total hip arthroplasty (n = 109)	Total knee arthroplasty (n = 74)
Sex; female, number (%)	60 (55%)	49 (66%)
Age; years, median [range]	68 [39 84]	69 [46 84]
BMI; kg/m ² , median [range]	27 [20 40]	27 [20 42]
Polyneuropathy; number (%)	36 (33)	16 (22)
Previous trauma; number (%)	35 (32)	30 (41)
Bespoke shoes or insoles; number (%)	23 (21)	27 (36)
Clavus ; number (%); ipsi/contra	3 (3)/4 (4)	9 (12)/10 (14)
Hamertoe; number (%); ipsi/contra	13 (12)/15 (14)	15 (20)/11 (15)
Hallux valgus; number (%); ipsi/contra	19 (17)/16 (15)	10 (14)/8 (11)
Hallux rigidus; number (%); ipsi/contra	1 (1)/1 (1)	2 (3)/1 (1)
ROM dorsiflexion; median [range]; ipsi/contra*	15 [0 30]/15 [0 30]	15 [0 30]/15 [0 30]
ROM plantarflexion; median [range]; ipsi/contra [#]	40 [10 70]/40 [10 70]	40 [10 60]/40 [10 60]

*Normal between 0-16.5 and 0-25 degrees^{14,15,16}.

[#]Normal between 0-40 and 0-50 degrees.¹⁵

TABLE 2. Functional outcome for foot and ankle complaints in the THA and TKA groups

Score	Subscale	THA				TKA			
		Median	% With 0	% 100	% <50	median	% 0	% 100	% <50
FOAS*	symptoms	92.9 [14.3-100]	0	32	2	92.86 [38.89-100]	0	35	4
	pain	100 [25-100]	0	61	9	100 [47.23-100]	0	55	1
	adl	100 [22.1-100]	0	54	6	98.6 [28-100]	0	49	4
	sport	100 [0-100]	1	73	14	100 [0-100]	3	51	24
	qol	100 [6.25-100]	0	62	16	93.75 [0.125-100]	0	49	18
FFI-5pt*	pain	0 [0-60.7]	73	0	2	0 [0-68.75]	60	0	4
	disability	0 [0-78.2]	73	0	5	0 [0-87.5]	53	0	11
	total	0 [0-64.8]	65	0	4	0 [0-78.1]	53	0	3

*Range from 0-100.
Median and range (in brackets) are shown for all scores, as well as the percentage of subjects scoring either 0 or 100, and <50 (i.e. <50 for the FOAS en > 50 for FFI-5pt).

measures of foot and ankle complaints. The β coefficients were smaller than -9.4 $[-27.64-8.84]$ for the FAOS scores and smaller than 1.62 $[-1.20-4.44]$ for the FFI-5pt.

For the TKA group there was an association between radiological score and both self-reported measures of foot and ankle complaints for the FAOS ADL (-4.39 $[-8.21--0.56]$), FOAS sports (-9.01 $[-15.74--2.29]$), and all FFI-5pt scores (>3.88 $[0.39-7.35]$). This was all not different for the contralateral MTP I (not shown).

DISCUSSION AND CONCLUSION

In a cross-sectional study we in patients planned for THA and TKA, about a quarter of the patients had some foot complaints, whereas the proportions with foot deformities were lower and with bespoke footwear somewhat higher, and ROM was on average normal. Signs of radiographic OA of foot and/or ankle were seen in 32-45% of the patients. We found no association between radiographical abnormalities and foot complaints or disability.

The ROM of the ankle was within normal range for the majority of the participants. A normal ROM was also found in a previous study on pre-operative TKA patients.²⁴ It is expected that ROM of the ankle is of low value when screening THA and TKA patients for foot complaints. However, foot related deformities were common in 12-20% of the participants. Alignment of foot rotation may be a

significant factor in determining development and distribution of knee but not hip OA.²⁵ Also, as the presence of preoperative foot comorbidities has been related to poor postsurgical outcomes in TKA and THA,²⁶⁻²⁹ identifying the patients with foot related comorbidities is advisable for pre-operative optimization in THA and TKA.

Although FAOS and FFI-5pt showed a good median function for both groups, there was a group of patients (up to 24%) who scored low on the subscales, especially in the TKA group. To the best of our knowledge no data are available on self-reported foot function in end-stage knee and hip patients. Concerning foot pain, it has been reported that this occurs in 25% of people with knee OA.³⁰ The numbers in our cohort for self-reported pain are lower (up to 9% in THA), but as Gates *et al.* have shown that patients with pre-operative foot pain are more likely to have poor clinically important outcomes at one year following TKA,²⁴ preoperative screening of pain and function of the foot can be of added value in lower limb arthroplasty patients, especially in those planned for TKA.

Concerning radiological signs of OA, the highest count was observed in the MTP I of both THA and TKA. This was also found in the general population regarding the incidence and treatment of foot OA.³¹ Also the prevalence of foot and ankle OA in our group is higher compared to the general population, which could be explained by the fact that they already have end-stage arthritis of hip or knee. Note that the occurrence of radiological signs of OA were relatively higher in the TKA group compared to the THA group. Studies on the detrimental effect of foot alignment on the knee are common,^{9,25,32} but not for the hip. This suggests foot and ankle complaints are closer related to knee function compared to hip function and may indicate that screening foot OA in hip and knee arthroplasty patients may be more relevant for those planned for TKA.

No associations were found between the radiological OA of MTP I and subjective foot complaints for the THA group. This suggests that radiography is of low value for prediction of the presence of symptomatic OA of the foot and ankle in THA. This was different for the TKA group, where both FAOS and FFI-5pt subscores were associated the radiological OA of MTP I. Kim *et al.* report that varus knee deformity is correlated to a higher incidence of hind foot pain, which might also be an important factor contributing to foot and ankle complaints in patients undergoing TKA.³³ Patients with a moderate varus

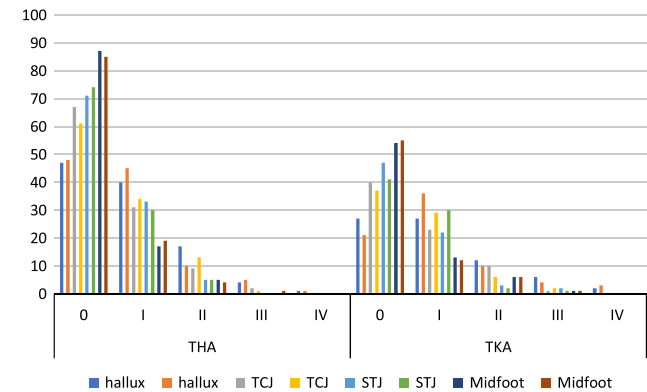


FIGURE 2. Number of cases per K&L score for different foot locations. The scores are shown for the THA and TKA group.

TABLE 3. Outcome of the association between radiological outcome of the MTP I joint and self-reported foot complaint scores

Score	Group	
	THA	TKA
FAOS symptoms	-0.78 [-3.90-2.34]	-0.63 [-4.13-2.87]
FAOS pain	-9.95 [-28.23-8.34]	-1.93 [-5.24-1.38]
FAOS ADL	-0.91 [-4.74-2.91]	-4.39 [-8.21--0.56]
FAOS sports	-0.53 [-6.34-5.28]	-9.01 [-15.74--2.29]
FAOS QoL	-1.43 [-6.94-4.09]	-2.44 [-8.78-3.90]
FFI-5pt pain	1.62 [-1.20-4.44]	3.88 [0.39-7.35]
FFI-5pt activity	1.08 [-2.57-4.73]	7.98 [3.42-12.53]
FFI-5pt total	1.35 [-1.74-4.44]	5.93 [2.25-9.59]

β coefficients and 95% CI (in brackets) are shown for the ipsilateral side of THA and TKA group.

knee deformity and compensatory hind foot alignment may experience less pain when the alignment is corrected during TKA surgery according to Okamoto *et al.*²⁹ No such correlations were described with THA surgery.

There are a number of limitations to our study. First, we conducted a cross-sectional study on THA and TKA patients planned for arthroplasty, and as such, postoperative follow-up data was not available. The primary goal of the study was to assess the prevalence of foot and ankle complaints with or without radiographical OA of the foot and ankle in patients with end-stage hip and knee OA. The results found in this study warrant a follow-up study with longitudinal data. Second, the FAOS and FFI-5pt showed, respectively, ceiling and floor effects in our cohort. These effects have been previously reported,^{18,20} and this has to be taken into account when interpreting the median scores which were often 100 and 0, respectively. We therefore also report the number of participants in the bottom half of the score, and have shown that this was the case for a substantial number of patients. Third, we did not screen for flat feet in our physical examination. Flatfoot deformities are associated with posterior tibial tendon deficiency and is one of the most common type of foot complaints in women over 50.^{7,34,35} During TKA the tibia may be rotated in a direction that exacerbates flatfoot issue. Also, with autoimmune inflammatory disease a higher prevalence of valgus knee deformity which could effect adult flat foot, and vice versa.^{35,36} It is therefore advised to screen for posterior tibial tendon deficiency and flatfoot deformities prior to TKA.

This study shows that a substantial number of patients undergoing THA and TKA have complaints of foot and ankle, with or without radiographic osteoarthritis. Orthopedic surgeons should consider pre-operative optimization in patients undergoing THA and TKA with bespoke footwear or inlays because this simple intervention could improve post-operative outcome in patients with preexistent foot complaints. In patients with a moderate varus knee deformity and compensatory hind foot alignment this intervention might not be effective since the alignment will be restored during surgery. Objective foot function or supplemental radiography of the foot and ankle should not be used to assess symptomatic OA in patients undergoing THA surgery, but could be of value for TKA surgery. In both groups anamnestic foot and ankle complaints are the best indicator for symptomatic OA.

ACKNOWLEDGMENTS

We would like to thank Adriaan van Breda Vriesman for scoring the radiographs.

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