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Scientific/Clinical Article

The effectiveness of orthoses in the conservative management of thumb CMC joint osteoarthritis: An analysis of functional pinch strength



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ABSTRACT

Study Design: The study was a retrospective cohort analysis for a 19-month period from May 2013 to December 2014.

Introduction: Although the use of orthoses has long been a staple of conservative treatment measures for individuals with osteoarthritis of the thumb carpometacarpal (CMC) joint, there remains little evidence exploring its effectiveness in improving functional outcomes for this client population.

Purpose of the Study: The purpose of this study was to assess the effectiveness of 3 frequently used orthoses in improving the functional pinch strength of adults with a diagnosis of thumb CMC joint osteoarthritis.

Methods: A retrospective cohort analysis was conducted to determine whether pinch strength improved after orthotic fabrication, and fitting in patients referred to a hand therapy clinic.

Results: Patients who received a Colditz design orthosis had a mean increase of 2.64 lb with regard to functional pinch strength after orthotic fabrication and fitting. Patients who received a Comfort Cool orthosis (North Coast Medical, Morgan Hill, CA) had a mean increase of 2.47 lb, whereas patients who received a Thumb Spica orthosis had a mean increase of 3.25 lb. There was no evidence of any statistically significant difference in the average improvements in pinch strength between the Colditz design orthosis and the Comfort Cool orthosis.

Conclusions: Results from this study demonstrate that orthosis wear consistently increases the functional pinch strength of individuals with thumb CMC joint osteoarthritis. Large-scale multisite research studies comparing various orthotic designs are necessary to help therapists determine best practice interventions for the conservative management of thumb CMC joint osteoarthritis.

Level of evidence: 2(c).

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Introduction

In 2002, the American Hand Therapy Foundation Board of Directors published the results of a large-scale survey aimed at establishing research priorities in the field of hand therapy.¹ A total of 401 certified hand therapists (CHTs) responded to the survey, and a list of 76 top research questions was generated.¹ The following was among the list of specific research questions posed by CHTs: “What is the effectiveness of splinting in arthritis?”.^{1(p8)}

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Although the use of orthoses has long been a staple of conservative treatment measures for individuals with osteoarthritis of the hand, particularly osteoarthritis of the thumb carpometacarpal (CMC) joint, there remains little evidence demonstrating its effectiveness in improving functional pinch strength for this client population. Meanwhile, clinicians are under increasing pressure to provide evidence-based and scientifically driven treatment interventions with a proven record of effectiveness.

Background

Thumb CMC joint osteoarthritis is thought to result from the following factors: 1) an insufficiency of the anterior oblique

ligament of the thumb CMC joint and 2) a gradual deterioration of the cartilage layers between the articulating surfaces of the trapezium and first metacarpal bones that form the thumb CMC joint.² Anterior oblique ligament insufficiency and cartilage deterioration within the joint result in reduced joint space, irregular motions of the articulating surfaces of the joint, dorsoradial subluxation of the base of the first metacarpal, and in advanced cases, the presence of a zig-zag deformity (Fig. 1). Individuals with thumb CMC joint osteoarthritis typically present with pain and swelling along the base of the thumb and thenar eminence, as well as decreased functional abilities, particularly during pinching tasks.^{3,4} Symptoms usually present between the ages of 50 and 70 years; however, cases of younger adults (20–30 years) presenting with symptoms are known.^{5,6} The prevalence of thumb CMC joint osteoarthritis is estimated at 7% for adult males and 15% for adult females.⁵

A diagnosis of thumb CMC joint osteoarthritis is typically based on the following: 1) symptoms reported by the client, 2) physical examination and provocative testing performed by the physician, and 3) radiographic evidence.^{4,7,8} Two main classification systems for thumb CMC joint osteoarthritis have been proposed to assist physicians in determining degree of severity and help guide intervention planning. The Eaton classification system, proposed by Eaton and Littler in 1973, describes 4 stages of the condition and is based solely on radiographic findings (Table 1).⁹ Current research suggests that the Eaton and Littler Scale is only moderately reliable as a diagnostic tool.^{7,10,11}



Fig. 1. Radiographic example of severe osteoarthritis of the thumb CMC joint. The zig-zag deformity, common in advanced stages of thumb CMC joint osteoarthritis, can be visualized. CMC = carpometacarpal.

Table 1

Eaton and Littler classification system for thumb CMC joint osteoarthritis

Stage 1	Radiographic views demonstrate slight joint widening (joint capsule distention because of effusion); articular surfaces are normal in appearance; and less than one-third subluxation of metacarpal base can be observed.
Stage 2	Radiographic views demonstrate significant joint capsule laxity. At least one-third subluxation of metacarpal base is present. Small bone or calcific fragments less than 2 mm in diameter can be observed (typically adjacent to the volar or dorsal facets of the trapezium).
Stage 3	Greater than one-third subluxation of metacarpal base is present. Bone or calcific fragments greater than 2 mm and slight joint space narrowing can be observed.
Stage 4	Major subluxation is present, and joint space is very narrow. Subchondral bone changes can be observed. Osteophyte formation and significant erosion of the dorsal facet of the trapezium is present.

CMC = carpometacarpal.

Note: Adapted from Reference 9.

The Burton classification system, proposed by Burton and Pellegrini in 1986, also describes 4 stages of the condition; however, classification is based on patient symptoms, clinical findings, and radiographic evidence (Table 2).^{12–14} No literature assessing the reliability or validity of the Burton Scale could be identified.

Both surgical and nonsurgical interventions for thumb CMC joint osteoarthritis are aimed at reducing pain, correcting instability and/or deformity, and increasing overall functional use of the hand. Surgical intervention techniques include volar ligament reconstruction, arthroscopy/debridement, resection arthroplasty with tendon interposition (with or without ligament reconstruction), suspensionplasty, implant arthroplasty, metacarpal osteotomy, trapeziectomy, and arthrodesis.^{4,15} A decision to pursue surgical intervention will depend on a number of factors, including severity of joint deterioration (staging based on classification systems), severity of pain symptoms, occupations and health of the client, and failure of prior conservative treatment options. Nevertheless, nonsurgical interventions are recommended for all clients before consideration of surgical intervention, irrespective of staging.^{4,15,16} Conservative interventions traditionally include pain control strategies, activity modification, use of adaptive aids/equipment, strengthening exercises, joint protection education, use of nonsteroidal anti-inflammatory drugs, corticosteroid injections, and the use of prefabricated and/or custom-fabricated orthoses.²

Numerous orthotic designs have been proposed for the conservative management of thumb CMC joint osteoarthritis. Among the most frequently used designs are prefabricated neoprene thumb orthoses, custom-fabricated forearm-based or hand-based Thumb Spica orthoses, and the Colditz design custom orthosis (Figs. 2A–2C).^{15,17–19} These orthotic designs aim to minimize or

Table 2

Burton and Pellegrini classification system for thumb CMC joint osteoarthritis

Stage 1	Pain Positive grind test Ligamentous laxity Dorsoradial subluxation of the thumb CMC joint
Stage 2	Instability Chronic subluxation Radiographic degenerative changes
Stage 3	Involvement of the scaphotrapezoidal joint or less commonly the trapeziotrapezoid or trapeziometacarpal joint to the index finger
Stage 4	Stage 2 or stage 3 with degenerative changes at the metacarpophalangeal joint

CMC = carpometacarpal.

Note: Adapted from Reference 12.

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