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Protocol-Driven Revision for Stiffness After Total Knee Arthroplasty Improves Motion and Clinical Outcomes

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ABSTRACT

Background: Stiffness after revision total knee arthroplasty (TKA) is a difficult problem without a well-defined treatment algorithm. The purpose of this study was to evaluate the results of revision TKA for stiffness within the context of differential component replacement.

Methods: Consecutive patients who underwent revision TKA were retrospectively identified and included those who received debridement and polyethylene liner exchange alone, revision of only one of the femoral or tibial fixed components, or revision of all components. Preoperative and postoperative range of motion and Knee Society score (KSS) were collected.

Results: Sixty-nine knees were included in the study group with a mean follow-up of 43 months (range, 12-205 months). The mean prerevision flexion contracture of 17° improved to 5° after surgical intervention ($P < .001$). Similarly, mean flexion and motion arc improved from 70° to 92° and from 53° to 87°, respectively ($P < .001$). Mean KSS knee scores improved from 42 to 70 and KSS function scores improved from 41 to 68 ($P < .001$). Mean arc of motion improved by 45° in patients who underwent complete component revision, 32° with component retention, and 29° with single component revision ($P = .046$). KSS knee scores improved by 34, 25, and 28 points in these respective groups ($P = .049$). KSS function scores improved by 33, 27, and 25 points ($P = .077$).

Conclusion: Revision surgery with or without component revision can improve motion and function in patients with stiffness after TKA. Complete component revision may offer the largest improvements in these outcome measures in properly selected patients.

Total knee arthroplasty (TKA) provides dramatic improvements in pain and function for patients with end-stage arthritis. Postoperative stiffness is a common complication after TKA that negatively impacts the outcome. The definition of stiffness is not standardized within the literature, making precise prevalence estimates difficult, but large series report a rate of 1.3% to 6.9% [1,2]. Current treatment for postoperative stiffness includes both nonoperative and operative options. Nonoperative treatment consists largely of physical therapy and manipulation under anesthesia, which both have mixed results for improving stiffness [3–6]. Similarly, arthroscopic lysis of adhesions demonstrates varied success [7–9]. The indications for these procedures are not well established [10–14]. Many surgeons describe open debridement procedures that vary from isolated lysis of adhesions, polyethylene exchange, or complete component revision. Historically, attempts at revision surgery produced more modest improvements in range of motion and function [15–18], but modern treatment protocols with multimodal pain management seem to attain a better outcome [19–21].

Previously published series generally consist of patients who were treated with either isolated debridement and polyethylene exchange or complete revision of components. Conversely, our approach uses an intraoperative algorithm evaluating each component and revising as necessary. This leads to a mixed cohort of patients with revision of different components. Therefore, the purpose of this study was to evaluate the results of revision knee arthroplasty for stiffness within the context of differential component replacement.

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Materials and Methods

After the institutional review board approval, our surgical registry identified patients who underwent revision knee surgery for stiffness at least 1 year after primary TKA between 1999 and 2015. The most recently published definition for stiffness was used: flexion contracture of greater than 15°, or less than 75° of overall motion, with pain and dysfunction [20]. Preoperative workup included radiographs and laboratory studies for infection in all cases. Computed tomography scans were not routinely obtained, as their ability to diagnose component malrotation after TKA remains unclear [21]. Postoperative physiotherapy was prescribed for all patients similar to after primary TKA but was administered independently by different therapists and not specifically standardized. Continuous passive motion was never prescribed. Demographic information, component revision status, Knee Society score (KSS), and range of motion were collected preoperatively and at most recent follow-up. Range of motion was collected by a single physical therapist in our clinic.

Eighty-two revision surgeries for stiffness were performed in 81 patients during the study period. Thirteen patients were excluded for a follow-up duration of less than 1 year, leaving a cohort of 69 surgeries (84%) eligible for evaluation (Table 1). The mean age at the time of surgery was 62 ± 11 years. The mean follow-up duration was 43 ± 37 months.

Descriptive statistics were calculated for the demographic information of the cohort including mean and standard deviation. The preoperative and final evaluation data was compared with paired *t* tests for continuous variables. As an additional subgroup analysis, the cohort was separated into 3 groups: patients with retention of components and a soft tissue debridement with/without polyethylene downsizing, patients who had a single metallic component (femoral or tibial) revised in addition to soft tissue debridement, and patients who had both metallic components revised in addition to a soft tissue debridement. The change in flexion contracture, flexion, arc of motion, and change in KSS were compared among these groups with analysis of variance tests. Statistical analysis was performed with GraphPad Software (La Jolla, CA), and statistical significance was set at less than 0.05.

Surgical Technique

All surgeries were performed using the previous medial parapatellar arthrotomy with extension and additional exposure as necessary. Regardless of component position and plan for revision, all patients underwent a systematic and thorough soft tissue debridement through a standardized method. The capsular closure layer can be difficult to recognize owing to scarring of soft tissue planes. This layer is identified both medially and laterally and isolated from the underlying hypertrophic scarring and synovium. An aggressive debulking synovectomy is then performed deep into this layer throughout the knee, including the suprapatellar pouch, the retropatellar tendon space, and medial and lateral gutters. The lateral gutter in particular is evaluated for scarring contributing to patellar maltracking, and a lateral release is always performed. The polyethylene liner is removed, and the posterior aspect of the knee is inspected. The posterior knee space is always carefully debrided (being mindful of the adjacent neurovascular structures), and a formal posterior capsular release is performed in patients with a flexion contracture greater than 10°. The patellar component is inspected and retained if well fixed and well positioned. Patellar osteophytes are excised. If the patellar component is removed, it can either be replaced [19] or the patella can be debrided and left without a formal component if bone stock is poor.

The femoral component is evaluated next for appropriate size, as well as coronal, sagittal, and axial alignment. The location of the joint line is specifically evaluated with respect to available landmarks about the knee including the epicondyles, the fibular head, and the patella. The tibial component is next evaluated in the similar fashion. In our experience, it is possible to revise a tibial component with retention of the femoral component in

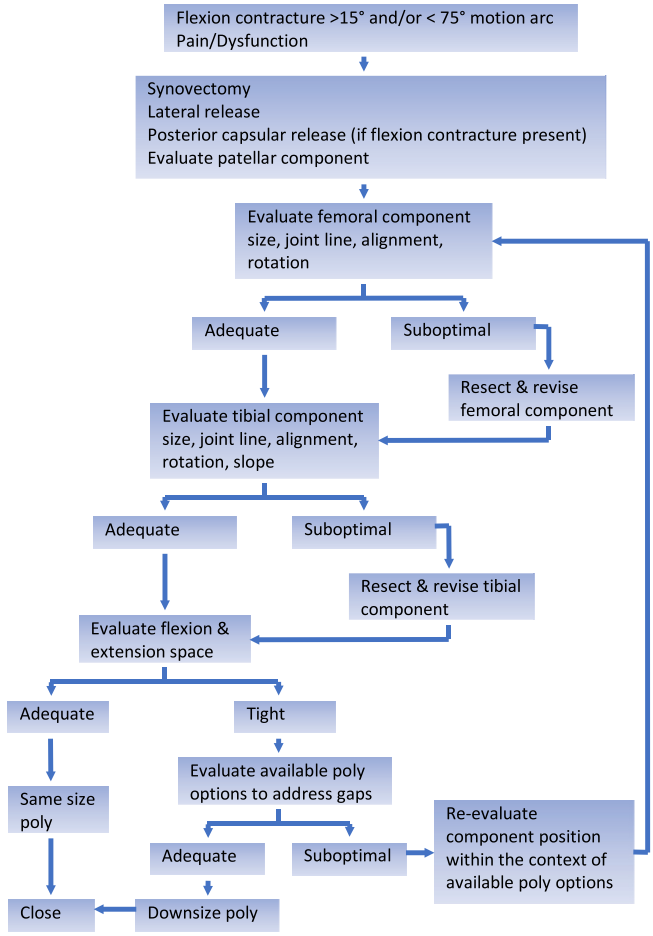

Fig. 1. Surgical algorithm.

Table 1
Demographics.

Number	69 (1 Bilateral)
Sex, male/female	30 (43%)/39 (57%)
Side, left/right	31 (45%)/38 (58%)
Age at revision, years	62 (range 40-82)
BMI, kg/m^2	30.9 (range 17.9-42.7)
Follow-up duration, months	43 (range 12-205)

BMI, body mass index.

Table 2
Overall Range of Motion and Knee Society Score.

	Prerevision	Postrevision	*P* Value
Flexion contracture	17° ± 10°	5° ± 7°	<.001
Flexion	70° ± 23°	92° ± 19°	<.001
Arc of motion	53° ± 22°	87° ± 21°	<.001
KSS knee score	42 ± 9	70 ± 14	<.001
KSS function score	41 ± 11	68 ± 16	<.001

The values are presented as mean ± standard deviation.
KSS, Knee Society score.