Total knee replacement in severe varus and flexion knee deformities using economical solutions

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Received 1 June 2013
Accepted 2 July 2013

The Egyptian Orthopaedic Journal
2016, 51:329–332

Background
Total knee replacement in severe deformities is a challenging procedure. Varus and flexion are the commonest deformities seen. Thorough soft tissue release and balancing is the key to a successful outcome. We tried to correct these cases without the need for expensive augments and specialized prosthesis.
Aim of the work
The purpose of this study is to offer economical solution for severe varus and flexion knee deformity and perform a follow-up. This was achieved by using bone grafts from the cuts, proper tissue release, and good preoperative and intraoperative assessment.
Patients and methods
Our study included 30 knees in 23 patients with severe flexion and varus deformities. The average preoperative varus deformity was 20° (range: 14°–38°), and the average flexion deformity was 15.6° (range: 5°–30°). Bone graft was used in eight (26%) cases and tibial stems in two (6%) cases. No constrained prosthesis was used.
Results
The average follow-up was 31 months (range: 8–65 months). The average postoperative range of flexion was 115° (range: 90°–147°), range of extension was between 0° and 6°, and the average varus correction was 26° (range: 12°–42°). At the final follow-up, we had 15 excellent, 12 good, two fair, and one poor functional result, giving a 90% success rate.
Conclusion
Total knee arthroplasty is a challenging procedure in severe grade of knee deformity. Different surgical facilities and solutions must be available to achieve optimum results. Although a wide scale of prosthesis types and bone defect replacement has been used in treating these cases, we were able to treat them with minimal cost and good results.

Keywords:
bone graft, flexion deformity, total knee arthroplasty, varus

Egypt Orthop J 51:329–332

1110-1148

Introduction

Till now in many parts of the world, there are patients with arthritic knees who present very late for treatment. Thus, they present with severe knee deformity, unyielding contractures, and major bone defects. The treatment of these cases requires extensive soft tissue release to attain proper alignment, which may necessitate the use of stems, wedges, and constrained or hinged prostheses. These additions or constrained prostheses are expensive and increase the cost of the procedure two-fold to three-fold. Failure to manage these cases adequately may lead to premature loosening and failure. Several methods have been described to address severe deformities, but these have been in smaller series and with a lesser magnitude of deformity [1].

Total knee arthroplasty (TKA) is extremely challenging if the aim is to correct pronounced deformity. Also, balancing the soft tissues to use the least amount of constraint is difficult. Severe preoperative deformities have long been a challenge for surgeons performing TKA. Restoring the knee alignment to an angular anatomic norm of 5° valgus may be difficult and may require intraoperative ligament releases and/or ligament tensioning to achieve proper ligament balance. Several reports have looked at severe valgus [2] and severe varus [3] deformities independently. However, Laskin *et al.* [4] mentioned both in their study.

Most of the surgical modalities that deal with severe deformities depend on constrained implants, long tibial stem, wedges, bone grafts, and other expensive solutions. In our study, we dealt with such deformities by the regular

 DOI: 10.4103/1110-1148.209001

Figure 1

(a) A 45-year-old lady with 18° preoperative varus deformity and 5° fixed flexion deformity. (b) Postoperative radiograph with 22° axial alignment correction.

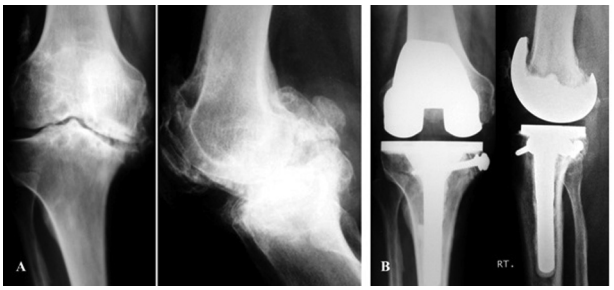
knee implants and affordable tools to achieve correction with an economic budget.

Patients and methods

Between May 2003 and March 2010, 30 total knee replacements in 23 patients were performed on knees with severe varus and flexion deformities (as measured on weight-bearing films and lateral radiographs). In all patients, cemented knee prosthesis was used. This was a prospective study with mean follow-up of 31 months (range: 8–65 months). In our study, we operated on 13 women and 10 men. We performed bilateral replacement in seven patients. In total, 13 knees were right and 17 were left. The mean age in this study was 57.4 years (range: 45-65 years). All of our patients had a combined flexion and varus deformity. The mean flexion deformity was 15.6° (range: 5°–30°), with the mean varus deformity of 20° (range: 14°–38°).

We used the Knee Society Clinical Rating System for postoperative clinical evaluation [5] of our patients after 3, 6, and every 6 months thereafter. Our technique focused on thorough soft tissue release and proper soft tissue balancing. For the medial side, the deep medial collateral ligament (MCL) was released, and this extended distally to do a complete release of the superficial MCL. This release was continued to the posteromedial capsule if necessary, to achieve a normal valgus alignment before proceeding with the bony cuts. We used a cruciate-sacrificing

Figure 2



(a) A 65-year-man with preoperative 16° varus and 25° fixed flexion deformity. (b) Postoperative radiograph with 23° axial alignment correction by use of bone graft and tibial stem (only case).

prosthesis in all patients, as the posterior cruciate ligament is usually contracted and diseased and does not allow full correction. In the lateral side, the tissues were stretched out, so proper balancing depended on putting a large tibial insert to stuff the knee, with equal tension between the medial and lateral soft tissues (Fig. 1).

For the flexion deformity, if more than 10°, the distal femoral cut was increased from the standard 9 to 11 mm from the start. This increased the extension gap in relation to the flexion gap. In all cases, a thorough posterior capsular release was performed with osteophytes removal from the posterior femoral condylar surface. These osteophytes and the posterior capsular contracture contributed to the flexion deformity. Bone grafts were used for the tibial surface in eight (26.6%) cases to fill the defect remaining after the bony cuts. The graft was taken from the bone remaining after the tibial or femoral cuts. The grafts were fixed with cortical screws after refreshing the bony beds (Fig. 2). Drilling of the sclerotic plateau was regularly performed before putting the tibial insert, as we did minimal bone cut. Tibial stems were used in only one patient, with bilateral knees (6%). This was done as the bone graft constituted more than 25% of the tibial surface. The patient had a preoperative 25° varus and 16°flexion deformity. These stems provided more stability. We did not use any metal wedges or constrained prostheses. A larger insert to stretch the lax lateral ligaments and the released medial ligaments intraoperatively achieved the stability of the knees. Conservative bone resection was our aim.

Results

The average correction of deformity was 26° (range: 12°–42°), both varus and flexion. The average postoperative tibio-femoral alignment angle was

5.24° valgus (range: 2° varus to 8° valgus). Most of the patients reached full extension with a range between 0° and 6°, and the mean flexion range of motion was 115.6° (range: 90°–147°).

The knee score (Knee Society Clinical Rating System) increased from a mean of 32 points (range: 12–48) to a mean of 92 points (range: 59–100 points). The function score improved from a mean of 32 points (range: 10–68 points) to a mean of 90 points (range: 60–100 points). The radiographic follow-up assessment showed no evidence of osteolysis, radiographic loosening, or component subsidence except in one patient with pigmented villonodular synovitis, where we had graft resorption with poor final functional result.

At the final follow-up, we had 15 knees with excellent results, 12 with good, two with fair, and one with poor functional result. The two fair cases had unexplained knee pain, and one of them was a preoperative malunited supracondylar fracture of the femur.

Discussion

Arthritic knees with severe deformities have always constituted a problem from a surgical and a financial point. There are different methods described to correct severe varus deformity during knee arthroplasty [6]. However, there are few reports in the literature dealing with large numbers of highly deformed knees. Whether satisfactory correction can be achieved in a predictable manner has not been clearly established [7]. Most reports have been of smaller series of cases: 17 cases by Karachalios *et al.* [8], 27 cases by Teeny *et al.* [9], and 10 cases by Dixon *et al.* [1].

In our study, we had 30 cases, and this is mostly contributed to the delayed presentation. Range of motion (ROM) and pain relief are important outcome variables following TKA. In patients undergoing primary TKA, 61% of knees presented with flexion contractures [10]. Moreover, preoperative ROM is the strongest predictor of postoperative ROM [11]. ROM is still a key factor in these cases [12]; a minimum of 90° flexion is required for normal daily activities, and anything less will severely affect quality of life [13,14]. The mean postoperative flexion of our patients was 115.65° and extension range between 0° and 6°. Li *et al.* [12] in their series had 105.1° postoperative flexion, with a loss of 2.4° flexion but a gain of 4.6° flexion arc after surgery, because of an increase in extension by 7.0°. The flexion of our patients was comparable with what has been reported in other studies (ranging from 100° to 115°) [15,16]. Flexion contracture resulted from a combination of ligamentous, capsular, and bony deformities, in which forces exerted across the patellofemoral and tibiofemoral joints increase and adversely affect knee biomechanics.

Proper soft-tissue balancing and sufficient ligamentous stability are important prerequisites for a successful TKA [17]. The technique by Insall *et al.* [18] for correction of varus deformity by progressively releasing the medial soft tissues until they equal the length of the lateral ligamentous structures is widely used. However, in severe varus deformity, this may require releasing of the superficial medial collateral ligament, the semimembranosus, the posteromedial capsule, and the pes tendons, leaving the medial side barren [6,9]. However, there may be situations for which soft tissue balance cannot be achieved by release of the contracted side of the knee alone, but may require the use of implants with greater constraint (such as a varus–valgus constrained implant) or MCL repair techniques (such as ligament advancement, imbrication, or MCL reconstruction) [19]. Our soft tissue balancing in varus and flexion deformities is similar to previous reports by Laskin and Schob [6] and Teeny *et al.* [9], and we were able to achieve a full correction in most cases with this technique.

The purpose of this study was to perform total knee replacement in these cases with a minimal armamentarium. In all the cases, we used the regular knee replacement prosthesis with no need for any constrained prosthesis. Wedges and blocks which are commonly used to treat bone defects were not used and replaced by local bone graft in eight (26.6%) cases. Tibial stem was used in two occasions only.

The limitation of this study is the short follow-up and relatively small number of cases compared with articles on primary knee arthroplasty, but severe deformities are less common, and the early results are promising, although there is a need for a longer follow-up.

Conclusion

Treatment of severe varus and flexion deformities during TKR is a challenging surgery. Different surgical facilities and solutions must be available to achieve optimum results. Although a wide scale of prosthesis types and bone defect replacement has been used in treating these cases, we were able to treat them with minimal cost and good results. Our techniques resulted in restoration of alignment and stability without the need for wedges or

constrained prosthesis with encouraging early and mid-term results.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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