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Total Joint Replacement of Ankle, Knee, and Hip: How Do Patients Perceive Their Operative Outcomes at 10 Years?

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Abstract

Background: Patient-reported outcomes (PROMs) are an integral part of national joint registers in measuring outcomes of operative procedures and improving quality of care. There is lack of literature comparing outcomes of total ankle replacement (TAR) to total knee replacement (TKR) and total hip replacement (THR). The aim of this study was to compare PROMs between TAR, TKR, and THR patient groups at 1, 5, and 10 years.

Methods: Prospective PROMs from patients who underwent a TAR, TKR, or THR procedure between 2003 and 2010 were studied. Patients were divided into 3 groups based on their index joint replacement (hip, knee, or ankle). Patient demographics (age, gender, body mass index), patient-reported outcome scores (Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC], 36-Item Short Form Health Survey [SF-36]) and patient satisfaction scores (4-point Likert scale) at follow-up were compared between the 3 groups.

Results: Data was available on 1797 THR, 2475 TKR, and 146 TAR patients. TAR patients were younger and reported fewer number of comorbidities. All 3 groups improved significantly from preoperative to 10 years for WOMAC scores ($P < .001$). For SF-36 scores at 10 years, the THR group (32.2% follow-up) scored the highest for 3 domains ($P = .031$) when compared to the TKR group (29.1% follow-up). All 3 groups had similar outcomes for 5 of 8 domains; $P < .05$). For patient satisfaction, the THR group reported overall 95.1% satisfaction followed by 89.8% for the TKR group and 83.9% in the TAR group (42.4% follow-up).

Conclusion: In this cohort with diminishing numbers over the decade of time the patients were followed up we found that patients are equally happy with functional and general health outcomes from total ankle replacement vs other major lower extremity joint replacement. TAR surgery should be considered as a viable treatment option in this patient group.

Level of Evidence: Level III, retrospective case series.

Keywords: total ankle replacement, total hip replacement, total knee replacement, patient-reported outcomes

Introduction

Ankle arthritis is a disabling condition associated with pain, stiffness, and loss of function and mobility.[12,30] The commonly reported incidence in ankle is post-traumatic arthritis,[27] followed by degenerative arthritis or systemic arthritis. Total ankle replacement (TAR) has emerged as an effective alternative treatment to ankle arthrodesis for relief of arthritic pain and disability.[12] There are increasing number of studies on medium- and long-term outcomes of second-generation TAR implant designs.[15] Integrated

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patient-reported outcomes (PROMs) data collection for national and local hospital joint registries provide us with insight into outcomes of operative procedures and patient satisfaction and serve as an evaluation tool for patient-centered care.[3,18]

Although the incidence of ankle arthritis is less when compared with hip and knee arthritis, the extent of physical and mental disability caused by this condition is similar to that of hip arthritis.[9,25] Although preoperative levels of disability caused due to ankle arthritis have been studied in comparison to knee and hip arthritis, there is lack of literature reporting postoperative comparisons of total ankle replacement outcomes in comparison to total knee replacement and total hip replacement outcomes. In our previous article, we had reported comparison of 5-year patient-reported outcomes (PROMs) of total ankle replacement (TAR) to total knee replacement (TKR) and total hip replacement (THR).[26] In this article, we aimed to study 10-year patient-reported outcome comparisons between TAR, TKR, and THR patients from our hospital registry. The scope of this study was to evaluate PROMs only and does not include clinical, radiographic, or adverse event outcomes from surgery.

Methods

This study was a prospective data collection for our institution's lower limb total joint replacement PROMs registry. The registry provides an ongoing follow-up of all lower limb total joint arthroplasties for hip, knee, and ankle and is part of a routine audit for monitoring patient progress. All the ankle arthroplasties were performed by the senior author (M.S.S.), and the total knee and total hip arthroplasties were performed by 12 multiple hip and knee arthroplasty surgeons.

Inclusion

All patients who had reached their 10-year follow-up time point by the end of 2020 who had underwent a total joint replacement (hip, knee, or ankle) during the period 2003-2010 were included in the study. Patients were divided into 3 groups based on index joint procedure (THR, TKR, and TAR). Our previous paper[26] included patients recruited between 2008 and 2013; for this study, we included all patients since the start of the hospital register in 2003 until 2010 to allow us to reach a timeline of 10-year follow-up leading to 2020. Owing to changes in study timeline, the total numbers of patients in each group reported in this study will differ from the initial paper.

Exclusion

Patients who refused consent and who had cognitive language problems did not participate in the registry. Patients who underwent their first surgery as a revision total joint arthroplasty at our center instead of a primary joint procedure were not included in the study

Assessments

All patients completed a self-administered questionnaire that included the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, health-related quality of life scores measured using the 36-Item Short Form Health Survey (SF-36), and patient satisfaction data (using a 4-point Likert-type scale) during follow-up.[3,8,20,21] The questionnaire was aimed to incorporate a disease-specific measure (eg, WOMAC), general health measure (eg, SF-36), and a patient satisfaction questionnaire. The WOMAC score is well established for its validity in measuring hip and knee arthritis population; its construct validity and reliability has been reported in response to other lower limb scales,[23,24] for use in measuring total ankle replacement surgery outcomes. The patient satisfaction score had responses ranging from very satisfied to very dissatisfied; this instrument has been validated for hip and knee arthroplasty[20] and has been adopted for use in TAR patients. Questionnaires were collected preoperatively and at 1, 5, and 10 years postoperatively. The questionnaire data also included age and self-reported height, weight, and details of comorbid medical conditions.

Data Analysis

Data analysis was carried out using IBM SPSS Statistics version 27 software package (IBM Corp, Armonk, NY). Analyses of variance (ANOVAs) and generalized linear modeling univariate tests were used to study differences in mean scores between groups. Repeated measures ANOVAs were carried out to measure improvement in scores by groups from preoperation to 1, 5, and 10 years for individual scores by groups. The analysis was adjusted for confounding factors such as differences in age, body mass index (BMI), number of comorbidities, and preoperative score differences between groups. ANOVAs and chi-square tests were used as appropriate to study the demographic differences between groups. A significance level of $P < .05$ was maintained for all analysis. WOMAC scores were calculated (from 0-100) for domains of pain, stiffness and function, and SF-36 scores were calculated (from 0-100) for each of the 8 domains (4 physical health domains and 4 mental health domains). Bootstrapping was performed for ANOVAs comparing scores between groups at each time point. Cross-tabulation with chi-square analysis was used to study patient satisfaction data and comparison between groups at each follow-up time point.

Results

Demographics

Mean age of patients for the THR, TKR, and TAR groups were 67.7, 68.8, and 61.6 years respectively. Patients who

underwent TAR were younger than those in the THR and TKR groups ($P < .01$) (Table 1). The TKR group reported the highest BMI (29.4 ± 5.1), followed by the TAR (28.4 ± 5.1) and THR groups (27.5 ± 4.9). The TAR group reported the lowest number of comorbidities (1.08 ± 1.06) compared with the TKR (1.8 ± 1.3) and THR groups (1.7 ± 1.2) ($P < .05$). The number of patients in each group at preoperation and 1, 5, and 10 years postoperation are highlighted in Table 1. The decline in follow up numbers at each time point included patients who required a revision surgery, patients who were deceased, lost to follow-up, or those who declined ongoing participation in the registry. The percentage of responses at 1, 5, and 10 years for the THR group was, respectively, 79.9%, 56.9%, and 32.2%. For the TKR group, it was 74.3% at 1 year, 51.1% at 5 years, and 29.09% at 10 years. For the TAR group, the percentage was 65.7% at 1 year, 47.2% at 5 years, and 42.4% at 10 years, which highlights a similar ratio of losses to follow-up between groups except for the TAR group having better response rates at 10 years postoperatively.

Table 1. Patient Demographics by Groups.

	THR	TKR	TAR	*P* Value
Age (mean ± SD)	67.7 ± 11.3	68.8 ± 9.7	61.6 ± 11.4	.005[a]
Comorbidities (mean ± SD)	1.7 ± 1.2	1.8 ± 1.3	1.08 ± 1.06	.035[b]
BMI (mean ± SD)	27.5 ± 4.9	29.5 ± 5.1	28.6 ± 5.1	.040[c]
Time of evaluation, n				
Preoperatively	1797	2475	146	
1 y	1436	1839	96	
5 y	1023	1266	69	
10 y	579	720	62	

Abbreviations: BMI, body mass index; TAR, total ankle replacement; THR, total hip arthroplasty; TKR, total knee replacement.
[a]The TAR group was significantly younger.
[b]The TAR group had significantly fewer comorbidities.
[c]The TKR group had significantly higher BMI.

Preoperative Scores

Preoperatively, for WOMAC scores, there was no difference between groups for the WOMAC pain ($P = .917$) and WOMAC stiffness domains ($P = .745$). For WOMAC function scores, the TAR group reported higher function scores compared with the THR group (40.60 vs 34.08; $P = .002$). For the SF-36 domains, there was no difference between the groups' scores for General Health ($P = .227$) and Role Emotional domains ($P = .609$). In Physical function, THR group scored lower than both TKR and TAR groups ($P < .001$); in Vitality, the THR group scored lower than the TKR group ($P = .014$). For domains of Role Physical ($P = .214$), Bodily Pain ($P = .169$), Vitality ($P = .816$), Social Function ($P = .997$), and mental health ($P = .997$), there was no difference between TKR and TAR groups

Follow-up WOMAC Scores

All 3 groups (TAR, THR, and TKR) reported significant improvement in WOMAC scores for the domains of pain, stiffness, and function from preoperation to 10 years ($P < .05$) (Figure 1).

At 1-year follow-up, there was no difference in the WOMAC function score between the TKR and TAR groups ($P = .561$), and the THR group scored better than the TKR group ($P = .008$). The THR group scored significantly better scores for pain and stiffness ($P < .001$) than the TKR and TAR groups.

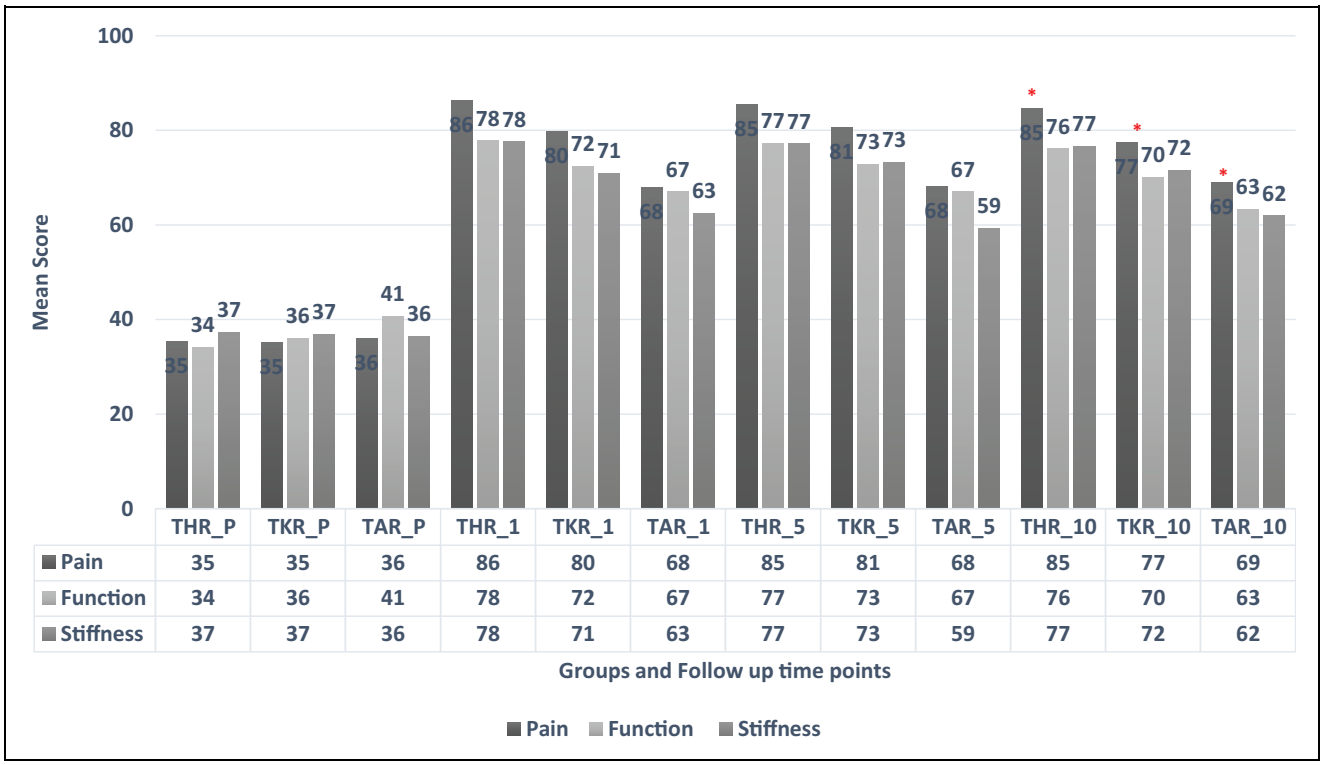
At the 5-year follow-up, a similar pattern was noted except for the WOMAC function domain, where there was no significant difference between the TAR and TKR groups ($P = .346$). At the 10-year follow up, the THR group scored higher for pain score than the TKR and TAR groups ($P < .001$); there was no difference between the TKR and TAR groups ($P = .059$). A similar pattern was observed for WOMAC function and stiffness scores, with the THR group scoring higher than the TKR and TAR groups ($P < .001$) and no differences between the TKR and TAR groups ($P = .076$ and $P = .1720$), respectively.

Follow-up SF-36 Scores

All 3 groups (THR, TKR, and TAR) reported a trend of drop in most of the domains of SF-36 scores from 1 to 10 years except for TAR Vitality domain scores (Figure 2).

1-year follow-up scores. For Physical domains (4 of 8), the THR group scored significantly higher than the TKR group for Physical function (52.06 vs 47.5; $P < .001$), Role Physical (56.7 vs 51.6; $P = .001$), Bodily pain (59.8 vs 53.0; $P < .001$), and General Health scores (62.2 vs 59.7; $P = .005$). There was no difference between the TKR and TAR groups in Physical function (47.5 vs 43.8; $P = .853$), Role Physical ($P = .773$), Bodily pain (53.0 vs 48.9; $P = .301$), and General Health scores (59.7 vs 60.5; $P = .949$). For Mental domains (4 of 8), the THR group again scored significantly higher in the Vitality (53.8 vs 50.5; $P = .013$) and role emotional domains (76.1 vs 70.7; $P = .002$) than the TKR group. There was statistically no difference in scores noted between the TKR and TAR groups for Vitality (50.5 vs 49.6; $P = .954$), Social function (71.2 vs 67.3; $P = .908$), and role emotional domains (70.7 vs 70.6; $P = .733$). There was no difference between all 3 groups for mental health scores ($P = .759$) and social function ($P = .523$).

At 5 years, for physical domains, the THR groups scored significantly higher in the physical function ($P = .014$), role physical ($P = .010$), bodily pain ($P < .001$), and general health subscales ($P = .004$). There was no difference in scores between the TKR and TAR groups for physical



	THR_P	TKR_P	TAR_P	THR_1	TKR_1	TAR_1	THR_5	TKR_5	TAR_5	THR_10	TKR_10	TAR_10
Pain	35	35	36	86	80	68	85	81	68	85	77	69
Function	34	36	41	78	72	67	77	73	67	76	70	63
Stiffness	37	37	36	78	71	63	77	73	59	77	72	62

Figure 1. Mean WOMAC scores by group at preop, 1 year, 5 years, and 10 years.

function ($P = .895$), role physical ($P = .970$), bodily pain ($P = .922$), and general health ($P = .374$). For mental domains, a similar trend was noted, where the THR group scored significantly higher than TKR group in the vitality ($P = .009$), Social function ($P = .029$), and role emotional domains ($P = .028$). There was no difference between the TKR and TAR groups for Vitality ($P = .902$), social function ($P = 1.000$), and role emotional ($P = 1.000$) domains. There was no difference in scores between all 3 groups ($P = .543$) for the mental health domains.

For the SF-36 scores at 10 years, there was no difference between groups for the Physical health domains of Role Physical ($P = .088$) and General health ($P = .090$). In the Physical function ($P = .024$) and Bodily pain domains ($P = .001$), the THR group scored better than the TKR group; there was no difference for these domains (physical function; $P = .662$; bodily pain $P = .792$) between the TKR and TAR groups. For mental component domains, there was no difference between groups for 3 of 4 domains: Vitality ($P = .434$), Role Emotional ($P = .252$), and mental health ($P = .973$). For social function, the THR group scored higher than the TAR and TKR groups ($P = .019$) but there was no significant difference between the TKR and TAR groups ($P = .974$).

Patient Satisfaction Scores

At 1 year postoperatively, the THR group reported the highest satisfaction from surgery for pain relief (94.7% THR vs 90.3% TKR vs 78.8% TAR), return to activities of daily living (88.6% THR vs 85.1% TKR vs 66.3% TAR), return to recreational activities (84.1% THR vs 78.1% TKR vs 61.6% TAR), and overall satisfaction from surgery (94.5% THR vs 89.8% TKR 81% TAR) ($P < .001$) (Figure 3). These percentages refer to overall satisfaction including responses of very satisfied and somewhat satisfied at each follow-up.

At 5 years postoperatively, the above trend was repeated with THR group reporting highest satisfaction from surgery for pain relief (94.1% THR vs 91.0% TKR vs 85.8% TAR), return to activities of daily living (89.2% THR vs 85.1% TKR vs 78.6% TAR), return to recreational activities (84.3% THR vs 77.8% TKR vs 64.3% TAR), and overall satisfaction (94.8% THR vs 90.4% TKR vs 86% TAR) from surgery ($P < .005$) (Figure 4).

At 10 years postoperatively, the THR group reported highest satisfaction for pain relief (95.1% vs 89.9% TKR vs 77.5% TAR), return to activities for daily living (88.3% THR vs 84.3% TKR vs 73.3% TAR), return to recreational activities (84.7% THR vs 79.5% TKR vs 60.7% TAR), and overall satisfaction from surgery (95.1% THR vs 89.8% TKR vs 83.9% TAR) ($P < .05$) (Figure 5).

Discussion

Although historically, the success of total joint replacement surgeries has been measured with parameters such as longevity of the implant used, complications, and clinical failures, measuring the success with the help of patient-reported

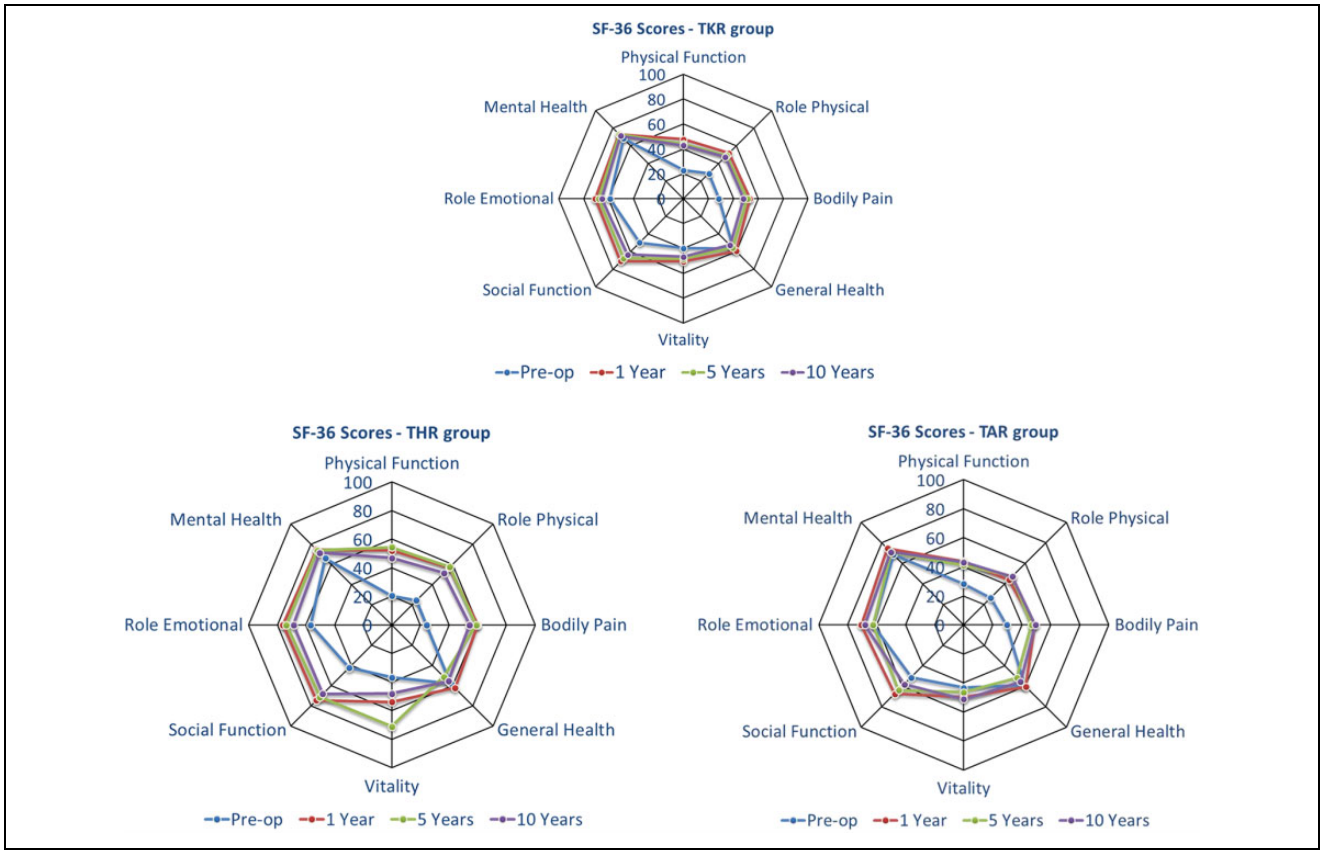


Figure 2. Mean SF-36 scores (by groups). No significant difference existed between groups at 10 years for Role Physical ($P = .088$), General health ($P = .090$), Vitality ($P = .479$), Role Emotional ($P = .434$), and Mental health scores ($P = .973$).

outcomes is being increasingly reported and it highlights the success of these types of surgeries from a patient's perspective.[4,5,7,18,19] Most registries try to incorporate generic health and disease-specific PROMs; our study included a comprehensive PROMs collection including regional scores (WOMAC), generic health scores (SF-36), and patient satisfaction scores.[29] Our previous article[26] reported the same measures, and the present study summarized the outcomes to 10 years on the data we have available from our local hospital joint registry. The loss to follow-up was fairly consistent between the 3 groups, with TAR patients having the highest percentage of follow-up PROMs at 10 years. Regarding demographics, the patients in the TAR group were much younger than those in the THR and TKR groups (67.7, 68.8, and 61.6 years). The mean age of the THR and TKR groups were similar to the data published by the National Joint Registry UK for 2020, but our TAR group patients were younger (61.6 vs 67).[7,22] Also, TAR group patients reported the fewest comorbidities among all the 3 groups (1.08 TAR vs 1.8 THR and 1.7 TKR). We attribute this cause to TAR group patients being much younger and therefore reporting fewer comorbidities. Our patient cohort included a greater number of TAR patients having posttraumatic arthritis and, thus, were younger in age compared with the other 2 groups. This result is similar to our previous cohort.[26] This is also reflected in the slightly higher WOMAC function scores reported by TAR patients in this study preoperatively.

For WOMAC pain scores, although the TAR group patients had similar levels of pain preoperatively as the TKR and THR groups, the THR group reported the highest improvement in outcomes for pain at 10 years followed by the TKR and TAR groups. This could be due to the complex nature of posttraumatic ankle arthritic pain (underlying ischemic, neurologic, or vascular causes) when compared to hip and knee arthritis patients. For WOMAC stiffness, although all groups had significant improvement from preoperation to 10 years ($P < .05$), the THR group reported better outcomes than the TAR and TKR groups, who had similar outcomes. Stiffness following TAR is an area less reported in the literature unlike stiffness following TKR surgery. Houdijk et al[11] in their study measured 3D kinematics and ground reaction forces in 10 patients who underwent TAR. They reported increased coefficient of stiffness in this patient group, with no significant difference in mechanical loading of the ankle. De La Fuente et al[6] in their study on 29 patients at 5-year follow-up reported that although the anatomy and alignment of a diseased ankle could be restored with TAR surgery, it does not improve the

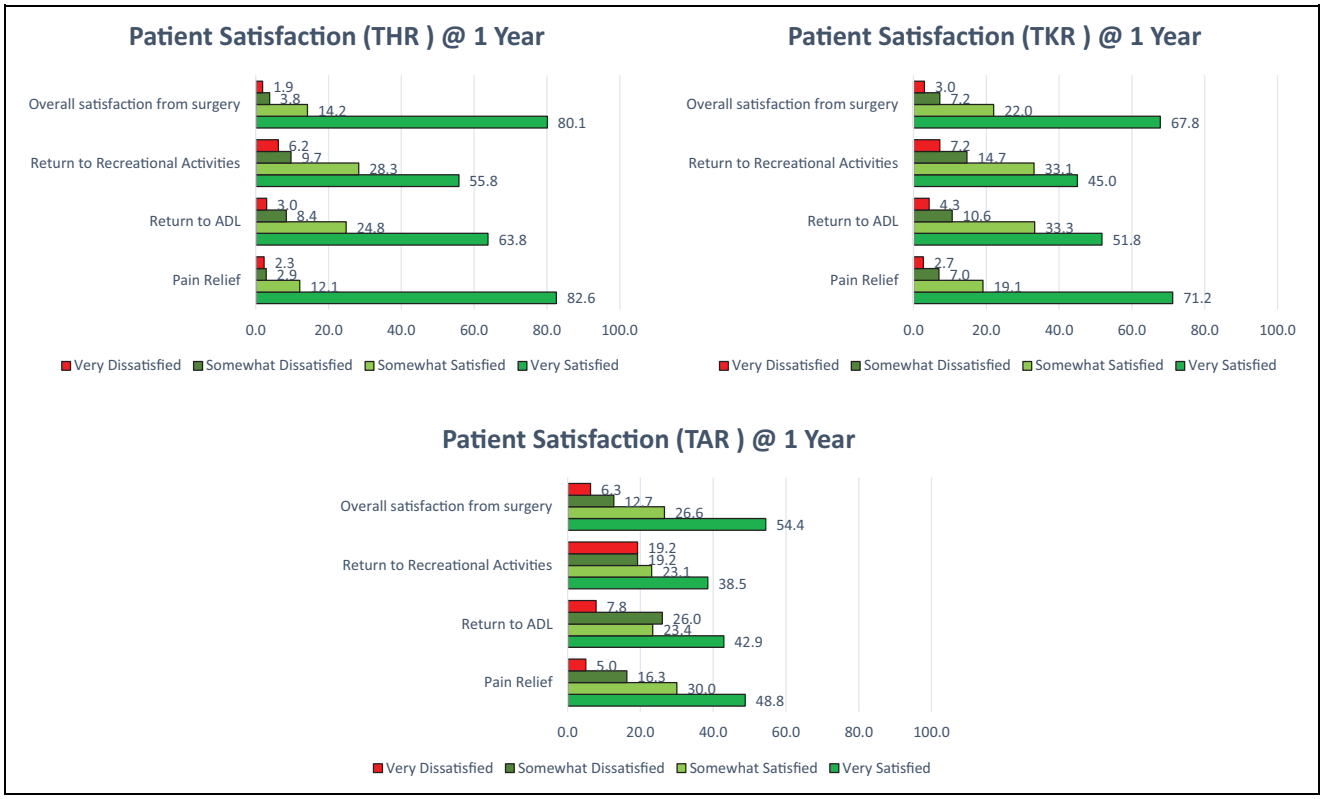


Figure 3. Patient satisfaction at 1 year by group.

neuromuscular adaptations to degeneration, which might explain the stiffness in this patient group. Another reason could be that most of the TAR patients in this study suffered from post-traumatic ankle arthritis; therefore, they could have experienced more stiffness compared with more dominant primary osteoarthritis in the other 2 groups. Other possible clinical causes could be gutter impingement, heterotrophic ossification, implant subsidence, or medial/lateral collateral ligament contracture. We are unable to verify this as it does not fit within the scope of this study.

Stiffness is a recognized complication post TKR surgery, Attard et al[2] in their recent article studying the cause for knee stiffness post TKR surgery have suggested intra-articular fibrosis to be an important contributing factor. Hinterman et al[10] in their article have suggested a preoperative diagnostic workup to be helpful in understanding the pathologic process behind the cause for stiffness following TAR surgery. Again, a limitation of our study is that we do not have preoperative range of motion in these patients as a factor that might have had an impact in predicting postoperative stiffness in these patients. Our study reflects a patient's perspective of stiffness rather than objective measurement of range of motion of ankle. Most of our patients had post traumatic arthritis and the genesis involved in this pathology needs to be explored[16,17] to understand this aspect better.

For WOMAC function, although the TAR group had the highest function scores when compared with TKR and THR ($P = .001$) preoperatively, they reported significantly lower scores compared with the THR group (63.1 vs 70.1) at 10 years. This trend has been consistent throughout the follow-up periods (1, 5, and 10 years) highlighting that TAR patients never did as well as the THR group for these time points but achieved similar function as the TKR group at 10 years.

Considering generic health SF-36 scores, in general we have seen a pattern of improvement in scores following THR, TKR, and TAR surgery from preoperation to 1 year and a drop in scores across domains from 1 to 10 years postoperatively for most domains. We attribute this cause to the patient group getting older and therefore reflecting a decrease in function to 10 years ago as a result of ageing.[13,31] For SF 36 physical domains, all 3 groups reported significant improvement in scores for 3 of 4 domains (physical function, role physical, and bodily pain) from preoperation to 5 years postoperatively and a drop in scores from 5 to 10 years for THR and TKR groups. At 5 years, the TAR group reported significantly lower scores for general health and bodily pain which highlights that TAR patients did not do as well as THR patients for improvement in general health, but they had similar outcomes to TKR group for all 4 physical domains (physical function, role physical, bodily pain, and general health). At 5 years, the TAR group had experienced similar outcomes as TKR and for all mental health domains, which indicates that the improvement gained for mental health is similar to TKR surgery.

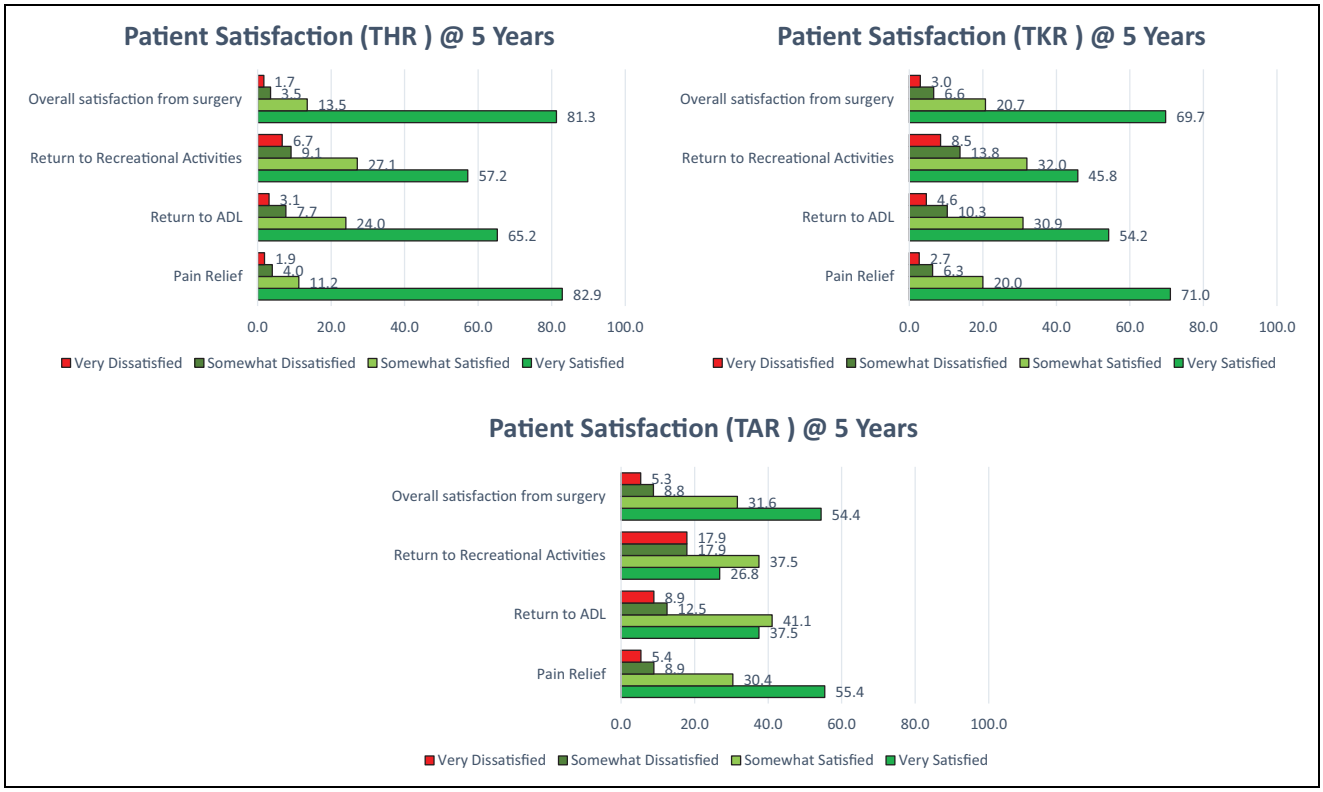


Figure 4. Patient satisfaction at 5 years by group.

The 10-year results of this study highlights that TAR group patients experience outcomes similar to the TKR group for all SF-36 domains and similar to the THR group for 5 of 8 domains. In terms of general health SF-36 measure, all 3 groups have comparable long term 5- and 10-year results.

For patient satisfaction relating to pain relief, the THR group reported the highest satisfaction (95.1%), followed by the TKR group (89.9%) and the TAR group (77.5%) at 10 years. This trend has been similar from 1 year to 5 and 10 years for THR and TKR groups, which show the maximum gain at 1 year is maintained. But for TAR groups the improvement continues from 1 to 5 years (78.8%-85.8%) and drops back to 78% at 10 years. This could be explained from a previous work that we did on topographic pain mapping for ankle arthritis[1]; the radiographic presence of additional pathologies in neighboring joints is masked by the pain of ankle arthritis. In the above study,[26] patients with radiographic pathologies did not necessarily present with markedly deformed ankle or symptomatic severe adjacent joint arthritis requiring additional surgery. Therefore, when pain from the primary pathology is addressed by TAR surgery, it is possible that patients perceive secondary pain from adjacent joint pathologies as ankle pain. For patient satisfaction with return to activities of daily living following surgery at 10 years, highest satisfaction was reported by patients who underwent THR (88.3%) followed by those having had TKR (84.3%) and TAR (73.7%). Again, this trend has been maintained by TKR and THR groups from 1 year to 5 and 10 years. However, the TAR group continued to improve from 66.3% at 1 year to 78.6% satisfaction at 5 years and this drops to 73.7% at 10 years. For satisfaction relating to return to recreational activities, highest satisfaction was reported by THR patients (847%) followed by TKR patients (79.5%) and TAR patients (60.7%). This trend has been the same from 1- to 5- and 10-year follow-up for all 3 groups. We attribute this could be due to higher patient expectations of the more younger TAR group. Because patients in the TAR group were much younger than those in the TKR and THR groups, they are probably more involved in recreational sports, including squash, tennis, etc, when compared to the other groups. They could have had much higher expectations from outcomes of surgery than the 2 other groups and therefore express greater dissatisfaction. For overall satisfaction from surgery, those in the THR group reported 95.1% satisfaction followed by the TKR (89.8%) and TAR groups (84%) at 10 years. This trend is more or less the same as that observed from year 1 to 5 and 10 years. This result is better than some of the results reported in the literature. Kamrad et al[14] reported 12% dissatisfaction by TAR patients at 2 years based on a study including 241 patients. Valderrabano et al[28] in their article studying sports activity following total ankle replacement have reported improvement in sports participation from 36% to 56%, and 31% of patients still reported pain postsurgery. In our cohort of patients, only

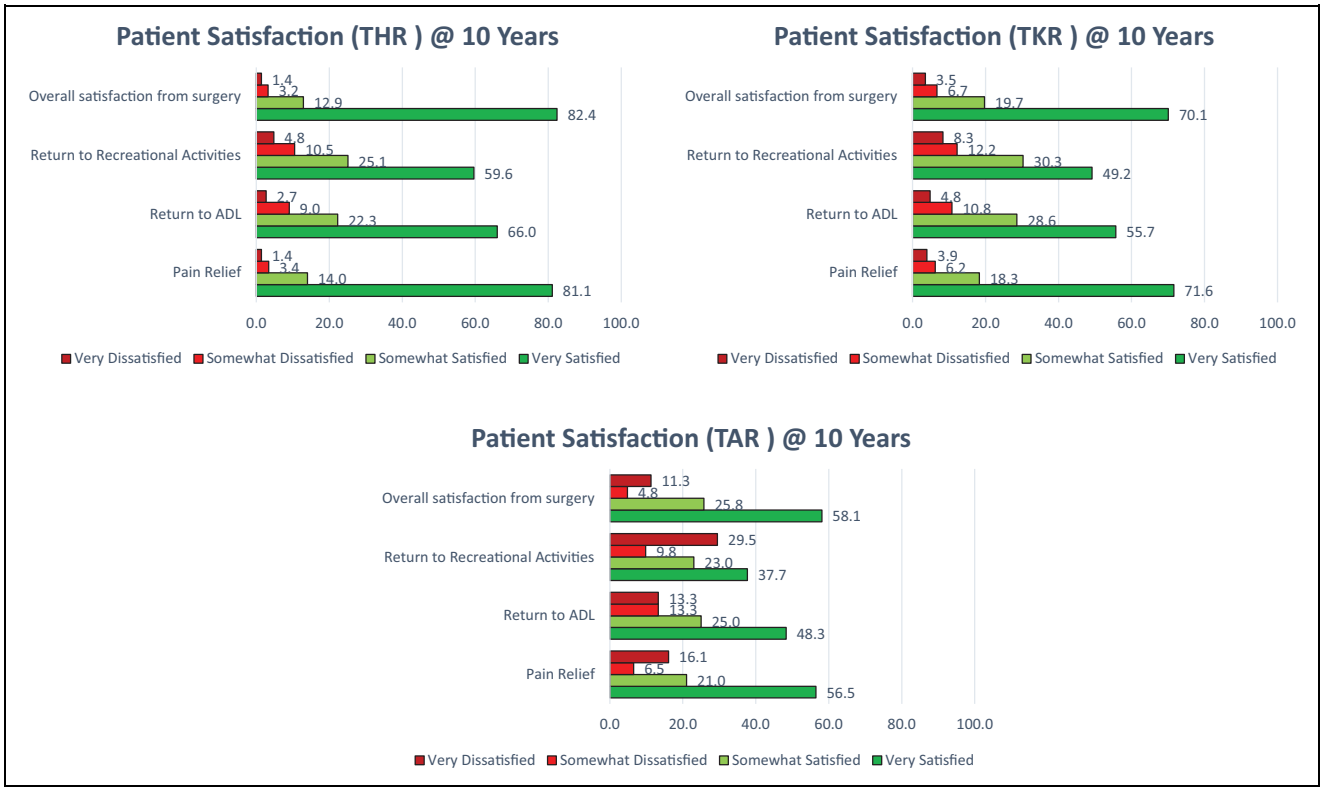


Figure 5. Patient satisfaction at 10 years by group.

16% were dissatisfied with overall results, and 22.5% with pain relief at 10 years.

Limitations of this study include the TAR patient group being smaller when compared with the THR and TKR groups, this could have an impact on the clinical power of the study. All TAR surgeries were carried out by a single surgeon and using mobile-bearing TAR prosthesis, which is no longer available in the market. The Mobility TAR implant was the highest-volume implanted TAR in the United Kingdom. The implant was withdrawn from the UK market in 2014 because of sales and other commercial reasons. Therefore, we are unable to ascertain that lower satisfaction rates in TAR might have been due to the failure of the prosthesis when compared with THR and TKR patients, who might have received more durable implants. Another major limitation is that this study is purely based on patient-reported outcomes and does not comprise clinical and radiologic outcomes, which need to be considered when evaluating overall outcomes of joint replacement surgeries individually. As this is a registry-based study, we did not have adequate funding to explore the dissatisfaction rates following TAR surgery by surveying these patients.

This study was an attempt to get a bird's-eye view on how TAR patients perceive their outcomes compared with TKR and THR patients at 1, 5, and 10 years. Studies with similar patient numbers between groups, including clinical, radiologic, and adverse event outcomes, are required to establish the findings on a larger population.

Conclusion

This study, with recognized substantial loss of follow-up, suggests that total ankle replacement patients have similar functional and general health outcomes to total hip replacement and total knee replacement patients at 10 years postsurgery.

Ethics Approval

Ethical approval was not sought for the present study because this study was part of prospective ongoing clinical audit register for lower limb arthroplasty patients at our hospital—the audit was registered with our hospital Clinical Effectiveness register R&D department and therefore did not require ethical approval.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. ICMJE forms for all authors are available online.

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