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## Orthotic intervention incorporating the dart-thrower's motion as part of conservative management guidelines for treatment of scapholunate injury

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## ABSTRACT

*Study Design:* Case series.*Introduction:* This paper describes conservative guidelines for the management of scapho-lunate interosseous ligament (SLIL) injury including fabrication of an orthosis that restricts active wrist movement to the dart-throwers (DTM) plane.*Purpose of the Study:* The dart throwers' orthosis (DTO) was designed as a response to biomechanical studies suggesting that restraining motion to the DTM would off-load a deficient SLIL.*Methods:* After six weeks of wearing the DTO, the 5 patients in this case series initiated an exercise program that incorporated wrist proprioceptive training and specific muscle strengthening.*Discussion:* The DTO was designed to incorporate controlled movement in order to better integrate the secondary wrist stabilizers in wrists that had a deficient SLIL. The orthosis and the exercise program harnessed proprioceptive influences using active motion within the DTM plane, and stimulated mechanoreceptors so as to enhance stability.*Results:* All patients demonstrated improvement in subjective and objective outcomes including self-reported pain and function.*Conclusions:* Orthotic intervention that controls motion within the DTM, combined with an appropriate proprioceptive rehabilitation program, may provide a viable conservative treatment option for patients with a similar clinical presentation.*Level of evidence:* 4.

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## Introduction

Permitting precise motion between the carpal bones, the complex carpal ligamentous system is essential to wrist motion, unique to human hand function, and highly susceptible to instability.<sup>1–4</sup> Given that scapholunate interosseous ligament (SLIL) injuries are the most frequent cause of carpal instability,<sup>5</sup> seemingly innocuous damage can lead to an alteration in carpal mechanics, which over time is likely to result in degenerative changes and severe wrist dysfunction.<sup>6,7</sup>

Surgical management of SLIL injuries includes direct repair, ligament reconstructions, capsulodeses, and various salvage

procedures.<sup>8–11</sup> Research studies evaluating these surgical procedures have reported inconsistent findings across a range of clinical outcomes.<sup>6,9,12–14</sup> Conservative management of SLIL injuries is not as well understood, and most published reports describe a treatment that is primarily based on the hand therapist's experience and preference.<sup>15</sup> These articles emphasize the use of static and controlled motion orthoses, patient education to avoid weight-bearing and forceful gripping, proprioceptive training, and specific muscle strengthening without reporting clinical results.<sup>3,15–18</sup>

Over the past decade, there has been an increasing amount of scientific study and discussion regarding the use of dart-thrower's movement (DTM) for rehabilitation of SLIL injury.<sup>2,19–22</sup> This multiplanar movement of radial–extension to ulnar–flexion is most commonly seen in functional activities, such as bouncing or throwing a ball, hitting a nail with a hammer, pouring water from a jug, or drinking from a cup.<sup>1,2,20</sup> The physiological importance of the DTM is that relative to each other and to the radius, the scaphoid

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**Fig. 1.** The dart throwers' orthosis demonstrating the guide wire as it passes through the eyelet in the first web space of the distal section to its attachment on the proximal section.

and lunate move very little during the midrange of this movement pattern compared with the uniplanar motions of flexion, extension, or ulnar and radial deviation.<sup>1,20,23,24</sup>

The DTM also serves to inhibit the effect of the extensor carpi ulnaris and flexor carpi radialis on distal carpal row pronation, which in turn increases the scapholunate (SL) interval in SLIL-deficient wrists.<sup>22,25</sup> Isolating wrist motion to the DTM provides sufficient proprioceptive input to mechanoreceptors in the dorsal ligamentous structures to enhance wrist control, and in the case of SLIL injury, encourages these secondary stabilizers to increase their stabilizing effect on the carpus.<sup>26</sup> Rehabilitation guidelines that incorporate intercarpal motion control with proprioceptive input have been proposed for safe mobilization of an injured or repaired SLIL.<sup>2,15,22,24,26</sup>

Although a recent biomechanical study of patients with SLIL injuries demonstrated increased gapping at the SL interval, the study did not identify at which point along the DTM plane the gapping occurred.<sup>25</sup> Thus, the potential for protected early DTM remains. The purpose of this article is to describe a rehabilitation program of proprioceptive training and a unique orthosis in a small cohort of patients with SLIL injury and report on the outcomes. The dart-thrower's orthosis (DTO) was designed by the author to restrain motion within the DTM plane and subsequently used in a series of patients with SLIL injury. The current orthotic design uses a bent wire that limits movement to the midrange of the DTM plane, thus further protecting stress to the SLIL. The curvature of the wire also ensures that the multiplanar aspect of the DTM is replicated accurately. Other previously described orthoses use different mechanisms to restrict movement to the DTM plane.<sup>18,27,28</sup>

The DTO was worn in conjunction with a rehabilitative program designed to increase proprioceptive input and maximize the activation of secondary stabilizers in the absence of an intact SLIL. The program is a modification of previously reported protocols<sup>26,29,30</sup>



**Fig. 2.** The dart throwers' orthosis demonstrating the end limit of radial extension.

and includes additional strategies based on the authors' clinical experience.

## Methods

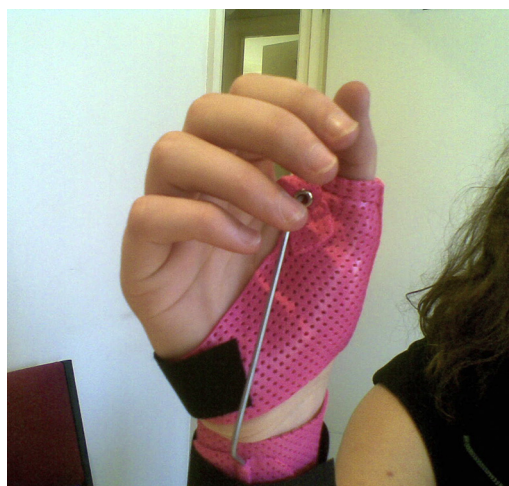
Ethics approval for this case series was granted by the Ethics Committee of The Avenue Hospital, Windsor, Australia. The authors conducted a retrospective review on the clinical outcomes of 5 patients treated with this method by the senior author between 2008 and 2015.

## Patients

The patients included in this study are all of whom diagnosed with SLIL instability treated by the author with the described guidelines between 2008 and 2015. Patients with SLIL injury who opted for surgery or who did not use the DTO were excluded from the series.

## Outcomes

Patient progress was consistently assessed with biweekly visual analog pain scores (VASs) beginning at week 2 of DTO use, and grip



**Fig. 3.** The dart throwers' orthosis demonstrating the end limit of ulnar flexion.

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