A retrospective comparative study of complications after total knee replacement in rheumatoid arthritis and osteoarthritis patients

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Abstract

Background

Total knee arthroplasty (TKA) rates have significantly increased over the past few decades; consequently, so too have the absolute number of complications. International literature expounds on complications in the rheumatoid arthritis (RA) and osteoarthritis (OA) subgroups from the developed context, but these findings cannot be generalised to the developing world, where access to medication, medical facilities and patient characteristics may differ. The purpose of this study was to determine the comparative rates and nature of complications that occur post total knee arthroplasty in RA and OA patients at a single South African quaternary hospital.

Methods

This was a retrospective comparative study of complication rates in two groups following TKA at Inkosi Albert Luthuli Central Hospital (IALCH) arthroplasty unit, between 1 January 2014 and 29 February 2020. The data was collected retrospectively, utilising the digitised patient management system at the hospital. Data extraction included patient demographics, time to surgery, indication for surgery and early complication rates. Descriptive analysis was performed to quantify complications, comparing the two groups.

Results

The chart review yielded 332 cases, comprising 41 RA and 291 OA patients. The mean age of the combined participant group was 65 years (standard deviation [SD] 8). Most cases were female (87%, 289 of 332), with males comprising 13% (43 of 332). Concomitant human immunodeficiency virus (HIV) was present in 6% of patients (20 of 332), and 24% (80 of 332) had diabetes mellitus (DM). The absolute number of complications was greater in the OA group, where revision surgery was performed in 3% (8 of 291) of cases, infection occurred in 1% (3 of 291), mechanical complications in 3% (10 of 291), and deep vein thrombosis (DVT) in 1% (2 of 291) of cases. There was one complication, a DVT, in the RA group (2%, 1 of 41).

Conclusion

In the current study, complications after TKA occurred predominantly in the OA group, 8% (23 of 291) as compared to the RA group, 2% (1 of 41). Complications included DVT, revision surgery, infection and mechanical complications. The study was underpowered to detect significant differences between the groups. Further large-scale investigation will be required to determine if differences in complication rate are significant when low complication incidence is anticipated.

Level of evidence: Level 4

Keywords: arthroplasty, complications, osteoarthritis, rheumatoid, knee

Introduction

The number of total knee arthroplasties (TKAs) has increased significantly from 2003 to 2013, with studies in Australia and the United States of America (US) estimating that by the year 2050, there will be a 276% increase in TKAs being performed each year.[1-3]

The most common conditions contributing to this burden are primary osteoarthritis and inflammatory arthropathies, and much attention has been paid to comparing them. Osteoarthritis (OA) and rheumatoid arthritis (RA) both require TKA at the end stage of disease; however, patient factors including age, sex and comorbidities, in addition to the disease processes, vary.[4] Consequently, one would expect variability in outcomes between these groups. There has been an increase in the number of OA patients requiring TKA (almost doubling over 14 years in one US study), compared to RA, which in the US has decreased from 21% in 1991, to as low as 2.4% in 2014.[5-8] This could be accounted for by medical advances in understanding the disease process and improving pharmacological treatments available. However, research comparing complication rates has had conflicting findings, with some reports reflecting higher complication rates in RA, while others show no difference between the two.[4-8]

Although international studies have shown a decrease in RA patients requiring TKA, these studies are generally based in developed countries.[9] In Finland for example, fewer RA patients required TKA, suggesting aggressive medical therapy may alter the natural history of the disease progression to resemble OA.[9] Studies are lacking in low- and middle-income countries (LMICs) with poorly controlled and late-presenting RA.[10] A study based in Africa and the Middle East reported the incidence of RA was higher than figures quoted in studies internationally (0.06–3.4% as compared to 0.24%).[10] This study concluded that lack of community education about the disease, and limited management options available, contribute to the late presentations with more advanced disease.[10] The same concern was highlighted in a local study, which demonstrated that despite appropriate treatment, a large proportion of RA patients still develop significant functional impairment.[11]

No local studies have evaluated complications after TKA comparing these two groups. The purpose of this retrospective study was to determine the comparative rates and nature of complications that occur post TKA in rheumatoid and osteoarthritis patients at a single South African quaternary hospital.

Methods

This study was a retrospective comparative study of complication rates in two groups of TKA patients from Inkosi Albert Luthuli Central Hospital (IALCH) arthroplasty unit, between 1 January 2014 and 29 February 2020. The data was collected retrospectively, utilising the digitised patient management system at the hospital. The individual patient files were accessed to determine eligibility and for data extraction purposes. All patients with RA (identified based on seropositive markers or antibodies) or OA, receiving primary total knee replacement with a minimum two-year follow-up, were eligible for inclusion. Patients presenting at the initial visit for a revision TKA, post-traumatic OA, postinfective OA, or other indications for primary TKA were excluded. Those patients that had required joint-preserving procedures, such as high tibial osteotomies, prior to TKA were also excluded.

Data extraction included patient demographics, comorbidities (human immunodeficiency virus [HIV] and diabetes mellitus [DM]), time to surgery (time from first visit to surgery), indication for TKA, follow-up, and the documentation of early complications, defined herein as occurring within two years of TKA. Complications were subdivided into five categories. Revision surgery included all noninfective causes for revision of components, such as malalignment due to subsidence of implants, aseptic loosening and periprosthetic fractures. The second category was infection: if revision was required for infection the case was counted as infection and not included in the revision surgery group, and infection was defined as early if it occurred within four weeks of surgery, or late, if it occurred after four weeks.[12] Mechanical complications included aseptic loosening awaiting revision or actively monitored cases, medial collateral ligament (MCL) insufficiency, stiffness post TKA, and persistent knee pain. For the latter three examples, further surgery may have been performed but did not require component alteration. The final two categories were deep vein thrombosis (DVT), and death. No patients had more than one complication.

jamovi (version1.6.23.0) was used for data analysis. Categorical data were summarised using counts and percentages. Numerical continuous variables were represented with means and standard deviations (SD) when normally distributed, or as medians with interquartile ranges (IQR) where non-parametric. Associations between categorical variables were tested using chi-square with exact two-sided significance tests, or Fisher's exact test where counts were less than five in a sample. Means were compared between two groups using t-tests. The non-parametric Mann–Whitney U test was used to compare time to surgery and follow-up between the two groups.

Table I: Demographics of (n = 332) study participants, comparing osteoarthritis and rheumatoid arthritis groups

	Combined	OA	RA	
	Count (%)	Count (%)	Count (%)	p-value*
Sex	332 (100%)	291 (88%)	41 (12%)	1.00
Female	289 (87%)	253 (87%)	36 (88%)	
Male	43 (13%)	38 (13%)	5 (12%)	
	Mean (SD)	Mean (SD)	Mean (SD)	p-value#
Age at time of operation (years)	65 (8)	66 (8)	59 (6)	**< 0.001**
	Count (%)	Count (%)	Count (%)	p-value*
Race	332 (100%)	291(88%)	41 (12%)	0.407
Asian	96 (29%)	79 (27%)	17 (42%)	
Black African	176 (53%)	157 (54%)	19 (46%)	
Coloured	19 (6%)	18 (6%)	1 (2%)	
White	40 (12%)	36 (12%)	4 (10%)	
Other	1 (0%)	1 (0%)	0 (0%)	
Comorbidities	Count (%)	Count (%)	Count (%)	p-value*
HIV	20 (6%)	18 (6%)	2 (5%)	1.000
DM	80 (24%)	68 (23%)	12 (29%)	0.408
	Median (IQR)	Median (IQR)	Median (IQR)	p-value**
Time to surgery (months)	21 (32)	19 (27)	33 (41)	**0.003**
Follow-up (months)	32 (20)	31 (20)	34 (27)	0.533

RA: rheumatoid arthritis; OA: osteoarthritis; SD: standard deviation; HIV: human immunodeficiency virus; DM: diabetes mellitus; IQR: interquartile range
* Fisher's exact test; # Independent samples t-test; ** Mann–Whitney U test
Where significant differences occur between the groups, p-values are bolded.

Results

Demographics (Table I)

The database search yielded 530 patients who had undergone primary total knee replacement for OA or RA. No patients underwent simultaneous bilateral TKA, and in patients who received a TKA for both knees on separate occasions, each TKA was considered a separate case. Two hundred and twenty-nine patients were lost to follow-up at approximately six months. A further seven patients were erroneously coded as OA or RA but had post-traumatic osteoarthritis or postinfective osteoarthritis. Combined, a total of 236 patients were excluded. A total of 332 patients were included in the study, comprising 41 RA and 291 OA patients. Most cases were female (87%, 289 of 332), 13% were males (43 of 332), and this trend was reflected in both subgroups. The mean age of the combined groups was 65 years (SD 8). There was a significant age difference between the RA and OA groups ($p < 0.001$), with a mean age of 66 years (SD 8) in the OA group and 59 years (SD 6) in the RA group.

The median time from initial visit to date of surgery was calculated for each group and was 33 months (IQR 27) for the RA group and 19 months (IQR 41) for the OA group, representing a statistically significant difference ($p = 0.003$).

Comorbidities

The comorbid diagnoses of HIV and DM were captured to explore their potential confounding effect. Six per cent of patients in this study (20 of 332) had concomitant HIV: 6% (18 of 291) in the OA group and 5% (2 of 41) of the RA group. Twenty-four per cent of patients (80 of 332) had DM, 23% (68 of 291) and 29% (12 of 41) in the OA and RA groups respectively, but no statistical difference was found between the groups. No patients had both HIV and DM.

Complications

One complication was found in the RA group (2%, 1 of 41): one patient developed a DVT which was treated successfully with oral anticoagulants. The remaining complications occurred in the OA group.

Revision surgery

Revision surgery was performed in 3% (8 of 291) of the OA cases. Indications for revision were as follows: one patient was revised to a hinged implant due to a medial collateral ligament (MCL) rupture (discovered at the six-week postoperative visit, no documentation of mechanism); three patients were revised for aseptic loosening (the tibial tray only in two cases and in one case both tibial and femoral components); one patient sustained a periprosthetic tibial fracture with consequent tibial component loosening; one patient had postoperative coronal plane instability which was managed by replacing the polyethylene tibial insert component with a size bigger; and two patients with persistent anterior knee pain underwent patella resurfacing (not performed routinely with TKA at our centre).

Infection

Infection occurred in 1% (3 of 291) of cases. All infections were defined as late infections and underwent surgical intervention. One patient developed infection more than two years post surgery, was treated with a poly exchange and had no recurrence. The remaining two patients required multiple surgeries, developed polymicrobial multidrug-resistant infection and each had a poor local soft tissue envelope. One patient required amputation and the other a knee fusion.

Mechanical

Mechanical complications occurred in 3% (10 of 291) of patients. Aseptic loosening occurred in three patients: two are awaiting revision surgery and one is being actively monitored. Four patients developed stiffness post TKA and each required manipulation under anaesthesia (MUA), two required arthroscopic release in addition to attain satisfactory range of motion (ROM). The first patient had a ROM of 0–110° prior to TKA, developed stiffness 16 days after TKA with a ROM of 0–45°, and after MUA a ROM of 0–110° was restored. The second patient prior to TKA had 0–80° ROM, almost two years after TKA had a ROM of 0–45° which required MUA and arthroscopic release to restore a 0–95° ROM. The third patient initially had 10–90° ROM, at 75 days post TKA had a 5–30° ROM, and following MUA and arthroscopic release had a 0–90° ROM. The fourth and final patient had a range of 0–90° prior to TKA, 60 days post TKA a ROM of 10–45°, and after MUA a ROM of 0–110°. One patient was found to have an insufficient MCL post TKA and underwent an augmentation with a tendo-Achilles autograft. The final two patients reported persistent pain post TKA; both patients had a biopsy and debridement performed, one patient had an anterior release performed at the same setting, and both patients had resolution of their symptoms.

DVT

DVT occurred in 1% of patients (2 of 291) in the OA group. Both were successfully treated with oral anticoagulants. There was no statistical difference in the combined or individual complications between the RA and OA subgroups; however, the study was underpowered to detect significance (*Table II*). There were no reported mortalities in either of the groups.

Table II: Comparative table of complications between the osteoarthritis and rheumatoid arthritis groups

	Combined (n = 332)	OA (n = 291)	RA (n = 41)	
	Count (%)	Count (%)	Count (%)	p-value*
Combined complications	24 (7%)	23 (8%)	1 (2%)	0.335
Complications requiring revision surgery	8 (2%)	8 (3%)	0	0.602
Infection	3 (1%)	3 (1%)	0	1.000
Mechanical complication	10 (3%)	10 (3%)	0	0.618
DVT	3 (1%)	2 (1%)	1 (2%)	0.327
Death	0	0	0	

RA: rheumatoid arthritis, OA: osteoarthritis
*p-values representing results of Fisher's exact test
No statistically significant differences were detected between the groups.
Post-hoc power analysis utilising overall complication rates between the two groups found a power of 17.9% for an alpha of 0.05.

Discussion

Our study included 332 patients undergoing TKA for either OA or RA: 89% were OA patients and the remaining 11% were RA. This was a much higher RA representation than a similar US population-based study where RA represented only 3% of cases requiring TKA.[13] This could reflect the late-presenting and more advanced disease of rheumatoid patients requiring TKA in South Africa, as is the case in other LMICs.[10] It may also be as a result of the large number of patients lost to follow-up, potentially patients with OA.

As in a US study, we also found that RA patients typically underwent TKA earlier than OA patients (a difference in mean age of seven years in our study), and both studies found this difference to be statistically significant. This correlates with the natural history of RA as the pathological process within the knee generally progresses faster in RA than in primary OA.[14] The age difference between the subgroups (59 years in RA vs 66 years in OA) could be a contributing factor to differing complication rates seen in this study; however, no significant difference in age was found for any of the complication groups.

We explored DM and HIV as potentially contributory to our complication rate. The seroprevalence of HIV in patients undergoing TKA was 6% (20 of 332) and DM was 24% (80 of 332). The HIV percentage was comparative to that of a local study by Maharaj et al. who quoted a figure of 6% seroprevalence in their patient population of 1 007 who had undergone TKA.[15] Of the 20 patients with HIV, only one complication occurred in a patient with OA who developed a DVT. This mirrors conclusions drawn in an article by Boylan et al., who found that HIV did not increase their TKA patients' overall risk of complications.[16] There is limited data on the concomitant diagnosis of DM and RA as factors potentially increasing TKA complications rates; however, DM alone has been shown to increase the risk of complication post joint replacement.[17]

This study looked specifically at the complications following TKA. We found an overall 7% (24 of 332) complication rate. In comparison to other studies, our overall complication rate was higher in some instances, likely due to comparative studies having greater patient volumes.[18] In alternative studies our complication rates were lower; these studies, however, included complications that we did not investigate in our study, and other primary indications for surgery such as post-traumatic and postinfective OA, which could account for the difference.[19] The demographics in these studies also differ, potentially contributing to a different complication profile. One such study showed a low overall complication rate compared to our study, a surprising finding as all patients in this study were over 80 years old. They reported higher mortality (ASA > 2), congestive heart failure and chronic obstructive pulmonary disease.[20]

Our overall complication rate was 7% (24 of 332). Comparing the complications rates between OA and RA, 7% (23 of 332) of cases complicated and had OA, and 0.3% (1 of 332) complicated and had RA. For the overall complication rate and each of the five subcategories, there was no statistical difference between the groups; however, the study was underpowered to detect statistical significance in the findings. We found that revision surgery occurred exclusively in the OA group and comprised 33% of the overall complications (8 of 24). This finding is in contrast to several research papers that reported higher occurrence in RA subgroups, or no difference compared to OA.[4,21]

Infection too was exclusive to the OA subgroup, accounting for 13% (3 of 24) of all complications in the study. All the infections reported were late infections (presenting after four weeks). We found no infections in the RA group, in contrast to the findings of Goodman and Hawker who explored the outcomes of total joint arthroplasty in RA patients. They found that TKA in RA patients carries an overall risk for infection of 2%, a two-fold increased risk of infection as compared to their OA group.[8]

With respect to time from initial presentation to surgery, the OA group had a shorter time to surgery compared to the RA group, and this was found to be statistically significant (power of 79%, for an alpha of 0.05). The study was, however, underpowered to determine if this finding was contributory to the differing complication rates.

The study had several limitations, most notably the small sample due to a large number of patients being lost to follow-up, with resultant exclusion. The small numbers limited calculation of significant differences between the RA and OA groups and the inability to determine the impact of many potential confounding variables. Evaluation was also limited to the variables routinely captured within the digitised patient management system, which restricted comparison to existing studies that explored additional variables. To ascertain if there is a true difference in complication rate among these groups, a larger, prospective study would be required. There appears to be a deficit in research investigating RA patients that require arthroplasty in the South African literature.

Conclusion

In the current study, the overall complication rate was noted to be 7% (24 of 332), predominantly affecting the OA group (7%, 23 of 332) as compared to the RA group (0.3%, 1 of 332). Complications included infections, deep vein thrombosis, component revision surgery and mechanical complications. We were unable to detect statistically significant differences due to the small number of complications. Further large-scale investigation will be required to determine if differences in complication rate are significant when low complication incidence is anticipated.

Ethics statement

The authors declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, 2010.
The study complied with the South African Department of Health ethics guidelines (2015), and the University of KwaZulu-Natal policy on research ethics. Prior to commencement of this research, the appropriate ethical approval was obtained from the Biomedical Research Ethics Committee of UKZN (BREC/00000013/2019).

Declaration

The authors declare authorship of this article and that they have followed sound scientific research practice. This research is original and does not transgress plagiarism policies.

Author contributions

AN: study conceptualisation, study design, data capture and analysis, first draft manuscript preparation and finalisation of edits to manuscript
PR: study conceptualisation, supervising of manuscript preparation and revisions

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