SCIENTIFIC ARTICLE

Anatomy and Biomechanics of the Forearm Interosseous Membrane

Leela D. Farr, MD, Frederick W. Werner, MME, Michael L. McGrattan, MD, Sierra R. Zwerling, BS, Brian J. Harley, MD

Purpose To examine the anatomy and function of the forearm interosseous membrane by exploring the anatomical insertions of the central band (CB) on the radius and the ulna and by quantifying the length of the intact ligament and replacement grafts located at the original CB attachment sites and alternative locations.

Methods Eight fresh cadaver forearms were supinated and pronated and the wrist was extended and flexed while the motion between the distal radius and ulna were recorded. The length of the CB was computed for the intact CB as well for several alternative graft orientations and positions.

Results The maximum length of the CB did not significantly change among different wrist motions. However, with the wrist in a static neutral position, the CB length was significantly shorter in forearm supination than in neutral. During active forearm rotation when CB replacement grafts were positioned distal or proximal to the original CB site, yet still parallel to it, each had a similar trend to be longer in neutral than in supination. If a graft was more transversely oriented, the computed CB length would be 1.6 mm shorter in supination than in neutral.

Conclusions These results support tensioning a CB graft with the forearm in supination if the goal is to maximize graft tension and to maintain the native 22° angle for a CB graft between the radius and ulna. The results also suggest that the CB graft can probably be located slightly distal or slightly proximal to its original attachment sites.

Clinical relevance Reconstruction of the interosseous membrane has been hampered by a lack of understanding of its length changes with forearm or wrist motion. These results provide a starting point in helping clinicians understand how to more precisely reconstruct this ligament in an anatomical manner. *(J Hand Surg Am. 2015;40(6):1145–1151.*

Key words Interosseous membrane, central band.

Additional material is available online.

From the Department of Orthopedic Surgery, SUNY Upstate Medical University, Syracuse, NY.

Received for publication April 3, 2014; accepted in revised form December 16, 2014.

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

Corresponding author: Frederick W. Werner, MME, Department of Orthopedic Surgery, SUNY Upstate Medical University, 3214 Institute for Human Performance, 750 E. Adams Street, Syracuse, NY; e-mail: wernerf@upstate.edu.

0363-5023/15/4006-0012$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2014.12.025

RUPTURE OF THE FOREARM INTEROSSEOUS membrane (IOM) often goes undiagnosed and is difficult to treat.[1] The IOM is a critical stabilizer of the forearm as it provides longitudinal[2,3] and transverse[4,5] stability and transfers force from the radius to the ulna.[6–8]

Repairs of the IOM using semitendinous,[9] palmaris longus, or flexor carpi radialis tendon or a patellar bone tendon graft[10] or a flexor carpi radialis tendon allograft[11] have been studied *in vitro*. Clinically, reconstructions

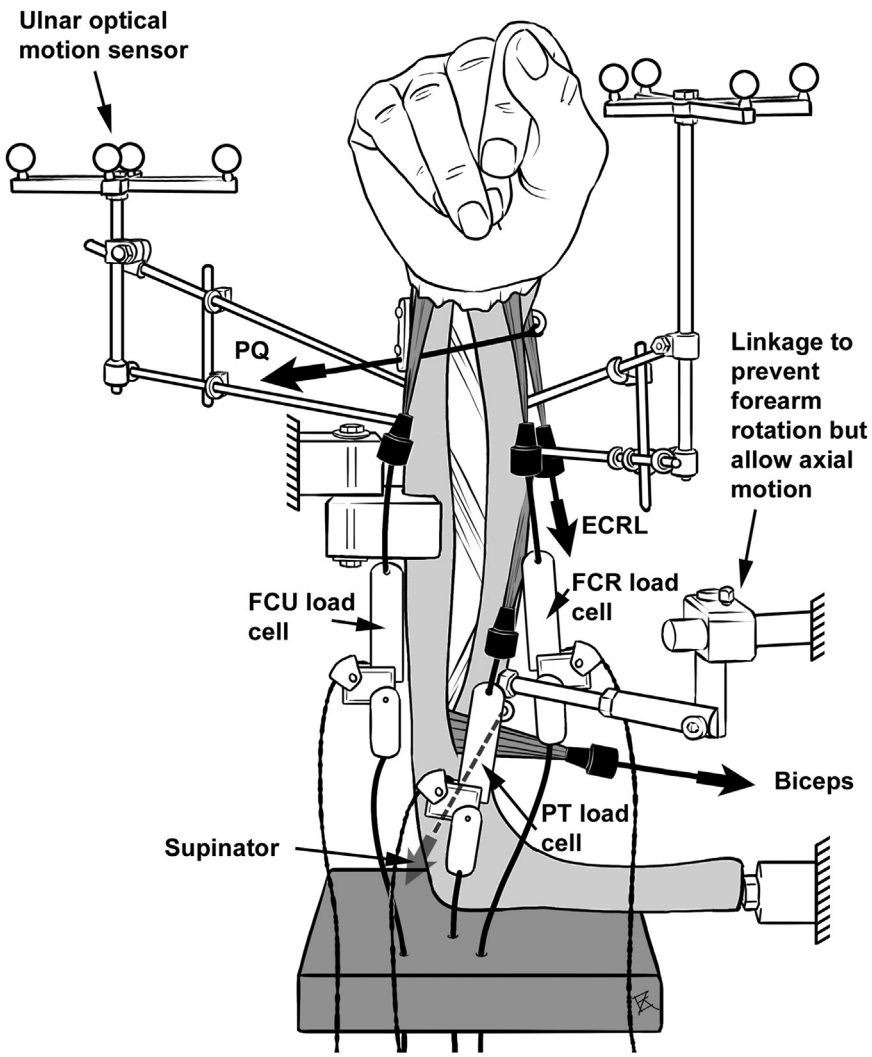

FIGURE 1: Volar view of wrist and forearm motion simulator. Optical motion sensors were used to measure forearm motion and locate the radius with respect to the ulna. Tendon clamps, load cells, and cables that connect to hydraulic actuators are shown for the flexor carpi ulnaris (FCU), flexor carpi radialis (FCR), and pronator teres (PT) tendons. These tendons are shown relaxed. Only the tendon clamps are shown attached to the extensor carpi radialis longus (ECRL) and biceps tendons. Only the cables simulating the pronator quadratus (PQ) and supinator are shown with their attachment to screw eyes on the radius.

have ranged from a bone-patellar tendon-bone graft[12,13] to a synthetic braided graft.[14] These reconstructions typically pass the graft through bone tunnels in the radius and ulna, entering or exiting through the apex of the radius or ulna. However, the central band (CB) has been shown by Pereira[15] to primarily attach on the volar aspect of the apex of the radius and on the dorsal aspect of the ulna. In this study, we consider the apex of the radius or ulna to be the ridge of bone on cross section of bones where the dorsal and volar surfaces unite and the interosseous membrane inserts. Depending upon where a graft is attached, supination may wrap the IOM around the bone and tighten rapidly.

The purpose of this study was to explore the anatomical insertions of the native CB on the radius and the ulna and determine the change in ligament length through biomechanical testing of forearm and wrist simulated motions. We hypothesized the insertion of a graft to reconstruct the CB of the IOM should not simply connect the apices of the radius and ulna. Instead, it should more closely replicate normal anatomy and lie on the surface of the volar apex of the radius so that during forearm supination the graft would wrap around the apex of the bone. A second purpose of this study was to assess the change in length of potential replacement grafts when located at the original and alternative attachment sites of the CB.

MATERIALS AND METHODS

Eight fresh-frozen cadaver forearms (average age, 68 years; 4 male) were dissected. The number and