SCIENTIFIC ARTICLE

Osseous and Ligamentous Scaphoid Anatomy: Part I. A Systematic Literature Review Highlighting Controversies

Geert A. Buijze, MD, Santiago A. Lozano-Calderon, MD, PhD, Simon D. Strackee, MD, PhD, Leendert Blankevoort, PhD, Jesse B. Jupiter, MD

Purpose The interpretation of scaphoid anatomy and kinematics is confusing and controversial. This results from a lack of consensus on the anatomy of the ligaments attaching to the scaphoid and an overwhelming variety of substantially different anatomic descriptions and classification systems of the wrist joint in the literature. The present study systemically reviews the consistencies or inconsistencies of the various scaphoid ligament descriptions and aims to clarify and unify different concepts and classification systems.

Methods We performed a systematic search of the medical literature from 1950 to 2010. We included all descriptive reports of the anatomy or morphology of the scaphoid, ligaments, or both. With the aim to describe the best available evidence, we considered all anatomical descriptions but emphasized a selection of the most frequently cited articles.

Results The literature search resulted in 555 potentially eligible descriptive reports, 58 of which met the inclusion criteria and were included in the review. Variations in the anatomic descriptions appear to be mostly due to the difficulty of identifying individual interdigitating ligaments or bundles by macroscopic dissections, as well as the interindividual variability in ligament anatomy. The most important areas of controversy in the scaphoid ligament attachments include the radial collateral ligament, dorsal radiocarpal ligament, dorsal intercarpal ligament, volar scaphotriquetral ligament, and scaphotrapezium-trapezoid ligament.

Conclusions None of the scaphoid ligaments other than the scaphocapitate ligament have been described consistently. Future research is required to verify the ligament attachments that currently have the most controversial descriptions, while addressing the interindividual variability of ligament insertions and morphology.

Clinical relevance Thorough knowledge of the anatomy will enhance our understanding of the kinematics of the scaphoid. *(J Hand Surg 2011;36A:1926–1935. Copyright © 2011 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Anatomy, scaphoid, ligaments, systematic review, controversy.

From the Orthopaedic Research Center Amsterdam and the Department of Plastic Reconstructive and Hand Surgery, Academic Medical Center, Amsterdam, The Netherlands; the Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, MA; and the Department of Orthopaedic Surgery, Westchester Medical Center, New York Medical College, Valhalla, NY.

Received for publication April 28, 2010; accepted in revised form September 16, 2011.

G.A.B. thanks the Netherlands Organisation for Scientific Research (NWO) for support to this research.

The authors appreciate the Francis A. Countway Library of Medicine and Harvard College Library Imaging Services for providing access to and scans of historical publications.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

Corresponding author: Geert A. Buijze, MD, Department of Orthopaedic Surgery, Academic Medical Center, Meibergdreef 9, 1100 DD Amsterdam, The Netherlands; e-mail: g.a.buijze@amc.uva.nl.

0363-5023/11/36A12-0005$36.00/0
doi:10.1016/j.jhsa.2011.09.012

THE SCAPHOID HAS characteristic anatomical features. The ligaments that attach to the scaphoid have an essential role in carpal stability of both normal and injured wrists.[1] To understand the kinematics of the scaphoid, a thorough knowledge of its anatomy is required. For instance, a comprehensive explanation of carpal instability can be found by assessing the carpal anatomy.[2] However, the literature provides a variety of substantially different anatomic descriptions and classification systems of the scaphoid ligaments, creating controversy and confusion.

Vesalius[3] was the first to describe the osseous anatomy of the carpus in 1543, when he referred to the scaphoid as the first carpal (os carpi primum). The first detailed description of the carpal ligament anatomy was not until 2 centuries later. In 1742, Weitbrecht[4] provided an illustrated description of the anatomy of all human ligaments including those of the wrist (Fig. 1). In the 18th and 19th centuries, a greater variety of descriptions and classifications by European anatomists followed.[5–9] The late 20th century was characterized by an exponential increase in anatomic and kinematic studies of the wrist, and the number of studies is still expanding.[10–15] No consensus has been reached on the anatomic description of the ligaments that have scaphoid attachments and their function in normal kinematics. Controversy increases when the discussion focuses on fractures or ligament pathologies such as scapholunate dissociation.

This study systematically reviews anatomical studies on the ligaments of the wrist with a specific focus on the scaphoid. We performed a literature search to collect all available articles and book chapters on carpal ligaments. With the aim to describe the best available evidence, we emphasized a selection of the most highly cited literature. The purposes of this study were to clarify and try to unify different concepts and classifications of the wrist ligaments, and to describe the ligaments related to the scaphoid, according to the available literature.

MATERALS AND METHODS

Literature search

We conducted a 2-step systematic literature search: an online search for articles and a manual search for book chapters. The search for articles was performed in MEDLINE from the inception of the database in 1950 to December 15, 2010, with the following terms: *ligament** [Title] AND (*carp** [Title] OR *scaph** [Title] OR *wrist* [Title]). We retrieved the abstracts and assessed them for eligibility. Inclusion criteria for the selection of manuscripts were: (1) original description of the anatomy or morphology of the scaphoid and/or ligaments, and (2) availability of the full-text copy of the manuscript. Exclusion criteria were: (1) personal communications, letters, or meeting proceedings; and (2) languages other than English, French, Italian, Dutch, German, and Spanish. We performed the manual search for book chapters by screening the reference lists for all selected articles using the same inclusion and exclusion criteria.

Study selection

There are many different systems to describe and classify ligaments related to the scaphoid; each has its own characteristics and limitations. To our knowledge, no guidelines have yet been developed to assess the quality of anatomical studies. With the aim of describing the best available evidence, we considered all anatomical descriptions that resulted from the search, emphasizing a selection of the most frequently cited articles. We investigated this using the database from the Institute for Scientific Information (ISI) Web of Knowledge. For each of the included studies, we recorded the number of citations using the option of "cited reference search" in the ISI Web of Knowledge.[16]

RESULTS

Literature search

The online search resulted in 555 potentially eligible articles, 45 of which met our inclusion criteria (Fig. 2). The manual search resulted in an additional 13 anatomical descriptions in book chapters. We included a total of 58 anatomical reports in the review.

Osseous anatomy of the scaphoid

The scaphoid has a characteristic and irregular form that is complex. A substantial variety in shapes has been described and classified in detail.[17–20] The scaphoid is the largest bone in the proximal carpal row. Its long axis is on an oblique plane. Approximately 75% of the surface of the scaphoid is covered with cartilage, forming articulations with adjacent bones.[21,22] It articulates proximally with the distal radius (scaphoid fossa) through a biconvex dorsally sloped articular surface (Fig. 3A).

The dorsoradial ridge separates the dorsal and proximal articular surfaces from the distal volar aspect (Fig. 3B). The ridge is a narrow and non-articulating area with several vascular perforations allowing important perfusion of the scaphoid. About 70% to 80% of the intraosseous vascularity and the entire proximal pole is supplied from branches of the radial artery entering through this ridge.[23] The convex articular surface distal to the dorsoradial ridge articulates ulnodorsally with the trapezoid and radiovolarly with the trapezium.[24–26]

The surface on the ulnar side is almost entirely articular. Proximally on the ulnar side, a flat and semi-