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Original Articles

Böhler's and Gissane's Angles of the Calcaneus in Bangladeshi Male

AHM Mazharul Islam[1], Humaira Naushaba[2], Tahmina Akter[3], Suraiya Jebin[4], Sharna Moin[5], Partha Sarathi Singha [6]

Abstract

Context: *Böhler's angle and Gissane's angle are commonly used to evaluate the severity of a calcaneal fracture and the goal of a surgical treatment is to restore these angles to normal values. Since the calcaneus is a weight bearing bone the calcaneal angles can possibly vary in different races due to variation in built and load bearing. Many studies were carried out in various populations to determine normal values of Böhler's angle and Gissane's angle. However, there is no published article on this topic in Bangladesh. So, this study was aimed to establish the standard data of Böhler's angle and Gissane's angle in adult Bangladeshi male and to make comparison with previous studies on other populations.*

Materials & Methods: *Digital radiographs of left foot in lateral view in bilateral standing position were taken from 50 consented male students of Sir Salimullah Medical College, Dhaka aged between 21 to 26 years without any history of foot deformities and injuries. These radiographs of foot were imaged with a digital camera according to scale and were transferred to a computer. From these images Böhler's angle and Gissane's angle were measured by MB ruler software.*

Results: *The mean±SD of Böhler's angle and Gissane's angle were 34.85±6.87° and 111.03±9.48° respectively.*

Key words: *Böhler's angle, Gissane's angle, Bangladeshi male*

Introduction

Calcaneus is the largest bone of the foot. It sits under and supports the talus. It is an elongated, irregular box-shaped bone with many muscular, ligamentous and tendinous attachments. It projects behind the ankle joint to form the skeletal framework of the heel and contributes to the posterior aspects of the medial and lateral longitudinal arches and shares in weight bearing.[1]

Fractures of the calcaneus are common in fall from height, slipping from stairways and road traffic accidents. These fractures account for 2% of all fractures and approximately 60% to 70% of the tarsal fractures.[2] The severity of a fracture can vary. A simple twist of the ankle may result in a single crack in the bone however a road traffic accident may result in comminuted fracture.

Imaging studies help in the diagnosis, treatment and prognosis of calcaneal fractures. Böhler's angle (BA) together with Gissane's angle (GA) is commonly used to evaluate the severity of a calcaneal fracture and the goal of a surgical treatment is to restore these angles to normal values. Radiological measurements of Böhler's angle and Gissane's angle of calcaneus at the time of initial presentation are the most important predictors of the postoperative functional outcome in calcaneal fractures.[3]

Böhler's angle also called the calcaneal angle or

[1]Assistant Professor, Department of Anatomy, Sheikh Hasina National Institute of Burn & Plastic Surgery, Dhaka
[2]Professor & Head, Department of Anatomy, Dhaka Medical College, Dhaka
[3]Lecturer, Department of Anatomy, Popular Medical College, Dhaka
[4]Lecturer, Department of Anatomy, Green Life Medical College, Dhaka
[5]Assistant Professor, Department of Anatomy, Army Medical College, Jashore
[6]Assistant Professor, Department of Anatomy, Brahmanbaria Medical College, Dhaka
Correspondence: Dr. A H M Mazharul Islam
Email: mazhar.milu@gmail.com

tuber joint angle was introduced by Dr. Lorenz Böhler in 1931. It is a 3-point angle in which all of the points are located entirely on the calcaneus.[4] Since all points are on the calcaneus, any fracture allows the posterior part of the calcaneus to move on the anterior part and the BA becomes smaller, straighter and can even reverse.[5] BA also measures the height of the posterior facet and identifies the degree of compression and deformity. Therefore, measurement of BA is an accepted method of quantifying fracture displacement and predicting the prognosis of calcaneal fractures.

Gissane's angle or critical angle of Gissane also has all its three points on the calcaneus. It also helps in the assessment of calcaneal fractures, especially by axial compressive forces and reflects the relationship of the anterior, middle and posterior facets.[5]

The previous studies performed in the American, Nigerian, Ugandan, Egyptian, Saudi Arabian, Turkish, Indian and Nepalese populations revealed a wide variability of the Böhler's and Gissane's angles among these respective populations.[2,3,5,6-8] Since racial differences have some influence on the anatomical structures,[9] it is necessary to find out the normal values of BA and GA for each population to avoid misdiagnosis. So far it is known that there is no published article on this topic in Bangladesh. So, the present study was designed to provide the normal values of BA and GA of adult Bangladeshi male population and to make comparison with those values reported by previous studies in other population.

Materials and Methods

This study was a cross sectional descriptive type of study carried out at the Department of Anatomy, Sir Salimullah Medical College, Dhaka from January 2017 to December 2017. A total of 50 consented male medical and dental students aged between 21 and 26 years of Sir Salimullah Medical College were recruited by purposive sampling method. Nationality and age of the study subject was confirmed from his national identity card. Those with any apparent disease, injury, deformity or disorder related to foot were excluded from the study.

Digital radiographs of left foot in lateral view were taken in the Radiology and Imaging Department of SSMCH. The subject was in standing position and the cassette was placed against the lateral aspect of the left foot. The X-ray beam was given from medial side of foot, perpendicular to the cassette and centered on the lateral cuneiform.[10]

These digital radiographs of left foot were imaged with a digital camera according to scale and were transferred to a computer. From these images Böhler's angle and Gissane's angle were measured.

Böhler's angle was measured as an angle formed by the intersection of two lines. The first line was drawn from the tip of anterior process of the calcaneus to the uppermost point of the posterior facet and the second line was drawn from the uppermost point of the posterior facet to the upper most point of the calcaneal tuberosity (Fig 1). Gissane's angle was measured as an angle between the lines drawn on the lateral border opacity of the posterior facet and the line drawn on the linear opacity of the anterior facet (Fig 2). Measurements of angles were performed by using MB ruler software.

Statistical analyses were performed using IBM

Fig.-1: *Digital radiograph of left foot in lateral view showing Bohler's angle (BA).*

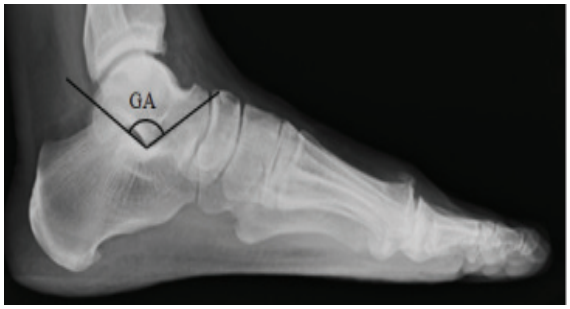

Fig.-2: *Digital radiograph of left foot in lateral view showing Gissane's angle (GA).*

SPSS Statistics (version 22) software, Armonk, New York. Normality of the data was checked using Kolmogorov–Smirnov test which showed that data were normally distributed. The descriptive statistics of the parameters were expressed as mean, standard deviation (SD) and range.

Ethical clearance

This study was approved by the Ethical review committee of Sir Salimullah Medical College, Dhaka, Bangladesh.

Results

Table- I

Descriptive statistics of the measured angles (n=50)

Dimensions	Mean ± SD	Range
Böhler's angle (°)	34.85 ± 6.87	20.20 - 49.38
Gissane's angle (°)	111.03 ± 9.48	89.89 - 132.69

SD = Standard deviation, n = Number of subjects

Böhler's angles of the study subjects were between 20.20° and 49.38° with mean±SD 34.85±6.87° and Gissane's angles of the study subjects were between 89.89° and 132.69° with mean±SD 111.03±9.48°.

Table- II

Comparison of Böhler's angle and Gissane's angle of the previous studies with that of the present study

Author (Year)	Study Population	Sample size	Böhler's angle(°) Mean ± SD (Range)	Gissane's angle(°) Mean ± SD (Range)
Present study (2017)	Bangladeshi	50	34.85 ± 6.87 (20.20 – 49.38)	111.03 ± 9.48 (89.89 – 132.69)
Rokaya et al (2016)[2]	Nepalese	140	31.3±5.28 (18 – 47)	108.4±10.59 (85 – 135)
Ramchandran and Shetty (2015)[7]	Indian	184	31.32±4.79 (19.6 – 44.8)	108.7±11.33 (86.9 – 136.1)
Sengodan et al (2012)[8]	Indian	324	30.63±5.77 (18 – 43)	126.80±7.89 (100 – 145)
Shoukry et al (2011)[11]	Egyptian	220	30.14±4.18 (22 – 40)	122.92±6.9 (108 – 138)
Seyahi et al (2009)[3]	Turkish	308	33.8±4.8 (20 – 46)	115.0±6.5 (100 – 133)
Khossal et al (2004)[5]	Saudia Arabians	229	31.21±5.62 (16 – 47)	116.16±8.51 (96 – 152)
Igbigbi and Mutesasira (2003)[13]	Ugandan	114	35.1±7.5 (20 – 50)	
Didia and dimka (1999)[12]	Nigerian	302	32.8±2.8 (28 – 38)	
Chen et al (1991)[14]	American	120	30±6 (14 – 50)	

Discussion

There are no standard parameters available for Bangladeshi male population. We use the values of the western text books as a reference values for Böhler's angle and Gissane's angle. But from our study it is evident that separate reference values are required for the Bangladeshi male population.

In the present study BAs were between 20.20° and 49.38° with mean±SD 34.85±6.87°. The range of BA of the present study population was almost equal to the Nepalese[2] population and higher as compared to the studies conducted in Indian,[7,8] Egyptian,[11] Turkish[3] and Nigerian[12] population and lower than that of the Saudi Arabian,[5] Ugandan[13] and American[14] population.

The GAs in the present study were between 89.89° and 132.69° with mean±SD 111.03±9.48°. The range of GA obtained in the present study population was higher as compared to the studies conducted in Egyptian[11] and Turkish[3] population and lower than that of the Indian,[8,9] Saudi Arabian,[5] and Nepalese[2] population.

Both Böhler's and Gissane's angles decrease in calcaneal fractures. So, the lower limit of these angles should be of greater interest especially when both calcanei are fractured because comparison to a normal side will not be possible. Otherwise, an incorrect assessment of calcaneal fractures could be made and an incorrect restorative treatment might be offered.

As there is no published article on radiographic dimensions of BA and GA in our country, comparison could not be made between the findings of the present study with previous studies of our country.

Conclusion

The present study will help in the assessment and decision making for the treatment of calcaneal fractures among the Bangladeshi male population

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