

# A Magnetized Brace Designed to Elevate the Extremity after Hand Trauma and Surgery

Travis J. Miller, MD

**Summary:** Hand elevation is a common recommendation for the treatment of hand injuries to combat development of painful swelling. However, noncompliance with elevation after hand procedures is common, and this is due in part to the lack of acceptable orthotics to assist in this elevation. Conventional slings are often not recommended due to potential shoulder morbidity. Additionally, the standard sling design allows for the hand to fall in a dependent position below the level of the heart. Herein described is a brace that uses magnetic technology designed to provide support for hand elevation that is intuitive to use. The simple design promotes elevation and also allows patients to easily exit the elevated position for shoulder ranging and activities of daily living with the hand as needed. Patient satisfaction data are presented. This brace may increase compliance for elevation after hand injuries and surgical procedures. (*Plast Reconstr Surg Glob Open* 2021;9:e3460; doi: [10.1097/GOX.0000000000003460](https://doi.org/10.1097/GOX.0000000000003460); Published online 15 March 2021.)

## INTRODUCTION

The hand is the most common part of the body to suffer traumatic injury, and hand injuries account for up to 20% of emergency room visits in the United States.<sup>1,2</sup> Additionally, elective hand surgeries are common and are estimated to occur in excess of 150 per 100,000 person-years, and this incidence appears to be increasing.<sup>3</sup> Elevation of the hand is known to alleviate pain and edema, and elevation may be a key factor in rehabilitation and final functional outcome.<sup>4</sup>

However, continuous elevation of the injured hand is not a trivial concern. An estimated 38% of patients will find standard slings uncomfortable, which will tempt patients toward sling abandonment.<sup>5</sup> Immobilization in a sling may also have a profound negative effect on shoulder mobility, leading to recent trends of shorter immobilization periods, even after procedures performed directly on the glenohumeral joint.<sup>6</sup> Self-application and removal of a sling is also greatly impaired after an injury or operation to one of the upper extremities. This imposes a great barrier to patients performing approved activities of daily living with the injured limb or performing hand therapy. Thus, many hand surgeons may elect not to provide slings and instead

instruct patients to elevate their hands through direct action of their shoulder, on their heads when ambulatory, or on objects around them when at rest (pillows, etc.).<sup>7</sup> Such tasks may be tiresome and inconvenient to patients, which may risk elevation noncompliance. A brace that easily allows a patient to rest their hand in an elevated position but also allows quick accessibility of the injured limb to be released from elevation would be ideal to counter these problems.

## INNOVATION

One possible solution is fixing the injured limb in place via a magnetic latch mechanism. One current option is the Elevate brace (Elevate LLC, San Francisco, Calif.). The brace consists of 2 parts. One part consists of a sleeve which wraps around the patient's injured limb with an attached male magnet. The sleeve is large enough to easily accommodate a patient's splint or other immobilization device used after surgery or an injury. The second component of the brace includes a chest and shoulder strap with an attached female magnet-latch that may be centered on either the ipsilateral or the contralateral shoulder (depending on the patient's comfort). When the patient wishes to elevate the hand, the hand is easily secured to the shoulder strap by locking the magnetic

*From the Division of Plastic & Reconstructive Surgery, Stanford University, Palo Alto, Calif.*

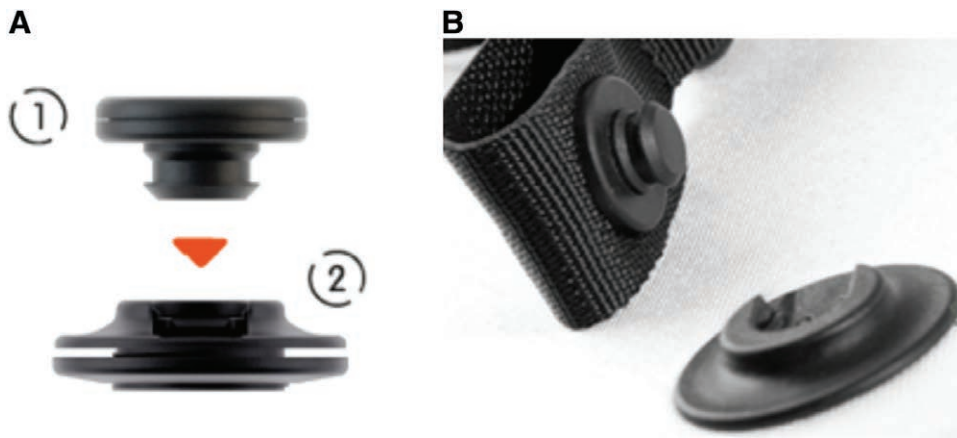
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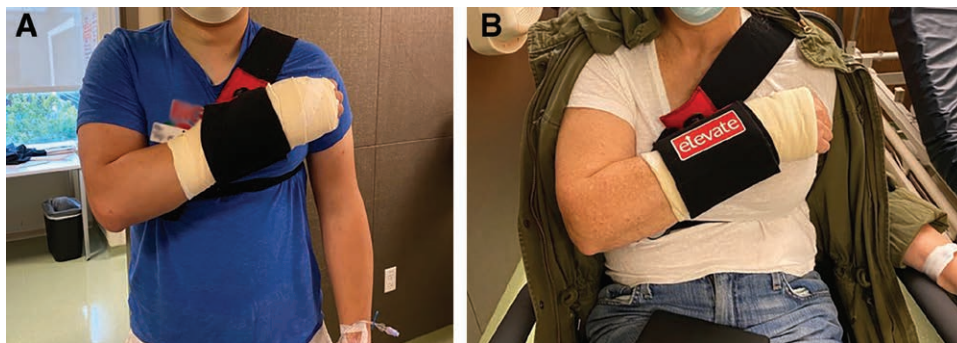
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**Fig. 1.** A, Male [see (1) in figure] and female [see (2) in figure] portions of the magnetic latch. Note that the male portion will be secured into the female portion in a downward vector, and once latched, will not allow further downward motion. The built-in magnet provides resistance to accidental upward escape of the male portion but will allow active release if the patient desires. B, The male and female portions of the latch before device engagement.



**Fig. 2.** Demonstration of brace on patients with splints in place. A, Use of the brace in a 26-year-old man after right triangular fibrocartilage complex repair. B, Use of the brace in a 53-year-old woman after right wrist dorsal ganglion removal.

latch. The latch component is able to support the full weight of the injured limb in a downward vector (such as due to gravity), and the magnetic charge of the latch prevents accidental release of the limb in an upward vector

(Fig. 1). When fully engaged, the limb can easily rest on the patient’s shoulder in the elevated position, and this is possible with a splint/cast in place (Fig. 2). Different levels of pronation/supination at the wrist are also possible through adjusting the strap at the wrist. However, the limb may be released as desired by pulling the limb in an upward vector volitionally. The patient may easily transition between the elevated and free position in this manner without assistance. (See Video [online], which demonstrates the device fit and intended use in a 26-year-old woman with left wrist immobilized for ulnar sided wrist pain. The patient is able to self-place the device, including activation and disengagement of the magnet-latch.)

Preliminary data have been gathered from 20 patients with hand or wrist injuries from 5 surgeons, and overall patient opinion toward the brace is favorable (Table 1). Most patients find the brace easy to use and comfortable, and average continuous wear time was noted to be greater than 4 hours.

**Table 1. Patient Reported Outcomes from Brace Use**

Question	Patient Response
Overall, was the brace easy to put on and take off?	4.00
Was the magnetic fastener easy to use?	4.65
Did you need to adjust the brace after the initial adjustment? (yes, no)	75% yes
If adjustments were made, how easy/difficult was it to make them?	3.44
Was it difficult putting on and removing the brace after the first time?	3.75
Was the wrist component easy to use?	4.38
Was the wrist component comfortable?	4.45
Was the torso component easy to use?	4.21
Was the torso component comfortable?	4.32
How comfortable was the complete brace to wear for long periods time?	3.65
What was the longest continuous period of time you wore the brace? (hours)	4.32 hours

Patient responses are from a 1 to 5 scale, unless otherwise noted. 1 = very difficult/uncomfortable, 2 = difficult, 3 = neither difficult nor easy, 4 = easy, and 5 = very easy/comfortable.

## DISCUSSION

The design of the magnetic elevation brace described here has many advantages compared with conventional slings.

The ability of the patient to easily free themselves from the elevated position may help prevent the known complication of shoulder stiffness that is well described with conventional slings.<sup>8</sup> The ability to disengage the elevation mechanism unsupervised also facilitates use of the injured extremity, such as with home hand therapy or exercise programs. Notably, other slings with the magnetic release design exist (NuSling, Active Arm Supports, LLC, Hygiene, Colo.), but may not provide the concurrent elevation function.<sup>9</sup>

With the potential for higher compliance for home exercise programs as well as benefits from elevation on pain and swelling, patients using this brace may have improved functional outcomes.<sup>10</sup> However, use of a magnetic brace may not be suitable for all patients. One concern is for patients with implanted pacemaker or defibrillators where proximity to the magnetic strap may potentially interfere with device function. Another relative contraindication would be for patients with significant injuries proximal to the hand or wrist, who may not be able to self-extricate from the brace and would likely receive little benefit compared with a conventional sling. Current reviews from patients regarding the brace are encouraging, but a well-designed trial comparing an elevated brace with conventional slings and/or no sling would be useful in evaluating the elevated brace as an improved standard of care.

### CONCLUSIONS

Upper limb elevation with the assistance of a brace utilizing magnetic technology offers the advantages of persistent comfortable elevation while potentially eliminating the negative effects of shoulder immobilization associated with conventional slings. The benefits provided by this brace may augment patient compliance with the important act of limb elevation.

Travis J. Miller, MD

Department of Surgery  
Division of Plastic and Reconstructive Surgery  
Stanford University  
770 Welch Road #400  
Palo Alto, CA 94304  
E-mail: [travismi@stanford.edu](mailto:travismi@stanford.edu)

### REFERENCES

1. Maroukis BL, Chung KC, MacEachern M, et al. Hand trauma care in the united states: a literature review. *Plast Reconstr Surg*. 2016;137:1100–1111e.
2. Chung SY, Sood A, Granick MS. Disproportionate availability between emergency and elective hand coverage: a national trend? *Eplasty*. 2016;16:e28.
3. Wildin C, Dias JJ, Heras-Palou C, et al. Trends in elective hand surgery referrals from primary care. *Ann R Coll Surg Engl*. 2006;88:543–546.
4. Lee JS, Kim YH. Factors associated with limited hand motion after hand trauma. *Medicine (Baltimore)*. 2019;98:e14183.
5. Kroeze M, Rakhorst H, Hout P. Arm sling after carpal tunnel surgery: myth or evidence based? *J Hand Surg Eur Vol*. 2020;45:255–259.
6. Gutiérrez-Espinoza H, Araya-Quintanilla F, Pinto-Concha S, et al. Effectiveness of supervised early exercise program in patients with arthroscopic rotator cuff repair: study protocol clinical trial. *Medicine (Baltimore)*. 2020;99:e18846.
7. Muraoka K, Kleimeyer J, Yao J. Development of a reproducible upper limb swelling model. *J Hand Surg Asian Pac Vol*. 2019;24:452–455.
8. McFarland EG, Curl LA, Urquhart MW, et al. Shoulder immobilization devices. *Orthop Nurs*. 1997;16:47–54.
9. NuSling Comfort Arm Sling. Active Arm Supports, LLC. Available at <https://activearmsupports.com/product/nusling-comfort-arm-sling/>. Accessed September 20, 2020.
10. Roll SC, Hardison ME. Effectiveness of occupational therapy interventions for adults with musculoskeletal conditions of the forearm, wrist, and hand: a systematic review. *Am J Occup Ther*. 2017;71:7101180010p1–7101180010p12.