

Original Research Article

A Study on the Functional Outcome of High Tibial Osteotomy through Medial Opening wedge Technique

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Abstract

Introduction: Knee osteoarthritis ranks among the most common disability in adults and often affects medial compartment of the knee leading to varus deformity. High tibial osteotomy is an accepted surgical technique for treatment of medial compartment varus gonarthrosis of the knee especially for younger and active patients. We followed the technique of biplanar medial opening wedge high tibial osteotomy, filled the osteotomy site with beta TCP wedge and fixed with a four holed HTO plate and screws. **Purpose of study:** To Evaluate the functional and radiological outcome of high tibial osteotomy through medial opening wedge osteotomy in terms of function, pain and patient satisfaction with functional scores and radiological indices and to assess any complications following high tibial osteotomy. **Background :** In this study, we examined the results of medial opening wedge High Tibial Osteotomy by using a HTO plate with beta TCP wedge for patients who suffered from early osteoarthritis of the knee with genu varum deformity. **Material and Methods:** All patients who underwent a medial opening wedge High Tibial Osteotomy for early osteoarthritis of the knee with genu varum deformity from June 2016 to June 2018 were followed up for a period of minimum of 6 months and maximum of 2 years. Assessment was done for correction of the varus deformity, mechanical axis deviation, hip knee ankle axis, varus regression, weight bearing line relation to fuji-sawa point, alterations in tibial slope, insall salvati ratios. Functional outcome of the surgery was assessed with knee society score and womac score. **Results :** The average knee society score improved from 43.09+/- 6.34 to 62.80+/- 11.66 and 79.15+/- 11.21 respectively on follow ups (p< 0.001) and womac scores improved from 68.11+/-6.52 to 45.61+/-9.80 and 24.69+/-14.24 respectively. Insall salvati ratio decreased from 1.172+/-0.1 to 1.096+/-0.01 post operatively. Tibial slope increased from 11.023+/- 0.93 to 11.639+/-0.96 degrees and MPTA values increased from 82.59+/-1.12 to 87.20+/-1.70 degrees. **Conclusion:** Medial opening wedge High Tibial Osteotomy when performed in early grades of Osteoarthritis has given us good functional outcome. Release of superficial medial collateral ligament and biplanar osteotomy were followed throughout the cases in study which have given good results.

Keywords : varus, medial opening wedge osteotomy, high tibial osteotomy, fuji-sawa point, biplanar osteotomy, Ahlback classification, knee society score, womac score.

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Introduction

Knee osteoarthritis ranks among the most common disability in adults and the prevalence is projected to increase sharply over next two decades[1]. The prevalence of OA is increasing due to population ageing and an increase in related factors such as obesity. According to the United Nations, by 2050 people aged over 60 will account for more than 20% of the world's population[2]. As per current scenario, India has comparatively more prevalence of osteoarthritis of knee compared to global scenario where Overall prevalence of knee OA in India was found to be 28.7%[3]. Osteoarthritis of the knee most often affects Medial compartment leading to varus

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deformity and subsequent disability is a common problem. High tibial osteotomy is an accepted surgical technique for treatment of medial compartment varus gonarthrosis of the knee. Especially for younger and active patients this method can produce long-term relief, which often significantly delays the need for knee arthroplasty. The biomechanical principle of high tibial osteotomy is to redistribute the weight bearing forces from the worn medial compartment across to the lateral compartment thereby relieving pain and slowing the disease progression. The benefit of HTO is that the patient is afforded unrestricted activity. For patients younger than 60 yrs, with varus deformity and isolated medial compartment arthritis, High Tibial Osteotomy (HTO) can be considered as a good option[4]. Selection of the appropriate patients, proper pre operative planning and accurate surgical technique are required for successful outcome. The methods of high tibial osteotomy include medial open wedge osteotomy and lateral closed wedge osteotomy, the medial open wedge procedure being more popular nowadays. This procedure stands ahead of closed wedge osteotomy because the Peroneal nerve is not in jeopardy and there is no disruption of proximal tibiofibular joint and lateral collateral ligaments with achievement of more precise correction[5]. Potential advantages like easier and accurate

correction, preservation of bone stock, gain in limb length, restoration of alignment, avoidance of disruption of the proximal tibiofibular joint, the peroneal nerve and muscles of the anterior compartment and better results have been observed(Hooper et al, 2005). The present study is to evaluate the functional outcome of medial opening wedge high tibial osteotomy.

Material and methods

This was a prospective , observational study of 26 patients in the age group 35-70 years with medial compartmental OA treated with opening wedge high tibial osteotomy with HTO plate and beta TCP wedge. This study was conducted in the department of Orthopedics, BIRRD Hospital, Tirupathi between june 2016 to June 2018. Functional results were analysed by Knee society score, WOMAC and VAS. Patients with osteoarthritis of knee with grade 0-2 Kellgren and Lawrence were included in the study.

Classification : The Kellgren and Lawrence system

Grade 0	no radiographic features of OA are present
Grade 1	doubtful joint space narrowing (JSN) and possible osteophytic lipping
Grade 2	definite osteophytes and possible JSN on anteroposterior weight-bearing radiograph
Grade 3	multiple osteophytes, definite JSN, sclerosis, possible bony deformity
Grade 4	large osteophytes, marked JSN, severe sclerosis and definite bony deformity

PRE OPERATIVE PLANNING: After careful evaluation of the patient by clinical and radiological examination and investigations, ruling out co morbidities, patient is planned for surgery.

Calculation of the varus correction and size of wedge :

The angle of correction is obtained from the intersection between a line drawn from the center of the femoral head to the point previously found on the surface of the knee for transfer of the axis of weight-bearing (62% of the joint line calculated away from medial side) and another line from this point to the center of the ankle.



Fig 1: Showing the Fujisawa method of calculation of wedge on an Orthostannogram

MINIACI ET AL METHOD: The opening wedge is calculated along the axis of weight-bearing to 62% of the surface of the tibia(on the joint line -FUJISAWA POINT) laterally(Fujisawa et al)[7], in cases of primary varus. This correction enables a final angle of 3 to 6 degrees of valgus (ideally 4 degrees)[8]from the mechanical axis to be obtained.

On an orthostannogram, line 1 is drawn from the centre of femoral head to centre of ankle. Line 2 is drawn from centre of femoral head passing through pre calculated desired weight bearing point of 62% joint line from the medial side of joint line where joint line is calculated as 100% . A 1cm lateral cortical hinge is left and a point is determined from which two lines are dropped in which one line joins line 1 and other line joins line 2 which were drawn earlier. Now, the angle between these two lines is the same angle as the angle that would be subtended by the osteotomy site. The angle measured gives us the total amount of correction required to correct the varus deformity, which includes the varus to be corrected in addition to normal physiological valgus of 40. Hence, the amount of correction gives us the size of wedge that can be fixed into the osteotomy site for the purpose of deformity correction.

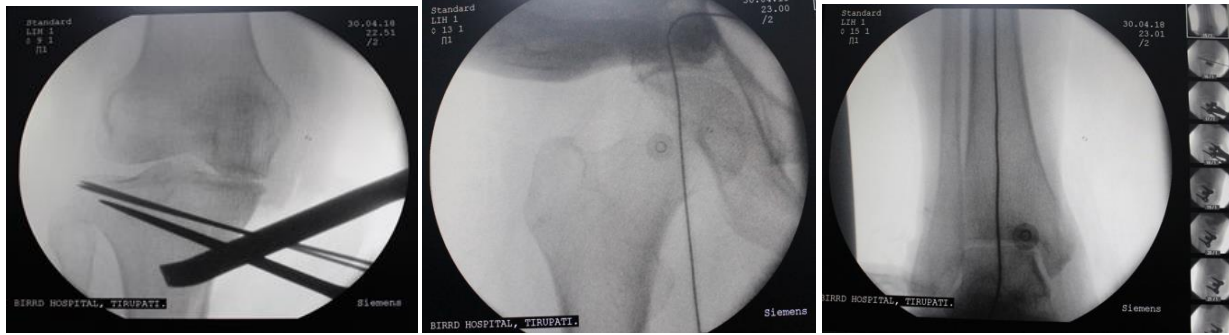
SURGICAL TECHNIQUE: The procedure is performed with the patient placed in a supine position on a radiolucent table with a lateral support. With the knee held at 90° of flexion, the medial side of the proximal tibia is exposed by a 6 to 8 cm incision placed midway between the tibial tuberosity and the posteromedial border of the tibia. The superficial fibres of the medial collateral ligament are mobilised and released. The knee is then extended, and two 2.5-mm Kirschner wires are passed starting at 5 cm distal to the joint line and are advanced aiming at the tip of the head of fibula. These act as guides for the oblique osteotomy . A biplanar osteotomy is then performed . The oblique osteotomy in axial plane is performed in the posterior two-thirds of the tibia while leaving a 10-mm lateral bone bridge intact. To prevent an unintended increase in the posterior tibial slope, special attention should be paid in retaining the intact cortical hinge on the lateral but not posterolateral side of the tibia. The osteotomy in coronal plane begins in the anterior one-third of the tibia at an angle of 135° to the first osteotomy while leaving the tibial tuberosity in continuity with the tibial shaft .The oblique osteotomy is opened stepwise using three stacked osteotomes and a wedge spreader. Trial wedge is placed as per the calculated correction angle and the alignment is verified using the cable method . The cable is placed over the centres of femoral head , ankle and its relationship to the Fujisawa point is noted the image guidance. The β TCP wedge is now introduced by gentle valgus thrust to open the osteotomy site,and then the 4 holed HTO plate is fixed with screws over the wedge and osteotomy site. Closure done in layers.



2.Oblique incision

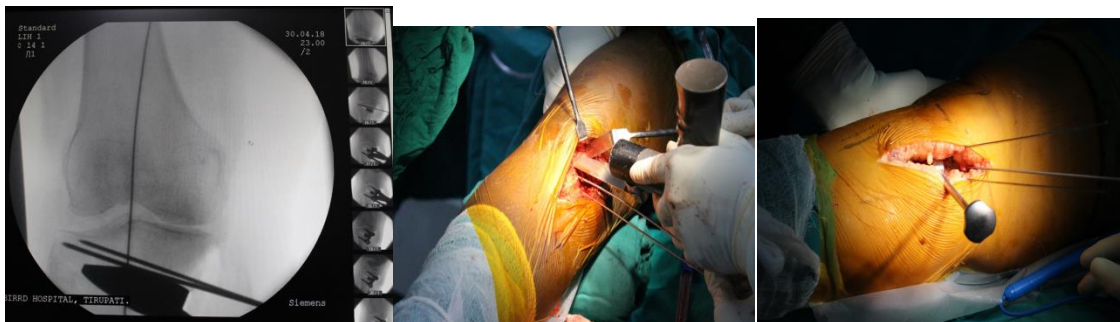
3.introduction of K wires.

4.Osteotomy with bone saw



5.Positioning of k wires.

6.Confirmation of Probes over hip and ankle



7. Fujisawa point.

8.Biplanar Osteotomy.

9. Stacking for wedge space



10. Wedge size trial.

11.Beta TCP wedge positioning in Osteotomy space



12.Fixation of HTO plate with Screws and position confirmed under C arm

POST OPERATIVE PROTOCOL:-

Day 0 – post operatively, knee range of motion brace is advised

Day 1 – physiotherapy is started from day 1 with static quadriceps exercises, straight leg raising with brace locked in extension, calf pump exercises. Weight bearing is not allowed till 6 weeks.

Day 2 – Knee range of motion exercises and straight leg raising in brace, calf pump exercises, hip range of motion exercises, hamstring strengthening exercises, active toe movements are continued from day 2 to 6 weeks post operative period.

OBSERVATION AND RESULTS :

The observations of this study are based on 26 patients(6 males and 20 females) treated by medial opening wedge high tibial osteotomy using hto plate and beta tcp graft in patients with varus gonarthrosis(left sided-14; right sided 12) of knee admitted in the department of orthopaedics,

BIRRD Hospital between June 2016 to June 2018. Age group ranged from 35-70 years with mean age being 48.76 years. Out of total sample size of 26, 12(46.2%) were in normal range ,12(46.2%) were over weight and 2(7.7%) were obese . BMI ranged from 21.9 – 31.6 in 26 patients . Mean BMI was 25.81+/- 2.68.

Table 1: Age wise distribution

		No. of Patients	Percent
Age	30- 40	5	19.2
	41- 50	10	38.5
	51 - 60	9	34.6
	61 - 70	2	7.7
	Total	26	100.0
Mean Age		48.769 ± 8.076	

Table 2: Gender distribution

		No. of Patients	Percent
Sex	Male	6	23.1
	Female	20	76.9
	Total	26	100.0

Table 3: BMI

	BMI			Total
	18.50 - 24.99 (Normal)	25 - 29.99 (Over weight)	Above 30 (obese)	
Correction	11.658 ± .815	12.167 ± 1.267	13.000 ± 1.414	11.996 ± 1.108
size of wedge	11.750 ± .866	12.167 ± 1.267	13.000 ± 1.414	12.038 ± 1.243

Higher the BMI, more was the deformity and consequently , more was the amount of correction necessary and also the size of wedge

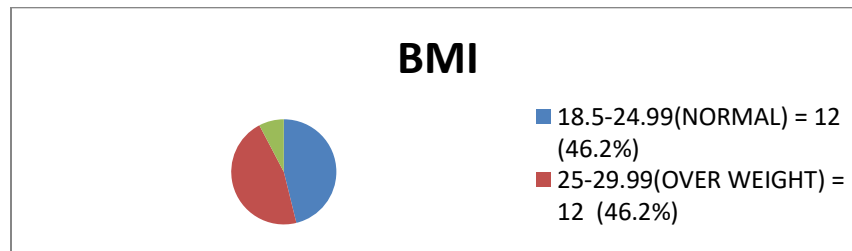


Fig 13. BMI

Pre operative varus deformity based on HKA angle was in the range of 6^o-10^o. Mean was found to be 7.96^o . Post operatively, regression analysis was done using orthoscanogram and it was in range of 0^o– 6^o and mean was found to be 1.56^o.

Table 4: Insall salvati ratio was calculated for pre operatively by length of patellar tendon(TL)/patellar length(PL). Insall salvati ratios and MPTA values were as follows:

	N	Pre-operative	Post-operative	95% Confidence Interval of the Difference		Sig.
Insall salvati	26	1.172± .100	1.096± .088	.057	.094	p< 0.001
Tibial slope	26	11.023 ± 0.932	11.639 ± 0.963	-0.721	-.510	P<0.001
MPTA	26	82.592 ± 1.126	87.208± 1.706	-5.404	-3.827	P<0.001

Table 5: HKA and MAD(mechanical axis deviation) were as follows :

	N	Pre-operative	Post-operative	95% Confidence Interval of the Difference		Sig.
HKA Angle	26	172.04 ± 1.125	182.44 ± 1.680	-11.246	-9.547	p< 0.001
Mechanical Axis deviation	26	26.35 ± 9.126	-4.38 ± 7.344	25.333	36.129	P<0.001

Table 6: Weight bearing line (WBL) in cm and % were found to be :

	N	Pre-operative	Post-operative	95% Confidence Interval of the Difference		Sig.
WBL Centi meters	26	1.370 ± 1.126	4.56 ± 0.858	-3.815	-2.558	p< 0.001
WBL Percent	26	16.23 ± 13.770	55.765 ± 9.487	-47.267	-31.795	P<0.001

Table 7: Knee society scores(KSS) were graded as follows : EXCELLENT- 80-100 ; GOOD -70-79; FAIR - 60-69; POOR - <60

Knee society scores	Mean± S D
KSS Pre op	43.096± 6.342
KSS R1	62.808± 11.664
KSS R2	79.154± 11.216

Table 8: WOMAC scores showed

	N	Pre-operative	Post-operative Review 1	Post-operative Review2
WOMAC	26	68.115 ± 6.520	45.615 ± 9.802	24.692 ± 14.249

Table 9: VAS (Visual analogue scale) scores showed :

Mean of pre op	Mean of 1 st review	Mean of 2 nd review
9.2	6.5	3.8



Fig 14: Pre operative Orthoscanogram Pre operative AP view Pre operative Lat view



Fig 15. Post operative Orthoscanogram Post operative AP view Post op Lat view



Discussion

High tibial osteotomy is a commonly performed surgery for medial compartmental arthritis associated with varus. Lateral closing wedge high tibial osteotomy had disadvantages like necessity for fibular osteotomy, proximal tibiofibular joint disruption, peroneal nerve injury, altered anatomy potentially complicating future arthroplasty, and difficulty in making fine angular corrections once the bony wedge has been removed. Medial Open wedge osteotomy had all the advantages of negligible peroneal nerve palsies, loss of bone stock and issues associated with proximal tibio-fibular joint disruption. This also had an added advantage of correcting and controlling deformity in sagittal and coronal plane. We intended to study the functional outcome of medial opening wedge high tibial osteotomy. In our current study, 3 patients out of 26, were aged above 56 yrs (58 yrs, 65 yrs, 70 yrs) with preoperative knee society scores averaging to 42.3 (poor) and improving only to 57.3 (poor) on first review. Hence, the younger the age, the better was the functional outcome. [6] BMI plays a significant role in the outcome

after HTO [7,8]. In our study, 12 patients (46.2%) fell in normal category, 12 patients (46.2%) in over weight category, and 2 patients (7.7%) in obese category. According to the literature, a BMI greater than 27.5 is associated with early failure of the osteotomy, [9] and the risk of unsuccessful surgery is 10 times higher in patients with a BMI greater than 30 [6]. Marco corgiat et al [10] have concluded that the ideal BMI for HTO is a value of between 25 and 27.5. Though the mean BMI value for our sample size of 26 comes to 25.819 ± 2.683, 12 patients had BMI < 25 and 14 patients had BMI > 25. The mean varus deformity and the mean size of the wedge used are calculated in relation to different groups of BMI. The group of 12 patients (46.2%) with normal BMI (18-24.99) showed a mean varus of 7.650 and mean size of wedge used was 11.750 mm, 12 patients (46.2%) with BMI 25.0-29.99 showed a mean varus of 8.330 and mean size of wedge was 12.167 mm and the group of 2 patients with BMI > 30 showed a mean varus of 9.0 with mean size of wedge used was 13.0 mm. It can be inferred that, more the BMI, more the varus deformity and more was the size of

wedge used for the deformity correction. The mean varus regression values of patients with BMI < 25 (12 patients) was 1.210 and mean varus regression values for BMI > 25 (14 patients) was 1.850 in which 12 patients with BMI 25.0-29.99 had mean varus regression of 1.950 and obese category with 2 patients with BMI > 30 had mean varus regression of 1.30. The mean varus regression for our sample size of 26 is found to be 1.5620 for a mean BMI of 25.819. Our study showed Insall salvati ratio of 1.17 pre operatively and 1.09 post operatively and tibial slope being 11.020 pre operatively and 11.630 post operatively. In our study, we have performed Biplanar osteotomy where, in addition to the oblique axial osteotomy of the posterior tibia, a second ascending anterior osteotomy in the coronal plane underneath the tibial tuberosity is performed. This provides improved rotational stability of the osteotomy and creates an anterior buttress against sagittal tilting of the osteotomy in extension [13]. The MPTA values in our present study were found to be 82.59 ± 1.120 pre operatively and 87.20 ± 1.700 post operatively, thereby creating favourable environment for the load transfer [14]. The HKA angles in our study were 172.040 and 182.440 post operatively and we achieved an overall correction more than 1800 angle of HKA which signifies the desired Weight Bearing Line (WBL) was more than 50% of joint line but less than 62% of joint line (fuji saw point) [12]. In the present study, we have evaluated the outcome of the surgery through Knee Society Scoring i.e. scores of functionality, pain relief and daily living [15, 16]. The present study showed functional scores as 43.09 pre operatively and 79.15 post operatively. In our study, the mean KSS is just below excellent results (grading - good) with mean value of 79.15 (< 80). Pain scoring was also assessed through VAS (visual analogue scale). The scores in the sample size showed mean of pre operative scores as 9.2, mean of 1st review was 6.5 and mean of 2nd review was 3.8 which indicates that scores were improved in terms of pain relief. In our study, the WOMAC scores were 68.11 pre operatively and 24.69 post operatively. Higher scores in WOMAC mean pain is worse and lower scores mean relief of pain [17]. In the present study, patients have improved well from a poor score of mean 68.11 to good score of mean 24.69 which signifies pain relief in patients. It is inferred from the above functional scores that the functional outcome improves with medial opening wedge high tibial osteotomy. For two cases (7.69%) out of 26, there was fracture of the lateral cortical hinge that occurred due to excessive valgus thrust, this being one of the most common described complications [6, 18]. Both the cases were managed by fixation with cannulated cancellous screws. One patient (3.84%) out of 26 had developed knee stiffness [18] in initial four weeks of post operative period due to non compliance to physiotherapy. After two weeks of intense supervised physiotherapy with continuous passive motion, patient was able to regain normal range of movement. Her knee society scores were 52 (poor) and 72 (good) at 1st and 2nd reviews respectively. One patient (3.84%) out of 26 had developed deep venous thrombosis [6] after four weeks of surgery and was successfully treated conservatively by the vascular surgeons.

Conclusion

Medial opening wedge High Tibial Osteotomy when performed in early grades of Osteoarthritis has given us good functional outcome. More the age of the patient, inferior was the functional outcome in the early post operative period. However, longer follow up would be necessary to determine the relationship of age with the result. Increased values of BMI were associated with higher degree of varus and thereby increased correction angles by HTO and size of wedge. This was related to higher levels of varus regression and hence with worse functional outcome. Pre operative weight reduction can be helpful for preventing post operative varus regression. In our study, Biplanar osteotomy has resulted in minimal changes in patellar height and posterior tibial slope.

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