

The Push® MetaGrip® Thumb CMC Brace



A White Paper

Describing the Stabilizing Mechanism of the Push MetaGrip



Exclusive US Distributor of



The Push® MetaGrip® Thumb CMC Brace

To the reader:

- The terms brace, splint, and orthosis are synonymous; the term brace is used in this paper.
- The joint at the base of the thumb has multiple names: 1) carpometacarpal or CMC joint, 2) basal joint, 3) trapezium-metacarpal or TM joint, and 4) trapeziometacarpal joint or TMJ. The term CMC joint is used in this paper.
- The brace described in this paper is called the Push MetaGrip in the US and Push ortho Thumb CMC outside the US.

Thumb CMC Osteoarthritis

Osteoarthritis (OA) of the joint at the base of the thumb, the carpometacarpal (CMC) joint, causes pain with resisted thumb motions and particularly with forceful pinching (Figure 1). *This creates difficulty with everyday tasks* such as twisting open a jar lid, turning a key in a lock, turning doorknobs, sustained pinching or writing, picking up a large book, holding a cup of tea/coffee, doing needlework/hand crafts, carrying a heavy object, playing golf/tennis and using scissors, etc.¹⁻⁴



Figure 1: X-ray view of a right thumb with osteoarthritis of the thumb CMC joint (circle).

Approximately one in four older women and one in twelve older men have osteoarthritis of this essential base joint.^{2,3,5-10} Pain and disability are significantly higher among patients with thumb CMC OA than those without¹¹ and this joint ranks as the most common site of upper extremity surgery related to osteoarthritis.^{1,2,9,12}

Development of Thumb CMC OA

The thumb CMC joint has a large range of motion enabled by the inherently lax joint ligaments (Figure 2). When thumb CMC joint osteoarthritis develops, the ligaments supporting the joint become insufficient and pathological joint motion develops.

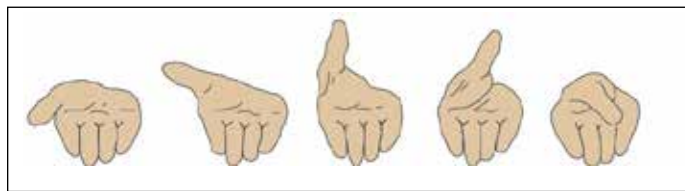


Figure 2: The range of motion of the thumb CMC joint from a position of full extension (left) to full flexion (right).

The pull of the strong thumb muscles against these inadequate ligaments results in the most common pathological motion at the CMC joint: dorsal translation. Dorsal translation is movement of the first metacarpal bone as it slides on the stationary trapezium in the direction of the dorsum (top) of the thumb (Figure 3).

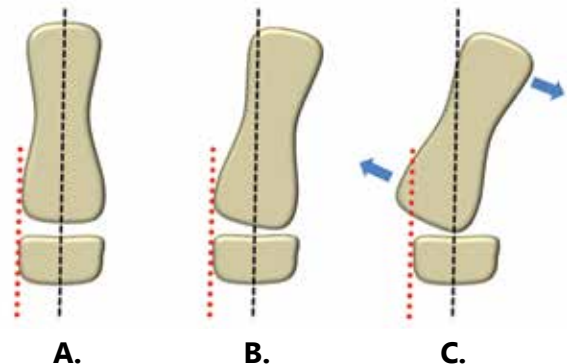


Figure 3: This schematic drawing of a left thumb illustrates the movement of the thumb metacarpal on the trapezium (red dotted line is dorsum of the thumb). A) Normal thumb CMC joint at rest with metacarpal and trapezium in alignment, B) Normal thumb CMC joint flexion; note the bones remain in alignment and C) Thumb CMC joint with osteoarthritis where first metacarpal base moves out of alignment in dorsal direction (dorsal translation) while the metacarpal head flexes forward.

Dorsal translation occurs when the thenar muscles contract: the thumb metacarpal tilts; the distal end of the bone moves toward the palm and the proximal end moves dorsally (Figure 3C). It is believed that this shift of motion, even slight, creates pain. In the early stages of thumb CMC osteoarthritis dorsal translation represents a small shift in joint alignment. As osteoarthritis progresses, the metacarpal base moves further and further dorsally, and may even dislocate relative to the trapezium.⁹

Bracing CMC Osteoarthritis

Bracing the osteoarthritic thumb CMC joint is standard non-surgical care for pain relief.^{1,2,7,11-24} Both the National Collaborating Centre for Chronic Conditions in the UK and the evidence-based European League against Rheumatism recommend bracing as part of treatment.^{15,25}

Numerous studies have investigated the effect of bracing on pain and function but none include a definition of the primary kinematic function of any brace. In other words, apart from general immobilization of the thumb CMC joint, there is no explanation of the precise mechanism by which a brace design achieves pain reduction or increased function.¹¹ To accomplish immobilization of the thumb CMC joint, most braces also incorporate the thumb metacarpophalangeal (MP) joint or the adjacent wrist joint^{1-3,13,16,22,26,27} (Figure 4). *The challenge of bracing the osteoarthritic thumb CMC joint is to balance the opposing goals of providing joint stability while also allowing mobility.*²⁸

Immobilization or Stabilization?

Immobilization seeks to decrease inflammation by providing periods of rest to the joint. The role of inflammation in osteoarthritis remains controversial,²⁹ bringing into question whether immobilization in a brace is the optimal treatment for thumb CMC osteoarthritis. It is well known that prolonged immobilization decreases muscle strength, which in turn decreases joint stability.²⁰ If immobilization is the chosen treatment for thumb CMC OA, the resulting decrease in stabilizing muscle strength is likely a contributing factor to the progression of the pathological imbalance at the joint.



Figure 4: Examples of brace designs for the thumb CMC joint which include CMC joint and thumb MP and/or wrist joints.

Motion, joint loading, and muscle strengthening have been shown to improve joint stability in patients with OA in large joints.^{30,31} Although data for small non-weight-bearing joints is lacking, recent publications on the treatment of thumb CMC OA suggest that exercises and bracing facilitate pain control and use of the thumb in a balanced manner.^{11,23,24,26,27,32-38}

Braces that do not impede daily activities allow longer periods of wear, which have been shown to decrease pain.^{13,16,22,26,27,39} Because the design of many thumb braces hinders function, however, such braces are often worn only at night, and normal daily activities continue without bracing support.²⁰ Consequently the dynamic force imbalance that encourages thumb CMC joint deformity continues to influence pathological progression during the day.⁴⁰

The Ideal Brace

The optimal brace for isolated CMC joint osteoarthritis would stabilize only the thumb CMC joint, controlling pain by preventing dorsal translation, while allowing maximal function. The brace would also encourage a balanced posture of the thumb during function so that it could be worn during nearly all activities. Maintaining ideal joint alignment during thumb muscle contraction increases function, decreases pain, and may potentially slow or control the deformity progression.^{18,21,33,41,42}

Since CMC joint osteoarthritis is typically limited to the CMC joint, the ideal thumb brace design need not restrict other joints. Although some individuals with OA develop associated MP

or wrist joint pathology and inclusion of either/both joints may be indicated for those individuals, this is not descriptive of the majority of those with thumb CMC osteoarthritis. Additionally, since activities requiring pinch are the primary cause of thumb CMC joint symptoms,⁹ the smaller brace design leaves critical sensory areas free while allowing unimpeded pinching, fingering, handling, and gripping activities.

A Different Design: Pseudo-Hydraulic Environment

The Push MetaGrip brace developed by Nea International excludes adjacent joints, specifically limits CMC joint dorsal translation, and allows maximum function.²⁶ This is accomplished through dynamic stabilization using a pseudo-hydraulic environment. Originally developed in the mid-20th century as a way to stabilize long bones during fracture healing, a pseudo-hydraulic environment uses pressure created by contracting muscles within a closed cylinder to stabilize the bone encircled by the muscles.⁴³

The Push MetaGrip stabilizes the thumb metacarpal by firmly encircling the thenar muscles. As the muscles enlarge during contraction, they fill the snugly-fitting cylinder, creating internal pressure within the brace which stabilizes the metacarpal (Figure 5). The brace does not need to cover the joint to provide this stability; it only needs to surround the thenar muscles. When the MetaGrip brace is in place, the very muscle contraction which normally causes the base of the first metacarpal to translate dorsally on the trapezium will, instead, stabilize the base of the metacarpal. This phenomenon is called “dynamic stabilization.”

In contrast to an immobilization design, a brace using the pseudo-hydraulic principle allows some motion within the “cylinder.” Those expecting traditional immobilization from the Push MetaGrip are surprised by the thumb mobility possible while wearing the brace. Thumb CMC motion is possible within the mid-range while wearing the brace, but when the thenar muscles contract, the muscle contraction stabilizes the first metacarpal and CMC joint movement is restricted. *The Push MetaGrip thus uniquely provides the most support when it is needed the most—during active use of the thumb.* Consequently, an individual try-

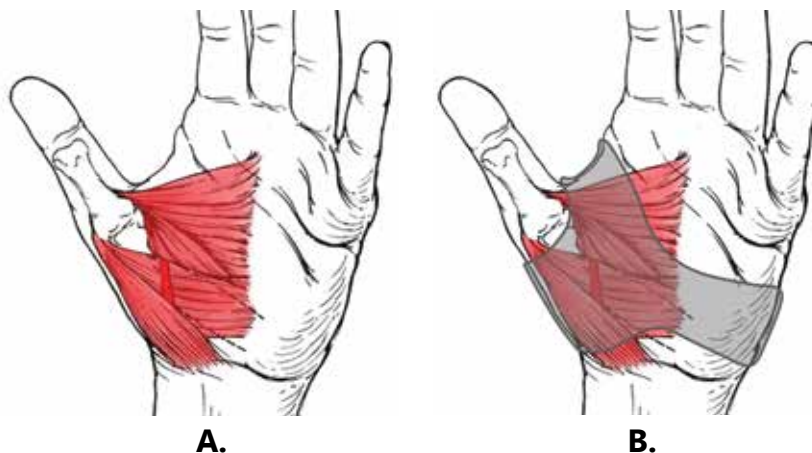


Figure 5: A) The thenar muscles (the flexor pollicis brevis is cut away to show the underlying opponens pollicis) enlarge when they contract. B) The Push MetaGrip encircles these muscles, creating stabilizing internal pressure when the muscles contract.

ing on the Push MetaGrip who does not have thumb osteoarthritis or CMC joint hypermobility will be unable to experience the restriction of dorsal translation the brace provides.

For the pseudo-hydraulic environment to provide stability the brace must precisely and snugly fit the contours and size of the relaxed thenar muscles. Because individual thumb sizes and shapes vary, the Push MetaGrip provides an adjustable custom fitting by incorporating a malleable, bi-contoured aluminum reinforcement around the thenar muscle area of the brace. **This metal must be firmly contoured to fit snugly around the thenar muscles** (Figure 6 & 7). If the fit is loose or imprecise, the pseudo-hydraulic environment does not exist.

Since symptom severity is influenced by joint loading,⁴⁰ a brace limiting metacarpal translation under load addresses the desired goal. Such a brace will likely be more effective in both alleviating symptoms and in influencing the course of the disease as compared to an immobilization brace that is rarely worn because its cumbersome design restricts function.^{26,27,44}



Figure 6: The aluminum insert must be snugly fitted around the thenar muscles.



Figure 7: X-ray showing the multi-contoured, bendable aluminum stay surrounding the thenar muscles.

Finally, and perhaps most importantly, disuse atrophy does not occur because the thenar muscles are actively contracting in the ideal mid-position while in the Push MetaGrip brace. Unlike an immobilization brace, the Push MetaGrip facilitates balanced use of the stabilizing thumb muscles, increasing the likelihood that brace wear may positively influence the course of the disease. By maintaining a balanced posture when under load, the patient can potentially retrain the thumb muscles to allow weaning from the brace over time. This is in sharp contrast to immobilization braces that prevent muscle use, thereby weakening the intrinsic thumb muscles.

Can a Small Brace be Effective?

As stated above, many braces endeavor to immobilize the thumb CMC joint and thus usually include the MP joint and may also include the wrist joint. Those who

encounter the minimal design of the Push MetaGrip brace (Figure 8) question whether a small brace can be effective.

A study correlating the joint restriction provided and the function allowed by four braces showed the Push MetaGrip (the only brace not including other joints) significantly restricted thumb CMC joint motion in all directions, although it retained the largest range of motion.⁴⁴

Two studies comparing braces including thumb CMC and MP joints with those including only the thumb CMC joint (one study was specifically the MetaGrip/ortho CMC) came to the same conclusions:

- Braces which include only the CMC joint have pain relief equal to that of braces including two joints
- Functional measures in both studies identified that the one joint brace allows retention of more function
- Patient preference strongly favors one joint inclusion.^{26,27}

Other studies have investigated patient compliance and pain relief using a variety of braces. These studies have also concluded that **patients prefer a smaller brace and a smaller brace can provide pain relief.**^{16,17,19,39,45-48}

Indications for the Push MetaGrip

Although the Push MetaGrip was designed to specifically limit dorsal translation of the first metacarpal on the trapezium, the **CMC joint stability provided by the brace makes it suitable for other applications.**

Post-Surgery Use

The goal of surgical reconstruction of the thumb CMC joint is to recreate stability while still allowing functional mobility. Because the Push MetaGrip brace only allows muscle contraction with the thumb CMC joint in mid-range, it is the ideal post-operative brace following thumb CMC joint reconstruction. The healing joint capsule is protected from the stress of end range joint motion. Unlike braces that immobilize the joint, the Push brace prepares the individual for effective weaning from external support by facilitating muscle strengthening in the ideal position while also protecting healing tissues. The brace can be fitted when the wound is stable, allowing the patient early protected use of the thumb for light activities.



Figure 8: The Push MetaGrip covers minimal area.

Thumb CMC Joint Hypermobility

Given the degree of motion the relatively lax ligaments allow at the normal thumb CMC joint, individuals with joint hypermobility often experience excessive motion at this joint, rendering it unstable during loading. Sometimes these hypermobile joints are symptomatic. Even if pain free, the use of the Push MetaGrip to stabilize the joint while under load enhances the ability of the thumb to hold and manipulate objects. The brace has been used successfully by individuals with general hypermobility as well as those with excessive hypermobility such as that caused by Erlos Danlos Syndrome.

Achieving the Impossible: Joint Stability and Mobility

Successful bracing of the thumb CMC joint must control pain through effective joint stabilization while at the same time maximize functional mobility. Since the release of the uniquely designed Push MetaGrip in the United States in 2011, many patients with thumb CMC osteoarthritis have reported wearing the MetaGrip for pain control during a wide range of vocational and avocational activities (Figure 9), suggesting that *the Push MetaGrip uniquely meets the contradictory goal of providing both mobility and stability of the thumb CMC joint.*



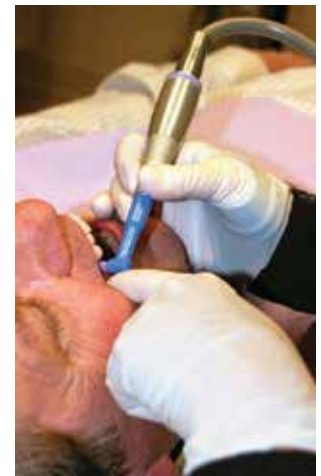
Golfing



Pruning



Quilting



Cleaning Teeth



Cutting with Scissors



Shoeing a horse



Knitting



Haircutting

Figure 9: Examples of vocational and avocational activities while wearing the Push MetaGrip.

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The U.S. Pricing, Data Analysis and Coding has assigned two HCPCS procedure codes for billing the Push® MetaGrip®:

- **L3923** - Hand finger orthosis, without joints, may include soft interface, straps, prefabricated item that has been trimmed, bent, molded assembled, or otherwise customized to fit a specific patient by an individual with expertise
- **L3924** - Hand finger orthosis, without joints, may include soft interface, straps, prefabricated, off-the-shelf

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