



Prospective Study of Short Term outcome of Medial open Wedge High Tibial Osteotomy Using Modified Arthrax Plate (Puddu Plate)

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Abstract

Introduction: High tibial osteotomy (HTO) is a well-established procedure for treatment of unicompartmental osteoarthritis of knee. HTO is a favoured choice of treatment for isolated unicompartment arthritis in patients who are aged less than 60 years. The biomechanical rationale for HTO in patients with unicompartmental osteoarthritis of knee is unloading of the involved joint compartment by correcting the malalignment and redistributing the stresses on the knee joint. The factors associated with good long-term results include: tibiofemoral angle > 8 valgus, body weight no > 132% of ideal body weight, age < 60 years, purely unicompartmental arthrosis, ligamentous stability, pre-operative range of motion knee > 90° & Ahlbak's grade 1 & 2.

Method: This prospective study of 32 patients was conducted in the department of orthopaedics at govt. Medical college, Jammu from May 2016 to December 2018, who satisfy the inclusion criteria.

Result: In our study 13 patients (40.63%) had excellent results, 18 (56.25%) had good results and 1(3.12%) had fair results. None of the patients in our study had poor results. Out of 32 patients 7 (21.88%) were males and 25 (78.12%) were females, the age of patients ranged from 42 to 57 years. the average range of motion of the involved knee in pre-operative period was 131.56 degree with range of 100-150 degree, With improvement in ROM at the final follow-up was 133.9 degrees with a range from 110 to 150 degrees. The pre-operative HSS score ranged from 56-72 with a mean of 63.312, at follow-up of 9 months HSS ranged from 69-89 with a mean of 83.46. There was an average increase of 20.01 in the score at final follow-up.

Conclusion: High tibial osteotomy is a safe, reliable procedure in unicompartmental osteoarthritis of knee. There is significant improvement in the pain and function which allows the patient to squat and sit cross legged which is very important in our community for social and religious activities. It is a valuable option in our community where majority of patients are unwilling for unicompartment or total knee arthroplasty.

Introduction

Osteoarthritis is the most common articular disease of the developed world and a leading cause of chronic disability, mostly as a consequence of the knee OA and/or hip OA

(Grazio S et al 2009). The most common deformity in patients with osteoarthritis of knee is varus malalignment position which causes stress to be concentrated medially accelerating degenerative changes in medial part of the joint

and progression of osteoarthritis (**Gomol AH et al. 2016**). There is as yet no drug that can modify the effect of osteoarthritis (**Solomon L et al. 1988**). The goal of treatment is to alleviate the signs and symptoms of the disease and, if possible, to slow its progression. Surgery is indicated when the patient's symptoms accord with the physical and radiological findings and all conservative treatments have exhausted. The fundamental principles of osseous deformity correction were defined by **Friedrich Pauwels** in 1964 and **Paul Maquet** in 1976. **Mark Coventry** in 1965 published his technique for closed wedge osteotomy^[3], which became the gold standard for many years. High tibial osteotomy (HTO) is a well-established procedure for treatment of unicompartmental osteoarthritis of knee (**Billing A et al. 2000**). HTO is a favoured choice of treatment for isolated unicompartment arthritis in patients who are aged less than 60 years (**Brinkman JM et al. 2008**). The biomechanical rationale for HTO in patients with unicompartmental osteoarthritis of knee is unloading of the involved joint compartment by correcting the malalignment and redistributing the stresses on the knee joint (**Dabov G et al.**). The factors associated with good long-term results include: tibiofemoral angle > 8 valgus, body weight no > 132% of ideal body weight, age < 60 years, purely unicompartmental arthrosis, ligamentous stability, pre-operative range of motion knee > 90° & Ahlbak's grade 1 & 2 (**Amendola A et al. 2010; Dabov G. D et al.; Insall JM, et al. 1984**).

Material and Method

This prospective study of 32 patients was conducted in the department of orthopaedics at govt. Medical College, Jammu from May 2016 to December 2018. All the patients were admitted on OPD basis. A detailed clinical history and examination was done. The examination included findings on inspection and palpation as, intercondylar distance with ankles touching or intermalleolar distance with knees touching,

testing for lateral ligaments with varus or valgus stress, testing for menisci and cruciate ligaments and patellofemoral joint examination by patellofemoral compression test (Zohlen test). Complete neurovascular status assessment was done. The patients who were found to have unicompartmental osteoarthritis with knee pain not relieved by conservative management and who satisfy the inclusion criteria (Table no. 1), willing for the surgical procedure were selected and their consent obtained. Pre-operative planning is done by Miniaci method. Normally there is valgus alignment of 5 to 8 degrees in tibio-femoral angle as measured by radiograph taken in the weight bearing position. The amount of correction of the arthritic knee needed to achieve a normal angle is calculated and an additional 3 to 5 degrees overcorrection is added to achieve approximately 10 degrees of valgus. Antero-posterior weight-bearing alignment view is used for pre-operative planning. To determine the weight-bearing line, two separate lines are drawn from the center of the femoral head and the center of ankle towards the Fujisawa point. Fujisawa point is point on lateral condyle of tibial, the width of the tibial plateau medial to this point is 62.5 % of the total tibial plateau width.

High tibial opening wedge osteotomy is done using Puddu plate (10 mm or 12 mm) according to the desired wedge to be created.

TABLE 1

i) Inclusion Criteria

1.	Age 20-60 years.
2.	Unicompartmental (medial) osteoarthritis on weight bearing radiograph with a corresponding varus deformity.
3.	Pain and disability resulting from osteoarthritis that significantly interfere with activities of daily living.
4.	Patients who needed less the 20 degrees of deformity correction.
5.	Patients with medial compartment osteoarthritis who have flexion contracture of less than 15 degrees with range of motion of 90 degrees or more.
6.	Body mass index (BMI) less than 30.

ii) Exclusion Criteria

1.	Age less than 20 and greater than 60 years of age.
2.	Osteoarthritis involving more than one compartment.
3.	Severe joint destruction (Kellegren and Lawrence stage 4)
4.	More than 15 degrees of flexion contracture and/or less than 90 range of motion.
5.	Lateral tibial subluxation of more than 1cm.
6.	Greater than 20 degree of deformity correction needed.
7.	Infective and inflammatory arthritis.
8.	Significant peripheral vascular disease.
9.	Poor skin condition
10.	BMI >30

Result

In our study, the age of patients ranged from 42 to 57 years with an average age of presentation was 50.63 years. Out of 32 patients 7 (21.88%) were males and 25 (78.12%) were female with male to female ratio of 0.28. Of the total 11 had involvement of left knee and 21 had involvement of right knee. Most of the patients had pain localized to the medial side of the knee aggravated by walking and stair climbing. The duration of symptoms ranged from 1 year to 8 years with mean duration of 3.625 years. In our study the BMI ranged from 20.8 to 28.4 with an average BMI of 25.46. For patients with MCOA, the average range of motion of the involved knee in pre-operative period was 131.56 degree with range of 100 to 150. Most of the patients included in our study had grade 2 and 3 osteoarthritis. The pre-operative HSS score ranged from 56-72 with a mean of 63.312, the range of pre-operative a TFA was 5-12 varus with an average of 7.56 degree varus and pre-operative mechanical axis deviation (MAD) ranged from 20-45mm medially with an average of 32 mm. Time taken for surgery ranged from 70 minutes to 110 minutes. The mean duration of surgery was 90.78 minutes and the mean hospital stay was 4.187 days with a range of 2-5 days. Range of motion of the operated knee was started on the second postoperative day. Non-weight bearing crutch walk was demonstrated and

started on second post-operative day. Weight bearing as tolerated was started at 06 weeks. The time of full weight bearing in our study ranged from 08-12 weeks, with a mean of 8.44 weeks. Average range of motion at the final follow-up was 133.9 degrees, with a range from 110- 150 degrees. The aTFA at final follow up ranged from 2-8 degree valgus with an average 5.5 degrees valgus. Mechanical axis deviation ranged from 5-15 mm lateral with an average of 10.25 mm. The HSS score at 9 follow-up months ranged from 69-89 with a mean of 83.46. There was an average increase of 20.01 in the score at final follow-up. In our study 13 patients (40.63%) had excellent results, 18 (56.25) had good results and 1(3.12%) had fair results. None of the patients in our study had poor results



X-ray of patient at initial presentation, at 3 month and 9 month follow up respectively.



Pictures of the patient taken on final outcome with sitting standing and squatting

Discussion

Medial open wedge osteotomy has been more popular recently. The advantages are the ability to correct the alignment in two planes (coronal and sagittal), no need for fibular osteotomy, little risk of peroneal nerve injury, no limb shortening, use of a single cut with no need to detach the muscles, no bone loss, easier conversion to arthroplasty, and ability to adjust the amount of correction during surgery. The modified conventional arthrex plate (Puddu plate) helps to stabilize high tibial osteotomy from the medial side. Its specific locking system and metallic wedge provides stability and obviate the need of the graft as well.

High tibial osteotomy gives adequate pain relief in younger patients, delaying the need for knee replacement.

Number of Patients

Series	Phillip Niemeyer et al 2008	Werner Kolb et al 2009	Present Study 2018
No. of Patients	88	51	32

The number of patients in our study was 32. It was less than the number in other studies on HTO with medial open wedge technique. The reason for having fewer patients in our study being our study was conducted for less time compared to other studies.

Side Involved

Series	M Pfahler et al(2008)	Tomisha k et al (2004)	Present study (2018)
Side			
Right	60	40	21
Left	44	35	11

Right side was involved more in our study. Other two studies also showed right side dominance. In our study 21 patients had right and 11 patients had left side involvement.

Age

AGE:- Series	Niemeyer et al. (2008)	Werner K et al. (2009)	Present study (2018)
Mean in years	49	47.3	50.63

The mean age in our study was 50.63 years. It was comparable to other two studies. Youngest patient in our study was 44 years and the eldest one was 57 year old.

Sex Distribution

Series	Tomihisa K et al. (2004)	Mehmet A et al. (2006)	Present study 2018
Male/Female	11/42	13/47	7/25
Ratio	0.26	0.78	0.28

25 out of 32 patients were females. Numbers of females in our study were similar to other two studies as well. The male to female ratio in our study was 0.28, it was 0.26 in study conducted by **Tomihisa et al (2004)** and 0.78 in the study conducted by **Mehmet Asik et al (2006)**.

Body Mass Index (BMI)

Series	Niemeyer et al. (2008)	Phillip S et al. 2018	Present study 2018
BMI	27.2	27.2	25.46

Body mass index in our study was an average of 25.46 and was comparable to other studies. We had a total of seven patients with BMI of more than 30, however they were excluded from our study and given other treatment options. The highest BMI in our study was 28.4 and the lowest BMI in our study was a patient with BMI of 20.8.

Radiological Grade

(Kellegren and Lawrence grading) series grade	J Vojtassak et al. (2000)	S Akizuki et al.(2008)	Present study 2017
1	7(15%)	0(0%)	00
2	20(42.5%)	09(6%)	12(37.5%)
3	20(42.5%)	53(33%)	20(62.5%)
4	0(0%)	0(0%)	0 (0%)
Total knees	47	25	32

Most of patients in our studies were grade 2 and grade 3 osteoarthritis. 37.5 percent in grade 2 and 64.25 percent in grade 3, were operated up on in our study. None of the patients with grade four arthritis was included in our study as in other two studies.

Anatomical Tibiofemoral Angle (aTFA)

Series	Mehmet A et al. (2006)	Niemeyer et al. (2008)	Present study 2018
Pre-operative aTFA (varus)	5.7	1.9	7.56
Final follow-up aTFA (valgus)	6.5	7.2	5.5

Anatomical tibiofemoral angle on average at final follow up was 5.5 (valgus). It was comparable to other two studies.

Mechanical Axis Deviation (MAD)

For patients with medial compartment osteoarthritis, preoperative MAD ranged from 20-45mm medially with an average of 32 mm MAD

Series MAD	Mehmet Asik et al. (2006)		P M Robinsont et al. (2011)		Present Study	
	Pre-op (medial)	Final follow-up (lateral)	Pre-op (medial)	Final follow-up (lateral)	Pre-op (medial)	Final follow-up (lateral)
	36	5.09	31.25	3.9	32	10.2

Range of Motion (ROM)

Series	Tarun K et al. (2015)	Present Study 2018
Pre. Op ROM	140 (116-154)	131.56 (120-150)
Post op. ROM	140 (115 -154)	133.9 (110 – 145)

The average range of motion in our study preoperative was 131.56 and post-operative at final follow up was 133.9. The pre and post-operative range of motion of knee were comparable. Same was observed in other study.

Complications

Complications \ Series Complication	Mehmet A et al. (2006)	Tarunkumar et al. (2015)	Present study 2018
Superficial wound infection	2	1	4
Tibial plateau fracture	1	1	2
Implant infection	1	0	0
Compartment syndrome	0		0
Deep venous thrombosis	2	0	0
Limb length (lengthening)	0	0	03

None of our patients had implant infection or deep venous thrombosis as reported in other studies. 4 of our patients had superficial wound infection which was managed on intravenous antibiotics and settled within one week. 2 of our patients had tibialplateu fracture. They were advised for delayed weight bearing however both united within 8 weeks. 3 of our patient had limb lengthening of 0.5 to 1 cm, however there was no limp.

HSS Score and Final Results

Series Mean HSS score	MehmatAsik et al (2006)	Werner Kolb et al (2009)	Present study (2018)
Pre-operative	61.3	65.8	63.32
Final follow-up	88.07	92.2	83.46

The preoperative HSS score on average in our study was 63.32, and postoperative score at final follow-up was 83.47

There was an average increase of 20.04 in HSS score in our study, which was comparable to other studies.

Final HSS Score (Percentage)

Series Result	Werner Kolb et al (2009)	Present study
Excellent	20(57%)	13(40.63%)
Good	12(24%)	18(56.25%)
Fair	4 (08%)	01 (3.12%)
Poor	5 (10%)	00 (0%)

40.63 percent of our patients had excellent, 56.25 percent had good and 3.12 percent had fair results. None of our patents had poor results.

Conclusion

- High tibial osteotomy is a safe, reliable procedure in unicompartmental osteoarthritis of knee.
- There is significant improvement in the pain and function which allows the patient to squat and sit cross legged which is very important in our community for social and religious activities.
- It is a valuable option in our community where majority of patients are unwilling for unicompartment or total knee arthroplasty.

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