

# Prospective and Retrospective Study to Evaluate the Role of High Tibial Osteotomy (HTO) Fixed with Angle Stable Plate in Treatment of Osteoarthritis of Knee.

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Received: July 2016

Accepted: July 2016

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## ABSTRACT

**Background:** Osteoarthritis is more common in females. It is because osteoarthritis in post-menopausal women is associated with higher body weight, higher subcutaneous fat, calcium deficiency and weaker muscles linked to hormonal changes. The purpose of this study was to evaluate the role of high tibial osteotomy fixed with angle stable plate in treatment of osteoarthritis of knee. **Methods:** In our study 10 cases were operated by modified coventry technique, 10 cases were operated by open wedge osteotomy with non locking plates and bone graft and 104 cases were operated by medial open wedge osteotomy and iliac graft secured by locking plate. In these cases full weight bearing was allowed at 8 week, 6 week and 3<sup>rd</sup> post operative day respectively. Radiographical analysis include post operatively change in tibio-femoral angle. Mean follow up of these cases was 2 year. **Results:** In our study thee knee pain and function score were significantly improved (p value <0.001). The average pain score preoperatively was  $1.8 \pm 7$  (the maximum pain score for pain is 50) and post-operatively was  $44 \pm 5$ . According to the grading used for functional assessment in knee scores there was definite improvement in the function of cases 122 (98.38%) at 2 yrs. The pre-operatively mean functional knee score in of 110 cases (88.7%) cases was 28.86 (the maximum functional knee score is 100) and postoperatively was 70.45. There is correction in tibiofemoral angle (mean preoperative and postoperative tibiofemoral angle was  $5.2 \pm 1.5$  degrees varus and  $5.8 \pm 1.3$  degrees valgus respectively). **Conclusion:** There was definite improvement in the pain and function of the knee after the correction of the deformity (P value <0.001). The results of high tibial osteotomy in 88.23 percentage knees were rated as excellent. 104 out of these 124 cases were fix by locking plates. 2 cases had poor results due to excessive over correction and associated comorbidities. There is a definite correlation between the post-operative valgus obtained and relief in the pain.

**Keywords:** Osteoarthritis knee, Osteotomy, Bone graft, Non locking plate, Locking plate.

## INTRODUCTION

Osteoarthritis is more common in females. It is because osteoarthritis in post-menopausal women is associated with higher body weight, higher subcutaneous fat, calcium deficiency and weaker muscles linked to hormonal changes. The results in our study showed that not only does osteoarthritis affects females more than males but also younger age group. In Koshino T. (2004)<sup>[1]</sup> study the female were 80% and male 20%, in Chol HR. (2001)<sup>[2]</sup> study female were 62.23% and male 30.77% and in ZakiSH (2009)<sup>[3]</sup> study 100% male pts and no female pts were included.

## MATERIALS AND METHODS

The study will be conducted on the patients admitted in the department of orthopaedics GSVM Medical College, LLR & Associated Hospital, Kanpur during the period of 2000-2009. The retrospective study was done from 2000 to May 2007 and prospective study from June 2007 to Oct. 2009. Retrospective patients were followed up

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every six month and prospective patient were followed up immediately after operation, at 6 weeks, at 3<sup>rd</sup> month, at 6<sup>th</sup> month post-operatively, and thereafter every 6 monthly.

**Criteria for selection of patients** was based on-

1. No relief of knee pain after 3 weeks of conservative treatment.
2. Pain restricting the daily activities.
3. Varus deformity/valgus deformity.
4. Uni-compartmental involvement.
5. Physiologically young and active patients having uni-compartmental involvement with mild ligament laxity even in chronological age more than 60.

Apart from usual examination and investigation, certain fixed criteria were are: -

### 1. Function-

- i. Bed ridden or able to walk a few yards with two sticks Or crutches.
- ii. Long distance walking possible with aids.
- iii. Walking without aids but with a limp.
- iv. Walking without aids.

2. **Knee mobility** was graded 0 to 5 (actual range of flexion divided by 25)

### 3. Radiological assessment:

- i. **Femurotibial Angle (FT angle)**-1  
Longitudinal Lines was drawn along the centres of long axis of Femur and tibia. The angle subtended by tibia on femur was measured in degrees and expressed as varus or valgus.
- ii. **Tibio-Perpendicular Angle (TP angle)**.  
This was taken as the angle subtended by a line perpendicular to the floor on the longitudinal axis of tibia.

### 4. Knee Society HSS Knee Rating Score

In the score different points are given for knee score and function score.

#### Patient Category:

- Unilateral or bilateral.
- Unilateral, other knee symptomatic.
- Multiple arthritis or medical infirmity.

**The WOMAC** (Western Ontario and McMaster Universities) **Index** of Osteoarthritis: The WOMAC (Western Ontario and McMaster Universities) index is used to assess patients with osteoarthritis of the hip or knee using 24 parameters. It can be used to monitor the course of the disease or to determine the effectiveness of anti-rheumatic medications.

Alternatively, a visual analogue scale (VAS) may be used ranging from 0 to 10 for pain.

#### Surgical Techniques:

##### 1. Modified Coventry technique

##### 2. Medial opening wedge high tibial osteotomy secured with internal fixation (plating) with bone graft.

**Follow-up:** Patients were reviewed in the OPD at 6th week, at 3rd month and at 6th month after the operation thereafter every 6 monthly.

**Retrospective Patients:** The BHT's of all the patients who had undergone High Tibial Osteotomy was procured and the management done was evaluated. The patients were reviewed in the OPD by sending letters and phone calls for regular follow-up.

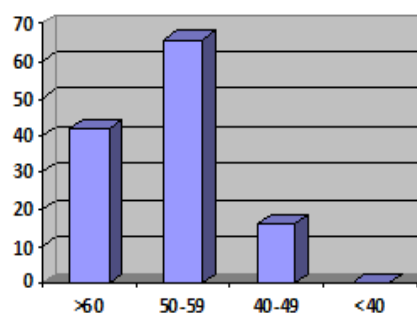
## RESULTS

In this study we evaluated the results of high tibial osteotomy performed in 124 knees of 111 patients in Department of Orthopaedics GSVM Medical College and associated LLR Hospital, Kanpur. Observations were recorded in the following manner:-

**Table 1: Age distribution.**

Age (Yrs)	No. Of Cases	Percentage
>60	42	33.87%
50-59	66	53.22%
40-49	16	12.90%
<40	0	0%
<b>Total</b>	<b>124</b>	<b>100%</b>

\* The most of the cases in which HTO was done fell in the age group of 50-59(53.22%) yrs and this constituted (53.22%). This was followed by 60>60 yrs of age group(33.87%). None of the patient belongs to 40 yrs or below in age showing that high tibial osteotomy is rarely performed in such age group for osteoarthritis of knee joint. Average age of pts. in our study was 55.±8.68 yr.



**Figure 1: Age Distribution.**

\* The female patients on whom more number of HTO were done comprising 57% of total cases. This shows that female patients are more prone to develop osteoarthritis changes requiring high tibial

osteotomy. In female patients symptoms were more marked and severe than radiological change seen.

Table 2: Sex distribution.

Sex	No. Of Cases	Percentage
Male	55	44.35%
Female	69	55.64%
<b>Total</b>	<b>124</b>	<b>100%</b>

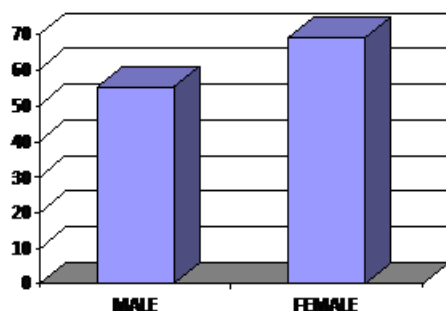


Figure 2: Sex Distribution.

Table 3: Side on which HTO was performed.

Side	No. of Patients	Percentage
Right	52	41.93%
Left	59	47.58%
Bilateral	13	10.48%
<b>Total</b>	<b>124</b>	<b>100%</b>

\* In our study HTO right knee was done in 41.93% cases. About 10.48% cases belonged to the group in which high tibial osteotomy was done in both knees and left knee was operated in 47.58% of cases

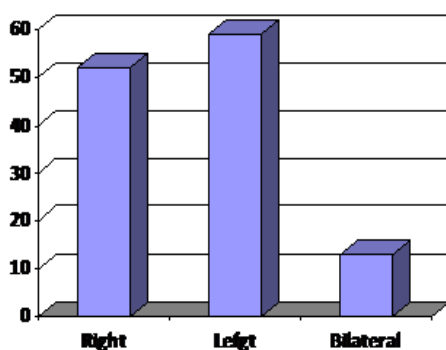


Figure 3: Side on which HTO was performed.

Table 4: Time interval between initiation of symptoms and operation.

Table 6: Average hospital stay.

Technique	No. of cases	Pre-op stay	Post-op Stay	Total Stay
Closed Wedge Tech.	10	2	13	15±2.67
Open Wedge with Non-locking Plate	10	2	13	15±3.2
Open Wedge with Small LCP And PHLP	60	2	3	5±3.6
Open Wedge with Tomofix	44	2	3	5±6.7

Time Interval	No. Of Cases	Percentage
>5YEARS	25	20.16%
4 to 5 YEARS	41	33.06%
3to4YEARS	27	21.77%
2to3YEARS	20	16.12%
1to2YEARS	11	8.87%
<b>TOTAL</b>	<b>124</b>	<b>100%</b>

\* Cases who took >5 years to get operated from the initiation of symptoms were 20.16%. About 33.06, 21.77% and 16.12% cases took between 4-5 years, 3-4 years and 2-3 years to get operated respectively.

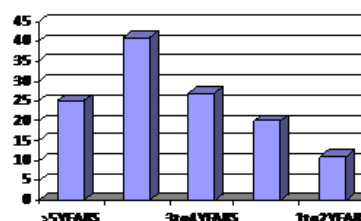


Figure 4: Time interval between initiation of symptoms and operation

Table 5: Method of operation.

S. No.	Techniques	No. of cases	Percentage
1.	Lateral Close Wedge Osteotomy (a) Modified coventry tech (Transverse osteotomy) (b) Oblique osteotomy	10 09 01	8.06%
2.	Open Wedge Osteotomy with non locking plate	10	8.06%
3.	OMWHTO With small LCP AND PHLP	60	48.38%
5.	OMWHTO with TOMOFIX	44	35.48%

\* Ten cases (8.06%) were operated by closed wedge technique out of which one case was operated by oblique wedge osteotomy .Ten cases (8.06%) operated by open wedge osteotomy fixed with Non locking plate and bone grafting. Sixty(48.38%) by open wedge osteotomy fixed with small LCP and PHLP and 44 cases(35.48%) by open wedge osteotomy fixed with TOMOFIX.

\* Average hospital stay in cases of closed wedge technique and open wedge cases with non-locking plate was 17 days as pts were discharged with POP Cast after stitch removal whereas in cases of open wedge osteotomy fixed with locking plate pts. were discharged after post op dressing on 3rd - 5th post op day.

\* Knees were graded from 0-4 according to Lawrence classification. In this study 80 knees (64.51%) had grade III changes and 18 knees (14.56%) had grade II changes and 26 cases (20.96%) with advanced osteoarthritis were operated.

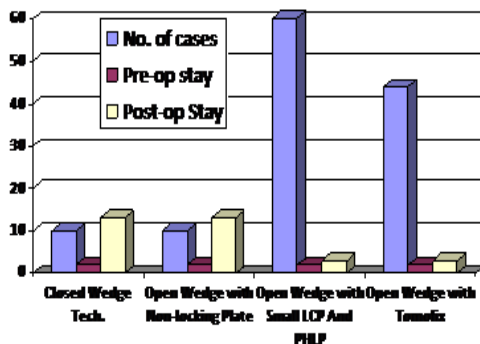


Figure 5: Average hospital stay.

Table 7: Pre-Operative radiological grading.

S.n.	Grade	No. Of cases	Percentage
1.	GRADE I	0	0%
2.	GRADE II	18	14.56%
3.	GRADE III	80	64.51%
4.	GRADE IV	26	20.96%
	<b>TOTAL</b>	<b>124</b>	<b>100%</b>

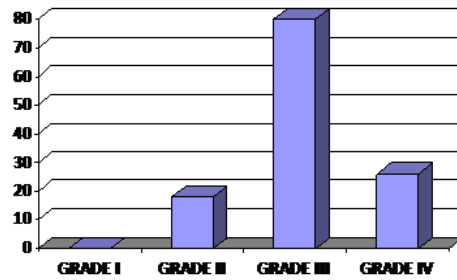


Figure 6: Pre-Operative radiological grading.

Table 8: Pre-Operative Femoro-tibial angle.

S.no.	Pre-op angle (in degrees)	No. of Cases	Percentage
1.	0-5 varus	77	62.09%
2.	6-10 varus	47	37.90%
3.	>10 varus	0	0%
	<b>Total</b>	<b>124</b>	<b>100%</b>

Mean preop. varus deformity in pts operated was 5.17+1.52.

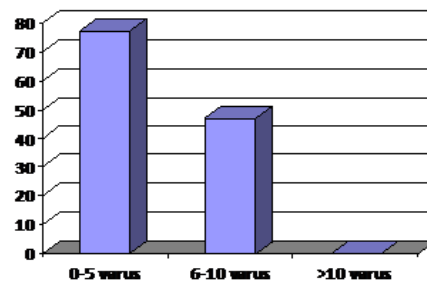


Figure 7: Pre-Operative Femoro-tibial angle.

Table 9: Post Operative Femoro-tibial angle.

S. No.	MEAN POST-OP F-T Angle in degrees	MEAN POST OP F-T ANGLE (At 2 year) in degrees	Average loss of correction in degrees
Closed wedge osteotomy group	5.9 SD-1.19	4.3 SD-1.15	1.6 SD 0.51
MOWHTO With Nonlocking plate group	9.1SD -1.79	6.1 SD-1.11	3 SD-1.56
MOWHTO With LCP group	6.170 SD1.26	6.06 SD-1.26	0.11 SD-0.23

Average loss of correction at 2 year duration in our study was maximum non-locking plate ± 1 in locking plate group (0.11± 0.33), the difference in

loss of correction between locking plate group and rest of the two groups is statistically highly significant P<0.001.

Table 10: Pre-Operative Pain score.

Knee Society Pain Score		WOMAC Pain Score		VAS Pain Score	
Pain Score	No. of Cases	Pain Score	No. of Cases	Pain Score	No. of Cases
10-20	27(77-41%)1-4	1-4	0	1-3	0
21-30	27(21.77%)	5-8	0	4-6	0
31-40	0	9-12	0	7-10	102(100%)
41-50	0	13-16	30(24.19%)		
		17-20	94(75.80%)		

**Pre-operative pain score:**

Mean pre op knee society pain score — 18±8

Men pre op WOMAC pain score- 17± 2.1

Mean pre op VAS score- 8.1 ±0.8

**Table 11: Post-Operative Pain Score.**

Knee Society Pain Score at 2 year		WOMAC Pain Score at 2 year		VAS Pain Score at 2 year	
Pain score	No. of cases	Pain score	No. of cases	Pain score	No. of cases
10-20	4 (3.22%)	1-4	58(46.77%)	1-3	27(21.77%)
21-30	31(25%)	5-8	66(53.22%)	4-6	95(76.66%)
31-40	49(39.51%)	9-12	0	7-10	2(1.6%)
41-50	40(32.25%)	13-16	0		
		17-20	0		

**Post-operative pain score:**

Mean post op knee society pain score at 2 yr —41±7.7

Mean post op WOMAC pain score at 2 yr —3.6±1.5

Mean post op VAS score at 2 yr - 3 ±1

\* On comparing the data between pre & post op scores at 2 yr by above three scores. The difference of values was found to be statistically highly significant (p<0.0001).

**Table 12: Average Gain in Total Pain Score.**

	Knee Society Knee Score		WOMAC Score	
	Mean pro-op total score	Mean post-op score at 2 yr	Mean pro-op total score	Mean post-op total score at 2 yr
CWHTO	87.9±7.78	165±10.08	74.7±11.19	41.9±5.85
MOWHTO with NLP	89.7±10.58	172.3±8.34	76.6±6.75	37.6±6.07
MOWHTO with LCP	94±14	179±13	77±9.5	30±6.4

\* There is a significant increase in total score in knee society score and WOMAC in all the three categories (p<0.001). On evaluating the data between the three groups in study there was a

significant difference in total score gain in between medial opening wedge osteotomy with locking plate & rest of the two method is highly significant P<0.000.

**Table 13: Post Operative Complication.**

S.No.	Complication	No. of cases	Recovery	Implant
1.	Wound infection	2	Full	1LCP, 1NLP
	Superficial			
2.	Common Peroneal Nerve palsy	0	Full, plate removal in 2 Pts.	1 Tomofix, 1NLP
3.	Plaster sore	0		
4.	Delayed union	2	United with 3 more wks of rest	1 NLP, 1LCP
5.	Pain and swelling at foot and ankle	6	Full is removed in 1 NLP case	2NLP, 3LCP, 1 Tomofix
6.	Reaction artificial graft bone graft	5	Full	2NLP, 1LCP

\* In 5 cases we used artificial bone substitutes. Out of them, in 3 case we found sterile serous discharge which was the reaction to artificial bone graft. After 3 week coming of this discharge was stopped and in 1 case deep bone infection was occurred as a complication of initial reaction of artificial bone graft. In 1 heavy built patient osteotomy was fixed

with PHLP which appears to be inadequate fixation. Screw was broken and osteotomy was displaced. Implant was removed. Patient was not ready for re-fixation and continue to walk on non-union osteotomy with support. Malunion occurred and patient condition has improved.

**Table 14: Correlation of reduction of pain with valgus alignment of femoro-tibial angle.**

S.No.	Post op FT angle	No. of cases	Percentage	Improvement in pain score (mean)
1.	0-4 Valgus	10	8.81%	16.67±7.63
2.	5-7 Valgus	94	75.80%	23.41±6.70
3.	>7Valgus	20	16.12%	13.20±5.83
4.	Valgus not attained	0	0	0
	<b>Total</b>	<b>124</b>	<b>100%</b>	

**DISCUSSION**

The present study was conducted on 124 knees of 111 patients. There were 57% female and 43% male cases. Mean age of Patients in our study was 55.97 years with maximum age of 79 years and minimum 40 years the maximum patients (53.22%)

were in the 50-59 years age followed by 33.87% cases in age group of more than 60 yrs. Osteoarthritis is more common in females. It is because osteoarthritis in post-menopausal women is associated with higher body weight, higher subcutaneous fat, calcium deficiency and weaker muscles linked to hormonal changes. The results in



our study showed that not only does osteoarthritis affects females more than males but also younger age group. In Koshino T. (2004)<sup>[1]</sup> study the female were 80% and male 20%, in Choi HR. (2001)<sup>[2]</sup> study female were 62.23% and male 30.77% and in ZakiSH(2009)<sup>[3]</sup> study 100% male pts and no female pts were included.

\* In this study the mean age of patients. At the time of operation was 55.97 years (51 yrs for female and 62.09 yrs for male pts). The mean age in Choi HR. (2001)<sup>[2]</sup>, Koshino T (2004)<sup>[1]</sup>, Dehoux. E (2005)<sup>[4]</sup>, Takeuchi R (2008)<sup>[5]</sup> and Zaki SH(2009)<sup>[3]</sup> studies were 59.0 years, 59.6 years, 45.2 years, 69 yrs and 39.5 yrs respectively.

\* The mean hospital stay of each case was 6.47 days (15 days in case of OWHTO with Non-locking plate and closed wedge technique whereas in cases of MOWHTO with Locking plate it was 5.15 days. Fitness for surgery was done on OPD basis and pts. were admitted 2 days before surgery. Hospital stay in LCP group was significantly reduced due to smaller exposure and lack of need of plaster cast.

\* All patients in this study had a genu varum deformity secondary to Osteoarthritis. Mean varus in our study was  $4.42 \pm 3.9$  degree. In this study the preoperative pain score was  $18 \pm 7$  (Knee Society Pain Score) range of motion /score was  $113 \pm 2.06$  degree. By comparing the pre-operative knee score (Pain, Range of motion and Stability) of all patients, the maximum affected knee was with pain score  $P < 0.00$  and pain was the primary cause of morbidity and that was the main reason for which High Tibial Osteotomy was done.

\* The roentgenograms were graded from 0-4 using Lawrence classification according to the severity of radiological changes. 18 patients (14.6%) had grade II changes and 80 patients (65.41%) grade III changes and 26 patients (20.96%) had grade-IV changes. No patient gave history of any trauma. The femoro-tibial angle was in varus alignment in all the cases. 77 cases (62.09%) had femorotibial angle between 0-5 degrees varus and 47 cases (37.29%) between 6-10 degrees varus.

\* We used three techniques for performing High Tibial Osteotomy.

\* 10 cases (8.06%) were operated by modified Coventry technique in which we disrupted the proximal tibio-fibular syndesmosis by osteotome. This allowed the fibula to migrate proximally on closure. In this way there was no need of exposing the common peroneal nerve therefore no chance of its injury. The osteotomy was secured with Coventry staples directed from lateral to medial just anterior to fibula. In one patient the osteotomy was done distal to the tibial tuberosity and was directed from lateral to medial and proximally and cancellous screws secured the osteotomy passed from medial to lateral.

\* 10 cases (3.06%) were operated by Open Wedge Osteotomy with non locking plate and bone graft. In 8 cases gap was filled by auto-graft taken from iliac crest and in 2 cases artificial bone substitutes (G-bone and G-graft). In 8 cases cervical H plate was used. In 2 cases spacer plate was used. 104 cases were operated by medial open wedge osteotomy and iliac bone graft secured by locking plate (60 cases by small LCP and 44 cases by Tomofix).

\* In 3 cases, operated by Modified Coventry Technique, a long leg plaster cast was applied. In these cases, patients were hesitant to bear weight because it was quite heavy for early weight bearing. To overcome this problem in rest 7 cases plaster cylindrical cast was applied for 6 weeks. All patients in Open Wedge Osteotomy with non-locking plate were given POP cast. No patient with Open Wedge Osteotomy fixed with LCP was applied any cast except for the three cases which had lateral cortex breach during opening of the wedge, who were applied a POP slab for 2 weeks. Majority of patients were allowed partial weight bearing from third post op day with walker (32 out of 60 in small LCP and 40 out of 44 in Tomofix) except for the three was based on type of plate (small LCP/Tomofix) and patient particulars.

\*Staubli AE (2003)<sup>[14]</sup>, Stoffelk (2004)<sup>[15]</sup>, Horacek D (2006)<sup>[16]</sup>, Niemyer P (2008)<sup>[17]</sup>, Justus (2010)<sup>[18]</sup> and Alex E staubli (2011)<sup>[19]</sup> also use Tomofix plate for the fixation of the High Tibial Osteotomy and were obtain good result.

\* Study by Takeuchi R, (2009)<sup>[6]</sup> partial weight bearing was started from first week in both unilateral & bilateral cases, using Tomofix with artificial bone block to fill osteotomy gap. Full weight bearing in our cases was started on  $7 \pm 0.46$  week in lateral closing wedge, after  $8 \pm 0.76$  weeks in Non-locking plate group of medial open wedge osteotomy & after  $3 \pm 0.62$  weeks in L-locking plate group of medial open wedge osteotomy. In study by Takeuchi R, (2009)<sup>[6]</sup> full weight bearing was allowed after 2 weeks in unilateral cases and after 3 weeks in bilateral cases using Tomofix.

\* All cases experienced definite improvement in the pain. It is amply clear from the percentage increase in average pain score of 21.77 (Knee Society Pain Score) P value  $< 0.001$ .

\* 66 cases (53.22%) cases had pain score  $> 40$  post operatively (the maximum pain score for pain is 50). It was noted that the patients keep on improving for 2 years after Osteotomy. The follow up in this study is relatively short and many patients complained of weakness or some swelling around the knee exercise. The average pain score preoperatively was  $18 \pm 7$  and post-operatively joint up to 3 months which finally improved with quadriceps strengthening was  $44 \pm 5.1$  the percentage increase in pain score post-operatively was 26.

\* According to the grading used for functional assessment in knee scores there was definite improvement in the function of cases 122 (98.38%) at 2 yrs. But up to 3 months patients required some walking aid in half of the cases. There was very little improvement in the functional knee score in 2 cases. The pre-operatively mean functional knee score in of 110 cases (88.7%) cases was 28.86 and postoperatively was 70.45 i.e. the mean improvement in functional knee score is 41.59 (the maximum functional knee score is 100). The mean improvement in total knee score was  $83.2 \pm 12.8$  in locking plate group and  $77.11 \pm 9.86$  &  $78 \pm 12.8$  in non-locking Open wedge osteotomy and lateral closing wedge osteotomy group respectively.

\* In our study the mean tibiofemoral angle in standing was  $5.2 \pm 1.5$  degrees varus pre-operatively and  $5.8 \pm 1.3$  degrees valgus post-operatively. Similar correlation of deformity were reported in the studies of Koshino T (2004)<sup>[4]</sup> and Spahn G (2005)<sup>[7]</sup> in which the tibiofemoral angle in standing was 6 degrees and 7 degrees varus pre-operatively and 9 degrees and 3.7 degrees post-operatively respectively.

\* In this study the results were rated as excellent in 110 cases (88.7%) good in 10 (8.06%) and poor in 2 cases (1.6%). This compares well with the study of Pfahler M (2003)<sup>[8]</sup> with 90% excellent and 10% poor result. In the study of U. Munzinger (2004)<sup>[9]</sup> results were good to excellent in 71.50% cases, fair in 10.70% and poor in 17.80% cases. In Wu LD (2004)<sup>[10]</sup>, Zhou YX (2003)<sup>[11]</sup> and Miklos Papp (2004)<sup>[12]</sup> studies results were excellent in 97.30%, 88.00%, and 91.30% cases at two years. The results deteriorated thereafter as the time passes. To comment on deterioration, this study needs further follow-up.

#### **Correlation between valgus attained and reduction of Pain**

In the study of Hernigou-P (1987)<sup>[13]</sup>, best result were obtained when the femoro-tibial angle attained was 3 to 6° post operatively. Under correction and over correction were related to poor results.

In our study, the patients who attained valgus post-operatively, definitely showed the better results. The cases in which post-operative femorotibial angle was between 0-4 degree 10 cases (8.81 %) the mean increment in pain score was  $16.67 \pm 7.63$ . In 94 cases (75.8 %) in which the post-operative femorotibial angle was between 5-7 degrees valgus, the mean increment in pain score was  $.41 \pm 6.7$ . and more than 7 degree valgus had a improvement in pain score of 13.20. This showed that post-operative increment in pain score was better if the post operative femorotibial angle was between 5-7 degrees.

## CONCLUSION

The conclusion drawn from the study of 124 knees of High Tibial Osteotomy done in GSVM Medical College and LLR and Associated Hospitals are as follows: -

1. High tibial osteotomy was done in 124 knees of patients. Out of which 104 cases by medial open wedge high tibial osteotomy with locking plate, 10 cases medial open wedge high tibial osteotomy with non locking plates and 10 cases by lateral closing wedge osteotomy.
2. High tibial osteotomy was generally performed in patients of age group 50-59 years, constituting the maximum number of cases (53.2%) followed by > 60 years age group (33.8%).
3. High tibial osteotomy was more frequently performed in women (56%) as compared to men (44%) in our study, because the degenerative joint disease, osteoarthritis is more common in women than men.
4. The mean hospital stay of the patients was  $5 \pm 3.2$  days in locking plate group and  $15 \pm 2.67$  days in non locking plates groups.
5. All cases had a Genu Varum deformity, with the mean value of 5.2 degree varus. There was definite improvement in the pain and function of the knee after the correction of the deformity. P value <0.001.
6. The results of High Tibial Osteotomy in 88.23 percentage knees were rated as excellent. 104 out of these 124 cases were fix by Locking plates. 2 cases had poor results due to excessive over correction and associated comorbidities.
7. High Tibial Osteotomy increase the range of movement. Particularly in locking plate group in short term study but long term results are inconclusive. It can rather lead to stiffness of the knee joint if proper physiotherapy is not instituted.
8. There is a definite correlation between the post-operative valgus obtained and relief in the pain.
9. The result of Open Wedge Osteotomy with bone graft was excellent. With the use of angle stable implants (LCP and Tomofix) over correction tendency which use to be the cause of pain over lateral joint line and abnormal gait in majority of the patient could be avoided. It resulted into better short term result early improvement and stable correction in long term thus angle stable implants are the choice for medial open wedge osteotomy now days.
10. Most of the cases fixed with angle stable implants started partial weight bearing within 1st week of surgery and full weight bearing in 3 weeks. There was negligible loss of correction even after two years of follow up in the group.
11. Only 2 knees had superficial infection, 2 patient had Deep infection which led to Chronic osteomyelitis and removal of plate after one year, but they recovered Fully later, 2 patients had

delayed union, 6 patients had pain and swelling over foot and ankle and 4 patients showed reaction to artificial bone graft. In one heavy built patient osteotomy was fixed with PHLIP, which appear to be inadequate fixation. Screw was broken and osteotomy was displaced.

12. From this study we conclude that High Tibial Osteotomy is the very effective method in uni-compartmental osteoarthritis with varus deformity to provide pain relief and mechanical realignment even if patient is of older age group.
13. With the use of angle stable implants like LCP and Tomofix and promotion of medial opening wedge technique resulted in revival of HTO. These implants are more tissue friendly and stable which resulted in constantly by excellent early results with negligible loss of correction at two years follow up.

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**How to cite this article:** Kumar S, Swaroop A, Bharti A, Jyoti A, Saini H. Prospective and Retrospective Study to Evaluate the Role of High Tibial Osteotomy (HTO) Fixed with Angle Stable Plate in Treatment of Osteoarthritis of Knee. *Ann. Int. Med. Den. Res*. 2016; 2(5):OR32-OR39.

**Source of Support:** Nil, **Conflict of Interest:** None declared