The Journal of Arthroplasty 29 (2014) 1774–1778

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Why Are Total Knee Arthroplasties Failing Today—Has Anything Changed After 10 Years?

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ARTICLE INFO

Article history:
Received 19 April 2013
Accepted 21 July 2013

Keywords:
knee arthroplasty
failure
revision

ABSTRACT

The purpose of this study was to determine the frequency and cause of failure after total knee arthroplasty and compare the results with those reported by our similar investigation conducted 10 years ago. A total of 781 revision TKAs performed at our institution over the past 10 years were identified. The most common failure mechanisms were: loosening (39.9%), infection (27.4%), instability (7.5%), periprosthetic fracture (4.7%), and arthrofibrosis (4.5%). Infection was the most common failure mechanism for early revision (<2 years from primary) and aseptic loosening was the most common reason for late revision. Polyethylene (PE) wear was no longer the major cause of failure. Compared to our previous report, the percentage of revisions performed for polyethylene wear, instability, arthrofibrosis, malalignment and extensor mechanism deficiency has decreased.

Since its introduction, total knee arthroplasty (TKA) has evolved into one of the most successful and thoroughly investigated surgical interventions, especially over the past two decades [1]. Survival rates greater than 90% after 10 years follow-up highlight the durability of primary TKA [2]. With expectations for successful outcomes, the number of primary TKA performed annually is projected to increase exponentially in the next few years [3,4]. In 2003 there were approximately 402,100 primary TKA performed and demand is anticipated to increase by 673% to over three million procedures by the year 2030 [5]. Despite long survivorship and improved outcomes, the increasing number of primary TKA has been associated with increased rates of revision TKA procedures [1].

An aging population and the acceptance of TKA in young active patients have contributed to the increasing number of both primary and revision TKA procedures performed annually. The Australian national registry reported revision TKA accounted for 8.3% of all knee replacement surgeries conducted in 2011 and this number trends higher yearly [6]. The most frequently reported mechanisms of failure in primary TKA have varied but consistently include periprosthetic joint infection (PJI), loosening, and instability [7]. Recent studies have further analyzed failure mechanisms of primary TKA highlighting not only the role of PJI and aseptic loosening in failure, but also how such failure mechanisms may affect revision surgery outcomes [7,8]. Knowledge of the etiology of failure mechanisms is of paramount importance for delivery of appropriate care.

A previous study performed 10 years ago at our institution determined the mechanisms of TKA failure between 1997 and 2000 [9]. However, surgical technique, prosthetic design, perioperative care, and surgical experience have evolved over the past 10 years. Additionally, it has been suggested that advancements in prosthetic component design and surgical instrumentation have generated a paradigm shift in the etiology of common failure mechanisms [8]. The purpose of the current study was to elucidate if the etiology of failure of TKA has changed over the past decade at our institution.

Methods and Materials

Following Institutional Review Board approval, we performed a systematic retrospective review of all revision TKA performed at our institution between July 1, 2003 and July 1, 2012. During this time period, 10,003 total knee arthroplasty surgeries were performed, with 781 (7.8%) revision surgeries. Important information pertinent to demographics such as age, gender, weight, and race was recorded. The interval from primary TKA to revision procedures was obtained in addition to whether the primary TKA had been performed at our institution or was referred from elsewhere. Failure mechanisms were determined by review of our institutional prospective revision database and corroborated by review of operative records. At our institution, data on revision cases are collected prospectively which includes collection of intraoperative data by a research fellow who is present during each revision arthroplasty. With the assistance of the primary surgeon, the research fellow completes questionnaires related to the cause of failure and nature of intraoperative findings.

All revision TKA patients were subdivided into early and late failure groups depending upon the time interval between primary

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2013.07.024.

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http://dx.doi.org/10.1016/j.arth.2013.07.024
0883-5403/

TKA and revision procedure with two years being considered as the cut-off between early and late failures. The cause of overall failure, as well as a comparison in the cause of failure of TKA in 2002 (previously reported) and 2012 was conducted. Statistical analysis was performed using SPSS Version 15.0 (SPSS Inc., Chicago, Illinois) software and significance was determined using Chi Squared analysis for dichotomous comparisons of early, late, and overall failure mechanisms. Patients were further categorized by the number of components involved in the revision procedure and grouped accordingly as complete (three-component revision or resection arthroplasty), two components, single component, PE exchange, or isolated patellar resurfacing.

Results

There were 781 total knee arthroplasty revisions included in the present study. Revision surgeries were performed in 318 (41%) patients referred from outside institutions. 453 patients were female and 291 were male. The average age of male patients was 65.4 years (range, 37–96 years) and the average age of female patients was 65.1 years (range, 34–86 years) at time of revision TKA. The average body mass index was 33.06 (kg/m^2) (range, 17.7–60.7) in female patients and 31.9 (range, 18.6–62.8) in male patients. Revision surgery was conducted for 667 posterior stabilized, 62 cruciate retaining, 49 unicondylar, and 3 constrained primary TKAs.

The average time before revision TKA in the early failure group was 0.84 years (range, 1 day to 1.97 years). In the late failure group, the average time to revision was 6.9 years (range, 2.01 years to 30.36 years). Fig. 1 displays the mechanism of the failure and the corresponding percentage of patients with each failure mode. Fig. 2 displays the percentage of patients with each failure mechanism stratified into early, late, and overall failure subgroups. The results of our prior investigation are provided for comparison. Patients undergoing early revision comprised 37.6% of our cohort and 62.4% of the revisions were performed more than 2 years after the initial surgery.

Of the revision surgeries, 299 (38%) involved exchange of all TKA components. Two components were exchanged in 273 (35%) cases. A PE exchanged was performed in 119 (15%) cases. One component was exchanged in 81 (10%) cases. Isolated patella resurfacing was performed in 9 (1%), (Table).

Aseptic loosening of the prosthesis was the most common etiology of failure overall, with component loosening observed in 39.9% of all revision procedures. Loosening of the prosthesis was more common in the late revision group, accounting for 51.4% of patients undergoing revision more than two years following index arthroplasty. By contrast, loosening accounted for 22.8% of early revision cases. Instability was observed in 6.1% of early and 10.3% of late revision surgeries.

The most common failure mechanism in the early revision group was infection, which was responsible for 37.6% of revisions performed less than 2 years after the primary procedure. Infection also accounted for 21.9% of revision TKA in the late failure group and for 27.4% of overall revision TKA procedures at our institution.

Complications related to the extensor mechanism were an important cause of revision TKA. The etiology of failure for extensor mechanism related complications in all revision TKA included loosening of the patellar component (3%), isolated patellar resurfacing (4%), and extensor mechanism deficiency (0.3%).

Cumulatively, the incidence of PE wear, with or without osteolysis, was 3.5% for overall revision TKA procedures and accounted for 4.3% of the patients in the late failure group and 2% of the patients in the early failure group. The overall incidence of other causes for revision TKA was similar in both the early and late revision groups. The overall incidence of arthrofibrosis and peri-prosthetic fracture was 4.5% and 4.7%, respectively.

Compared with our results of 10 years ago, the current data suggest polyethylene (PE) wear is no longer the primary cause of TKA failure. Figs. 3 and 4 display a comparison of the percentage of patients in 2002 and 2012 with TKA failure stratified by mechanism and segregated by early and late presentation. The most common indications in our present cohort for revision TKA in all the patients were loosening (39.9%), infection (27.4%), instability (7.5%) and periprosthetic fractures (4.7%). 62.4% of the revision TKA procedures were performed more than 2 years after primary surgery. Additionally, as depicted in Fig. 5, the overall incidence of loosening and infection was seen to have increased since 2002 and predominate in our recent cohort. However, significant reductions were seen in the

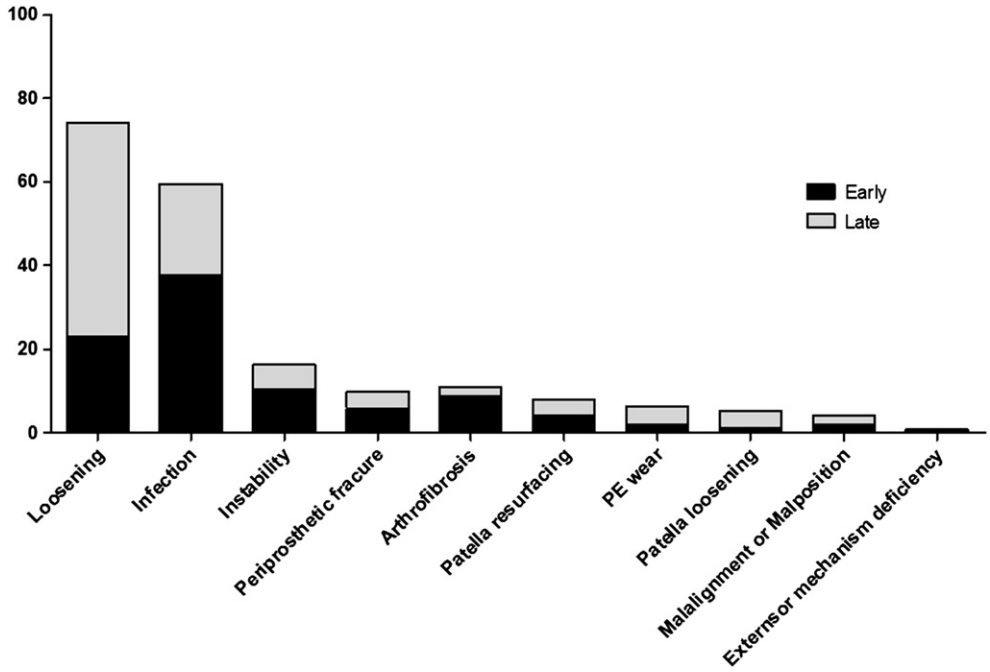

Fig. 1. The percentage of patients with each failure mechanism stratified into early and late subgroups is shown.