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Original Article

Total knee arthroplasty for severe valgus knee deformity

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Abstract: To investigate the surgical methods and clinical effects of total knee arthroplasty (TKA) in patients with severe valgus knee deformity. From January 2005 and January 2009, 16 patients with 18 severe valgus knee deformity underwent TKA by means of medial parapatellar approach, standard osteotomy and only lateral soft tissue release were retrospectively analyzed. All implants were cemented. Clinical and radiographic evaluations including range of motion (ROM), The Knee Society's Knee Scoring System (KSS) and Limb alignment, patellar position, and evidence of loosening or osteolysis using standing radiographs were performed at follow-up. The average KSS score improved from 18.5 points preoperatively to 85.6 points at the time of the last follow-up. The average ROM improved from 39.5° preoperatively to 109.5°. The mean tibiofemoral alignment improved from valgus 31.2° at preoperative period to 5.5° at the final follow-up ($P<0.05$). A normal patellar position was observed in all knees. Two patients developed transient peroneal nerve palsies. Lateral instability after soft tissue releasing was found in one knee during the surgery. One patients developed symptomatic deep vein thrombosis. Prosthetic survival rate was 100% at a mean of mean 7 years postoperatively. The techniques of medial parapatellar approach, standard osteotomy and only lateral soft tissue release can deal with a severe valgus knee deformity very successfully in patients undergoing primary total knee arthroplasty, and provide excellent results.

Keywords: Arthroplasty, knee, genu valgum, medial parapatellar approach, lateral soft tissue release

Introduction

Rheumatoid arthritis, osteoarthritis, posttraumatic arthritis and metabolic disorders can lead to valgus deformity of the knee. About 10% of patients were underwent total knee arthroplasty (TKA) will involve valgus of the knees to varying degrees [1]. Previous reports suggested that the normal femorotibial angle (the angle between the anatomical axis of the femur and the tibia) was naturally between 5° to 10° [1, 2]. The femorotibial angle with more than 10° was defined as valgus deformity. The angle with more than 20° is defined as severe valgus deformity. Application of for the patients with valgus deformity was extremely difficult, especially for patients with severe valgus deformity [2].

The valgus knee occurs along with primary or secondary bone and soft-tissue abnormalities such as lax medial structures, contracted lateral ligamentous and capsular structures, as well as preexisting or acquired bony anatomic deficiencies [3-7]. The combination of above deformities would lead to abnormal rotational alignment of the distal femur and patellar tracking, as well as femoral malformations which made attaining soft-tissue balance when the knee is returned to physiologic alignment extremely difficult. Although bone anatomic alignment can be achieved through advanced instruments or osteotomy technique, but lax medial ligamentous and contracted lateral structures still need to be addressed in order to attain a satisfactory soft tissue. When the condition deteriorating, the surgeon would have not to choose constrained prosthesis [8]. However, the application of constrained prosthesis was bound to increase the probability of loosening and revision surgery [9].

Bone anatomic alignment may be achieved by osteotomy technique, while how to get flexion-

extension joint gap balance by soft tissue release was extremely complex [10, 11]. Goal of proper soft tissue release was to obtain not only immediate but long-terms tability of the knee, which may determine the rate of prosthesis loosening and wear. The lateral side of the knee has dynamic and static structures available for release. The dynamic structures include the iliotibial tract, the popliteus, and the lateral head of the gastrocnemius, while the static structures include the lateral collateral ligament, posterolateral corner, and the posterior capsule [12-14]. If release of the lateral structures does not sufficiently stabilize flexion and extension gaps, then the medial structures of the joint should be tightened.

A standard management did not be made about soft tissue release in TKA for severe valgus knee deformity [1, 8, 9]. The stepwise release has been based upon surgeon's experience. In the clinical practices, we used medial parapatellar approach, conventional osteotomy, only lateral soft tissue release and posterior-stabilized, cemented, knee prostheses in TKA for severe valgus knee deformity. In the present study, we would review the related case to investigate the following issues in TKA for severe valgus knee: (1) the anatomical characteristics about operative approach, (2) the method of osteotomy and soft tissue release, (3) the midterm results of case series in clinical practices.

Materials and methods

Patients

The study was approved by the institutional review board at our hospital. Between January 2005 and January 2009, 18 primary TKAs were enrolled in our hospital and received medial parapatellar approach, conventional osteotomy, only 15 patients with severe valgus knees which were receiving lateral soft tissue release and posterior-stabilized, cemented, knee prostheses performed were included. The inclusion criteria were more than 20° with valgus deformity for knee osteoarthritis or rheumatoid arthritis. Any patient who had extra-articular deformity of the knee, neurological disorders and severe osteoarthritis of the hip joints or muscular imbalance in the lower extremities was excluded from the study.

The study group included four male and twelve female patients. The mean age at the time of surgery was 64 years (range from 48 to 72 years). The mean body mass index was 26.4 kg/m^2 (range from 23 to 31 kg/m^2). The preoperative weight bearing valgus (tibiofemoral alignment) for all patients was between 23° and 50° (mean, 31.2°). Of the 18 knees, 14 had osteoarthritis and 4 had rheumatoid arthritis. There were 2 cases (2 knees) of patellar dislocation, one case (one knee) of medial instability of the knee. Four knees had flexion contracture with valgus deformity. All patients were followed for at least 5 years.

Surgical methods

Anesthesia and approach: The knee was exposed in flexion using a midline longitudinal skin incision and a medial parapatellar arthrotomy that resected part of the lateral patellar fat pad and cleared the medial tibial osteophytes, but not released the medial soft tissue. If the patella cannot be easily everted without the risk of patella tendon avulsion, obtain more extensile exposure either by extending the arthrotomy, doing more distal soft-tissue releases.

Osteotomy: Firstly, tibial osteotomy was carried out. The tibia was then prepared using an extra-medullary Jig. For severe valgus deformity associated with severe defects of the lateral tibial plateau, the lowest point of the medial tibial plateau were measured was referenced to conduct osteotomy. Osteophytes were resected in order to expose the substantial tibia bone bed, then the tibial prosthesis was implanted. The amount of bone for tibial osteotomy should be as little as possible.

Secondly, femoral condyle osteotomy was carried out. The femur was prepared using intramedullary instruments. Entrance should be slightly medial 1-2 mm to the standard entry point. For the reason that the most of patients with severe valgus deformity, lateral condyle dysplasia or obvious defects of the femoral condyle and lateral structure contracture, valgus angle of the distal femoral osteotomy should be reduced to 30° to 50°. The rotational alignment of the femur was referred to the anatomical axis of the femur (the Whiteside line and transepicondylar axis). For the cases with patellar dislocation, when the dislocation was

not corrected lateral release through lateral release, external rotation angle of the femoral prosthesis may be slightly increased (about 1° to 2°) without affecting the balance of lateral gap.

For the cases with flexion contracture deformity, the joint capsule should be firstly released by stripping the posterior capsule from posterior femur and tibia, then osteophytes around posterior joint capsule were removed. The degree of correction of flexion deformity after posterior release would decide whether additional osteotomy of the distal femur was taken up.

Finally, patella was addressed. Patellar denervation was carried out, and the patella was not resurfaced for all patients.

Lateral soft tissue release: Flexion and/or extension joint gap was tight for all patients with severe valgus knee. Therefore, lateral soft tissue release need routinely be taken up during TKA with severe valgus deformity. The selective release of the lateral structures technique (Pie crusting) for tight extension gap was carefully performed with small, multiple inside-out incisions. The release for tight flexion gap always started from the posterolateral capsule at the level of the collateral ligament and the iliotibial band. The popliteus tendon would be released if need. Cleaning up osteophytes of posterior femoral condylar and resecting sesamoid in the lateral head of the gastrocnemius would further achieve the release for tight flexion gap. Flexion and extension gaps changes were tested by spacer block after each puncture until gap symmetry was achieved. Based on the competency of the medial collateral ligament, advancement of the ligament was not needed in any of the knees in our study. Lateral release must be performed in a graduated, organized stepwise fashion to provide adequate stability without over releasing. Patellar maltracking was judged by a no-thumb technique. If significant preoperative valgus deformity has been corrected, it is often necessary to perform a lateral retinacular release to allow proper patellar tracking and prevent patellar subluxation or dislocation. Finally, we assessed gap balancing by placing the trial components and applying varus and valgus stress to the knee again until gap symmetry was seen.

Valgus was predominantly of femoral origin, bone deficits in the lateral femoral condyle or lateral the tibial plateau may require bone-grafting as estimated, and the remaining defects in lateral femoral condyles were filled with autograft bone taken from other cuts during the procedure. Bone resection balance of the knee in lieu of soft tissue releases were not used in the series, and a tibial tubercle osteotomy is not suggested here yet.

Selected prosthesis

In the 18 knees with severe valgus deformity, Posterior Sacrified implant Genesis II (Simth & Nephew Company, USA) were used in 15 knees, cruciate-retaining knees (Gemini MK II, Link Company, Germany) in 3 knees. All implants were cemented.

Postoperative management

Postoperatively the knees were placed in 10° of flexion for 3 days to prevent stretching of the peroneal nerve, active and passive range-of-motion exercises (within a range of 10° to 80°) were allowed. Routine postoperative care such as early mobilization, walking with full weight bearing, and quadriceps-strengthening and range-of-motion (ROM) exercises beginning after 3 days postoperatively under a physiotherapist's supervision. The mean duration of hospital stay was 16 days with a range of 15-18 days.

Assessment methods

Patients were followed up by the same surgeon at 3, 6, and 12 months, and then yearly. The Knee Society's Knee Scoring System (KSS) and range of ROM of the knee was assessed. Limb alignment, patellar position and evidence of loosening or osteolysis were evaluated by using standing radiographs. Mediolateral stability was assessed by a varus-valgus stress in full extension. Anteroposterior stability was assessed by an anteroposterior stress test in 30° and 90° of flexion.

Statistical analysis

Statistical analysis was performed using SPSS 13.0 (SPSS, Inc., Chicago, IL), the paired t-test was employed for comparison of preoperative and postoperative results for HSS knee score,

ROM of the knee and femorotibial angle. The size of test took bilateral $\alpha = 0.05$.

Results

Perioperative data

The average operative time was 85 minutes (range 50 to 120 min). The average blood transfusion was 550 mL (300-800 mL). Lateral instability in the knee extension after soft tissue releasing was found in one knee during the surgery. The protected brace was used after the surgery.

Clinical results

All patients were followed up for a mean value of 7 years (range from 5 to 9 years). The mean preoperative KSS score and ROM were 18.5 points (range from 15 to 38 points) and 39.5° (range from 20° to 79°), respectively, which improved to a mean of 85.6 points (range from 80 to 94 points) and 109.5° (range from 80° to 126°) at the last follow up ($P < 0.05$). All patients had no claudication. The mean tibiofemoral alignment improved from valgus 31.2° (range, 23°-50°) at preoperative period to 5.5° (range, 3°-9°) at the final follow-up ($P < 0.05$).

Radiographic results

Based on the postoperative radiographs, no aseptic loosening or subsidence was observed. No femoral or tibial osteolysis was observed as well until final follow-up. On the skyline radiographs a normal patellar position was observed in all knees.

Complications and survival of implants

Two patients developed transient peroneal nerve palsies, which was recovered within six months. Lateral instability in the knee extension after soft tissue releasing was found in one knee during the surgery. The protected brace was used after the surgery. Instability of this patient disappeared after three months. One patients developed symptomatic deep vein thrombosis. There was no incidence of pulmonary embolism. Two patients had transitory knee pain for one year after the surgery (4 points or more on the visual analog scale). However, the pain was gradually disappeared after one year.

No late-onset instability was displayed in the follow-up. No patient underwent revision. Prosthetic survival rate was 100% at a mean of mean 7 years postoperatively.

Discussion

In this study, the mean preoperative tibiofemoral valgus angle (mean value 31.2°) is the highest comparing with previous reports. All total knee prosthesis achieved satisfactory clinical results and no revisions were needed for any reason during a follow-up (Mean value 7 years).

A midline longitudinal skin incision and a medial parapatellar arthrotomy were used for all patients in our study. Our results demonstrated this approach was better than other approach in arthroplasty for valgus knee deformity. Most orthopedic surgeons are familiar with it is conducive to accurate osteotomy, while the lateral structure can be completely, fully released. Ranawat et al concluded the inside-out release technique for correcting a fixed valgus deformity in patients undergoing primary total knee arthroplasty is reproducible and provides excellent long-term results [2]. This approach would help to release the lateral retinaculum completely and joint capsule, as well as avoid contracture of the lateral structure after the surgery. Therefore, to achieve the purpose of improving the patellar track. All patients in our study had first intention healing, with no incisional disunion and patellar dislocation.

Adequate soft-tissue balance during surgery of valgus knee deformity in TKA is really challenging [11]. Any tight lateral structures were released with a low complication rate in this study. Some surgeons believe reconstruction of the medial collateral ligament complex was extremely important [15-18]. In our study, we did not select medial advancement of the medial collateral ligament as an option to reduce the degree of soft-tissue release because it will increased surgery time, delayed mobilization and avoided complications such as non-union at the medial collateral ligament advancement site [19-21].

In the process of lateral release by means of pie crusting, tense lateral tissues were touched repeatedly by finger in flexion and extension position of the knee. When the lateral structure of fixed contracture deformity by above method

was still unable to correct valgus deformity, part of the tense ligament may be cut off directly.

There was report suggested that thorough decoherence of popliteal tendon and lateral collateral ligament from the femoral condyle may increase the risk of loose and revision after the surgery [22]. However, there was also reports demonstrated that lateral soft tissue released by selective cutting of tight lateral collateral ligament and popliteal tendon for severe knee valgus deformity in TKA did not increased the risks of loosening and postoperative knee instability in a long-term follow-up [23]. In our study, iliotibial band and the lateral collateral ligament for all patients are released. Popliteal tendon and lateral collateral ligament for some patients were striped from the femoral condyle. In postoperative follow-up period, knee instability for all cases did not appear. For these reasons, we suggested that the remaining lateral structure after lateral soft tissue release such as the joint of the contractured joint capsule can be compensated for knee stability.

In conclusion, this study emphasis is on reasonable release for lateral tight soft structure in TKA for the severe valgus deformities in order to obtain an initial stability of the knee. This study is a retrospective analysis of a small number of cases, and follow-up time is shorter. Long-term effect for our cases needs further be observed.

Disclosure of conflicting interest

None.

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