



Stabilization effectiveness and functionality of different thumb orthoses in female patients with first carpometacarpal joint osteoarthritis



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ABSTRACT

Background: Thumb orthoses have to reconcile and satisfy competing goals: stability and mobility. The purpose of the study was to characterize the stabilization effectiveness and functionality of different thumb carpometacarpal osteoarthritis orthoses.

Methods: Eighteen female carpometacarpal osteoarthritis subjects were included. Four orthoses were compared: BSN medical (BSN); Push braces (PUSH); Sporlastic (SPOR); and medi (MEDI). Three-dimensional thumb kinematics during active opposition–reposition with and without orthosis was quantified. Ranges-of-motion of the carpometacarpal and metacarpophalangeal joint in x- (flexion–extension), y- (adduction–abduction) and z-direction (pronation–supination) were determined. Hand functionality was examined by Sollerman test.

Findings: All orthoses restricted carpometacarpal range-of-motion in all directions. In x-direction carpometacarpal range-of-motion was smallest with MEDI and BSN, in y-direction largest with PUSH compared to all other orthoses, in z-direction smaller with BSN and MEDI compared to PUSH, but similar to SPOR. All orthoses restricted metacarpophalangeal range-of-motion in x-direction, except PUSH. In x-direction metacarpophalangeal range-of-motion was smallest with MEDI compared to all other orthoses. In y-direction and z-direction only BSN and MEDI restricted metacarpophalangeal range-of-motion. Sollerman score was highest with PUSH, lowest with MEDI and both differed from other orthoses. Values for BSN and SPOR were similar and lay between PUSH and MEDI.

Interpretation: Stabilization is borne by functionality. The high stabilization effectiveness provided by MEDI resulted in lowest hand functionality. PUSH, which partially stabilized the CMC joint and allowed large motions in the MCP joint, afforded largest hand functionality. Best compromise of stability and functionality could be reached with BSN. Long-term studies are needed to monitor clinical efficacy.

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1. Introduction

Osteoarthritis (OA) of the thumb carpometacarpal (CMC) joint, also called the thumb trapeziometacarpal (TMC) joint, is a disorder that often causes pain and motion loss affecting typically postmenopausal women in their fifth to sixth decade of life (Fitzgerald and Hofmeister, 2008; Ghavami and Oishi, 2006). Although the exact etiology is unknown, genetic, gender, environmental and physiological factors all appear to play a role (Estes et al., 2000).

The CMC joint is considered the most important joint of the thumb; in turn, the thumb is the most important digit of the hand, as it greatly magnifies the complexity of human prehension (Neumann and Bielefeld, 2003). When individuals with symptomatic hand OA were compared with asymptomatic individuals, they reported two to three

times as many functional limitations with dressing, eating and carrying a 10-pound load (Dillon et al., 2007).

In accordance to Eaton and Littler (1973) CMC OA can be classified into four stages that are discernible on X-rays. It is interesting to note that the degree of pain and associated functional problems varies considerably among patients with different stages of the disease; patients with minimal disease can experience severe pain, whereas those with advanced disease may be symptom free (Glickel, 2001).

The mainstay of conservative treatment of thumb CMC OA has been stabilization by orthotic devices (Barron et al., 2000), which has been fairly shown to relieve pain in patients (Bani et al., 2013a, 2013b; Becker et al., 2013; Berggren et al., 2001; Boustedt et al., 2009; Egan and Brousseau, 2007; Gomes Carreira et al., 2010; Valdes and Marik, 2010; Wajon and Ada, 2005; Weiss et al., 2004). The focus of splinting the thumb CMC joint is to decrease inflammation by providing rest and immobilization and to decrease pain by providing stability during activities that load the joint as well as to prevent or correct subluxation and deformity of the thumb (Zhang et al., 2007). A variety of thumb

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Fig. 1. Thumb orthoses to be tested. (A) Rhizo Forte V/2013, BSN medical (BSN); (B) Ortho CMC, push braces (PUSH); (C) Rhizo Hit, Sporlastic (SPOR); (D) Rhizomed, medi (MEDI).

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