New Findings about the Intrascaphoid Artery System

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Objective: To explore the details of the intrascaphoid artery system and to reveal the relationship between scaphoid nonunion and the damage to the blood supply.

Methods: We investigated the intraosseous arteries of six normal cadaveric scaphoids using red lead injection and three-dimensional reconstruction with micro-computed tomography. And the intrascaphoid artery system was observed and measured.

New findings about the intrascaphoid artery system:
(1) There are two to three constant trunk arteries entering the scaphoid at the dorsal ridge of the waist. We did not find any specimen with a single trunk, which means that the scaphoid blood supply is not so poor and precarious as has been thought.
(2) We found that the distal part of the scaphoid was mainly supplied by arteries from the waist. In only one-third of the cases was the distal part supplied by the arteries around the tubercle. So the blood supply from the dorsal ridge plays a more important role than was previously thought.
(3) We studied both scaphoids from three donors. The arterial patterns were not identical between the different sides of an individual.
(4) The distribution of trunk arteries in the proximal part presents as an eccentric arc. This means that the blood supply can be largely preserved if a cannulated screw is placed in a central position.
(5) The mean location value of the most proximal artery was 42% (SD 11). This means the blood supply will be severely damaged if the fracture line is located within the proximal 40%.
(6) All arterial entrances were located around the ligaments, such as the SC and RSC ligaments. Although there is no significant ligament insertion at the dorsal ridge, the septa of the midcarpal and radiocarpal joints are attached to this area. In this way, the arteries are well protected by a rigid ligament or septum.

Relationship between scaphoid nonunion and the damage to the blood supply:
• According to our measurement of the most proximal artery and the most proximal trunk artery, it can be seen that there was no arterial entrance in the proximal 40% and no trunk arterial entrance in the proximal 50%. This means that the proximal part will lack blood supply, not only as a result of a proximal fracture, but also after many waist fractures. Why then do proximal pole fractures have a much higher rate of nonunion and necrosis?
• We believe this cannot be explained on the basis of the blood supply alone.
• Compared with the proximal fracture, in a fracture at the waist of the scaphoid, the size of the proximal fragment would be much bigger, and the stress concentration should be much less than occurs on the proximal pole fracture. As a result, nonunion and final collapse would be less frequent.
• Another key point is that because of the curved shape of the scaphoid, the fracture line at the proximal pole usually lies in a somewhat vertical direction on a posteroanterior view, whereas the fracture line at the waist is transverse (Figure 7). When the wrist flexes and extends, the proximal fracture line will rotate with wrist movement, but the fracture line at the waist will not. This means that a waist fracture is much more stable than a proximal fracture. We believe that this is the most important factor influencing the occurrence of nonunion at different fracture sites.