

Analysis of Bohler's Angle in Individuals with Sedentary Lifestyle of Central India

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Abstract

Introduction: Calcaneum is one of the tarsal bones who forms the base of the foot and takes the stress of body. Bohler's angle is subtended by calcaneus which is used in assessment of severity of calcaneum fractures. There is a physiological variation of Bohler's angle amongst various groups of population and also amongst both the sexes. We planned to measure the Bohler's angle from lateral view X rays of ankle and evaluate the results in normal individuals having a sedentary lifestyle.

Materials and Methods: This study was done at a tertiary care multi speciality hospital in Central India. The study was performed over 84 individuals coming to the OPD as attendants of patients. After prior informed consent, all of these individuals who completed the inclusion criteria were taken up for lateral view X ray of unilateral ankle depending on the dominant side of the patient. Bohler's angle of calcaneum was determined through Picture Archiving and Communication System (PACS) at our institute. All the basic particulars of the individuals were also recorded and evaluation done between different individuals.

Results: Out of the total 84 individuals, 37 were males and 47 were females. The average age of the individuals was 35.35 ± 12.12 years with a range of 18 - 65 years. Most of the individuals were right handed (72) whereas 12 patients were left hand dominant. The average Bohler's angle calculated was 29.65 ± 5.60 in females and 33.51 ± 4.46 in males. The variation in Bohler's angle measured in different individuals lies in range of $17^\circ - 43^\circ$ degrees.

Conclusion: The range of Bohler's angle in Indian population is comparable to standard reference values but it is slightly more in males as compared to females. The range of angles is variable in different population groups. There is still no clear reference of Bohler's angle for Indian population and hence accurate knowledge of Bohler's angles in different individual groups aids in accurate diagnosis and treatment of calcaneum fractures.

Keywords: Calcaneum; Bohler's Angle; X Ray; Sedentary; India

Abbreviations

CT Scan: Computerized Tomographic Scan; OPD: Out patient Department; PACS: Picture Archiving and Communication System; IBM: International Business Machines Corporation; USA: Unites States of America; SD: Standard Deviation

Introduction

Foot forms the base of the human body and it has attained its shape over million years of evolution. It can take load of over six times the body weight. One of the key bones supporting the body weight is the calcaneum which is largest tarsal bone, cuboid in shape, forms

heel pad of foot. Fracture of the calcaneum commonly occurs following fall from height and slip over stairs. Radiographic imaging plays an important role in the management of calcaneal fractures. Radiological measurement of Bohler's angle of the calcaneum are important parameters in calcaneal fracture diagnosis, management and assessment of prognosis.

Bohler's angle which is also called calcaneal angle is used to assess the change in anatomy of calcaneum. It is formed by angle formed by an imaginary line between the tip of calcaneal tuberosity and the highest point in the posterior talar facet, to another line drawn from the anterior process of the calcaneum to the posterior talar facet. The normal range is from 28° to 40° [1,2].

Displaced calcaneum fractures causes reduction of angle to less than 28° [3]. Bohler's angle plays a key role in diagnosis of calcaneal fractures and while planning and performing reduction and fixation during surgery. As calcaneum is the weight bearing bone, the calcaneal angle has evolved variably in different races due to differences in built and load bearing [4,5].

Objective of the Study

The objective of our study is to measure the Bohler's angle of calcaneum from radiological images of ankle joint in a group of Indian individuals having a sedentary lifestyle and assess it with the current standard values. We also compared our values with previous studies performed at various places across the world.

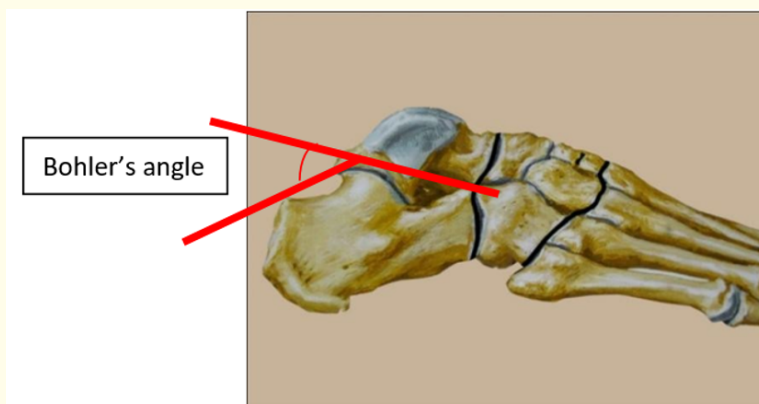


Figure 1: Bohler's angle in Calcaneum.

Materials and Methods

This is a hospital based cross sectional study done at a tertiary care centre in Central India from August 2018 to April 2019. In this study, X rays of 84 normal ankles of individuals having sedentary lifestyle were analysed. We considered attendants of patients coming in our OPD. We included individuals above 18 and below 65 years of age, individuals having sedentary lifestyle, individuals with no history of trauma in either of the lower limbs and no history of pain in ankle/heel. Exclusion criteria were age below 18 and above 65 years of age, individuals with history of injury/fracture in either lower limbs, deformity/congenital anomalies in ankle/foot, manual labourers, individuals having pain/symptoms of arthritis in heel/ankle.

Our study included 37 males and 47 females. Ethical clearance was obtained from the institutional ethical committee. Individuals coming to the hospital as patient attendants were randomly chosen and explained regarding this study. Out of 106 individuals who completed the inclusion criteria, 84 individuals agreed to be a part of the study. After taking their prior consent, they were referred to the radiology department. Radiograph of the lateral view of the ankle was taken in a single exposure. All the radiographs were visualized in

Picture Archiving and Communication System (PACS) available at the radiology department and orthopaedics department at our institute. Bohler’s angle was identified and measured using lines made on the radiograph through the PACS software. All the data was entered in an excel sheet. All the data was analysed and evaluated using SPSS 19.0 software (IBM).

Results

We considered 106 individuals to be a part of the study. Out of the total group, 84 individuals accepted to be a part of the study. All these individuals underwent radiographs of the ankle of their dominant side.

The average age of the individuals was 35.35 ± 12.12 years (Range - 18 - 65 years). There were 37 males and 47 females. Most of the individuals were right handed (72) whereas 12 patients were left hand dominant. The mean Bohler’s angle was found to be 33.51 ± 4.46 in males and 29.65 ± 5.60 in females in our study.

The minimum and maximum values of the Bohler’s angle were 17° and 43° respectively. We compared our data with various studies done in different parts of the world.

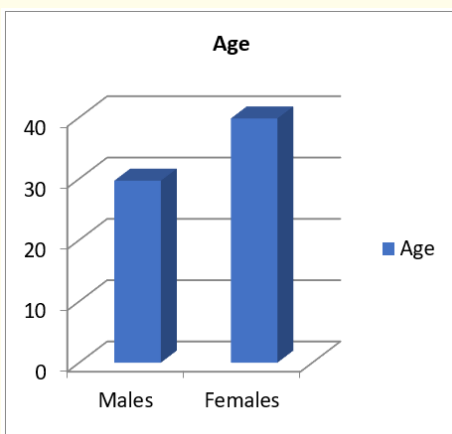


Figure 2: Age wise distribution.

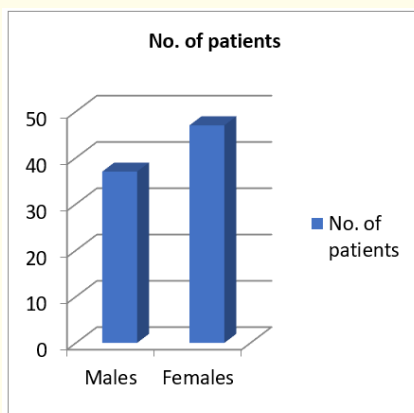


Figure 3: Sex distribution.

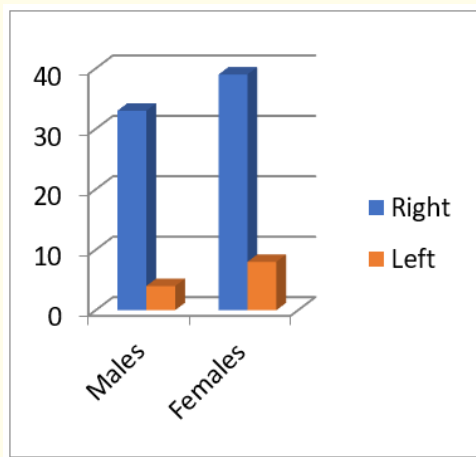


Figure 4: Side determination.

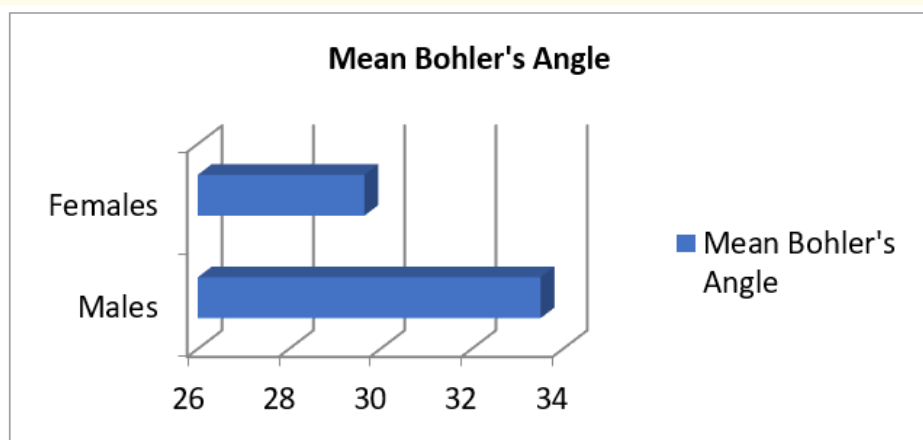


Figure 5: Mean Bohler's angle.

Criteria	Males	Females
Age	29.67 ± 12.02	39.82 ± 10.27
Number of patients	37	47
Right : Left dominant	33 : 4	39 : 8
Mean Bohler's Angle	33.51 ± 4.46	29.65 ± 5.60

Table 1: Comparison of variables in males and females.

Discussion

Calcaneum fractures account for approximately 2% of the total fractures. There have been a few studies have on Bohler’s angle in different races. We compared studies done in USA, Nigeria, Saudi Arabia, Turkey, Egypt and determined the variation in Bohler’s angle amongst different populations.

The studies have shown that there is significant relation of decreasing Bohler’s angle with age suggested by various studies, the tuber angle of Bohler ranges from 28 - 40 degrees. If the angle is decreased, it suggests that posterior facet of the calcaneum has collapsed which causes the weight of the body to shift anteriorly. The decreased Bohler’s angle is because of proximal displacement of the calcaneal tuberosity and occurs in both intra-articular and extra-articular calcaneal fractures.

Bohler’s angle is the most commonly used for assessing calcaneal fractures [3]. Ideally, four views are required to diagnose fractures of calcaneum- antero posterior view, lateral view, oblique view and Broden’s view [4,5]. The lateral view is most important to assess loss of height using Bohler’s angle. If the Bohler’s angle is less than 15 degrees, it is an indication for surgery [6]. While performing surgery, it is taken care that the Bohler’s angle is restored [7]. The Bohler’s angle prior to surgery helps in planning the treatment [8].

Study	Year	Range of Bohler’s angle	Mean	No. of cases
Chen., <i>et al.</i> (USA) [9]	1991	14° - 50°	30 ± 6	120
Didia and Dimkpa (Nigeria) [10]	1999	28° - 38°	32.8 ± 2.8	302
Khoshhal., <i>et al.</i> (Saudi Arabia) [11]	2004	16° - 47°	31.2 ± 5.6	229
Aksel Seyahi (Turkey) [12]	2008	20° - 46°	33.8 ± 4.8	308
Fahmy Anwar Shoukry (Egypt) [13]	2010	22° - 40°	30.14 ± 4.18	220
Our Study	2019	17° - 43°	31.35 ± 5.45	84

Table 2: Comparison of Mean Bohler’s angle in various studies.

Chen., *et al.* [9] concluded that higher normal range of Bohler’s angle would give more number of false positive results. As the normal range of BOhler’s angle is reduced, the number of false positive cases also reduced. Most of the studies took 28 degrees as the reference minimum range for normal Bohler’s angle. There is a need to establish normal range values in different populations to avoid high number of false positive cases of calcaneum.

Didia and Dimbka [10] found that the calcaneal angle in Nigerians is not significantly related to sex, age, or side of the body (left or right). Proper alignment of the calcaneus is essential for the maintenance of the arches of the foot, for standing erect, and for walking and running. Thus the calcaneal angle must be borne in mind whenever reconstructive surgery is performed.

Khoshhal., *et al.* [11] showed that there is a difference between the Saudi and various other populations in regard to Bohler’s angle and Gissane’s angle and reinforces the need to establish the normal ranges of Bohler’s angle and Gissane’s angle in a given population.

Seyahi., *et al.* [12] determined that there was no correlation between Bohler’s angle and Gissane’s angle nor between the calcaneal angles and age. The calcaneal angles show considerable variations in diverse ethnic groups and populations in terms of normal range, age, gender, and side.

Shoukry., *et al.* [13] suggested that there is a wide variation of normal range of calcaneal angles in different populations. Hence, the normal range should be variable for a given population.

The literature shows that the Bohler’s angle serves as a guide to assess outcome in surgical or non-surgical management of Calcaneal fractures [6]. The goal of treatment should be to restore the normal Bohler’s angle.

Conclusion

Bohler's angle plays an important role in the management of calcaneal fractures. There is no significant correlation between Bohler's angle and side of body, however It is significantly related to age i.e. decreases with aging. The range of Bohler's angle in Indian population is comparable to standard reference values but it is slightly more in males as compared to females. There are various range of angles in different population groups. There is still no clear reference of Bohler's angle for Indian population and hence accurate knowledge of Bohler's angles in different individual groups aids in accurate diagnosis and treatment of calcaneum fractures.

Limitations of the Study

Since the study sample is small, the data analysis cannot be applied for the whole population. Hence, there is a need to perform a higher level study to make a data analysis of Bohler's angle in Indian population.

Acknowledgements

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Conflict of Interest

None.

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