



DETERMINATION OF SEX FROM THE TALUS OF INDIAN POPULATION USING MORPHOMETRICAL ANALYSIS

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ABSTRACT

The determination of sex from an adult human skeleton is a fundamental task for forensic and physical anthropologists. Sex determination from skeletal remains may be done through morphologic (non-metric) or metric analyses. The talus has been shown to be useful for human identification as it is often well preserved during excavations and easily distinguished even in a fragmentary state due to its unique morphology. The aim of the present study is determination of sex from the talus of Indian population using morphometrical analysis. Therefore, the present study was undertaken to study talus for various morphological features such as length, width, height, neck length and neck breadth of the talus. In this study five variables of right and left talus were taken with the intention to show the differences in variable measurements of both sides and determine the sex. We have tried to determine the sex of the talus (162), taking into consideration the variable measurements of the 21 (seven females and 14 males) tali where the sex of the bone was known. The mean for all the variables of the tali studied viz., length, width, height, its neck length and breadth of the male right and left tali are more than those of the female right and left tali on either side. For the determination of the sex the literature available was not adequate, hence, we have compared tali of known sex and evaluated the results with the bones of unknown sex and tried to establish the sex of the bone. As per the variables in most cases (length, width, height, neck length, neck breadth) the sex of the bone identification was up to 75-92%.

KEYWORDS: Breadth, height, length, sex determination, talus, width.



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INTRODUCTION

Many skeletal traits have been investigated in studies of sex identification of adult skeletons. Sex estimation from skeletal remains is crucial in the identification of human remains, as it halves the number of possible matches. Furthermore, other biological reconstruction variables, such as age at death, rely on the knowledge of sex of the individual. The determination of sex from an adult human skeleton is a fundamental task for forensic and physical anthropologists.

In these fields, it is important to determine the sex of a human skeleton regardless of its state of preservation. Sex determination from skeletal remains may be done through morphologic (non-metric) or metric analyses. The morphological methods are simple and show great accuracy of about 98% with pelvis and skull¹. However, these methods tend to be subjective and depend on the experience of the observer². The metric method is objective in that it employs measurements and statistical results that can be repeated and validated³. Metric methods can also detect dimorphism in skeletal traits that may be characterized as ambiguous by morphological assessments^{4 & 5}.

⁶⁻⁸research have applied metric methods to postcranial elements and shown high accuracy rates for the determination of sex. Therefore, developing methods for estimating sex from preservationally favoured and/or fragmentary bones is essential. The talus has been shown to be useful for human identification as it is often well preserved during excavations and easily distinguished even in a fragmentary state due to its unique morphology⁵. This increased preservation is related to the increased strength and density of the bone's trabeculae and because it is often encased in socks and/or shoes⁹.

Owing to the high incidence of recovery of intact foot bones, several studies have focused on sex determination using the talus and calcaneus¹⁰⁻²¹. Although research has shown high accuracy rates for sex determination from the talus, these studies have cited the methods to be population specific.

Nearly all bones in the skeleton have been studied to calculate discriminant functions²². These studies indicated the utility of these foot bones for sexual assessment, with accuracy ratios from 67 to 97%. Several studies indicated that sex assessment with measurements of the talus and calcaneus was highly effective among many populations. In addition, the preservation of the talus and the calcaneus tend to be good even in ancient skeletal remains representing a great potential for sex determination. The percentage at which they were preserved reached 44.3– 51.1% at a Romano-British site²³. This means that their analysis could increase the opportunity to assess the sex of skeletal remains. Although ¹⁰stated that the discriminant functions could be applied to remains of unknown ethnic origin, ²⁰concluded that osteometric differences exist between different population groups, and East Asians may have smaller tarsal bones than people of European or African origin, which may affect the results of the discriminant functions.

In South Africa, similar efforts have also been made to derive population specific equations, with varying degrees of success based on average accuracy.

However, the femur (68% – 91%) remains the most studied bone for sex estimation in South Africa. The talus has now been shown to be a good indicator of sex, race and for categories of sex with race. The successful placement of individuals in the category of sex was 93% using the model selected. The percentage of those correctly classified using the race model with interactions was 95%. These previous studies indicate that sexual dimorphism is present in the tarsals. ^{10&24}reported that length measurements (particularly those of the talus) are the most useful for distinguishing between males and females in different human populations, and provide support for the following research on sexual dimorphism in a modern skeletal population.

The talus is the second largest bone among the tarsals and the bone with no muscular or tendinous attachments. It is the only bone through which entire body weight load is channeled, before being distributed to the arches of the foot. Accurate estimations and derivations of metric features can be obtained straight forwardly from calcaneus and talus bones, since these bones are compact and more durable. Even, for designing and fabrication of prosthesis, data of the normal dimensions of the talus is needed. Therefore, the present study is taken up to have a base line data regarding the dimensions of the talus. As the talus is resisting degeneration for a long time unlike other bones the present study was undertaken to study talus for various morphological features. The objective of the present study is determination of sex from the talus of Indian population using morphometrical analysis. Therefore, the study is aimed to measure length, width, height, neck length and its breadth of the talus.

The aim of studying the various morphometrical measurements of the tali is to obtain normal range of distribution of various dimensions of tali among the subjects and also to conclude any greater differences among obtained measurement values between right and left sided tali within the collected sample. In this study we have taken five parameters for obtaining the normal range of dimensions in the area of study.

MATERIALS AND METHODS

The osteological material used in this study was collected from the department of anatomy of various medical colleges in and around Hyderabad, Telangana and also from the dissected cadavers in Osmania Medical College, Hyderabad, Telangana, India. The sample for study consisted of one hundred and eighty three human tali among which 21 (7 females and 14 males) were collected from dissected cadavers while 162 were from the departmental collections. The instruments used for the purpose of extracting and cleaning the tali were scalpel, forceps, blunt forceps, serrated / toothed forceps, pointed forceps. Sliding Vernier Calipers, protractor, electronic weighing scale were the instruments used for the purpose of measurements.

METHOD OF CLEANING OF THE TALUS

All the tali were carefully and thoroughly dusted using a paint brush. Sex of the tali was noted for those tali which

were collected from the dissected cadavers. After displacing the surrounding soft tissues, the ligaments around the talus were cut and the talus was extruded. The talus bone thus separated was washed and immediately transferred into a plastic box containing 5% formaldehyde solution in which it was left for 48-72 hours. All the specimens were given serial numbers (Fig. 1A) and preserved in separate plastic boxes. After 72 hours, the specimen was washed in the running tap water for removing formalin, left outside on glass surface and allowed to dry for about 1-2 hrs. Later, all the soft tissues were removed with the help of scalpel and forceps. Defating i.e., removal of the remnant tissues of all the bones was done separately with the help of scalpel and forceps. The tali were kept in acetone for a period of 24 to 72hrs so that no further loss of weight occurs. All the tali were dried and numbered with help of adhesive stick paper and a gel ink pen.

For determination of sex the talus of each individual was measured using sliding Vernier Calipers, taking five measurements. All measurements were done according to Martin²⁵ methodology, with exception of two defined by Steele¹⁰. The measurements used for the talus are: talar length (TL), talar width (TW), body height (TH), talar neck length (NL) and its breadth (NB). All metric values were collected by one observer with digital vernier calipers and measured to the nearest 0.01 mm.

Thus, for each individual talus right and left side measurements were taken considering ten variables for the talus (length on the right, LeR_T, and on the left, LeL_T; width on the right, WiR_T, and on the left, WiL_T; height on the right, HeR_T, and on the left, HeL_T; neck length on the right NIR_T, and on the left, NIL_T, neck breadth on the right, NbR_T, and on the left, NbL_T).

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences) software package Version 16.0.

RESULTS AND DISCUSSION

In this study five variables of right and left talus were taken with the intention to show the differences in variable measurements of both sides and determine the sex. We have tried to determine the sex of the talus (162), taking into consideration the variable measurements of the 21 (seven females and 14 males) tali where the sex of the bone was known. The various variables which were taken into consideration and the method of measuring (Fig. 1B-F) them is described in the materials and methods.

Table 1
The number and range of the known and predicted male and female right tali for the measured parameters

| Parameters of talus | Number of known Specimens | Range of known Specimens (cm) | Number of predicted Specimens | Range of specimens Studied (cm) | Number of known Specimens | Range of known Specimens (cm) | Number of predicted Specimens | Range of specimens Studied (cm) |
|---------------------|---------------------------|-------------------------------|-------------------------------|---------------------------------|---------------------------|-------------------------------|-------------------------------|---------------------------------|
| | | Male right tali | | | | Female right tali | | |
| Length | 06 | 5.6-6.1 | 25 | 5.6-6.2 | 04 | 5.0-5.4 | 49 | 4.5-5.4 |
| Width | 06 | 3.8-4.6 | 25 | 3.9-4.6 | 04 | 3.4-3.8 | 45 | 3.2-3.7 |
| Height | 06 | 3.0-3.6 | 12 | 3.2-3.5 | 04 | 2.9-3.1 | 62 | 2.3-2.9 |
| Neck length | 06 | 1.2-2.0 | 64 | 1.4-2.4 | 04 | 1.2-1.3 | 10 | 1.0-1.1 |
| Neck breadth | 06 | 1.9-3.1 | 56 | 2.0-3.2 | 04 | 1.8-1.9 | 16 | 1.6-1.8 |

Table 2
The number and range of the known and predicted male and female left tali for the measured parameters

| Parameters of talus | Number of known Specimens | Range of known Specimens (cm) | Number of predicted Specimens | Range of specimens Studied (cm) | Number of known Specimens | Range of known Specimens (cm) | Number of predicted Specimens | Range of specimens Studied (cm) |
|---------------------|---------------------------|-------------------------------|-------------------------------|---------------------------------|---------------------------|-------------------------------|-------------------------------|---------------------------------|
| | | Male left Tali | | | | Female left Tali | | |
| Length | 08 | 5.2-6.3 | 39 | 5.3-6.5 | 03 | 4.5-5.2 | 36 | 4.3-5.1 |
| Width | 08 | 4.0-4.5 | 17 | 4.1-4.8 | 03 | 3.7-4.0 | 62 | 3.1-3.9 |
| Height | 08 | 2.9-3.4 | 28 | 3.0-3.9 | 03 | 2.7-2.9 | 45 | 2.3-2.8 |
| Neck length | 08 | 1.2-1.6 | 56 | 1.3-2.4 | 03 | .9-1.2 | 18 | 0.7-1.1 |
| Neck breadth | 08 | 1.8-2.7 | 57 | 2.0-3.1 | 03 | 1.8-1.9 | 11 | 1.6-1.7 |

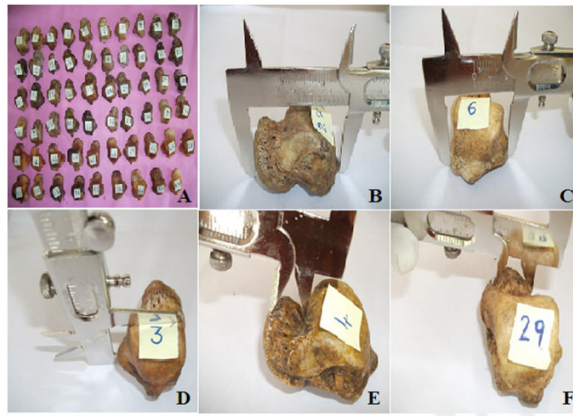


Figure 1
A-Talus bones studied, method of talus measurements taken: B- length, C- width, D- height, E- neck breadth, F- neck length.

Table 3
The ranges and overlapping values of the predicted male and female tali

| Parameters of talus | Range male right tali(cm) | Range female right tali(cm) | Overlapping range of male and female right tali (cm) | Range male left tali(cm) | Range female left tali(cm) | Overlapping range of male and female left tali (cm) |
|---------------------|---------------------------|-----------------------------|--|--------------------------|----------------------------|---|
| Length | 5.6-6.1 | 4.5-5.4 | 5.5 | 5.2-6.3 | 4.5-5.2 | 5.2 |
| Width | 3.8-4.6 | 3.4-3.8 | 3.8 | 4.0-4.5 | 3.7-4.0 | 4.0 |
| Height | 3.0-3.6 | 2.9-3.1 | 3.0-3.1 | 2.9-3.4 | 2.7-2.9 | 2.9 |
| Neck length | 1.2-2.0 | 1.2-1.3 | 1.2-1.3 | 1.2-1.6 | 0.9-1.2 | 1.2 |
| Neck breadth | 1.9-3.1 | 1.8-1.9 | 1.9 | 1.8-2.7 | 1.8-1.9 | 1.8-1.9 |

Table 4
The number of the predicted male, female and unpredicted tali.

| Parameters of talus | Number of predicted Male tali | Number of predicted Female tali | Total number of predicted tali | Number of unpredicted tali |
|---------------------|-------------------------------|---------------------------------|--------------------------------|----------------------------|
| Length | 64 | 85 | 149 | 13 |
| Width | 42 | 107 | 149 | 13 |
| Height | 40 | 107 | 147 | 15 |
| Neck length | 120 | 28 | 148 | 14 |
| Neck breadth | 28 | 113 | 141 | 21 |

Table 5
The number, range and mean for length, width and height tali

| Sex and side | Length | | | Width | | | Height | | |
|-------------------|----------------|------------|-----------|----------------|------------|-----------|----------------|------------|-----------|
| | Number of tali | Range (cm) | Mean (cm) | Number of tali | Range (cm) | Mean (cm) | Number of tali | Range (cm) | Mean (cm) |
| Male right tali | 25 | 5.6-6.2 | 5.82 | 25 | 3.9-4.6 | 4.12 | 12 | 3.2-3.6 | 3.30 |
| Male left tali | 39 | 5.3-6.5 | 5.61 | 17 | 4.1-4.8 | 4.25 | 28 | 3.0-3.9 | 3.15 |
| Female right tali | 49 | 4.5-5.4 | 5.05 | 45 | 3.2-3.7 | 3.55 | 62 | 2.3-2.9 | 2.72 |
| Female left tali | 36 | 4.3-5.1 | 4.85 | 62 | 3.1-3.9 | 3.53 | 45 | 2.3-2.8 | 2.58 |

Table 6
The number, range and mean for neck length and neck breadth

| Sex and side | Neck length | | | Neck width | | |
|-------------------|----------------|------------|-----------|----------------|------------|-----------|
| | Number of tali | Range (cm) | Mean (cm) | Number of tali | Range (cm) | Mean (cm) |
| Male right tali | 64 | 1.4-2.4 | 1.78 | 56 | 2.0-3.2 | 2.28 |
| Male left tali | 56 | 1.3-2.4 | 1.66 | 57 | 2.0-3.1 | 2.28 |
| Female right tali | 10 | 1.0-1.1 | 1.07 | 16 | 1.6-1.8 | 1.74 |
| Female left tali | 18 | 0.7-1.1 | 1.01 | 11 | 1.6-1.7 | 1.67 |

The range and mean values for the predicted male and female tali are summarized in Tables 1-6. The range and mean values of the length (in centimeters) for the

predicted male and female tali are summarized in Table 1. From the table it was observed that talar length among the male (25) and female (49) right tali was in

the range of 5.6 - 6.2cm and 4.5 - 5.4cm, and their respective mean were 5.82 and 5.05cm (Table 5). While, among the male (39) and female (36) left tali in a range of 5.3 - 6.5cm and 4.3 - 5.1cm (Table 2) and their respective means were 5.61 and 4.85cm (Table 5).

The range and mean values of the width (cm) for the predicted male and female tali presented in Table 1 indicates that the talar width among the male (25) and female (45) right tali were in the range of 3.9-4.6cm and 3.2-3.7cm, and their respective means were 4.12 and 3.55cm (Table 5). While, among the male (17) and female (62) left tali in a range of 4.1-4.8cm and 3.1-3.9cm (Table 2) and their respective means were 4.25 and 3.53cm (Table 5).

The range and mean values of height for the predicted male and female tali presented in Table 1 showed that among the male (12) and female (62) right tali in a range of 3.2-3.5cm and 2.3-2.9cm and their respective means were 3.30 and 2.72cm (Table 5). While, among the male (28) and female (45) left tali in a range of 3.0-3.9cm and 2.3-2.8cm (Table 2) and their respective means were 3.15 and 2.58cm (Table 5).

The range and mean values of the neck length predicted male and female tali summarized in Table 1 shows that among the male (64) and female (10) right tali in a range of 1.4 - 2.4cm and 1.0 - 1.1cm and their respective means were 1.78 and 1.07cm (Table 6). While, among the male (56) and female (18) left tali were in the range of 1.3 - 2.4cm and 0.7 - 1.1cm (Table 2) and their respective means 1.66 and 1.01cm (Table 6).

The range and mean values of the neck breadth predicted male and female tali presented in Table 1 indicates that among the male (56) tali and female (16) right tali in a range of 2.0 - 3.2cm and 1.6 - 1.8cm and their respective means were 2.28 and 1.74cm (Table 6). While, among the male (57) and female (11) left tali

were in the range of 2.0 - 3.1cm and 1.6 - 1.7cm (Table 2) and their respective means 2.28 and 1.67cm (Table 6).

The mean for all the variables of the tali studied viz., length, width, height, its neck length and breadth of the male right and left tali are more than those of the female right and left tali on either side. The results for the sex differences among tali sexing skeletons from a contemporary Greek population are appropriate for this study. Being the only weight bearing bone in the ankle joint the talus has attracted anatomists, surgeons and orthopedicians for its morphometric studies. The unique feature of the talus apart from the specificity of transmitting the weight of the body to the ground is that it has no muscular attachments. The bone is sandwiched in between the tibia, fibula, calcaneum and navicular bones. Unfortunately it has less blood supply when compared to the other bones. Hence it can undergo avascular necrosis because of less blood supply.

Many authors have worked on the morphometrical measurements of the right and left tali and were interested to see the differences in the measurements in between the two bones. It was found that there was some difference in the measurements of the right and left tali which varied among the various races throughout the world. Regarding the measurements of the tali in relation to the sexes, it was found that 92% of the male bone variable measurements were more compared to that of the female bone variable measurements. Similar results were reported earlier^{4, 15-16, 21, 26-27}.

The present study results are correlating with the earlier results^{15-16, 21, 26-28} since, the mean for the length of the male tali are more than those of the female tali (Table 7).

Table 7
Comparative study of the mean for the length (in centimeters) of the male (right and left) and female (right and left) tali.

| Author | Male talus | | Female talus | |
|--|----------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | Right | Left | Right | Left |
| Murphy ²⁸ | 53.23(5.32cm) | | 47.99(4.79cm) | |
| Ferrari, Jill <i>et al</i> ²⁶ | 52.59(5.25cm) | | 46.85(4.68cm) | |
| Gualdi-Russo ²¹ | 56.1+/-2.9 (5.61+/-0.29cm) | 56.1+/-2.9 (5.61+/-0.29cm) | 49.2+/-2.3 (4.92+/-0.23cm) | 49.3+/-2.1 (4.93+/-0.21cm) |
| Harris and Case ⁴ | 61.05+/-3.59 (6.10 +/-0.35cm) | 61.69+/-3.62 (6.16+/-0.36cm) | 53.75+/-2.87 (5.37+/-0.28cm) | 54.64+/-2.94 (5.46+/-0.29cm) |
| Torres. Terri ²⁷ | 60.96+/-3.61 (6.09+/-0.36cm) | - | 53.75+/-3.37 (5.37+/-0.33cm) | - |
| Present study | 5.82 | 5.61 | 5.05 | 4.85 |

Table 8
Comparative study of the mean for the width (in centimeters) of the male (right and left) and female (right and left) tali.

| Author | Male talus | | Female talus | |
|--|----------------------------------|---------------------------------|----------------------------------|--------------------------------|
| | Right | Left | Right | Left |
| Murphy ²⁸ | 44.23(4.42cm) | | 39.47(3.94cm) | |
| Ferrari, Jill <i>et al</i> ²⁶ | 38.03(3.80cm) | | 34.36(3.43cm) | |
| Gualdi-Russo ²¹ | 43.3+/-2.2 (4.33+/-0.22cm) | 43.4+/-2.2 (4.34+/-0.22cm) | 38.3+/-2.2 (3.83+/-0.22 cm) | 38.5+/-2.0 (3.85+/-0.2cm) |
| Harris and Case ⁴ | 44.45+/-2.44 (4.44 +/-0.24cm) | 44.45+/-2.46 (4.44+/-0.24cm) | 39.43+/-2.51 (3.94+/-0.25 cm) | 39.15+/-2.04 (3.91+/-0.2cm) |
| Torres Terri ²⁷ | 45.28+/-2.86 (4.52+/-0.28 cm) | - | 39.30+/-3.25 (3.93+/-0.32 cm) | - |
| Present study | 4.12 | 4.25 | 3.55 | 3.53 |

Murphy²⁸ studied width of 24 adult male tali and 27 adult female tali, and the means observed were 44.23 mm and 39.47 mm respectively. ²⁶study included 107 skeletons and the means observed in their study for the male and female tali were 38.03 mm and 34.36 mm. Gualdi-Russo²¹ study sample consisted of 118 skeletons (62 males and 56 females) and the means for the width of the talus observed for the male and female right tali were 43.3 and 38.3 mm while, for the male and female left tali the means were 43.4 and 38.5 mm respectively. Harris and Case⁴ studied a sample of 82 White males and 78 White females and the mean observed for the male and female right tali were 44.45 and 39.43 mm while, for the male and female left tali were 44.45 and

39.15mm respectively. Torres Terri²⁷ studied sample size representing 227 individuals, composed of 113 females and 114 males. The mean for the width observed were 45.28 and 39.30mm respectively. The present study included 183 talus bones consisting of 91 right and 92 left tali. The means for the width of the talus observed for the male and female right tali were 4.12 and 3.55mm while, for that for male and female left tali were 4.25 and 3.53mm respectively. The present study results are correlating with the results of the earlier workers^{4, 21, 26-28} since, the mean for the width of the male tali are more than those of the female tali (Table 8).

Table 9
Comparative study of the mean for the height of the male (right and left and female (right and left) tali in centimeters

| AUTHOR | Male Talus | | Female Talus | |
|-----------------------------------|----------------------------------|---------------------------------|----------------------------------|---------------------------------|
| | Right | Left | Right | Left |
| Murphy ²⁸ | 29.09(2.90cm) | | 26.15(2.61cm) | |
| Ferrari. Jill et al ²⁶ | 38.03(3.80cm) | | 34.36(3.43cm) | |
| Gualdi-Russo ²¹ | 32.3+/-1.8 (3.23+/-0.18cm) | 32.6+/-1.7 (3.26+/-0.17cm) | 29.0+/-1.4 (2.90+/-0.14 cm) | 29.2+/-1.2 (2.92+/-0.12cm) |
| Harris and Case ⁴ | 34.81+/-1.98 (3.48+/-0.19cm) | 34.69+/-1.99 (3.46+/-0.19cm) | 30.63+/-2.05 (3.06+/-0.20cm) | 30.48+/-1.56 (3.04+/-0.15cm) |
| Torres Terri ²⁷ | 33.06+/-2.11 (3.30+/-0.33 cm) | — | 29.01+/-2.34 (29.0+/-0.23 cm) | — |
| Present study | 3.30 | 3.15 | 2.72 | 2.58 |

The present study 183 talus bones consisting of 91 right and 92 left tali. the mean for the height of the talus observed for the male and female right tali were 3.30 and 2.72cm and while for the male and female left tali the means observed were 3.15 and 2.58cm (Table 9). The present study results are correlating with the earlier study results^{4, 21, 26-28} since, the mean for the height of the male tali are more than those of the female tali.

From the present 183 talus bones (91 right and 92 left) the mean for the neck length of the talus observed for the male and female right tali were 1.78 and 1.07cm while, for the male and female left tali the means observed were 1.66 and 1.08cm (Table 10). The present study results are correlating with the earlier reports²⁷ since, the mean for the neck length of the male tali are more than those of the female tali on right side.

Table 10
Comparative study of the mean for the neck length (in centimeters) of the male (right and left) and female (right and left) tali

| Author | Male talus | | Female talus | |
|----------------------------|----------------------------------|------|----------------------------------|------|
| | Right | Left | Right | Left |
| Torres Terri ²⁷ | 18.41+/-2.65 (1.84+/-0.26 cm) | — | 16.03+/-4.86 (1.60+/-0.48 cm) | — |
| Present study | 1.78 | 1.66 | 1.07 | 1.01 |

The present study 183 talus bones (91 right and 92 left) the mean for the neck breadth of the talus observed for the male and female right tali were 2.28 and 1.74cm while, for the male and female left tali the means were 2.28 and 1.67cm (Table 11). There was no literature available to correlate and discuss the present study results of talar neck breadth, but the findings are that the mean for the neck breadth of the male right tali were more than those of the female right tali while, the mean for the neck breadth of the male left tali were less than those of the female left tali. The morphological methods are simple and show great accuracy.

The morphological methods are simple and showed great accuracy. This study has shown that measurements of the talus can be useful for the assessment of sex in Indian population. This agrees with the results of previous studies^{10-11, 15-21}. These results showed that talus measurements can be used for determining sex and the results are comparable with other similar studies and the studied talus variables showed sexual dimorphism with an accuracy. This paper provides indications that the talus is an important bone for sex diagnosis and could be effectively used as alternatives in forensic cases.

Table 11
The mean for the neck breadth in centimeters of the male (right and left) and female (right and left) tali

| Author | Male Talus | | Female Talus | |
|---------------|------------|------|--------------|------|
| | Right | Left | Right | Left |
| Present study | 2.28 | 1.66 | 1.74 | 1.67 |

In the present study various variables of the talus were studied. The sample consisted of 183 tali among which 162 were of unknown sex while 21 were of known sex. In this study the main criterion was laid on to study and compare the various measurements of the talus in Telangana with that of those studies done in various parts of the world. The talar measurements vary with the side, sex, race etc. we have tried to evaluate the sex of the bone which has medico legal importance. For the determination of the sex the literature available was not adequate, hence, we have compared tali of known sex and evaluated the results with the bones of unknown sex and tried to establish the sex of the bone. As per the variables in most cases (length, width, height, neck length, neck breadth) the sex of the bone identification was up to 75-92%.

Thus in the absence of preferred remains or identification, the talus can provide evidence that should result in a good probability of correct identification with the help of most of the variables. The following are the results of the various measurements of the talus studied: The mean for the length, width, height, neck length and neck breadth of the male tali (right and

left) are more than those of the female tali (right and left). On compiling the results, it is found that the dimensions of the male tali were more compared to that of the female tali and the dimensions of the male and female tali of the present study were more often less compared to the previous studies.

CONCLUSION

The talus is one of the most durable bones of the foot and often recovered in forensic and archaeological cases. The results of this study indicate high accuracy rates for the determination of sex from the talus bone in Indian population. Hence, the talus being an important bone for sex diagnosis could be effectively used as alternative in forensic cases.

CONFLICT OF INTEREST

Conflict of interest declared none.

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