SCAPHOID DIMENSIONS AND APPROPRIATE SCREW SIZES IN A KENYAN POPULATION

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ABSTRACT

Introduction: Scaphoid fractures are common and mainly affect the waist. While most injuries are amenable to non operative management, internal fixation is gaining traction due to predictable results and early return to physical activities. As scaphoid dimensions vary across populations, determining our population specific dimensions will aid in identifying appropriate screw systems.
Objective: The purpose of this study was to determine the dimensions of the scaphoid and its distal pole and relating this to commonly used screw systems.
Methods: One hundred and four human scaphoids were studied and their dimensions determined. These were compared to common screw systems.
Results: The mean length was 30.3±2.9mm with males having longer dimensions. The distal pole measured 10.1±1.0mm. There were no side to side differences in the total length or the distal pole.
Conclusion: Scaphoid screws of between 24 and 34mm with a distal threading of between 7mm and 11mm should be made available for surgeons in the region. Hospitals are advised to stock implant sizes guided by their unique population data.

INTRODUCTION

Scaphoid fractures are common injuries representing about 60-70% of all carpal fractures (1-3). They occur most commonly at the waist, constituting about 65% of all scaphoid fractures (4). Most scaphoid fractures can be managed conservatively (5). However, due to predictable healing, early return to physical activities and higher patient satisfaction associated with internal fixation, it is being increasingly suggested as the primary mode of treatment of acute scaphoid fractures (2,6). During internal fixation, the dimensions of the scaphoid are essential for proper implant selection (6,7). The length of the bone determines the length of the screw to be implanted while the length of the distal segment determines the amount of distal threading required on partially threaded screws to achieve adequate compression (6). As the dimensions of the scaphoid vary across different populations, it is important to determine the dimensions in the Kenyan African population as this would be of importance in determining the appropriate screws sizes. While a variety of screw systems exist, it is important to determine if these systems would have the screw sizes needed in this population (8). For prudent inventory management, the results of this study would also guide hospitals as to the sizes required to reduce the stock of implants that are unlikely to be utilized. This study therefore sought to describe the lengths of the scaphoid and correlate this information with commonly available screw systems.

MATERIALS AND METHODS

One hundred and four dry adult human scaphoids were obtained from the Department of Osteology, National Museums of Kenya, Nairobi, for this study. Broken scaphoids and those that showed obvious gross malformations were excluded from the study. The scaphoid was fixed on a transverse axis and three points identified: the proximal pole, the distal pole and the narrowest portion of the scaphoid waist. The waist was marked using a string. Vernier calipers were used to measure the distance from the proximal to the distal poles (whole length) and from the waist to the distal pole (distal segment). All measurements were taken by one author (PQO) twice and an average obtained. We compared the results with commonly available screw systems. The Synthes 2.4/3.0mm HCS (DePuy Synthes, West Chester, PA) has screw sizes from 9-40mm and the distal segment lengths from 4-16mm. The Arthrex 2.5/3.5/4.0mm Compression FT (Arthrex, Naples, FL) is fully threaded and has screw lengths from 8-50mm. The Smith & Nephew Headless Compression (Smith & Nephew Memphis, TN) ranges from 8-40mm with the distal segment being 40% of the screw length. The Zimmer Herbert screws (Zimmer, Warsaw, IN) range from 10-30mm. The Acutrack 2 screws (Acumed, Hilsboro, OR) range from 8-34mm.

RESULTS

There were fifty two pairs of bones; 21 being male, 16 female and 15 of unknown sex. The length of the scaphoid ranged from 25.9 to 34.5mm with a mean of 30.3±2.9mm. In males the mean length was 32.7±1.7mm while that in females was 27.3±0.6mm ($p<0.01$). The left side measured 30.5±2.9mm while the right was 30.2±2.9mm ($p=0.97$).

The length of the distal segment ranged from 8.4 to 11.7mm with a mean of 10.1±1.0mm. It was longer in males than females being 10.8±0.7mm in males and 9.1±0.3mm in females ($p<0.01$). The left side measured 10.3±1.0mm while the right was 9.9±1.0 mm (0=0.86).

DISCUSSION

The current study has shown a mean scaphoid length of 30.3±2.9mm. This is similar to findings from the American population (6) but differs with those from the Indian (9) and Turkish populations (10). The differences above could be due to interobserver variability in the identification of the points while measuring or they could be a reflection of population differences in carpal motion. The longer lengths of the scaphoid in the Kenyan and American populations could be attributed to a more prominent scaphoid tubercle. Prominence of scaphoid tuberosity is associated with a greater angle for ligament attachment and this may alter the mechanical positioning of the scaphoid by its supporting structures leading to variant kinematics (11). This suggests that different populations exhibit different types of scaphoid motion.

Observations of the present study in which males had a significantly longer scaphoid than females confirm and extend those of previous studies in other populations (6). Male-female differences in bone size are a result of many factors acting together. Higher levels of testosterone in males give them larger and stronger muscles (12). The stronger muscles exert a stronger pull on insertion areas on bone inducing bone remodeling that result in alterations of bone sizes around these areas (13). It is also possible that gender differences in prehension may contribute to the differences seen in scaphoid length dimensions. These anatomical findings are evidenced by previous kinematic results where some degree of sexual dimorphism in carpal motion has been reported (14).

The present study did not find any statistically significant differences in the right and left sides in the same individual similar to previous authors (6,10). This however differs from the results of an Indian study that showed bilateral differences (9). Radiographs of the uninjured wrist thus provide an accurate template when planning reconstruction of scaphoid nonunion with collapse in this population (15).

Knowledge of scaphoid lengths in our population is of importance during internal fixation of scaphoid fractures as it provides information on the stock of screws needed in this region (6). The range of scaphoid lengths is between 25mm and 34.5mm. Allowing for 1mm countersinking at either pole since the measurements were done on dry bone without articular cartilage, screws of between 24mm to 34mm would be appropriate for use in our population. Screw systems including Acutrack, Arthrex, Smith & Nephew and Synthes would be appropriate for our population while Zimmer would not be. Among the systems found appropriate, hospitals may be best served by stocking implants ranging from 24mm to 34mm as they are more likely to be used compared to other sizes. The distal segment of the scaphoid ranged from 8.4mm to 11.7mm. Allowing for 1 mm countersinking at the distal pole, partially threaded screws should have a threading of between 7mm to 11mm to achieve adequate compression. The systems found adequate for length would also be adequate for the distal segment.

This study is limited because of the difficulties of determining the long axis intraoperatively leading to a variation somewhat with the axis used to determine the various dimensions in this study.

CONCLUSIONS

Scaphoid screws of between 24mm and 34mm with a distal threading of between 7mm and 11mm should be made available for surgeons in the region. Hospitals are advised to stock implant sizes guided by their unique population data.

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