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High tibial osteotomy as a treatment protocol for osteoarthritis of a knee- time for a change?

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Abstract

Osteoarthritis is a common degenerative condition of the joints, consisting of retrogressive sequence of cell and matrix changes that result in loss of articular cartilage structure and function. It affects all ethnic groups in all geographic locations.

There are several treatment options available for early OA knee including non pharmacological, pharmacological treatment and various surgical treatment. An arthroplasty is a good option for low demand and older patients there remains a significant concern regarding the longevity of implant, particularly in younger patients whereas high tibial osteotomy is joint preserving surgery . The normal anatomical tibial bone shape is maintained after the HTO, which allows for conversion to knee replacement if required in future .

Early ambulation and weight bearing on operated limb is possible with use of orthofix .Orthofix does not require additional surgery for implant removal and bone graft is also not needed.

Keywords: Osteotomy; Fracture Fixation; Joint Degeneration

1. Introduction

Osteoarthritis is a degenerative condition of cartilage and also known as degenerative joint disease, degenerative arthritis, osteoarthrosis or hypertrophic arthritis. Knee is most commonly affected joint in osteoarthritis (1). The global prevalence of Osteoarthritis knee was found to be 16% with incidence of 203/1000 per year in 2020 (2).In India, the prevalence of OA knee reported by a study conducted in 2016 is around 28.7%.(3)

It is classified as primary i.e. idiopathic, and secondary in which some underlying disorders of knee joint are identifiable as a causative factor which may be traumatic, inflammatory, infective etc.(1)

The primary OA of knee is a chronic, progressive degenerative disorder which ultimately results in disabling pain, gelling (stiffness after short duration of inactivity) and deformities in sagittal plane like genu varum or genu valgum. During the progression of degenerative OA the genu varum deformity occurs more commonly (in about 74% of patients of primary OA)(4) because of the fact that even in normal persons the mechanical axis passes a little medial to the center of joint that drives 60%-80% of body weight through the medial compartment of knee joint.

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Genu varum deformity is characterized by mechanical femorotibial axis of less than 180 degree with a consequent medial joint space narrowing in standing anteroposterior (AP) scanogram(5).

The diagnosis of Osteoarthritis knee is made clinico-radiologically and pain is the most presenting symptoms which is aggravated by joint use and relieved by rest.(6)

There are several treatment options available for early OA knee including non pharmacological, pharmacological treatment and various surgical treatments including High tibial osteotomy, Unicompartmental knee replacement (UKR),Total knee replacement (TKR) and arthroscopic debridement .

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 relieves pain and slows the disease progression. (9,10,11, 12,13,14)There are various HTO techniques including closing wedge osteotomy, opening wedge osteotomy, dome osteotomy, progressive callus distraction, and chevron osteotomy. Recently, opening-wedge osteotomies have been found advantageous over older procedures because of improved accuracy of correction with comparable short-term to midterm results.(15),(16).

Medial opening wedge high tibial osteotomy (HTO) is described as a biomechanical intervention designed to alter dynamic knee joint loading, with the aim of improving patient function and decreasing pain. (17)

Medial opening wedge osteotomy is a relatively simple procedure that involves a single osteotomy and a few dissections. The technique does not necessitate either a fibular osteotomy that has been associated with neurovascular complications or bone resection of the lateral tibia. (18)

The level of correction can be identified and adjusted intraoperatively on the coronal and sagittal planes and shortening of the lower limbs can be prevented or treated. (19,20,21)

With the use of orthofix,the establishment of union can be judged easily on a radiograph, the assessment can be repeated and the fixator can maintain the corrected position until union occurs.(22,17) The ability to maintain the sagittal alignment, which is difficult to control after stapling (23,24) or various forms of plating,(23,24,25,26,27) is an advantage of Hemicallotasis done by orthofix.

In our study,we conducted Medial opening wedge high tibial osteotomy with orthofix using Hemicallotasis method.

2. Material and methods

This study was conducted in Shri Mahant Indresh Hospital, Dehradun, from December 2019 to June 2021. Patients with medial compartment osteoarthritis knee fulfilling inclusion and exclusion criteria were selected and treated by high tibial osteotomy using orthofix and those who were available for follow up.

2.1. Inclusion criteria

- Patients below age<65yr
- No ligament laxity
- Unicompartmental osteoarthritis knee
- Varus should be <20 degree
- Grade 3 or less The Kellgren Lawrence grading of osteoarthritis knee

2.2. Exclusion criteria

- The patients with bicompartamental and tricompartmental osteoarthritis knee
- Restricted range of movements at knee i.e. knee flexion of less than 90 degrees or flexion contracture of more than 15 degree
- Inflammatory arthritis
- Patella baja

Necessary radiological investigations and hematology were done on admission.

Preoperative evaluation done by standard radiograph, Type of surgery and details were noted. The immediate post-operative x-rays were evaluated. All the cases were evaluated again clinically, radiologically and functionally at 4weeks, 12 weeks and 24 weeks with respect to knee society score and Hip knee ankle angle . Patients were selected from orthopaedics OPD after taking written informed consent.

2.3. Pre-operative evaluation

- Evaluation of functional outcome-Knee society score was evaluated.
- Radiographic evaluation-a weight bearing scanogram of knee joint along with entire lower extremity was obtained and Hip-knee -ankle angle (HKA) was checked in accordance with the method described by Bauer et al. (36) as follows: A straight line will be drawn along the axis of the femoral shaft to intersect a corresponding line drawn through the tibial shaft, and the medial angle (Fig 1,2) between these two lines will be measured.

Measurement of hip-knee-ankle angle and angle of correction will be done in soft copy radiographs.

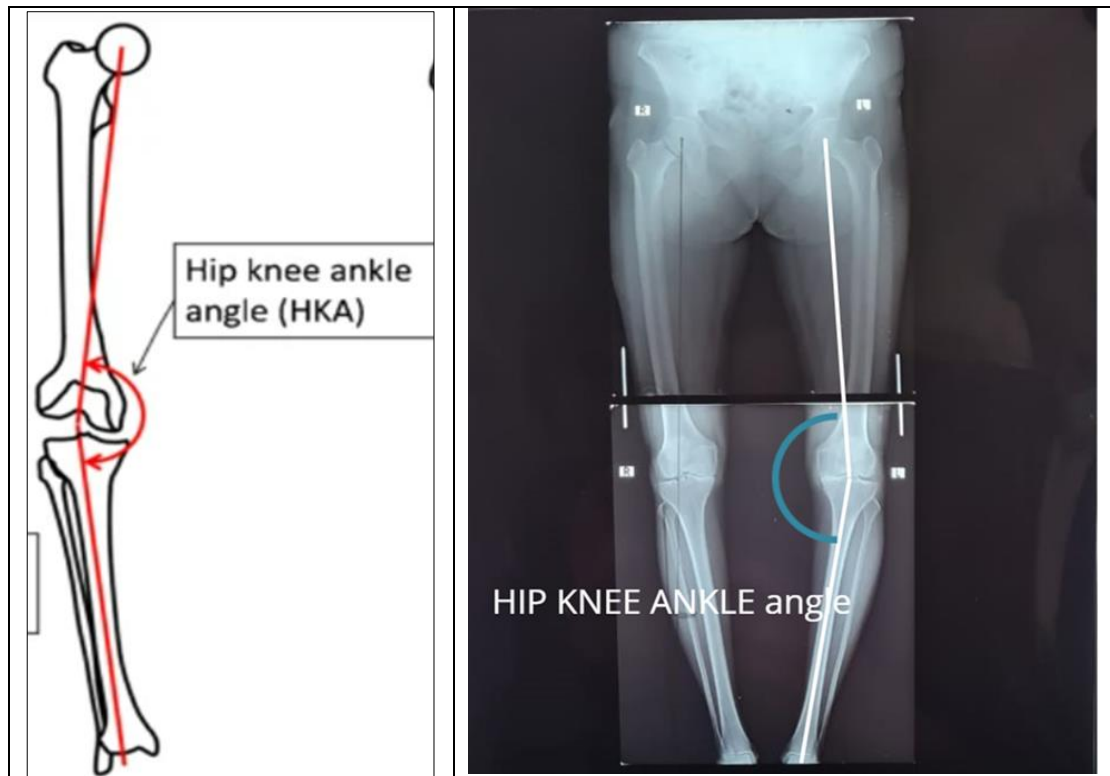


Figure 1 and 2 HKA angle

Angle of correction –it is determined by drawing two straight line i.e. from the center of the femoral head and another from center of ankle towards Fujisawa point(11). Angle (Fig 3,4) made by intersection of these two lines and adding normal physiological valgus will indicates the amount of correction needed .

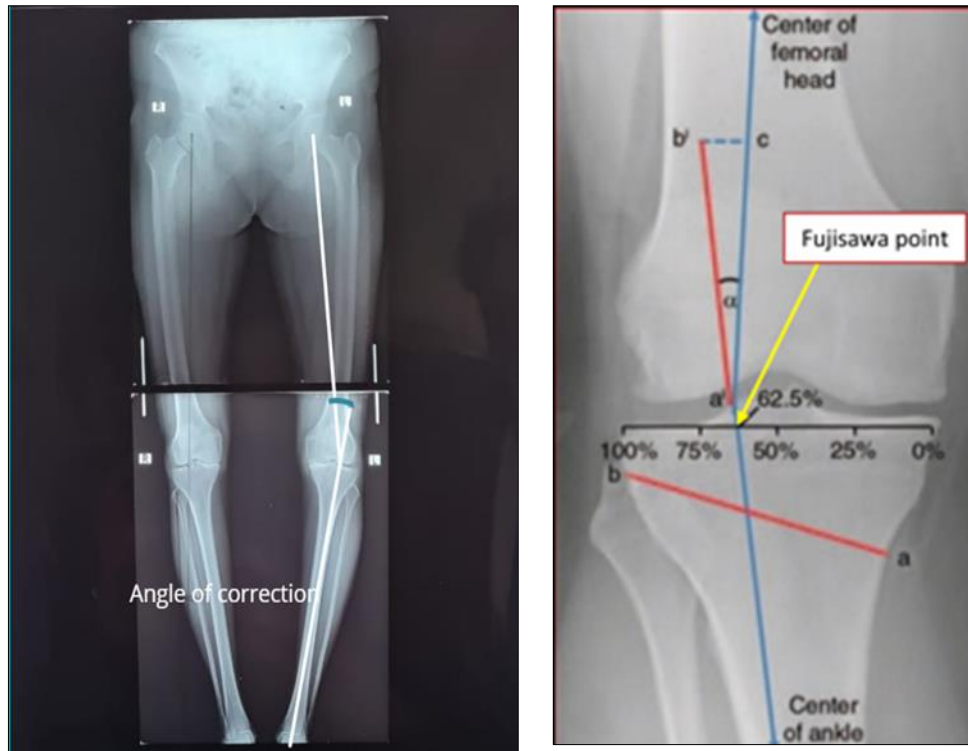


Figure 3 and 4 Correction angle

Consolidation at Osteotomy site – Consolidation was evaluated by osteotomy filling index which was calculated by dividing the total osteotomy length by 20 % into 5 zones (Medial to Lateral)Fig 5 .Consolidation /gap healing was considered adequate when osteotomy filling index was zone equal or more than 3 in knee anteroposterior radiograph.(55)

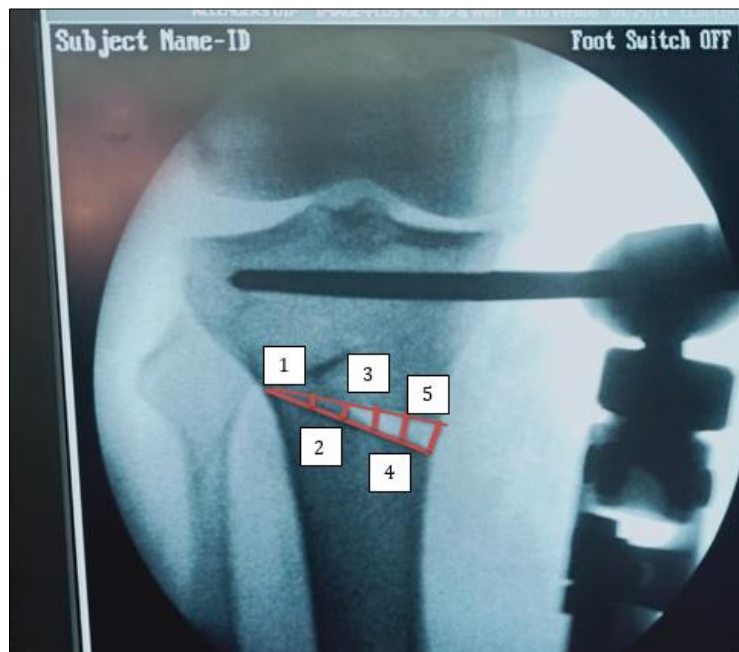


Figure 5 Consolidation zone

The Patient is positioned in supine position. Using fluoroscopy, Kirshner wire of size 1.5mm was placed in proximal tibia as posterior as possible parallel to tibial plateau 1 cm below the joint line. After confirming the position, cannulated drill passed over k wire and pin was inserted.

Another pin was placed anteriorly to the first pin using T clamp of orthofix. Orthofix was then passed in 2 proximal pins and 2 distal pin were inserted accordingly to orthofix length into anteromedial aspect of tibial shaft.

Under fluoroscopy, Kirshner wire was passed 4 cm below the medial joint line aiming towards the tip of head of fibula.

Osteotomy was then performed first making multiple drill hole using drill in posterior cortex and then using osteotome just parallel to placed Kirshner wire.

Another anterior osteotomy plane was made just anteriorly in relatively horizontal plane only up to tibial tuberosity. Medial osteotomy site was then opened by giving a valgus stress and making lateral cortex as hinge and checked under image intensifier.

2.4. Post-operative protocol-

Full weight bearing ambulation was allowed from post op day 1 and knee range of motion exercises from post op day 1 on basis of tolerance of postoperative pain experienced by patient. Daily pin track dressing was done during hospital stay and was explained to patient and their relatives to be done in their home. After 1 week, hemicallosis was started at a speed of @ 1mm over 24 hours. After 2 weeks, suture removal was done and after 3 month orthofix was removed on the basis of presence of consolidation at osteotomy site .

2.5. Follow up protocol-

During the follow-up period, subjective evaluation (patient satisfaction), clinical assessment and Radiological assessment were done .Knee society score was used for objective and functional assessment. The patients were followed up and evaluated at 3 months and 6 months.

3. Results

Mean age of the patients suffering from Osteoarthritis knee was 54 years in our study. In our study,4 cases (25%) were male and 12 cases (75%) were female. The most common operating side for osteoarthritis knee in our study was right with (62.5%) and left with (37.5%).

Table 1 Distribution of cases on the basis of KL grading system

Classification	No. of cases	Percentage
KL Grade 2	6	37.5%
KL Grade 3	10	62.5%
Total	16	100.0%

In our study,62.5% cases were having OA knee KL grade 3 and 37.5% had KL grade 2 .Patients with KL Grade 4 and 5 were excluded from the study .

Pre-Operative Hip Knee Ankle angle in our study group ranges between 160-165° in 18.75%, between 166-170° in 31.25% of cases and remaining 50% of cases ranges between 171-175°. Mean pre-operative HKA angle is 170.1 +/-3.5

The mean knee varus in our study group was 10.8 +/-1.9 degree and minimum value 8 degree was and maximum value was 14 degree.

The mean correction angle required in our study group was 17.8+/-1.9 degree.

KNEE SOCIETY SCORE(Knee score + Functional score) in our study shows better outcome in 90.6% of cases and only 9.4% cases show satisfactory outcome.Paired t Test was used and p value was 0.001 which shows significant outcome. The knee society score (Knee score + Functional score) was improved preoperatively from 42.4 to 77.45 postoperatively.

In our study, there were no complications in majority of cases (87.5%) and mild (6.3%) to moderate complications (6.3%) were found only in 2 cases.

4. Discussion

Medial joint OA knee has always been a topic of debate among surgeons with respect to perfect line of management regarding surgical and non surgical methods with advancement in non surgical methods like PRP, prolotherapy which are gaining popularity nowadays.

High tibial osteotomy with orthofix is considered a good surgical method for management while considering unicompartmental osteoarthritis knee. As TKR is considered as clear end point in management of OA knee, HTO with orthofix does not hamper the surgical site and anatomical profile of tibia for future TKR.

In our study, total of 16 patients were enrolled with mean age group of patients suffering from early grade medial joint OA knee was 54 years. Our findings also matched with the studies conducted by Patel et al(27), Magnussen et al(28), Luites et al(29), Raaij et al(30), and Brouwer et al(24).

A total of 16 cases included in our study out of that 12 were female (75%) and 4 were male (25%). Similar to findings of our study, other authors have also reported a higher female dominance by Patel et al(27), Raeissadat et al (31), Song et al(32),(33), and Deie et al(34). Wangsuea A et al(35), Brouwer et al(24), Luo et al(36), S Gunter(37), and El Azab et al(38) reported a male preponderance in their studies.

In our study, as per Kellegren Lawrence classification Grade - III & Kellegren Lawrence Grade -II had 62.5% and 37.5% respectively, all were treated with HTO with orthofix. Our result coincided with the results of Patrick A Smith (39) in which there were 18 of 30 cases(60%) in grade 2 and 40% in grade 3. In the studies by Raeissadat et al (31)(Grade 1:2:3:4 = 6:44:38:6 %) and (Grade 1:2:3:4 = 0:47:37:16 %) in the PRP and HA group respectively, JFSD Lana et al (70) (Grade 1:2:3= 25:44:31 %), (Grade 1:2:3= 25:39:36 %), and (Grade 1:2:3= 15.2:42.4:42.4 %) in the PRP, HA, and PRP+HA group respectively.

In our study Hip Knee Ankle angle was measured. In present study, mean HKA angle pre operatively was $170.1 \pm 3.5^{\circ}$ and after correction by HTO with orthofix (post-operative) mean HKA angle was $182.8 \pm 1.0^{\circ}$. So restoration of HKA Angle to 182-186 degree is associated with a better outcome, which can be precisely attained by HTO with orthofix,

Post operative restoration of HKA angle was possible in all the patients in our study. These results were comparable to other study conducted by other authors. Similar results were obtained The results of the study by Polat et al (42) also concluded the improvement from 56.1 ± 1.9 preoperatively to 70.4 ± 10.7 postoperatively at the mean follow up of 12.4 ± 3.2 years. In present study, 90.7% of cases having excellent and good prognosis,

In our study, the mean varus angle preoperatively was 10.08 degrees which improved to 2 degree valgus at 3 months postoperatively. Similar results were seen in the research study "The Knee" by T.O.Smith (44). Bae et al (45) in their study concluded that the mean significant correction angle was 11.5 ± 1.9 degrees. Song et al (33) concluded in their study that the angle correction was from 6.8 degree varus to 2.8 degree valgus postoperatively. Kapila et al (46) were successful in improving the correction angle from 8-10 degree varus to 5-7 degree valgus in 60% patients using limb reconstruction system.

5. Conclusion

Observations recorded from this study and the experiences obtained during course of this study can be concluded in following points:

- Outcome of HTO with ORTHOFIX in unicompartmental medial joint osteoarthritis knee can be considered as a good option in terms of functional and Clinical outcome.
- Orthofix as fixation device for high tibial osteotomy in medial joint OA knee can be considered as a safe, reliable, simple device and with precise effect.
- Radiologically Hip knee ankle angle and varus angle after HTO with orthofix shows good results.
- Protective soft tissue dissection, less operative time, minimal postoperative complications, no need of bone grafting, and no another hardware removal surgery make the Orthofix a good choice of implant.
- Less incidence of complications in a present study indicates HTO with Orthofix as a better option in OA knee.
- KSS score shows better outcome in 90.6 % cases and 9.4% cases have satisfactory outcome in present study which shows HTO with ORTHOFIX as a better option.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the author

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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