INTRODUCTION
The heel has played a significant part in man’s life from several standpoints- physical, historical and rhetorical. The ‘Achilles Heel’ has long been a synonym for vulnerability, but the heel has also been the fulcrum of terrestrial action in man’s evolution and achievement in civilization.

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Pain in the heel area varies from annoyance to a significantly disabling problem. Heel pain has multiple origins and it is imperative that a careful history and physical examination should be carried out to pin point the cause as precisely as possible. Heel pain may result from disorders of Achilles tendon, soft tissue disorder near heel, hind foot bone injury, bony prominence irritation, neurological disorders, biomechanical causes and systemic cause [2]. Pain emanates from four areas in the heel complex. Plantar and medial heel pain are much common than lateral and posterior heel pain.

Posterior heel pain is a common complaint in both the athlete and the non-athlete and a variety of pathological processes have been implicated as its cause [3].

Posterior heel pain i.e. pain when the Tendo-Achilles attaches to the calcaneum are mediated by Posterior Tibial nerve which ramifies in the area. Pain is experienced both on action and contact as well as at rest. Direct pressure triggers a posterior calcaneal discomfort from the subcutaneous and the Tendo–Achilles attachment zones. The principal cause of posterior heel pain is almost always an action produced in the area. Pain in the heel area varies from annoyance to a significantly disabling problem. Heel pain has multiple origins and it is imperative that a careful history and physical examination should be carried out to pin point the cause as precisely as possible. Heel pain may result from disorders of Achilles tendon, soft tissue disorder near heel, hind foot bone injury, bony prominence irritation, neurological disorders, biomechanical causes and systemic cause [2]. Pain emanates from four areas in the heel complex. Plantar and medial heel pain are much common than lateral and posterior heel pain.

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CONCLUSION
Calcaneal Inclination angle was found to be most reliable indicator of posterior heel pain among the three parameters.

KEYWORDS
Fowler Philip angle, Calcaneal inclination angle, Ruch's total angle.
Figure 1: (A) Photograph demonstrating the technique standing weight bearing x-ray of right foot from lateral view. (B) standing weight bearing x ray of left foot from front where arrow is representing the x ray beam.

**Fowler – Philip angle**

The angles formed by a line tangential to the postero – superior surface of the greater tuberosity and another line tangential to inferior border of calcaneus [Figure 2].

**Calcaneal inclination angle**

Intersection of the baseline tangent to the anterior tubercle and medial tuberosity with horizontal surface [Figure 3].

**Ruch’s total angle**

Summation of Fowler – Philip angle and Calcaneal Inclination angle [Figure 4].

**RESULTS**

The range of age in case group was 18-80 years and in control was 22-67 years. In cases mean was calculated to be 39.52 ± 16.2 as against 39 ± 12.9 in control. The p value was calculated to be 0.864, hence statistically insignificant. [Table 1].

Table 1: Relationship of Posterior heel pain with age

Table 2: Gender distribution of case and control groups

The mean Fowler & Philip angle in the case group was 69.05 ± 6.7 (62.35-75.75) and in control was 61.10 ± 4.3 (56.8-65.4). There was a significant difference of mean value between the two groups (p=0.000). 28 heels out of 60 heels in case group are abnormal (more than 75°) with sensitivity of the test being 46.6%. No heels were found positive in control group hence percentage of false positive is 0%. The percentage of false negative is 54% i.e. in 54% of cases the Fowler Philip angle was found to be normal. [Table 3].

Table 3: Relationship of Fowler & Philip angle and Posterior heel pain in case and control group

The Calcaneal Inclination angle in the case group was 18.65 ± 3.15 (15.5-21.8) and in control group was 13.4 ± 3.7 (9.7-17.4). There was a significant difference between case and control group as depicted by the p value =0.000. 41 heels out of 60 in cases were abnormal (more than 17°) with sensitivity of the test being 63.3%. 82 heels were positive in control hence percentage of false positive is 82%. The percentage of false negative is 31.6% i.e. 31.6% of cases calcaneal inclination angle was found to be normal. [Table 4].

Table 4: Relationship of Calcaneal Inclination angle and Posterior heel pain in case and control group

The Ruch’s Total angle in the cases was 87.77 ± 7.6 (80.1 – 97.37) and in Control group was 74.5 ± 7.5 (67 - 82). There was a significant relationship between case and control group (p value =0.000). 23 heels out of 60 in cases group are abnormal (more than 89°) with sensitivity of the test being38.8%. 8 heels were positive in control hence % of false positive is 8%. The percentage of false negative is 61.6% i.e.
According to Cheng-Chang Lu et al, Fowler Philip angle in symptomatic group was 62.31± 7.79, and in control group was 60.14± 7.01 degree [14]. There was no significant difference between the two groups (p=0.49). 35 out of 37 heels did not meet the criteria for Fowler pathologica criteria in the symptomatic group and the false negative rate was 94.6%.

Fiamengo SA et al observed 100% false negative and 62% false positive [15]. Similarly, Schneider et al also did not find the angle to be of importance [16].

In the present study Fowler Philip angle in symptomatic group was found to be 69.06± 6.7 degree and in control was 61± 43 degree. There was significant difference (p=0.000) between the two groups. 28 out of 60 subjects had Fowler Philip more than 75° and no angle was positive in control group. Thus though significant but its sensitivity was found to be only 46.66% with 54% false negative i.e 54% of cases were found to be normal though clinically they had posterior heel pain.

CALCANEAL INCLINATION ANGLE

In cavus deformity, the calcaneus is more vertical directly affecting the prominence of postero-superior aspect of the calcaneus predisposing to bursitis because of cavus foot [8]. Fuglsang and Troup found 57% of their study having cavus foot [13]. Moynou et al repeated a constant association of more than 12° of calcaneal angle with Haglund’s disease [17].

Sharma SC found only 3 heels of 2 patients to be highly arched. The control group had slightly greater angle (23.20) than the symptomatic patients (20.82). This comprised 5% of high arched foot among the total subjects [18].

R Singh found calcaneal inclination angle to be 29.6% sensitive and 30% false positive and 70.4% false negative not agreeing with its contribution in diagnosis of posterior heel pain [19].

In the present study, Calcaneal Inclination angle in case group was 18.75± 3.16(5.5-21.8) and in control group was 13.4± 3.79(7-17.4). There was a significant difference (p=0.000) between the two groups.41 out of 60 heels had more than 17° Calcaneal inclination angle and 82 out of 100 had Calcaneal Inclination angle more than 17°. The sensitivity was 68% and 31.6% was false negative among case group% i.e. 31.6% of cases calcaneal inclination angle was found to be normal (less than 17) though they had heel pain. Since this proportion is quite less of the total hence this angle seems to be a reliable indicator of posterior heel pain.

RUCH’S TOTAL ANGLE

According to Ruch’s when Fowler Philip angle was added to Calcaneal Inclination angle there would be more accuracy, but according to R Singh Ruch’s total angle had a sensitivity of 7.04% and 93% false negative [5,19].

Sharma SC found Ruch’s total angle to be less significant (p=0.27) with only 5 heels (12.5%) had an angle more than 90°[18].

In the present study Ruch’s total angle calculated by summation of Calcaneal Inclination angle and Fowler Philip angle does not attract much with the findings of Ruch and Vaga et al according to whom symptoms increased with the correlation of heel pain with value more than 90degree. In the present study Ruch’s total angle in case group was 87.77± 7.6 (80.1- 97.37) and in control group was 74.4± 7.5 (67-82).23 out of 60 heels in case and 8 out of 100 in control group was found positive. Sensitivity being 38.2%, 8% false positive and 61.6% false negative.Hence this angle does not correlate much with the findings of previous studies.

SUMMARY

In our clinical practice, it has been seen that a large number of patients suffer from pain in the posterior part of heel associated with tenderness, erythema and oedema. They have obvious prominence at the posterior part of their heel. In 1928 Haglund first drew attention towards this painful heel condition also known as Pump bump, winter heel, Albert’s disease and Retrocalcaneal bursitis. This was followed by the development of new radiological angles by Fowler and Philip (1945), Ruch JA (1974).

A study was thus conducted at North Bengal Medical College where 50 cases were examined out of which 10 had bilateral heel pain and 50
bilateral control heels were examined to determine the relationship between posterior heel pain with the variation in shape and anatomical structures of calcaneus based on the above mentioned radiological angles and lines.

Considering the age group and sex it was found that in the present study, age of the patient was not influencing variation in calcaneal anatomy to cause posterior heel pain. Females were no doubt affected more than males in our study.

Considering the various angles:
1) Fowler and Philip angle:-
   It was 46.6% sensitive and in 54% it was found to be normal though they had pain clinically, hence not very reliable.

2) Calcaneal inclination angle:-
   Sensitivity 63.5% with 31.6% false negative thus making it appear as a reliable indicator.

3) Ruch’s total angle:-
   Sensitivity was 38.8% and 61.6% false negative, thus making it less reliable.

The present study result has been compared with the previous ones in table 7.

### Table 7: Comparison of sensitivity of three radiological parameters of previous studies with the present one:

<table>
<thead>
<tr>
<th>Name of the Author</th>
<th>Sensitivity of Calculaneal Inclination angle</th>
<th>Sensitivity of Fowler Philip angle</th>
<th>Sensitivity of Ruch’s Total angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuglsang F, Torup D (1961) [13]</td>
<td>57%</td>
<td>86%</td>
<td></td>
</tr>
<tr>
<td>Sharma SC et al (2005) [18]</td>
<td>5%</td>
<td></td>
<td>12.5%</td>
</tr>
<tr>
<td>R Singh et al (2008) [19]</td>
<td>29.6%</td>
<td></td>
<td>7.04%</td>
</tr>
<tr>
<td>Lu CC et al (2007) [14]</td>
<td>-</td>
<td>94.6%</td>
<td></td>
</tr>
</tbody>
</table>

Present study:
68% 54% 38.2%

Hence to sum up Calcaneal inclination angle could be of importance while evaluating posterior heel pain radiologically but it has to be kept in mind that no single parameter gives 100% accuracy so these parameters should be treated as adjuncts to the case history and clinical examination of the patient for proper and effective treatment.

**CONCLUSION**

An attempt has been made to find out if there is any significance of these three angles in posterior heel pain and one parameter was found to be reliable, objective diagnostic indicator of bony deformity of calcaneus namely Calcaneal inclination angle. Increased Ruch’s total angle is taking the least position of importance among the diagnostic parameters though their presence was found clinically and statistically significant. Hence, we can conclude that no single radiological parameter alone gives 100% accuracy; it is the combination of these bony parameters which enhance the diagnostic significance.

The angles were not much reliable in making decisions for surgery and it is important that the clinician diagnosis and treatment of posterior heel pain should be done according to clinical symptom and use these parameters as only auxiliary tools.

Hence the combination of changes in shape, inclination around calcaneus which can to some extent be calculated by the studied angles might be responsible for the posterior heel pain which is initially managed symptomatically by non operative care requiring surgical intervention only when there is lack of desired response.

**LIMITATIONS OF THE STUDY**

1. The sample size for Case (sample 1) was 50 with n=60 (40 unilateral and 10 bilateral posterior heel pain). For Control (sample 2) sample size was 50 with n=100 (50 bilateral). Thus, maintaining the ratio of Case: Control of 1:1. Hence the statistical significance of the result was comparable with similar studies only.

2. Exact documentation of distribution of body weight equally on two limbs during taking standing X ray could not be done due to lack of such instruments.

3. There might be age subjective variation during study because the observer had to depend fully on the statements of the subject.

4. During this study only bony parameters which are commonly measured in day to day practice were considered, further study taking other soft tissue parameter and bony calcification can be done namely: Plantar spur, Posterior calcaneal step, Calcaneal length, Test of Denis& Huber- Levrenieux, Achilles tendon calcification. Soft tissue parameters are Retrocalcaneal recess, Achilles tendon anterior-posterior diameter, Superficial tendon Achilles bursa.

5. Further accuracy in diagnosis can be achieved by taking additional views beneficial for specific presentation.

   i. Calcaneal axial view for frontal plane curvature within body of calcaneus.
   ii. Modified Calcaneal axial view for location of the calcification and exostoses on posterior surface of heel. This view can be taken by ankle dorsiflexed and heel on the ground with the tube 90° to the plate and angled parallel with posterior calcaneus.

This view provides excellent visualization of the middle and superior third of the calcaneus for the evaluation of Retrocalcaneal and Intra tendinous calcification.

6. This study leaves a window to study of these angles by advanced radiological techniques and imaging modalities like CT scan and MRI which will be beneficial for additional visualization of calcaneal and Achilles tendon pathology. These advanced modalities are adjuncts to clinical and Radiological evaluation.

**REFERENCES**