

PARTICULARITIES OF TOTAL KNEE ARTHROPLASTY IN KNEE OSTEOARTHRITIS WITH VALGUS DEFORMITY. MEDIUM-TERM CLINICAL RESULTS

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Abstract: In total knee arthroplasty for cases with valgum axial deformity, ligament balancing requires special attention due to specific changes in osseous configuration and periarticular soft tissues. In this study we followed a consecutive series of patients with knee osteoarthritis and valgus axial deviation who underwent total knee arthroplasty with posterior stabilized endoprostheses. We used either a medial or lateral parapatellar approach, depending on the degree of deviation. The patients were followed clinically and radiologically on average 4.1 years, and we recorded the clinical and functional Knee Society Score. We found a statistically significant improvement in all followed parameters: clinical and functional scores increased from the average preoperative values of 33.73 and 29.8 points to 93.5 and 86.73 points at 1 year, and 93.15 and 87.3 points at 4 years postoperatively ($p=0.0001$), with no cases of endoprosthetic component loosening.

Cuvinte

gonartroză, genu valgum, artroplastie totală de genunchi, Knee Society Score

Rezumat: În artroplastia totală de genunchi, în cazul artrozelor cu deviere axială în valgum, balansul ligamentar necesită o atenție deosebită datorită modificărilor configurației osoase și a părților moi periarticulare. În acest studiu am urmărit o serie consecutivă de pacienți ce prezentau gonartroză cu deviere axială în valgus, la care s-a practicat artroplastia totală a genunchiului cu endoproteze stabilizate posterior. Am utilizat abordul parapatelar medial sau lateral, în funcție de gradul devierii. Pacienții au fost urmăriți clinic și radiologic pe baza Knee Society Score pe o perioadă medie de 4,1 ani. S-a înregistrat o îmbunătățire semnificativă statistic a tuturor parametrilor urmăriți: scorul clinic și funcțional au crescut de la valorile medii de 33,73 și 29,8 puncte preoperator la 93,5 și 86,73 puncte la 1 an, respectiv 93,15 și 87,3 puncte la 4 ani postoperator ($p=0,0001$), fără cazuri de mobilizare a componentelor endoprotetice.

INTRODUCTION

In the literature genu valgum usually represents an anatomic femoral-tibial angle of $>10^\circ$, still, values of 7 to 9° are also considered as cases of valgus deviation.(1)

Valgum axial deviations of the knee, although less frequent compared to those in varum, are a difficult problem to be addressed in the endoprosthetic reconstruction of the knee. In these cases, osteoarthritis is associated with changes in both bone and soft tissue, in various combinations:(1) retraction of the lateral capsuloligamentous structures and a laxity of the medial structures, osseous defects that affect the articular surfaces of the lateral femoral-tibial compartment, external rotation deformity of the distal femur, as well as patella mobility problems (the so-called "maltracking").(2)

PURPOSE

This paper presents the results of total knee arthroplasty in patients with valgus axial deviation of the knee, with an average follow-up period of 4.1 years postoperatively.

METHODS

Included patients

Between January 2004 and December 2010 the same surgical team performed a number of 26 total knee arthroplasties in 24 patients with knee osteoarthritis and genu valgum axial

deviation at the Clinic of Orthopaedics and Traumatology of Țirgu Mureș. The mean age at operation was 64.9 ± 5.3 years (53-74 years). We had 4 male patients (16.66%) and 20 female patients (83.34%). Mean body mass index was 32.5 ± 3.4 kg/cm² (29.1-40 kg/cm²). Patients were followed an average of 4.1 years (2-7 years).

Preoperative diagnosis was primary osteoarthritis in 15 cases (57.69%), osteoarthritis secondary to rheumatoid arthritis in 6 cases (23.07%) and post-traumatic osteoarthritis in 5 cases (19.24%). All cases were thoroughly evaluated radiologically before surgery, with anteroposterior, lateral and axial knee radiographs, as well as radiographs of the whole lower limb while weight-bearing.

The operative technique

We initiated thromboprophylaxis with low-molecular-weight heparin 24 hours before surgery and administered perioperative prophylactic antibiotics (4 doses of second generation cephalosporin). In all cases we used posterior stabilized Zimmer NexGen® Legacy endoprostheses.

We used a median vertical incision, 12 to 14 cm in length, centred on the tip of the kneecap. In cases of valgus deviation of $<10^\circ$ we used a medial parapatellar approach, while in those with valgum of $>10^\circ$ we performed a lateral parapatellar arthrotomy using the technique described by Kebabian, associated with a Hoffa fat pad plasty. The lateral approach offers the

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CLINICAL ASPECTS

advantage of a better exposure of the capsuloligamentous structures that require release in cases of genu valgum. The disadvantage of the lateral approach is related to the soft tissue deficit on the anterolateral portion of the wound, which can make closure difficult, but this setback can be avoided by the mentioned "hoffaplasty".

Arthrotomy is performed using an oblique incision that begins proximally at the quadriceps tendon and passes approximately 1 cm lateral to the edge of the patella, finally reaching the Gerdy tubercle (the insertion site of the iliotibial tract) – the latter is resected using a chisel. The Hoffa fat pad is prepared taking care to maintain a posteroinferior pedicle with an intact vascular supply; this pedicle is isolated to the lateral side of the wound. The next step is the release of the posterolateral capsule, which can be achieved in two ways: either using the technique called "pie crusting" with the knee in extension (this implies a fractional elongation of the capsular structures by multiple scalpel incisions) or a desinsertion performed with the knee in a flexed position.

After the distal femoral cut is made, we measure the size of the femoral component (using the anteroposterior guide). For this we need to take into account a series of parameters: the posterior condylar axis, Whiteside's line and the transepicondylar axis (Whiteside's line must be perpendicular to the transepicondylar axis). We choose 5 to 7° of external rotation, compared to the 3° used in cases of genu varum. The tibial cut is performed using intra- or extramedullary alignment, the entire process is actually a "mirror image" using the contralateral cutting guide.

Lateral structures must be released in a sequential fashion, with control of stability and alignment after each phase, both in flexion and in extension. We used the following sequence of release: release of the iliotibial band and posterolateral capsule – in all cases, before making the osseous cuts; release of the lateral collateral ligament from the femoral epicondyle; release of the popliteus tendon at the level of the joint line. We did not release the long head of the biceps tendon in any of our cases.

During wound closure we used the preserved pedicle from the Hoffa fat pad to cover the soft tissue defect created by alignment on the inferior-lateral side.

The medial parapatellar approach used was performed using the classic technique.

Suction drainage was ceased at 24 hours postoperatively, and the limb was maintained in elastic bandage for 2 weeks. Simultaneously quadriceps toning exercises were initiated, alongside continuous passive motion exercises (flexion/ extension with Arthromot® equipment). Loading of the operated limb started at 24 hours postoperatively, using auxiliary support (walker). Thromboprophylactic treatment with low-molecular-weight heparin was continued for 4 weeks.

Postoperatively we evaluated the patients at 3 and 12 months, and yearly thereafter. During the clinical examination we assessed knee range of motion and anterior knee pain and/ or other complications, also calculating the Knee Society clinical and functional scores (KSS). We used a modified version of the KSS, because in the standard version(3) points are deducted for valgus changes of the knee anatomic axis <5° and >10°. In our cases we aimed to achieve 3 to 5° of valgus alignment, so we deducted points for valgus alignments of <2° and >7°, as described by Miyasaka and Ranawat.(4) Patients were also followed radiologically to detect any signs of endoprosthesis component loosening.

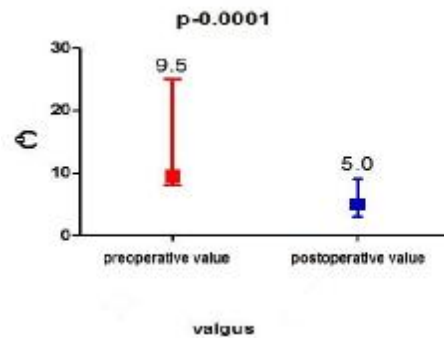
Statistical analysis was done using MedCalc statistical software (version 12.3.0, Mariakerke, Belgium): Anova,

Wilcoxon and Friedman tests, with a significance threshold $p=0.05$ (statistical significance considered for values of $p<0.05$).

RESULTS

Preoperative valgus deformity showed a median of 9.5° (8-25°) reaching a postoperative median of 5° (3-9°) – a statistically significant reduction ($p=0,0001$, Wilcoxon test, figure no. 1).

Figure no. 1. Valgus deviation values pre- and postoperatively (small square = median, extremes = range of values)



We used an external approach with hoffaplasty in 30.7% of cases, the remaining 69.3% being resolved through internal parapatellar approach.

Table no. 1 presents the values of the assessed parameters along with the statistical tests used to determine their changes.

Table no. 1. Values of the parameters assessed pre- and postoperatively (* Friedman test; ** Anova test)

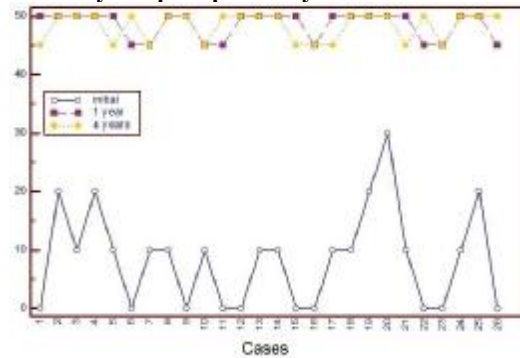
Parameter	Initial	1 year postoperatively	4 years postoperatively	p value
Pain: median (range)*	10 (0-30)	50 (45-50)	50 (45-50)	0,0001
Range of motion: mean±SD**	97,8 ±9,7	107,8±8,4	106,5 ±8,4	0,0002
Stability: median (range)*	17,5 (5-25)	23,8 (20-25)	21,1 (20-25)	0,0001
Walking: median (range)*	10 (10-30)	50 (30-50)	50 (40-50)	0,0001
Stairs: median (range)*	15 (0-30)	40 (30-50)	40 (30-50)	0,0001
KSS clinical: mean±SD**	33,7 ±16,4	93,5±5,29	93,1 ±5,25	0,0001
KSS functional: mean±SD**	29,8 ±14,2	86,7±13,2	87,3 ±11,8	0,0001

Pain and knee range of motion showed a statistically significant improvement at 1 and 4 years after surgery ($p=0.0001$).

Knee joint stability increased from a median of 17.5 points preoperatively to 23.8 points at 1 year postoperatively, then slightly decreased at 4 years postoperatively to a value of 21.1 points (figures no. 2 and 3).

CLINICAL ASPECTS

Figure no. 2. The evolution of the pain score (in points) from baseline to 4 years postoperatively



A similar situation was found for the scores for walking and stair climbing, as well as clinical and functional KSS: all these parameters showed statistically significant improvement at 1 and 4 years postoperatively ($p < 0.0001$, figure no. 4).

During follow-up, 3 complications (11.53%) were recorded: one case each of paralysis of the external popliteal sciatic nerve (3.84%), thrombophlebitis (3.84%) and skin necrosis (3.84%), that were adequately addressed and solved.

Figure no. 3. Evolution of knee range of motion (left) and stability (right) from baseline to 4 years postoperatively

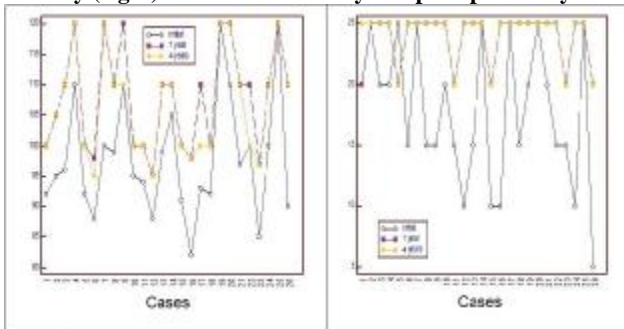
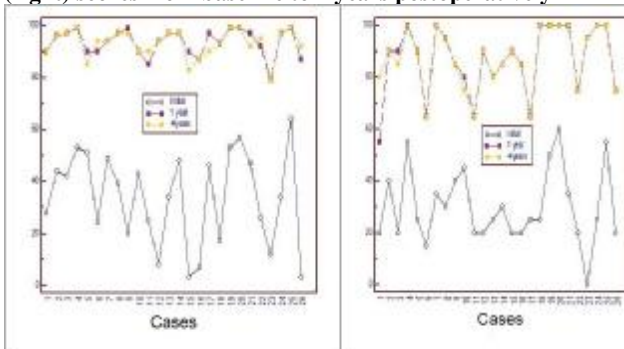


Figure no. 4. Evolution of KSS clinical (left) and functional (right) scores from baseline to 4 years postoperatively



We found no radiological signs of endoprosthesis loosening, and none of the patients required revision arthroplasties during follow-up.

DISCUSSIONS

Valgus axial deviation is a complex deformity that cannot be characterized only by the position of bony landmarks. Usually a soft tissue asymmetry is also present, so ligament balancing is as important as achieving adequate bone cuts.(5) Although there is still no consensus regarding the exact order for approaching capsuloligamentous structures and soft tissue

during ligament balancing in genu valgum, the main structures that require release are: the iliotibial band, posterolateral capsule, lateral collateral ligament, popliteus tendon and lateral head of the gastrocnemius muscle. Also several methods have been described for the shortening or transposition of medial structures (especially the medial collateral ligament).

The most detailed and organized description of the release order of knee periarticular soft tissues was published by Whiteside in 1999, (6) in which, after the osseous cuts are made, the release approach is decided based on what structures are tensioned in flexion and extension respectively, with release of the iliotibial band, popliteal tendon, lateral collateral ligament and lateral head of the gastrocnemius muscle, as needed. Most authors have also stressed the importance of checking stability and mechanical axis after each step of release.(1,2,7)

The lateral parapatellar approach was suggested by Buechel[8] and Fiddian et al.(9), but Keblish was the first to describe this operative technique in detail.(10) The main problem with this approach was the lack of lateral soft tissues for adequate wound closure, but this drawback can be corrected by performing a hofoplasty. Complication rates in our study were similar to those reported in the literature.(1,7)

CONCLUSIONS

Valgus axial deviation of the knee significantly increases the difficulty of total knee replacement interventions, but using a suitable technique, good and excellent results can be achieved in these demanding cases. One of these techniques involves the use of a lateral parapatellar arthrotomy that facilitates the approach of the retracted lateral anatomical structures. For correct ligament balancing, sequential release of these structures is required, and by associating a hofoplasty we were able to ensure adequate wound closure. Using these methods we obtained a statistically significant improvement of clinical and functional scores of the followed patients.

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CLINICAL ASPECTS

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