ORIGINAL ARTICLE

Hindfoot alignment variation before and after total knee arthroplasty - results of a pilot study.

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ABSTRACT:

Introduction: Limb alignment to balance the weight transmission across the knee joint is essential part of total knee replacement surgery. Conventionally the hip-knee-ankle (HKA) axis is considered for correction; however the weight transmission to the ground also involves the joints distal to ankle. Heel alignment will thus play and important part in weight transmission. Genu varum deformities in osteoarthrosis are associated with heel valgus deformity and we hypothesize that this deformity persists even after correction of the knee deformity after TKR.

Material and methods: patients with primary knee osteoarthrosis genus varus deformity >10° but <30° were included in the study. Preoperative and three months post operative scanogram and cosby's ankle radiographs are taken. The HKA and the tibi calcaneal angles were measured and compared using paired t test. Preoperative genu varum was also correlated with preoperative tibio calcaneal angle using Pearson's correlation

Results: the mean HKA improved from a preoperative value of 16.53° (valgus) to 1.36° (valgus). The tibia calcaneal angle slightly increased postoperative from 13.16° (valgus) to 14thus the knee alignment returned to normal HKA, however the heel valgus did not change at three months post surgery. This will further lateralize the weight transmission axis.

Conclusion: This is a small sample, short follow up pilot study; however it does indicate that the heel valgus deformities may persist after total knee replacement. This may be needed to be considered while preoperative planning, however a longer follow up will be required to assess the complication rates and clinical result.

Key words: Knee alignment, Hip knee ankle axis, tibio calcaneal axis.

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INTRODUCTION

The basic technical aim in total knee replacement surgery is alignment of mechanical axis and soft tissue balance. Hip knee ankle (HKA) mechanical axis (angle between the mechanical axis of femur and tibia) is taken as reference for correcting deformities and alignment of 0±3° is taken to be normal alignment.1,2,3 Normally the knee joint-line is parallel to the ground, however the femur and tibia anatomical axis are at an angle of 5-7° Valgus. So during TKR, the tibial cut is taken 90±2° to the axis of tibia while femoral cut is taken in 6-8° valgus so that the normal joint alignment with mechanical axis passing through the centre of the knee is attained. It is postulated that this restoration of HKA axis will equalize the weight transmission across the implanted joint and improve survival.2,4 Guichet et in 2003 distinguished between the conventional HKA axis and the Hip Ground mechanical (HG) axis.5 This distinction was however done in pediatric cases with genu varum deformities. Lee et al in 2007 comment HG axis to be more accurate than the HA axis and considered it as the axis of weight transmission through the lower limb.6 HG axis also included the hind foot alignment. This hind foot alignment can be measured by clinical or radiological tibia calcaneal angle (TCA). Rilley et al7 used the clinical TCA and concluded that the normal population has heel alignment a mean varus of 2.5 while the patients with knee osteoarthrosis with varus knees had a mean valgus TCA of 2.02 . In their later paper too they concluded that genu varum of medial knee osteoarthrosis was associated with heel valgus.8 Valgus at the heel will not affect the conventional HKA but will significantly affect the HG axis in maintaining its alignment as physiological as possible. This preoperative deformity if it persists after aligning the knee post TKA may cause lateralization of the mechanical axis.

This pilot study tries to quantify the correlation between Knee and ankle alignment in knee Osteoarthrosis. We hypothesize that TKA corrects the knee alignment, however the long standing ankle deformity may persist post knee surgery.

MATERIALS AND METHODS:

A prospective pilot study was started at our institute between June 2010 to August 2010. We enrolled all patients undergoing TKA and having >10 but <30° knee varus deformities. All cases were of primary osteoarthrosis and having flexion deformity not more than 10°. Patients with

other diagnosis like rheumatoid and posttraumatic osteoarthrosis were excluded as were the patients with body mass index >30. These inclusion and exclusion criteria made the sample homogeneous and decrease the chances of confounding biases. From a total of 69 TKA done during the study period 29 were excluded depending on inclusion exclusion criteria, 10 patients were excluded as follow up was doubtful in these cases (7 patients were from out of country and 3 were staying in different states of India). Thus a total of 30 patients were selected for the study. All patients were explained about the procedure and a written informed consent was taken. This study was approved by the institutional Ethics Committee.

There were 21 females and 9 males with mean age of 60.1±5.7years (range 49 to 79 years). All patients underwent a preoperative standing scanogram and a Cosby's view.9 For Cosby's view the patients were made to stand on the radiographic plate while the radiographic tube was angled to 45 to the long axis of the leg centered on the ankle joint. Postoperatively the radiographs were repeated at three months interval to assess any change in the alignment status of the limb.

Radiographic measurement was done by either one of the authors. Measurement was done using the PACS system (Pi View Agfa, India). HKA axis was measured by marking the centre of the hip to centre of knee to centre of the ankle. The angle of varus was measured in degrees as suggested by Cooke et al.3 For measurement of TCA on Cosby view technique as suggested by Relingh was used.10 To measure the mid-diaphyseal axis of the tibia two transverse lines 30 mm apart were marked. The line joining the midpoints of these lines was joined to extend inferiorly. To mark the long axis of Calcaneum two transverse lines are made. The distal line is transversely drawn 7 mm from the tip of calcaneum. A mark was made on the line dividing the line into medial 60% and lateral 50%. Another transverse line 30mm from the tip of calcaneum and is divided equally. The line joining both points is then extended superiorly to meet the tibia axis. This angle was the tibia calcaneal angle (TCA).

Preoperative and 3 months post operative angles were compared using online calculators. Paired t test was sued to compare the changes in the angles from preoperative to post operative values. A Pearson's correlation test was done to assess the correlation between preoperative HKA and preoperative TCA. P value of <0.05 was taking to be significant.

RESULTS:

The mean HKA was 16.53±4.91 of varus with range from 10 to 30 of varus. This improved significantly to 1.36± 1.47 of valgus alignment with range from (2 varus to 4 valgus). P value calculated for paired t test was highly significant (0.001). The preoperative TCA was 13.16±5.5 , while the post operative TCA was 14.01±4.58 . This difference was not statistically significant (p=0.298).

When Pearsons correlation for correlation between preoperative HKA and TCA was moderate with correlation value of +0.506 (p value 0.00). Thus with increase in HKA the TCA also increased i.e. increase in HKA varus was associated with increase in TCA.

	HKA	**TCA**
Preoperative	16.53±4.91 (varus)	13.16±5.5 (valgus)
Postoperative	1.36±1.47 (valgus)	14.01±4.58 (valgus)
P value	0.001	0.298

P value is for paired t test

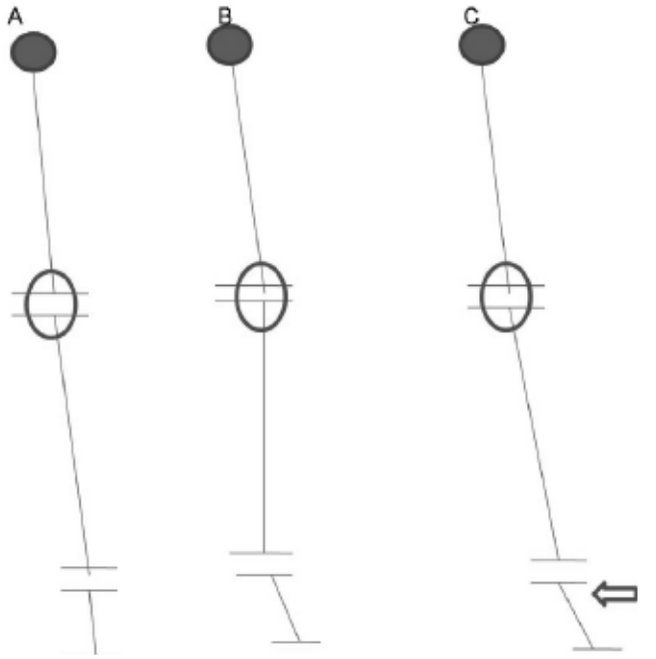

Figure 1-Our Hypothesis-

a- normal HKA axis with normal hind foot alignment, with mechanical axis and weight bearing axis being same.

b- Case of genu varum deformity with associated compensatory heel valgus to keep the weight bearing axis close to normal.

c- Post TKR correction of the knee deformity, but ankle valgus persists (arrow) lateralizing the weight bearing axis.

DISCUSSION:

Maintaining a balanced weight transmission to pass through the total knee replacement is a function of aligning the weight transmission axis of the limb on the whole.

Malalignment of the axis will cause unbalanced weight transmission11 which may result in increased differential wear and early failure of the implant,1,4, 11 however the decreased survivorship is multifactorial and depends on the body mass index, bony cuts, implant quality and also the activity level. 12,13,14 Recent study has reported that the dichotomous division between aligned and malaligned knee

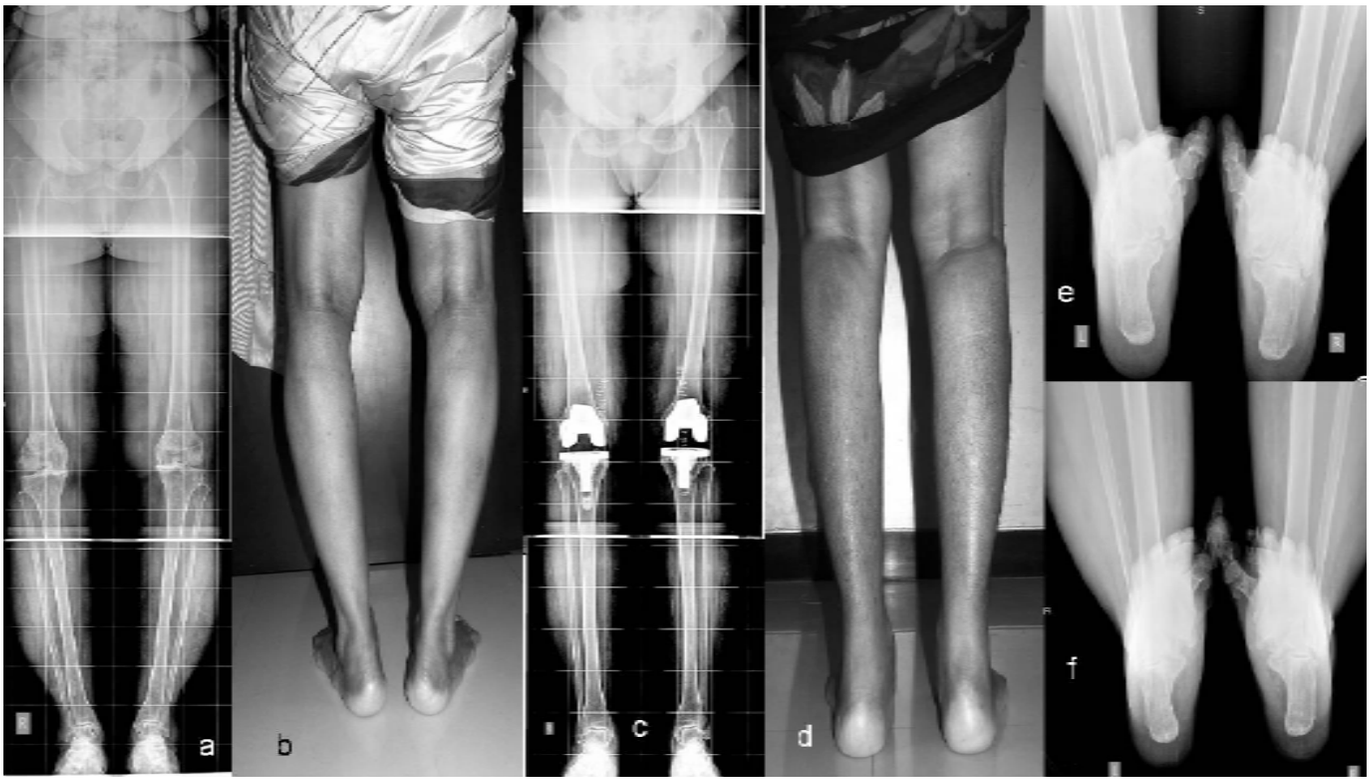

Figure 2 – 59 year old female with bilateral genu varum deformity. a,b shows preoperative scanogram and clinical photograph of the patient. c,d- show the post operative scanogram and clinical photograph. Note the change in heel alignment in clinical photographs from preoperative to 3 months post operative status. There was no change in the tibio-calcaneal angle in the pre and post surgery Cobey's view.

based on HKA of 0±3 may not be very predictive of long term outcome.16 This may be because consideration of alignment only at the knee joint may not align the weight bearing axis to pass through the centre of the implant. Bardakos et al17 studied the valgus cut angle of distal femur required to align the mechanical axis of the limb. They commented that the angular measurements at the proximal joint (hip joint) like offsets and neck shaft angle play an important role in deciding the angle of valgus cut for alignment at the knee joint. Ours is a similar study that investigates the role of distal joints and heel alignment. We found that varus knees are associated with heel valgus with a positive correlation. Thus patients with higher knee varus will have higher heel valgus. This has also been reported by other investigators; however it has not been investigated with respect to limb alignment in total knee replacement. We found that the HKA axis was well aligned post operatively; however heel valgus remained the same. Due to this the HG axis will be more lateralized after correction of the HKA axis. This will cause imbalance in the weight bearing across the prosthesis. Also correction of the knee axis will further accentuate the heel valgus and cause planovalgus foot. Meding et al18 reported planovalgus foot as harbinger of early failure for knee replacement prosthesis. They mentioned posterior tibial tendon insufficiency as a cause of plano valgus foot, however they too commented on alteration in the mechanical alignment of the knee as a cause for the foot deformity. They found problems with posterolateral femoral rollback and instability to be major reason for revision in these cases. Excessive wear at posterolateral and posteromedial part of the tibial polyethylene was noted. Our study is a pilot study of only 3 months follow up and no cases of revision. However our results indicate that patients with varus knees have an associated heel valgus which is accentuated postoperatively. This persistent heel valgus will cause lateralization of the weight bearing axis and an unbalanced weight distribution on the implant. A very recent study by Mullaji A and Shetty GM20 too had similar conclusions. They had used modified Cobey's view for assessment of the heel valgus. As in their study too we found the heel valgus to be persistent 3 months post surgery. The major drawback of both these studies is the timing of the post operative ankle measurements. They had measured the ankle radiograph at 6 weeks post surgery and we had measured at 3 months postsurgery. A longer follow up of these patients will be required to study the effect of this 'malalignment pattern' on the longevity of the implant of failure rates. Also like a compensatory deformity the heel valgus too may correct over a period of time and 3 months may be a too short follow up to conclude with certainty. If the deformity at heel is persistent, it will be required to compensate for the deformity while planning of limb alignment in TKR. With persistent hind foot valgus in varus knee, a compensatory undercorrection will be required to be added to the conventional planning.. Although our results do

force us to rethink the neglect of ankle deformities while planning TKR, however as mentioned earlier a longer follow up with a larger cohort will be needed. We have planned a 6 months, 1 year and 2 year follow up for our cohort and this data will clarify the subject further.

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