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CORR Insights®: Carpal Tunnel Syndrome Impairs Thumb Opposition and Circumduction Motion

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Where Are We Now?

The development of the thumb is considered an important development in human evolution. The evolution of the opposable thumb facilitated reach-grasp functions and allowed for the advanced handling of tools. The thumb's complexities and apparent contradictions — such as the disparate functions of fine motor skills and power grip — continue to intrigue researchers and surgeons alike. A recent Medline search on “thumb

function” returned more than 6000 publications. Despite this, certain aspects of thumb control and kinematics remain unknown or controversial. An important controversy concerns the neuromuscular function of the thumb, particularly its role in the stability of the basal thumb joint that is frequently afflicted by osteoarthritis. The influence of hormones, gender, and ligament laxity on static thumb stability [2, 6], the interplay between intrinsic/extrinsic thumb muscles in dynamic joint stability, and the role of proprioception and sensorimotor control [1] all are

aspects of thumb function that remain contested.

Where Do We Need To Go?

In the current study, the authors conclude a series of three recently published articles on the effect of carpal tunnel syndrome on thumb kinematics [3–5]. Their publications provide new insight into the neuromuscular control of the thumb and the importance of a maintained sensorimotor innervation. In earlier reports, they found that carpal tunnel syndrome, the most common nerve entrapment treated by hand surgeons, reduces thumb motion and flexion/extension ability in the thumb joints [3]. In addition, they observe that carpal tunnel syndrome alters proprioceptive performance in reach and grasp functions [4], and adversely affects the fine motor skills required in precision pinch tasks [5]. Although their motion-capture studies contribute to our overall understanding of thumb neuromuscular function, we still lack information on the dynamic interplay in muscles innervated by the radial, ulnar and

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median nerves, as well as the proprioceptive integration of peripheral and central-mediated thumb control, and the complex mechanisms involved in the evolution of basal thumb osteoarthritis.

How Do We Get There?

To resolve the controversies outlined above, further studies are needed to illustrate the actual role of the intrinsic and extrinsic muscles during thumb functions — reach and grasp, precision pinch, and power grip — through in-vivo studies utilizing neurophysiologic protocols of dynamic muscle control with combined analysis of electromyography and afferent sensory action potentials. Additionally, future studies should illuminate the influence of peripheral nerve entrapments and injuries on thumb control and function, in particular, the proximal forearm nerve disorders and compression syndromes,

which will affect thumb neuromuscular control to a greater degree than does the carpal tunnel syndrome. In order to gain a more comprehensive understanding of thumb kinematics, larger, more diverse populations need to be studied, and better tools — such as functional MRI analysis of peripheral-central interactions — are needed. Gender-specific and age-related changes need to be studied to enhance our understanding of the change in thumb function and control seen with advancing age. Lastly, future studies should detail hormonal and inflammatory mediators involved in the onset and development of basal thumb arthritis in order to potentially provide treatment strategies for generations to come. Indeed, the immense complexity of thumb function and control will likely keep us busy for a long time to come.

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