Anatomical Landmarks for Volar Percutaneous Scaphoid Screw Fixation: A Cadaveric Study

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Background: Percutaneous screw fixation of non/minimally displaced scaphoid fracture is becoming more popular due to improved instrumentation, low morbidity and excellent outcome.

Objective: To determine surface landmarks for the insertion of guide wire to minimize radiation exposure.

Design: Cadaveric anatomical experimental study.

Setting: Fresh frozen cadaveric upper limbs obtained from the anatomy laboratory, Singapore General Hospital.

Method: Twelve cadaveric upper limbs were used for this study. The first five specimens were used in a pilot study to identify surface landmarks and possible trajectory for guide wire placement. The remaining seven specimens had the scaphoid guide wire inserted using the newly identified surface landmarks and trajectory. In the last set of specimens, it was done using the identified landmarks and trajectory technique without the use any image intensifier. All the last seven specimens were then X-rayed and dissected to determine the position of the guide wire within the scaphoid bone.

Result: We found that an entry point of 1cm distal to the midpoint of the scaphoid tubercle and a trajectory in the direction of the thumb metacarpal in the coronal plane and at 45 degrees in the sagittal plane, all the wires were in satisfactory axial intraosseous position by X-ray and confirmed with subsequent dissection.

Conclusion: Passing the guide wire using our anatomical landmarks and technique was very reliable and reproducible. It is safe and easy percutaneous screw fixation of scaphoid fractures via the volar approach.

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Fractures of the scaphoid constitute 2-7% of all fractures;they aresecond to distal radial fractures[1]. The tiny blood supply combined with the demanding functional requirements could lead to delayed healing[1].Eighty to ninety percent involvethe scaphoid[1]. The incidence is approximately 5 in every 10,000 in Western countries[1]. Percutaneous fixation of non/minimally displaced scaphoid fracture is becoming more popular due to improved instrumentation, low morbidity, excellent results in term of healing, avoidance of prolonged immobilization and possibly lower costs[2-5].

The aim of this cadaveric study is to find simple and reliable surface anatomical landmarks to pass the guide wire for the cannulated screw through a volar approach.

METHOD

Twelve cadaveric specimens were used. In the first 5 specimens, the guide wire (1.2 mm, non-threaded) was passed with the aid of an Image Intensifier through volar approach in multiple projections to make sure that the wire was in axial intraossous position within the scaphoid bone. In all the specimens, the wrist was maintained in neutral position to standardize our technique. We used these 5 specimens to find a reference anatomical landmark for the entry point and possible trajectory for the guide wire. After identifying the above-mentioned landmark and trajectory, it was used for passing the guide wire in the subsequent 7 specimens without using any image intensification. All the 7 specimens were then X-rayed and dissected to check the position of the guide wires.

RESULT

The starting point for the passage of the guide wire from the volar side was 10 mm distal to midpoint of the scaphoid tubercle (range 8-12 mm) was found in the first group.

The radial ulnar (coronal) direction was parallel to the thumb metacarpal bone (range+/- 5 degrees) with both the thumb carpometacarpal and the wrist joint in neutral position. The volar dorsal trajectory (sagittal) was around 45 degrees (range 40-50 degrees) with neutral joint position maintained, see figure 1. We used this anatomical landmark (i.e. 0 degrees in coronal plane and 45 degrees in sagittal of the thumb metacarpal) for the next 7 specimens without using image intensifier, see figure 2. X-rays of these specimens showed that all the wires were in acceptable position within the bone except for one which was slightly ulnar in position, a second wire was passed radial to it and in the same sagittal (volar dorsal) direction. A subsequent X-ray showed good position in the coronal (radial ulnar) direction.

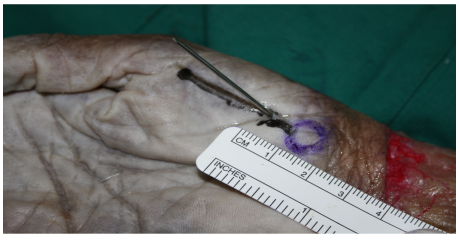

Figure 1: Surface Landmark and Trajectory of the Entry Point after Passing the Guide Wire under X-ray Control (First Group-Five Cases), Purple Circle Mark the Scaphoid Tubercle, Black Line indicates the Direction of Thumb Metacarpal

Figure 2: Using Same Landmarks to Pass the Wire in the Second Group without Image Intensifier, Red Circle Represents the Scaphoid Tubercle, Blue Line Indicates the Direction of Thumb Metacarpal

The twelve specimens were then dissected to check the actual position of the wires. We found that all the wires were in good intraosseous positions (figure 3) except the one that was found slightly ulnar (as mentioned before);the second wire was in a good position. In all the specimens the wire always went through the proximal volar aspect of the trapezium and the scaphotrapezial joint, see figure 4 (a,b,c).

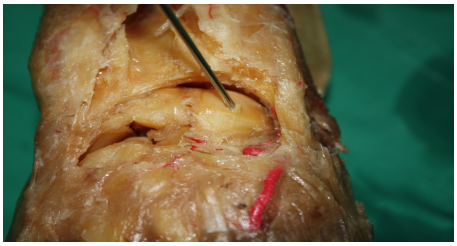

Figure 3: The Wire Exiting the Dorsiproximal Scaphoid after Using the Proposed Landmarks

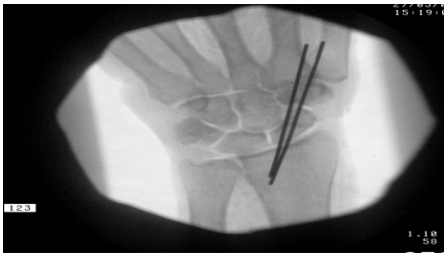

Figure 4 (a): X-ray Showing the First Wire Slightly Ulnar and the Second Wire in an Acceptable Position

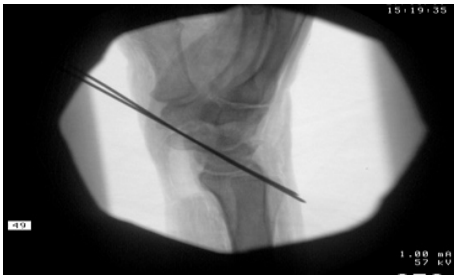

Figure 4(b): Both Wires were in Good Position, the Volar Part of the Scaphotrapezial Joint is Traversed by Both Wires

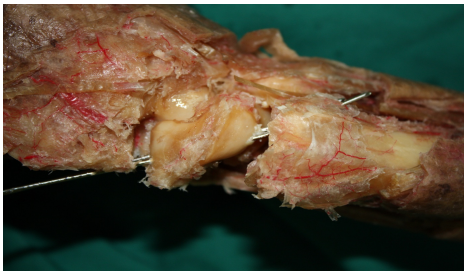

Figure 4(c): After Dissection Showing Both Wires, the Volar Trapezium and Scaphotrapezial Joint Traversed by Both Wires

After dissection, the wires were also found to be in good intraosseous axial position within the scaphoid. Furthermore, the proximal volar trapezium and scaphotrapezium joint were also traversed by the guide wire.

DISCUSSION

Percutaneous fixation of non/minimally displaced scaphoid fracture had recently became popular due to predictable healing, early return to previous activities, less pain, higher patient satisfaction, less morbidity and cost effectiveness[6-9]. Many studies support such procedure[10-12].Different authors describe slightly different techniques[13-15]. Some advocate dorsal and others prefer volar approach[16]. Both have been found to be comparable in providing good screw position and fixation[17-20].Others even went further to describe screw insertion using more sophisticated techniques, such as navigation[21].

In this study,the scaphoid tubercle was found to be consistently 10 mm proximal to the starting point for the guide wire entry. We were able to pass the wire correctly in 6 out of 7 specimens without single X-ray. Our technique was easily replicated.

In the wrist position, the guide wire always traverses the volar aspect of the scaphotrapezial joint and this finding was shared by other investigators. To avoid this, we recommend that when inserting the screw in real cases, the screw must be countersunk past the trapezium so that the distal end of the screw does not transfix, irritate or damage the scaphotrapezial joint, which can translate clinically into stiffness and pain. Another method to overcome potential scaphotrapezial joint transfixation is to dorsally translate the trapezium over the distal pole of the scaphoid. This maneuver can be done after passing the wire through the soft tissue and prior to engaging the distal pole of the scaphoid. Other authors have advocated partial resection of the trapezium[22-23].

CONCLUSION

A volar entry point just 1 cm distal to the palpable midpoint of the scaphoid tubercle and in line with the thumb metacarpal bone in the coronal plane and in 45 degrees inclination in the sagittal plane was used.We found that using the above mentioned technique the passage of the guide wire was easy, reproducible and with high accuracy. The procedure could be taught to junior surgeons with very short learning curve.

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