

# Geometry of Carpal Scaphoid in Thais: Anatomical Study

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## Abstract

In order to develop new surgical techniques on, and fixation devices for, carpal scaphoid fractures in Thais, the authors determined the mean and standard deviation of the length, width and thickness of 141 carpal scaphoid bones on 93 left and 48 right wrists from the skeletons of 99 Thai males and 42 Thai females. The deceased averaged 60 years (range, 22 to 89). The scaphoid length averaged 25.59 mm; the dorsal width at the distal, middle and proximal poles averaged 14.89, 10.23 and 7.08 mm, respectively; the palmar width at the distal, middle and proximal poles averaged 14.22, 9.81 and 7.44 mm, respectively; and the thickness at the distal, middle and proximal poles averaged 9.77, 10.96 and 9.19 mm, respectively. The authors found no significant difference ( $p = 0.96$ ) in the length and width of the Thai carpal scaphoid bone between the left and right wrist. The widths of the dorsal and palmar sides at the distal end were wider than the proximal end and tapered from the distal to the proximal pole. The thicknesses were constant throughout the length of the bone, ranging between 9 and 11 mm.

**Key word :** Carpal scaphoid, scaphoid, geometry, anatomy

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The scaphoid is the most frequently fractured carpal bone<sup>(1,2)</sup>. The initial treatment of scaphoid fractures includes *thumb-spica cast immobilization* for non-displaced stable fractures and *anato-*

*mical reduction* for displaced or unstable fractures. The scaphoid, a small bone, has an irregular shape resembling a cashew. Articular cartilage covers 80 per cent of the bone<sup>(3)</sup>, the only non-articular part being a

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narrow oblique dorsal strip that allows an umbilical-like blood supply to enter the area<sup>(4,5)</sup>. Treatment of scaphoid fractures using internal fixation at this non-articular area is vulnerable to avascular necrosis or non-union.

The AO group performed fixation using an AO cancellous screw<sup>(6)</sup>, which left the large head of the screw outside the bone, requiring later removal. Herbert and Fisher<sup>(7)</sup> invented a headless screw to solve the problem of passing a screw head through barrel cannulation. The Herbert screw has different pitches on both ends so treatment results for scaphoid fractures were promising<sup>(7-18)</sup>. Notwithstanding, technical expertise is required for optimal results and the quite large diameter of the regular Hebert is not appropriate, especially at the proximal pole, in slightly-built Asians and some Americans<sup>(9)</sup>.

Previous studies<sup>(11-18)</sup> describe the figure of the scaphoid without detailing the range of size, length, width or thickness. To study the geometry of carpal scaphoid in Thais, the authors measured the length, width and thickness of the scaphoid the result of which will be used for developing and designing fixation device of carpal scaphoid fractures in Thais and other people with a similar slight build.

## MATERIAL AND METHOD

The Department of Anatomy supplied 141 scaphoid bones donated by Thai adults all over 15 years of age<sup>(19)</sup>. Incomplete or broken scaphoid bones were excluded. The authors measured the length, width (both dorsal and palmar aspects) and thickness from

the proximal to distal poles three times in each position, then the mean and standard deviations were calculated (Fig. 1-4). The difference between the left and right scaphoids was analyzed using the *t*-test.

## RESULTS

The 141 carpal scaphoid bones, 93 left and 48 right wrists, came from the skeletons of 99 Thai males and 42 Thai females. The deceased averaged 60.1 years of age (range, 22 to 89). The length of the carpal scaphoid averaged 25.59 mm, while the dorsal width at the distal, middle and proximal poles averaged 14.89, 10.23 and 7.08 mm, respectively. The mean palmar width at the distal, middle and proximal poles averaged 14.22, 9.81 and 7.44 mm, respectively, and the mean thickness at the distal, middle and proximal poles averaged 9.77, 10.96 and 9.19 mm, respectively (Table 1).

## DISCUSSION

The most common carpal bone fractured is the scaphoid. The scaphoid is small and irregularly shaped and has articular cartilage covering 80 per cent of its surface area<sup>(1-5)</sup>. The initial treatment of scaphoid fractures includes *thumb-spica cast immobilization* for non-displaced stable fractures and *anatomical reduction* for displaced or unstable fractures. Non-surgical treatment of displaced fractures generally yields poor results. Many surgeons have developed surgical techniques and novel fixations to improve the surgical treatment of this fracture. Fixations include

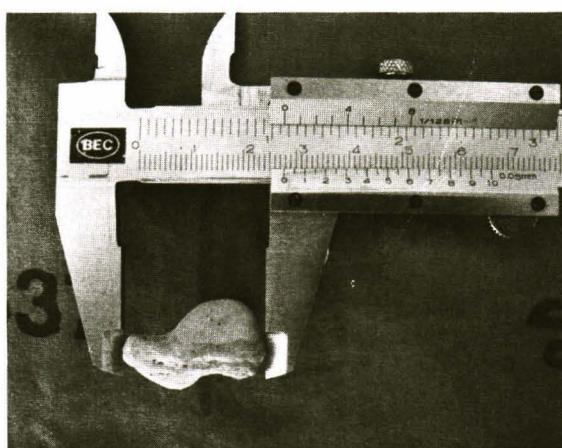


Fig. 1. The measurement of scaphoid length.



Fig. 2. The measurement of scaphoid dorsal width.

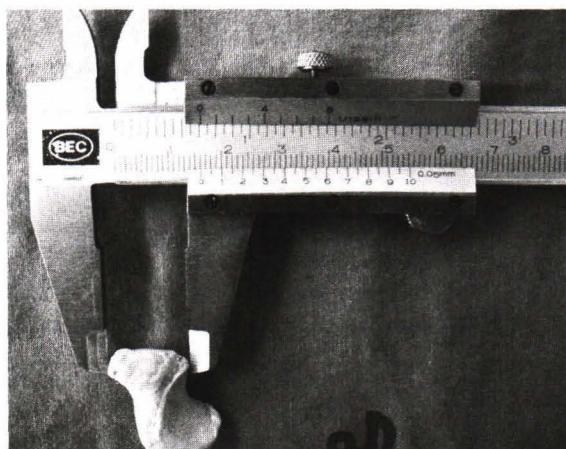


Fig. 3. The measurement of scaphoid palmar width.

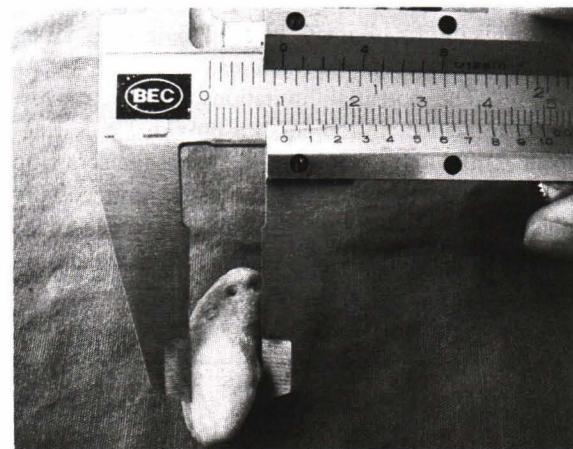


Fig. 4. The measurement of scaphoid (lateral width) thickness.

Table 1. Geometry of the carpal scaphoid in Thais.

Scaphoid (mean $\pm$ standard deviation)	Left (mm)	Right (mm)	Total (mm)
Length	25.52 $\pm$ 2.22	25.74 $\pm$ 2.25	25.59 $\pm$ 2.22
Dorsal width			
Distal	14.93 $\pm$ 1.64	14.89 $\pm$ 1.73	14.89 $\pm$ 1.66
Middle	10.28 $\pm$ 1.53	10.14 $\pm$ 1.39	10.23 $\pm$ 1.48
Proximal	7.10 $\pm$ 0.99	7.05 $\pm$ 0.87	7.08 $\pm$ 0.95
Palmar width			
Distal	14.38 $\pm$ 1.63	13.92 $\pm$ 1.62	14.22 $\pm$ 1.64
Middle	9.83 $\pm$ 0.97	9.78 $\pm$ 0.82	9.81 $\pm$ 0.92
Proximal	7.47 $\pm$ 0.76	7.38 $\pm$ 0.59	7.44 $\pm$ 0.70
Lateral width (Thickness)			
Distal	9.87 $\pm$ 0.94	9.56 $\pm$ 0.71	9.77 $\pm$ 0.88
Middle	11.04 $\pm$ 0.92	10.80 $\pm$ 0.69	10.96 $\pm$ 0.85
Proximal	9.26 $\pm$ 0.77	9.05 $\pm$ 0.58	9.19 $\pm$ 0.72

the Kirschner wire(2), the AO cancellous screw(6) and the Herbert screw(7). The AO cancellous screw, however, leaves a large head outside the bone requiring subsequent removal. The headless Herbert screw with its different pitches on both ends was an improvement and treatment of scaphoid fractures using it have been satisfactory(7-18). However, a high level of technical expertise is required to use this large screw, especially at the proximal pole, in small-boned Asians and smaller Americans(9). Other studies(11-18) have only described the figure of the scaphoid without regard to its size, length, width and thickness. In fact, the lack of explicitly stated dimensions is an obstacle

to the development of appropriate fracture fixation devices and setting techniques for use in Thais and similarly-sized Asians and Americans.

The authors findings represent an important resource for differentiating treatment protocols for more slightly built persons. The authors found no significant difference in the length and width of the carpal scaphoid bone between the left and right wrist ( $p = 0.96$ ). The widths of the dorsal and palmar sides on the distal end were wider than the proximal end, tapering from 15 cm at the distal pole to 7 mm at the proximal pole. The thicknesses were constant throughout the length of the bone, between 9 and 11

mm. This information will be used to develop a fixation device for scaphoid fractures.

The potential limitations for using screw fixation include: 1) too small a proximal pole fragment, 2) failure to place the threads of the screw tip across the fracture site and 3) a screw not centrally placed(20). All these pitfalls can be avoided by 1) using a proper thread-length for small proximal fragments, 2) ensuring sufficient screw-length for threading across the fracture site, and 3) selecting a screw-

thread diameter appropriate for central fixation. Based on the present study, a suitable device would be < 5 mm in diameter and < 25 mm in length.

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## รูปพรรณลักษณะกระดูกข้อมือรูปเรือทางกายวิภาคในคนไทย

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คณะผู้รายงานได้ทำการศึกษา รูปร่างของกระดูกข้อมือรูปเรือในคนไทย 141 ข้อมือ โดยวัดขนาดความกว้าง, ยาว และความหนาของกระดูกข้อมือรูปเรือ สำหรับพัฒนารูปแบบบริการผู้ตัดและกรองแบบวัสดุยีตติงกระดูกข้อมือรูปเรือให้มีความเหมาะสมสมสำหรับคนไทยและคนเอเชียทั่วไป

โดยทำการวัด 3 ครั้ง ในแต่ละตัวແղน์และหาค่าเฉลี่ย จากการศึกษากระดูกข้อมือรูปเรือ 141 ข้อมือ เป็นเพศชาย 99 ข้อมือ เพศหญิง 42 ข้อมือ ข้างซ้าย 93 ข้อมือ และข้างขวา 48 ข้อมือ อายุเฉลี่ย 60.05 ปี (ช่วง 22-89 ปี) พบร่วมกับความยาวเฉลี่ย 25.59 มิลลิเมตร, ความกว้างเฉลี่ยด้านหลังมือ ที่ปลายล่าง, กลาง และปลายบน เท่ากับ 14.89, 10.23 และ 7.08 มิลลิเมตรตามลำดับ, ความกว้างเฉลี่ยด้านฝ่ามือ ที่ปลายล่าง, กลาง และปลายบน เท่ากับ 14.22, 9.81 และ 7.44 มิลลิเมตรตามลำดับและความกว้างด้านข้างเฉลี่ย (ความหนา) ที่ปลายล่าง, กลาง และปลายบน เท่ากับ 9.77, 10.96 และ 9.19 มิลลิเมตรตามลำดับ

จากการศึกษาสรุปว่า ความยาวและความกว้าง ของกระดูกข้อมือรูปเรือ ข้างซ้ายและขวา ไม่แตกต่างกัน ( $p = 0.96$ ) โดยมีความกว้างด้านหลังมือและฝ่ามือ ของปลายล่าง (ติดโคนิ้วหัวแม่มือ) กว้างกว่า และแคบลงตามลำดับจนถึงปลายบน (ติดกระดูกแข็ง) สำหรับความหนา ค่อนข้างคงที่ตลอดความยาวกระดูก คือ 9-11 มิลลิเมตร

**คำสำคัญ** : กระดูกข้อมือรูปเรือ, กระดูกรูปเรือ, รูปพรรณลักษณะ, กายวิภาค

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