

Extended Exposure in Difficult Total Knee Arthroplasty Using Tibial Tubercle Osteotomy

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ABSTRACT

Objectives: In some total knee arthroplasty cases, the usual medial parapatellar approach does not allow the appropriate patellar eversion and the desired exposure of the knee joint. Partial disinsertion of the patellar tendon doesn't substantially improve the surgical exposure and can lead to extensor apparatus weakening and complete secondary ruptures, while the V-Y quadricepsplasty leads to post-op immobilization of the knee, which delays the functional rehabilitation, with negative impact on the range of motion. The tibial tubercle osteotomy, however, allows an extension of the approach in total knee arthroplasty, without endangering the quadriceps extensor apparatus.

Material and Methods: In this study we analysed the post-operative results of 11 cases of primary total knee arthroplasty in which a frontal plane osteotomy of the tibial tubercle was performed in addition to the standard medial parapatellar approach, as a result of the patients associated conditions, like rheumatoid arthritis with an extension deficit higher than 150, previous knee synovectomy by arthrotomy, progressive genu varum with more than 150 deviation, varus deviation of the lower limb with previous closing wedge proximal tibial osteotomy or patellar fractures with vicious consolidation.

Outcomes: Overall, the results were more than satisfactory with a significant increase in the patients mean range of motion and Knee Society Score. There were some post-op issues in some of the patients, but they were addressed accordingly, having no long-term impact on the results.

Conclusions: We could thus conclude that, in special cases, the frontal plane tibial tubercle osteotomy is an effective technique which can provide a wide approach with appropriate protection of the knee extensor apparatus.

Keywords: arthroplasty, tibial tubercle osteotomy, knee joint exposure, knee range of motion

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INTRODUCTION

The classic medial parapatellar approach frequently used in total knee arthroplasty (TKA) proves to be sometimes insufficient in difficult cases with previous surgical procedures on the knee extensor apparatus (1), patellar fractures with vicious consolidation, patella baja, irreducible genu flexum (2-4), important axial varus deformity (5), or rheumatoid arthritis (6). All these particular conditions involve a difficult patellar eversion during surgery and can lead to iatrogenic lesions of the patellar tendon with severe functional outcome on the knee (7).

Different techniques, like controlled distal partial disinsertion of the patellar ligament (8), "V" or "Y" plasty of the quadriceps tendon (1) and tibial tubercle osteotomy (9,10) are used to obtain a better eversion. Partial disinsertion of the patellar tendon doesn't substantially improve the surgical exposure and can lead to extensor apparatus weakening and complete secondary ruptures. The V-Y quadriceps plasty is relatively safe, not technically demanding, but it implies post-op immobilization of the knee, which delays the functional rehabilitation, with negative impact on the range of motion. Tibial tubercle osteotomy has its own complications like avulsion or fracture of the tubercle fragment. Whiteside technique (11) of tibial tubercle osteotomy with its subsequent changes proved to be the safest (12,13). □

MATERIAL AND METHODS

We analyzed the results of 11 primary TKA, where frontal plane tibial tubercle osteotomy was necessary, performed on 11 patients aged 57 to 78 years (with a mean age of 71.2 years), 6 females and 5 males, with a follow up from 1 to 4 years (mean follow up of 35 months).

Patient's associated conditions were: rheumatoid arthritis – 5 cases with an extension deficit higher than 150, previous knee synovectomy by arthrotomy – 2 cases (Figure 1), progressive genu varum with more than 150 deviation – 3 cases, varus deviation of the lower limb with previous closing wedge proximal tibial osteotomy – 2 cases and patellar fractures with vicious consolidation – 2 cases (in one case a dash board neglected fracture and in the

other case a failed patellar osteosynthesis) with secondary osteoarthritis (Figures 2 and 3).

Before surgery all patients presented pain and functional impairment, with significant impact on their quality of life. Clinical examination showed a mean range of motion of 63.6° and a KSS (Knee Society Score) from 34 to 53 with a mean of 43.5 (Table 1).

In all cases, the difficult patellar eversion required a frontal plane tibial tubercle osteotomy in addition to the standard medial parapatellar approach. The approach is extended 10-12 cm distally on the anterior border of the tibia. The osteotomy line is marked using thin power drill holes and both the medial and lateral cortical bone are cut in a frontal plane with an oscillating saw that passes through the cancellous metaphyseal bone. The cut is oblique starting with a proximal curve above the tibial tubercle (to preserve the proximal anterior cortical bone) and ending 10-12 cm distally on the anterior tibial border. The osteotomy is performed from the medial side of the tibia, in order to preserve the lateral periosteal and muscular insertions which will act like a hinge for externally displacing the extensor apparatus.

In all cases we used Nexgen (ZIMMER - <http://www.zimmer.com>, Address: Zimmer, Inc.

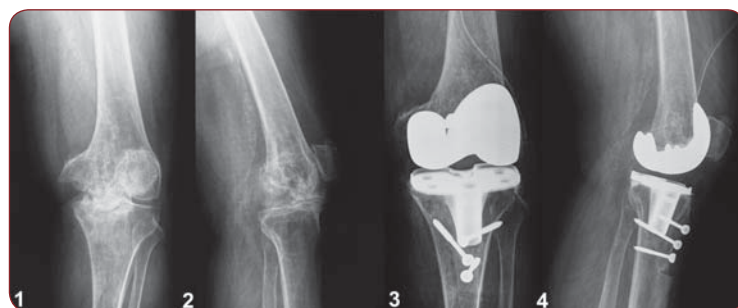


FIGURE 1. Rheumatoid arthritis with previous knee synovectomy – 1, 2 – pre-operative antero-posterior and lateral X-ray views; 3, 4 – post-operative antero-posterior and lateral X-ray views.



FIGURE 2. Knee osteoarthritis and malunion after patellar fracture – 1, 2 – pre-operative antero-posterior and lateral X-ray views; 3, 4 – post-operative antero-posterior and lateral X-ray views.

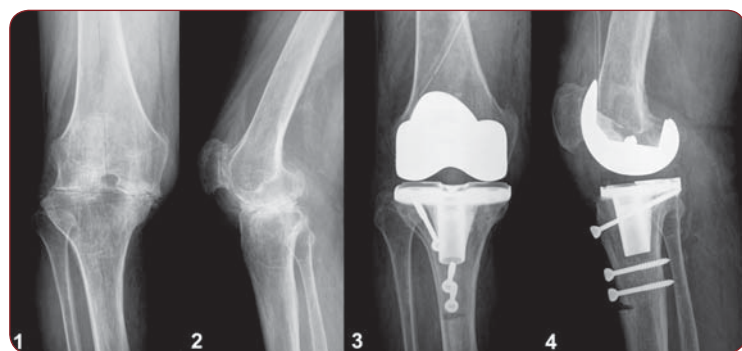


FIGURE 3. Global knee post traumatic osteoarthritis – 1, 2 – pre-operative antero-posterior and lateral X-ray views; 3, 4 – post-operative antero-posterior and lateral X-ray views.

P.O. Box 708 1800 West Center Street Warsaw, IN 46581-0708) PS (posterior stabilized) cemented Total Knee Prosthesis.

After prosthesis implantation, the tibial tubercle is reattached and fixed with two or three bicortical screws at the tibial metaphyseal bone. To avoid the contact with the tibial component of the implant and to get good bicortical fixation, the upper screws were introduced with an oblique tilt in the coronal plane.

Rehabilitation after surgery has no major differences compared to the regular approach, except the limit of maximum 60° of flexion until 3 weeks from arthroplasty. No splints or orthosis are needed. Active and passive mobilization of the knee using CPM (continuous passive motion) devices starts at 48h after surgery and

progressive weight bearing is only limited by pain. Also, a pre-op extension deficit implies the use of a post-op sand bag on the anterior aspect of the knee in order to avoid flexum recurrence. □

RESULTS

Clinical and radiological evaluations were performed at 6 weeks, 3, 6 and 12 months after surgery. The range of motion increased from a mean of 63.6° (with limits of 35-90) to 84.10 (with limits of 70-100). The KSS score increased from a mean of 43.5 (with limits of 34-53) to a mean of 78.7 (with limits of 69-90).

More than a half of the patients included in this study (6 out of 11) had a residual 5 to 150 extension deficit but it should be taken into consideration the fact that 9 out of the 11 cases initially presented extension deficit (Table 1). A higher pre-op extension deficit made the rehabilitation more difficult. The efficacy of the sand bag on the knee in preventing post-op knee flexum recurrence is controversial because more than half of the patients tended to remove it during the night. We had one case (3rd case of Table 1) of tubercular fragment fracture at 12 weeks post-op with proximal migration. Surgical reintervention was needed in order to reattach it with another screw and a bone staple, secured with a wire loop between the patella and the proximal tibia.

Case	Diagnosis	Pre-operative				Post-operative			
		Ext. (°)	Flex. (°)	RoM (°)	KSS	Ext. (°)	Flex. (°)	RoM (°)	KSS
1	Rheum.arth. Synovectomy	- 20	80	60	39	-5	75	70	69
2	Rheum.arth. Synovectomy	-15	50	35	47	-5	80	75	79
3	Rheum.arth.	-15	60	45	50	0	90	90	80
4	Rheum.arth.	-15	90	75	47	0	90	90	76
5	Rheum.arth.	-30	70	40	34	-15	90	75	69
6	Genu varum > 150	-5	80	75	53	0	100	100	90
7	Genu varum > 150	0	90	90	48	0	95	95	83
8	Genu varum > 150 + neglected patellar fracture	- 15	70	55	39	-5	80	75	73
9	Osteotomy + residual genu varum < 150	-5	90	85	41	-5	90	85	80
10	Osteotomy	0	65	65	41	0	80	80	79
11	Patellar fracture with vicious consolidation	-10	85	75	40	-5	95	90	88
Mean				63.6	43.5			84.1	78.7

TABLE 1. Pre- and post-operative ranges of motion and KSS value.

Ext. = Extension; Flex. = Flexion; KSS = Knee Society Score; Osteotomy = Closing wedge proximal tibial osteotomy; Rheum. arth. = Rheumatoid arthritis; RoM = Range of motion

At 6 weeks no proximal migration of the tubercular fragment was noted, regardless of the number of screws (there was no difference between the 2 screws and the 3 screws fixation). The mean time until the consolidation of the osteotomy was 14.7 weeks. There were no clinical or radiological signs of non-union or other complications regarding wound healing, infection or tibial fractures. □

DISCUSSIONS

The tibial tubercle osteotomy allows an extension of the approach in total knee arthroplasty, without endangering the quadriceps extensor apparatus. Previous studies showed that during surgery, a higher mechanic stress occurs on the supra-patellar part of the extensor apparatus than on the patellar tendon (14). Excessive traction during surgery may lead to rupture during rehabilitation. Furthermore, using this technique (11) the correction of the eventual axial deviation of the extensor apparatus is possible as well, during tibial tubercle re-insertion. This technique uses bicortical screws or wiring for the fixation of the osteotomy tranche. The screws make a better fixation but, due to the holes made in the cancellous bone, they weaken the tubercular fragment and can lead to its fracture.

The main disadvantage of the wires (even if they preserve more the solidity of the bone) is

their poor fixation that cannot prevent in all cases proximal migration of the fragment. Whiteside reported only 1 of 71 cases of proximal migration of the fragment (11). Also, the shorter the fragment is, the looser the fixation. A 10 to 12 cm tranche can be easily fixed with 2 or even 3 bicortical screws that can provide the required stability. The osteotomy line must be initially marked with thin drill holes in order to prevent the fracture of the tubercular fragment or even of the tibial meta-diaphysis (15). □

CONCLUSIONS

In special cases, the frontal plane tibial tubercle osteotomy is an effective technique which can provide a wide approach with appropriate protection of the knee extensor apparatus. An adequate length of the tubercular fragment can ensure a solid fixation with preferably 3 bicortical screws in order to obtain the required stability and a normal rehabilitation after total knee arthroplasty.

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Abbreviations list

CPM = Continuous passive motion
KSS = Knee Society Score
PS = Posterior Stabilized
TKA = Total Knee Arthroplasty

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