ORIGINAL ARTICLE

STUDY OF ANATOMICAL VARIATIONS OF SCAPHOID BONE AND ITS CLINICAL IMPORTANCE

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ABSTRACT: OBJECTIVES: Fractures of the scaphoid are the most common of the carpal bone injuries, because of its connection with the two rows of carpal bones. The scaphoid fractures are slow to heal because of the limited circulation to the bone. Hence they must be recognized and treated quickly, as prompt treatment by immobilization or surgical fixation avoids mal-union or non-union. This study presents the anatomical variations in dimensions and appearance of scaphoid bone. **MATERIALS AND METHODS:** Thirty dried human scaphoid bones were studied from the Department of Anatomy, Mahathma Gandhi medical college, Puducherry, to identify the possible anatomical variations. The morphometric Parameters were measured with vernier calipers. The circumferences and length were measured using a thread. The number of foramina was observed using a magnifying lens. **RESULTS:** Out of 30 scaphoid studied, the tubercle was present in all of the bones. Among the left sided scaphoid 7 were conical and 8 were pyramidal in shape. Similarly on the right side 9 were conical and 6 were pyramidal in shape. Most of the scaphoid had main dorsal sulcus (19 Scaphoids) and 11 scaphoids had two dorsal sulci. All the scaphoids had more than five foramina on the dorsal sulcus.
KEYWORDS: wrist, Scaphoid, morphology, tubercle.

INTRODUCTION: Scaphoid has derived its name from a Greek word called skaphos, which means a boat and Greek word eidos, which means "kind"[1]. The scaphoid is one of the important bone among the proximal row of carpal bones. It is situated on the radial side (thumb) of the wrist. Scaphoid articulates with the Radius and other carpal bones namely lunate, Trapezium, Capitate. It is connected with lunate bone by means of scapholunate ligament. Scapholunate instability can occur when scapholunate ligament gets disrupted. Scaphoid heals slowly due to limited blood supply hence any fracture of this bone should be attended immediately in order to avoid either mal-union or non-union. Occasionally non-union may lead to post-traumatic osteoarthritis.[2]

The middle and distal portions of the scaphoid bone is supplied by the lateral and distal branches of Radial artery via palmar and dorsal branches but neglects the proximal portion. The radial collateral ligament gives attachment to narrow lateral surface. The medial surface has two facets, a flattened semi-lunar facet articulating with the lunate bone and an inferior concave facet articulating with the head of the capitate bone[3]. Occasionally Abductor Pollicis Brevis arises from the tubercle of scaphoid.[4] The position of scaphoid bone is similar to the position of the Navicular bone in the foot hence scaphoid bone is referred to as Navicular bone of the hand [5].

Surgeons performing operative fixation of scaphoid fractures using a headless compression screw such as the Herbert screw and corticocancellous bone grafting for nonunion need to be familiar with these anatomical variations.

MATERIALS AND METHODS: Thirty (15 left and 15 right) dried unknown human scaphoid bones were studied from the department of Anatomy, Mahathma Gandhi Medical College and Research Institute, Pondicherry. Scaphoid with arthrosis, evidence of trauma or other pathological changes were excluded from this study. Side determination of the bones was done by anatomical features.

Morphological parameters-The scaphoid tubercles was assessed based on its shape either conical or pyramidal (Fig. 1). The presence of waist, dorsal sulcus, ridge for origin of scaphocapitate interosseous ligament(SCIL) and the sulcus for Flexor Carpi Radialis (FCR) were observed and tabulated (Fig. 5). The number of foramina was observed using a magnifying lens. The shape of the scapholunate joint surface were also noted (Fig. 2).

Morphometric parameters were measured with vernier calipers of 0.02mm accuracy. The length was measured by distance between the most prominent points of proximal articular surface and the tubercle. The circumferences of the width were measured at three different regions (proximal, waist, distal) by placing a thread around them. The primary and secondary height of the tubercle was measured and tabulated (table 4). Primary height of the tubercle was defined as the distance between the most prominent point of the tubercle and the intersection of the anterior and superior ridges of the scaphalolunate articular surface. The secondary height of the tubercle was defined as the most prominent point of the tubercle and the deepest point of the waist. Circumference of the tubercle was measured at its base. The length and width of the dorsal sulcus were calculated.

RESULTS:

Morphology:

Tubercle: The tubercle was present in all the scaphoid bones. Among the left scaphoid 7 were conical and 8 were pyramidal in shape, whereas on the right side 9 were conical and 6 were pyramidal in shape (Table- 1).

Waist: Waist was present in all the 30 scaphoids. The waist serves as an important anchoring point for several ligamentous attachments (Berger RA).[8] In the absence of waist there could be more ligamentous injuries.

Dorsal Sulcus: The shape and variations of the dorsal sulcus were noted. Most of the scaphoid had main dorsal sulcus (19 Scaphoids) and 11 scaphoids had two dorsal sulci. Foramina in the dorsal sulcus were counted; all the scaphoids had more than five foramina on the dorsal sulcus. All the scaphoids with secondary sulcus also had more than five foramina. The foramina in the proximal and distal regions were counted as well. The foramina which were assessed in the proximal region were present only in 6 scaphoids, this may explain the occurrence of non union

and avascular necrosis after proximal fracture (oblez BE, Halbstein BM)[9] The foramina in the dorsal sulcus is related to the vascular supply of the scaphoid.

Ridge for the origin of scaphalocapitateinterosseus ligament: SCIL were present in 12 cases on the left side and 10 on the right side. The absence of ridge could indicate the weak attachment of SCIL further making the scaphalocapitate joint weak. Sulcus for Flexor Carpi radialis were also seen and it was present in 11 cases on the left side and 10 on the right side.

The shape of scapholunate articular surface was noted whether it is half moon or cresentic.

Morphometry: The parameters were compared with both sides of the scaphoid (Table 2). The circumference of the waist, width and length of the dorsal sulcus were statistically significant. The mean and standard deviation of the parameters were shown in Table -3 and 4.

DISCUSSION: Scaphoid injury is the most common pathology of the carpal bone[6]. The reported incidence of nonunion after conservative treatment has been more than 12% particularly in young men.[7] The waist serves as an important anchoring point for several ligamentous attachments.[8] A study has been done by Gelberan RH and Menon J[10] on vascularity of scaphoid bone in 15 fresh cadavers. They studied extraosseous and intraosseous vascularity by injections and clearing techniques. Radial artery is the major blood supply to the scaphoid bone. There is excellent collateral circulation through dorsal and volar branches of Anterior interrosseous artery.[10] Scaphoid bone is known for its fracture when the individual falls on outstretched hand. There may be associated fracture of the end of the fore arm bones especially radius. Fracture may take place at all ages, even in children. In males, it may occur between age group of 20-30 years of age.[11]

The Scaphoid bone is unique in shape and function. It has unique three dimensional orientation and forms a mechanical link between the proximal and distal rows of carpal bones on the radial aspect of the wrist to perform a unique function.[12] The scaphoid due to its complex shape and its orientation with other carpal bones makes it difficult to interpret its anatomy radiologically.[13, 14] They have stated that the aim of surgical intervention in the case of non union of scaphoid is to restore normal shape of bone. In acute scaphoid fractures, internal fixation is the only well established line of treatment alternative to casting.[15]

In healthy and young individuals, scaphoid is the only carpal bone of the wrist to get fractured.[16] Megerle K et al did a study on morphology of scaphoid and alignment of carpal bones on a total of 65 patients in an average age group of 29 years and follow up was done for a mean period 45 months. There was confirmation of osseous union in the middle third in all patients. When reconstruction of scaphoid has been done, there is every chance of Scaphoid mal-union and carpal mal-alignment when two segment of fractured scaphoid are not properly reduced.[17]

Purushothama C et al[18] conducted a study on one hundred unknown human scaphoid in Sikkim of North Eastern Indian population. The morphometric parameters were measured and statistically assessed. On the left side scaphoid were conical in (44%), pyramidal shape in 28 (56%). On the right side, they were conical in 36(72%) and pyramidal shape in 14(28%). In the

present study, on the left side, 7 scaphoid were conical and 8 were pyramidal in shape. Similarly on the right side 9 scaphoid were conical and 6 were pyramidal in shape. All the scaphoids had waist except one. In the present study, Waist was present in all the 30 scaphoids.

In 63% of cases scaphoid had main dorsal sulcus, while in 29%, they had two dorsal sulci and there was absence of dorsal sulcus in 3 cases - two on the right side and one on left side. In the present study, 19 Scaphoids had main dorsal sulcus and two dorsal sulci were present in 11scaphoids.There were more than 5 foramina on dorsal sulcus in all scaphoids. All the scaphoids with secondary sulcus also had more than five foramina.

Purusothama C et al stated that Y shaped sulci was seen in 6%. Scaphalo capitate interosseusligament (SCIL) was present in 12 cases on the left side 10 on the right side. Sulcus for flexor carpi radialis were present in 11 cases on the left side and 10 on the right side. In the present study, no Y shaped sulci was seen. This difference in sulci, tubercle and Y shaped sulci may be due to population difference, genetic difference or numerical difference with a great anthropological importance.

The mean length of scaphoid bone on left side was 21.97mm and of right side 22.42 mm with a standard deviation of 1.480 and 1.140 respectively.

CONCLUSION: Scaphoid injury is the most common pathology of the carpal bone. Along with fracture of Scaphoid bone, there may be associated fracture of other bones like radius and other carpal bones. The reported incidence of nonunion after conservative treatment has been more than 12% particularly in young men. An established nonunion or mal-union after fracture can lead to pain, loss of function and osteoarthritis. The preferred treatment is surgical reduction with internal fixation. Hence the data obtained may help the orthopedicians, hand surgeons and radiologists.

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	Conical	Pyramidal	Total
Right	9	6	15
Left	7	8	15
Total	16	14	30

Table 1: shows the number of scaphoid with shape of the tubercle

	Left	Right	Total
Tubercle	15	15	30
Waist	15	15	30
Dorsal sulcus	15	15	30
Sulcus for FCR	11	10	21
Ridge for the origin of SCIL	12	10	22

Table 2: shows the various morphological parameters of scaphoid

FCR- Flexor carpi radialis SCIL- Scaphalocapitate Interosseous ligament

SL. NO.	Parameters	Left (mm)	Right (mm)
1	Length	21.97	22.42
2	Proximal width	11.23	11.53
3	Waist width	6.97	6.91
4	Distal width	10.66	10.56
5	Primary height	9.34	9.34
6	Secondary height	6.52	6.31
7	Length of dorsal sulcus	16.46	16.50
8	Width of dorsal sulcus	1.82	1.79
9	Waist circumference	30.57	30.47
10	Tubercle circumference	25.41	25.13

Table 3: shows the Mean of the morphometric parameters

SL. NO.	Parameters	Left (mm)	Right (mm)
1	Length	1.480	1.140
2	Proximal width	0.746	0.633
3	Waist width	0.370	0.430
4	Distal width	0.580	0.550
5	Primary height	0.350	0.485
6	Secondary height	0.520	0.520
7	Length of dorsal sulcus	0.440	0.400
8	Width of dorsal sulcus	0.441	0.380
9	Waist circumference	0.486	0.630
10	Tubercle circumference	0.660	0.920

Table 4: shows the standard deviation of morphometric parameters

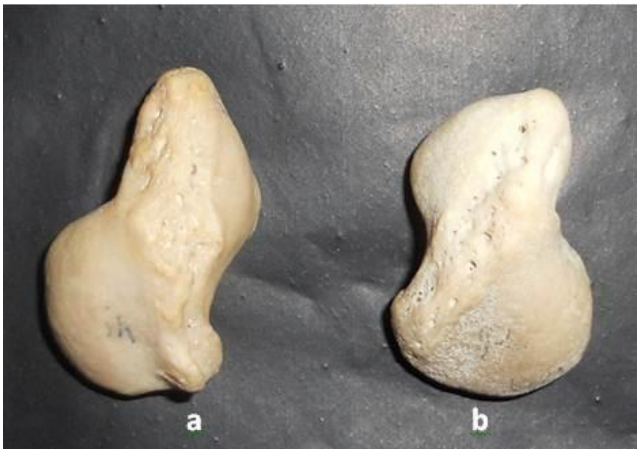

Fig. 1: Shape of the tubercle

a) conical
b) pyramidal

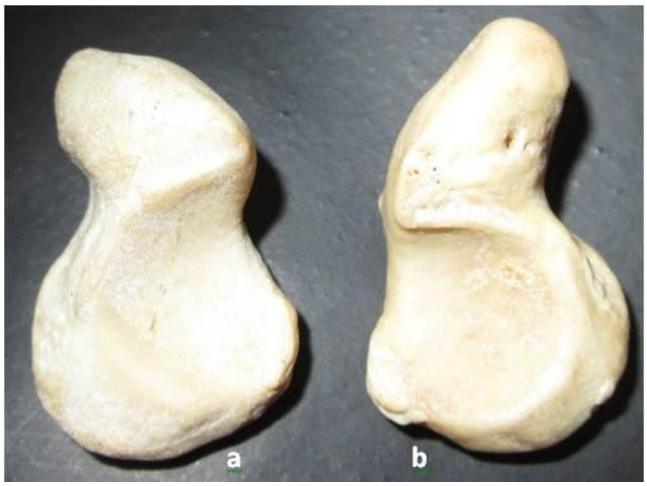

Fig. 2: Shape of the scaphalolunate joint surface

a) Crescent
b) Half moon

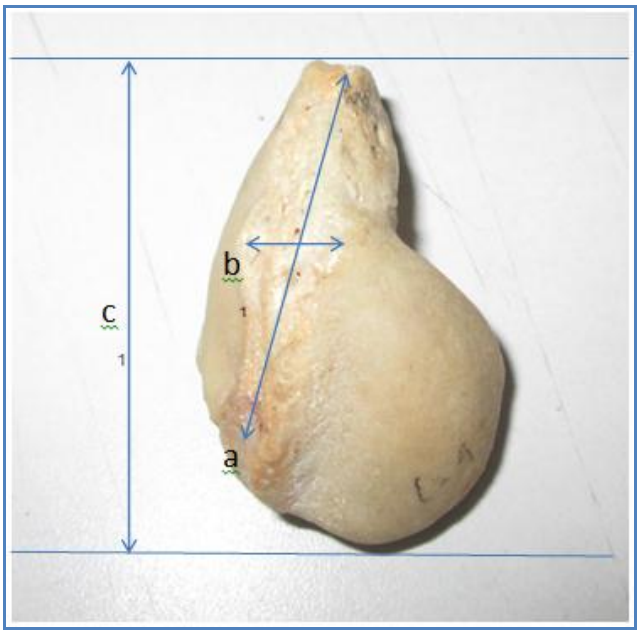

Fig. 3: Morphometric parameters of scaphoid

a) length of dorsal sulcus
b) width of dorsal sulcus
c) scaphoid length

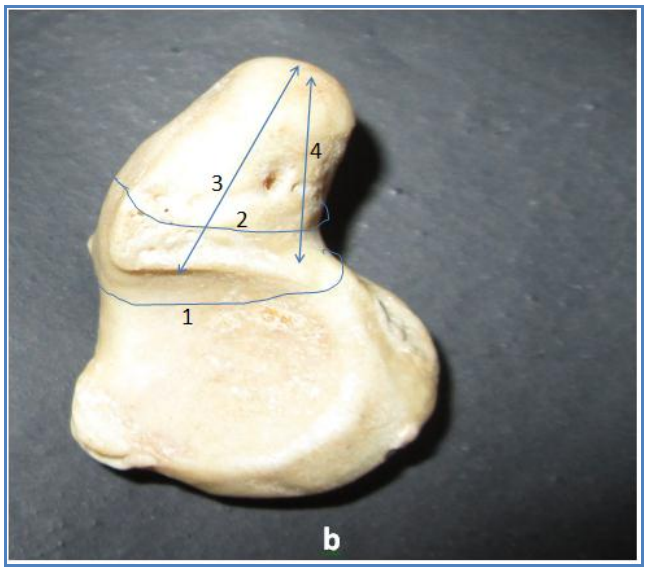

Fig. 4

1) Waist circumference
2) Tubercle circumference
3) Primary ht of the tubercle
4) Secondary ht of the tubercle

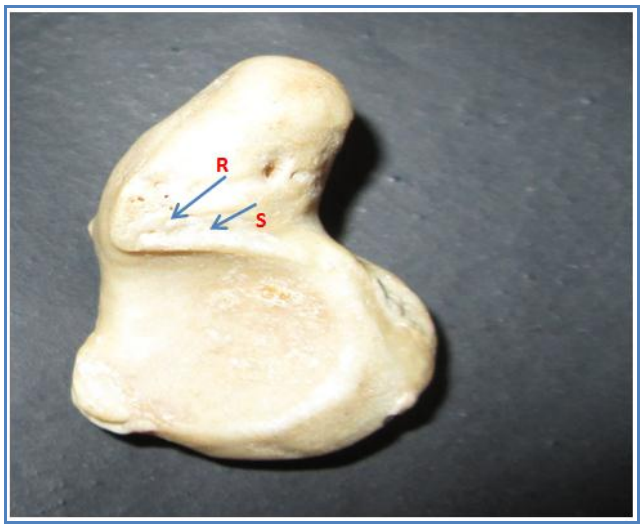

Fig. 5

R-ridge for the origin of scaphocapitate ligament,
S- sulcus for flexor carpi radialis

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