Patient-Reported Outcomes Can Be Used to Identify Patients at Risk for Total Knee Arthroplasty Revision and Potentially Individualize Postsurgery Follow-Up

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ABSTRACT

Background: Patient-reported outcomes are increasingly used as complementary measures to clinical outcomes in total knee arthroplasty (TKA). However, their prognostic importance has yet to be established. We aimed to determine whether the long-term revision risk in TKA relates to pain and Knee Society Score (KSS) measures at baseline, 1, and 2 years.
Methods: This was a registry-based study of primary TKA procedures at a large tertiary care institution between 1995 and 2010. Patients completed pain and KSS questionnaires both preoperatively and at 1 and 2 years of follow-up. Clinical information including revision outcomes and mortality was collected and recorded by trained registry personnel. Age and gender-adjusted Cox regression models were used to assess the association between pain and KSS measures and revisions and mortality as outcomes.
Results: Both the 1-year and 2-year pain and KSSs were significantly associated with the risk for revisions ($P < .0001$ for trend). The risk for revision was 50%-100% higher among individuals reporting poor or fair KSS at 1 year. Similarly, ≥ 10 points worsening on the KSS was associated with about 2-fold higher risk for revision (hazard ratio, 2.50; 95% confidence interval, 1.25-5.47). The predictive power of the 1- and 2-year KSS diminished but persisted for revisions that occurred furthest from the reporting time points. The results with pain scores were similar but stronger than the KSS.
Conclusion: Patient-reported outcomes in TKA have long-term prognostic importance and should be taken into account when planning frequency of aftercare of TKA patients.

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Patient-reported outcomes are measures to capture the patient's perspective related to their health and treatment status [1,2]. The assessment comes directly from the patient, without interpretation by a clinician or anyone else. They include a wide range of generic and nongeneric measures to capture items such as symptoms, functional status, and health-related quality of life [3]. Since

the initial introduction of patient-reported outcomes back in the 1980s [4,5], their use became increasingly widespread over the years, including use in clinical care, clinical research, quality assessment, and even public reporting [6–10].

Patient-reported outcomes are routinely collected and reported as part of the majority of the arthroplasty registries [11–13]. Despite the widespread use in the arthroplasty population, they are traditionally viewed as complementary to other clinical and biological measures [11,14]. A potential but so far unexplored value of patient-reported outcomes is streamlining the frequency of post-arthroplasty follow-up. In other words, they can be used as a screening tool to individualize the frequency of postarthroplasty clinical and radiographic follow-up to high-risk patients who have the highest risk for revision and this can substantially improve the efficiency in individual practices and in large registry–linked populations.

Although it is somehow assumed that patient-reported outcomes predict subsequent arthroplasty outcomes, there is limited evidence on the prognostic importance of patient-reported outcomes in predicting the long-term risk for revision and other clinical outcomes. In one study, lower hip scores after total hip arthroplasty were significantly associated with a higher risk for revision [15]. Also, in the same study, patients who reported no improvement or worsening hip scores had almost 4-fold higher risk for revision. In another unpublished report of total knee arthroplasty (TKA) patients [16], the Knee Society Score (KSS) and the function scores were significantly associated with the subsequent risk for revision. Additional research is warranted to assess the potential long-term prognostic importance of arthroplasty-specific patient-reported outcomes so they can be used as a screening tool to individualize postarthroplasty follow-up.

The purpose of this study was to determine whether the risk for revision in TKA relates to pain and KSS measures at baseline, 1, and 2 years. We also determined whether the long-term mortality risk in TKA relates to pain and KSS measures at baseline, 1, and 2 years.

Methods

This was a retrospective, registry-based, cohort study of primary TKA procedures at a large tertiary care institution between 1995 and 2010. All patients were invited to complete pain and KSS questionnaires preoperatively and at 1 and 2 years after TKA. Analyses were limited to patients who had completed the preoperative and/or follow-up questionnaires which in total comprised 55% of all primary TKA procedures performed at our institution.

Clinical information including revision outcomes and mortality was collected and recorded by trained registry personnel over the entire follow-up period. Patients are followed up by the surgeon at least twice in the first postsurgical year, in years 2 and 5, and at 5-year intervals thereafter to ascertain subsequent complications and surgeries, including details of revision surgeries. If in-person follow-up is not possible, patients are contacted by letter and/or telephone and asked to complete a standardized data collection form. If a revision surgery is performed elsewhere, then the surgeon is contacted, after permission from the patient, to ascertain surgical details. Completeness of clinical follow-up remains excellent at 95% at 20 years.

A single pain question (Do you have pain in the knee in which the joint was replaced?) was scored (discrete score range 0-50) based on pain severity as no pain (45-50), mild (30-40), moderate (10-20), and severe pain (0). The KSS was a composite score analogous to the Knee Society Knee Clinical Rating system [17] and consisted of pain, function (walking, stairs, and use of knee supports), and range of motion measures. The total score ranged 0-95 and grouped into 4 categories as excellent (≥80), good (70-79), fair (60-69), and poor (<60). Age and gender-adjusted Cox regression models were used to assess the association between pain and KSS measures and mortality and revisions as the 2 outcomes.

Results

Preoperative pain and KSS were available for 7818 surgeries, and we observed 440 revisions in this cohort. The distribution of preoperative pain scores were no pain (5%), mild (11%), moderate (71%), and severe pain (13%). In terms of preoperative KSS, 1% of patients reported excellent, 2% good, 5% fair, and 92% poor KSS. Preoperative pain and KSS were not significantly associated with the risk for revision (*P* > .05; Fig. 1).

One-year pain and KSS were available for 6962 surgeries, and we observed 393 subsequent revisions (159 revisions by 5 years of follow-up) in this cohort. The distribution of 1-year pain scores

were no pain (93%), mild (2%), moderate (4%), and severe pain (1%). Similarly, 44% patients reported excellent, 29% good, 10% fair, and 17% poor KSS at 1 year. Both the 1-year pain and KSS were significantly associated with the subsequent risk for revisions (Fig. 1; *P* < .0001 for trend). The association with the pain scores was stronger than the KSS. Compared with patients reporting no pain at 1 year, those reporting mild (hazard ratio [HR], 2.93; 95% confidence interval [CI], 1.63-4.81) or moderate pain (HR, 2.99; 95% CI, 2.06-4.19) had a 3-fold higher risk for revision. The risk for revision was as high as 10-fold higher for patients reporting severe pain at 1 year (HR, 10.16; 95% CI, 4.60-19.16). When we examined the association with the 1-year KSS, the risk for revision was also significantly higher among individuals reporting fair (HR, 1.58; 95% CI, 1.10-2.29) or poor KSS (HR, 2.24; 95% CI, 1.51-3.34) compared with excellent KSS at 1 year.

Two-year pain and KSS were available for 12,351 surgeries, and we observed 459 subsequent revisions (134 revisions by 5 years of follow-up) in this cohort. The distribution of 2-year pain scores were no pain (89%), mild (3%), moderate (7%), and severe pain (1%). Similarly, 51% patients reported excellent, 25% good, 7% fair, and 17% poor KSS at 2 years. In a pattern similar to 1 year scores, the 2-year pain and KSS were significantly associated with the risk for revisions (*P* < .0001 for trend for both). Compared with patients reporting no pain at 2 years, those reporting severe pain had 6-fold higher risk for revision (HR, 6.70; 95% CI, 3.20-12.19), whereas patients with poor KSS at 2 years had a 3-fold higher risk for revision (HR, 3.09; 95% CI, 1.91-5.18).

The predictive power of the 1- and 2-year pain and KSS diminished slightly but persisted for revisions that occurred furthest from the reporting time points. For example, severe pain at 1 year was more strongly associated with imminent revisions with an HR of 7.63 (95% CI, 4.23-13.13) for revisions up to 24 months and an HR of 2.62 (95% CI, 0.78-6.61) for revisions up to 36 months. Severe pain at 2 years was associated with 6- to 7-fold higher risk for revision, but the strength of the association was slightly less for revisions after 3 years (HR, 4.57; 95% CI, 1.63-9.91). Similarly, poor KSS at 2 years was associated with 3-fold higher risk for revision, but the strength association was slightly less for revisions after 3 years (HR, 2.32; 95% CI, 1.36-4.15).

We also examined the association between change in KSS and the subsequent risk for revision using an arbitrary cutoff value of 10 points (Fig. 1). Compared with patients who reported an improvement of ≥10 points on KSS, patients who reported worsening of ≥10 points between year 1 and year 2 experienced about 2.5-fold higher risk for revision (HR, 2.50; 95% CI, 1.25-5.47).

Mortality Risk

Preoperative pain and lower KSS were significantly associated with a higher mortality risk (*P* < .008). Patients reporting severe preoperative pain had a 45% higher risk for death (HR, 1.45; 95% CI, 1.16-1.81) than those reporting no or mild pain. Similarly, patients with poor KSS had about 50% higher risk for death than those with excellent KSS. The 1- and 2-year pain and KSS were not significantly associated with the mortality risk.

Nonresponse Bias

Using Kaplan-Meier survival curves, we further compared the revision and mortality rates for TKA patients with and without patient-reported pain and KSS at individual time points. Both the revision and mortality rates were higher among patients without the patient-reported scores, and the absolute differences were greater furthest from surgery. The 10-year revision rate was 7.5% among patients with preoperative scores and 8.6% among patients