Intersection syndrome, an overuse injury affecting the forearm, has been reported in sporting activity involving the upper limb, such as rowing, canoeing, racket sports, weight lifting, and skiing. People who have intersection syndrome report pain, crepitus, and/or swelling in the dorsal forearm, 4 to 8 cm proximal to Lister’s tubercle, where the muscle bellies of the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) cross the underlying extensor carpi radialis longus (ECRL) and extensor carpi radialis brevis (ECRB). The pathophysiological basis for intersection syndrome is uncertain, but 2 potential mechanisms are considered. The first may be friction between the tendons of the APL and EPB, and those of the ECRL and ECRB; the second may be stenosis, due to entrapment within the second dorsal compartment that houses the ECRL and ECRB. Aso et al argued in support of the former mechanism, due to the presence of pain on palpation and crepitus over the intersection of the APL and EPB, and the ECRL and ECRB, rather than the distal area of the second dorsal compartment, and due to thumb movements that accompany crepitus. A key feature of intersection syndrome on magnetic resonance imaging (MRI) is peritendinous edema around the first and second extensor compartment tendons, which extends proximally from the intersection between the APL and EPB, and the ECRL and ECRB.

Current management of intersection syndrome comprises a combination of rest, nonsteroidal anti-inflammatory drugs, and splinting. One report indicated that 60% of patients responded to this form of management within 2 to 3 weeks. However, splinting the wrist in 15° to 20° of extension restricts wrist and thumb movements, possibly leading to difficulty with daily living and work activities. Steroid injection is recommended for those failing to respond to the reported case series.

**CASE DESCRIPTION:** Five patients with intersection syndrome were managed by taping, in an effort to reduce crepitus induced by thumb movements. Nonstretch sports tape was applied, with an ulnarly directed tension force across the dorsal aspect of the forearm. Taping was performed daily for 3 weeks. Follow-up took place at 1, 2, 3, and 4 weeks, and at 1 year from the initial consultation.

**OUTCOMES:** All patients demonstrated complete elimination of crepitus with the application of tape. Crepitus induced by wrist movements, tenderness over the dorsal forearm, and swelling were no longer present at 3-week follow-up. Disability identified by the disability/symptom subscale of the Disabilities of the Arm, Shoulder and Hand questionnaire decreased at 3-week follow-up, and this reduction was maintained at 4-week and 1-year follow-ups.

**DISCUSSION:** Taping improved symptoms and function in this small case series. One possible explanation for this improvement may be the alteration of soft tissue alignment.

**LEVEL OF EVIDENCE:** Therapy, level 4.

**KEY WORDS:** overuse syndrome, tape, thumb, wrist

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conservative management.\textsuperscript{26,26} Mulligan\textsuperscript{12} suggests that tape can be used to reduce pain and enhance healing for Achilles tendinopathy by altering the direction of forces across the muscle-tendon unit. If tendon friction is the predominant cause of intersection syndrome, as Aso et al propose, then the taping technique as described by Mulligan across the APL and EPB tendons may change the mechanical force around the painful area, decreasing friction, and resulting in less pain, while assisting healing processes.

We used the conceptual paradigm proposed by Mulligan as a new form of management for intersection syndrome. The purpose of this case series is to describe the use of tape for the management of intersection syndrome in 5 patients.

**CASE DESCRIPTIONS**

Five female patients (mean age, 49.4 years), referred to physiotherapy with a diagnosis of intersection syndrome, were managed with taping. The right arm was symptomatic in 4 and the left arm in 1 of the patients. Patient demographics are summarized in **Table 1**. These data include duration and predominant side of symptoms, presence of crepitus induced by active wrist movements, swelling along the course of the affected tendons, and tenderness over the dorsal forearm for each patient. Pain at rest and raised skin temperature were not seen in any of the patients.

An orthopaedic surgeon diagnosed intersection syndrome, based on physical assessments, including Finkelstein’s test, isometric muscle testing of the APL, EPB, ECRL, and ECRB, Tinel’s sign, upper limb neurodynamic tests, and the overall clinical presentation (tenderness over the dorsal forearm, 4 to 8 cm proximal to the wrist joint, crepitus induced by active wrist movements, and visible swelling along the course of the affected tendons). Diagnosis was also made with MRI, by identifying peritendinous edema around the first and second extensor compartment tendons, extending proximally from the intersection between the APL and EPB, and the ECRL and ECRB. All patients in this case series had requested not to be treated with a hand splint, due to the hindrance of the splint for their work. Consequently, the patients were deemed suitable for a trial of taping, and volunteered for this intervention after being informed of the available treatment options.

All patients demonstrated limited range of motion for active and passive flexion at the metacarpalphalangeal (MP) joint of the thumb, passive wrist flexion, and active wrist extension, as measured by a goniometer (**Table 2**). Finkelstein’s test was positive in each case. Finkelstein’s test is most commonly associated with De Quervain’s disease; but other instances of radial-sided wrist and distal forearm pain, such as intersection syndrome, wrist injuries, and entrapment neuropathy of the superficial radial nerve, can be provoked by the Finkelstein’s test maneuver.\textsuperscript{9,12} However, pain was also provoked by isometric muscle testing of the ECRL or ECRB, but not for the APL or EPB, suggesting the presence of intersection syndrome rather than De Quervain’s disease.\textsuperscript{3} Furthermore, tenderness was found on the dorsal forearm rather than along the radial aspect of the wrist,\textsuperscript{6} which is a clinical picture different from that of De Quervain’s disease. Moreover, crepitus during active thumb movements was found on the intersection between the APL and EPB, and the ECRL and ECRB, on the dorsal forearm, in contrast to crepitus found over the first dorsal compartment or at the styloid process of the radius in individuals with De Quervain’s disease.

### **Table 1**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age, y</th>
<th>Gender</th>
<th>Dominant hand</th>
<th>Painful hand</th>
<th>Employment</th>
<th>Symptom duration, d</th>
<th>Crepitus*</th>
<th>Swelling†</th>
<th>Tenderness‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44</td>
<td>F</td>
<td>R</td>
<td>L</td>
<td>Homemaker</td>
<td>90</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
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<td>50</td>
<td>F</td>
<td>R</td>
<td>R</td>
<td>Nursing care</td>
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<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
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<td>+</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>F</td>
<td>R</td>
<td>R</td>
<td>Cleaning</td>
<td>14</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>53</td>
<td>F</td>
<td>R</td>
<td>R</td>
<td>Nursing care</td>
<td>21</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Abbreviations: *, present; †, present; ‡, present; F, female; L, left; R, right.

*Crepitus induced by thumb movements.
†Swelling was visually estimated from a comparison with the opposite side.
‡Tenderness was present based on pressure pain over the dorsal forearm rated at 3 or more on an 11-point numeric rating scale (0, no pain; 10, pain as bad as it could possibly be).

### **Table 2**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Active MCP flexion</th>
<th>Passive MCP flexion</th>
<th>Active wrist flexion</th>
<th>Passive wrist flexion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45° (55°)</td>
<td>45° (55°)</td>
<td>50° (60°)</td>
<td>60° (85°)</td>
</tr>
<tr>
<td>2</td>
<td>45° (55°)</td>
<td>45° (55°)</td>
<td>50° (60°)</td>
<td>65° (85°)</td>
</tr>
<tr>
<td>3</td>
<td>45° (55°)</td>
<td>45° (55°)</td>
<td>50° (60°)</td>
<td>60° (90°)</td>
</tr>
<tr>
<td>4</td>
<td>45° (55°)</td>
<td>45° (55°)</td>
<td>50° (60°)</td>
<td>70° (90°)</td>
</tr>
<tr>
<td>5</td>
<td>40° (60°)</td>
<td>40° (60°)</td>
<td>50° (60°)</td>
<td>60° (90°)</td>
</tr>
</tbody>
</table>

Abbreviation: MCP, metacarpalphalangeal.

*Range of motion on the pain-free side provided in parentheses.
Quervain’s disease.² These findings indicated less possibility of the presence of De Quervain’s disease. In addition, in each of our patients, the Tinel’s sign and upper limb neurodynamic tests suggestive of entrapment neuropathy of the superficial radial nerve²,⁹ were negative.

**TABLE 3** summarizes functional disability for each patient and pain intensity prior to the application of taping at the initial consultation. Pain intensity was measured with an 11-point numerical rating scale (NRS), and functional scores measured with the disability/symptom subscale of the Disabilities of the Arm, Shoulder and Hand questionnaire, Japanese version (DASH-JSSH disability/symptom), for which reliability and validity have been established.¹¹ All patients provided informed consent for publication and their anonymity was guaranteed.

**Taping Technique**

A generic, 50-mm-wide nonstretch tape (Battlewin C50F; Nichiban Co, Ltd, Tokyo, Japan) was utilized in this study. The taping direction for each patient was determined by assessing crepitus during thumb movements, while manual force was applied across the soft tissue of the dorsal aspect of the forearm. A reduction of crepitus, when force was applied in either the ulnar or radial direction, indicated a positive response, which determined the taping direction to be used. Tape was then applied in an attempt to replicate and maintain the manually applied force across the muscle-tendon unit. The distal end of the tape was applied first to the muscle bellies of the APL and EPB. Tension was exerted with the free end of the tape as it was applied across the dorsal forearm, perpendicular to its long axis (FIGURE 1). A second layer of tape was used to reinforce the first layer. Reevaluation of thumb movement was performed to ensure the effectiveness of the tape in eliminating crepitus induced by active thumb movements. If crepitus remained, the tape direction or tension force was altered slightly until no crepitus was perceived. Once the specific taping direction and tension force were determined, each patient was instructed in self-application of the tape.

The tape was removed at night, and each patient was instructed to maintain the taping regimen for 3 weeks and allowed to continue work. Patients were advised to reapply the tape if the effects of taping were not optimal and to stop taping if they had any adverse skin reaction, of which there were none during the treatment period. The patients were also advised to perform their normal daily activities. Following the 3-week intervention, all patients were advised to use the symptomatic limb during activities of daily living and to work without tape. They were instructed to reapply the tape if they had any return of symptoms.

**Outcome Measures**

Outcome measures included the pres-
ence of crepitus induced by active thumb movements with no tape application, tenderness over the dorsal forearm (3 or more on the NRS), swelling, and functional disability as measured by the DASH-JSSH disability/symptom. Assessments were taken at the initial evaluation, prior to the initial application of tape, and at the follow-up points of 1, 2, 3, and 4 weeks. In addition, 1 year following the initial assessment, each patient was assessed with the DASH-JSSH disability/symptom via phone interview.

**OUTCOMES**

In all patients, crepitus induced by thumb movement was diminished or reduced by the manual application of an ulnarily directed force on the soft tissues of the dorsal forearm, as force applied in the opposite (radial) direction produced no change. In addition, crepitus was resolved by taping across the dorsal forearm with an ulnarily directed force in all patients. Movement was less painful when the tape was applied, and all patients reported that the symptom-relieving effects of taping lasted throughout the day, making reapplication of the tape unnecessary.

At 3-week follow-up, all patients reported the absence of crepitus induced by thumb movements. In addition, other findings were no longer present, including swelling and tenderness over the dorsal forearm (Table 4). Figure 2 demonstrates the scores on the DASH-JSSH disability/symptom at each follow-up point for each patient. There was considerable improvement in upper limb function at the 3-week follow-up in all patients, as evidenced by change in DASH-JSSH disability/symptom scores. At the 4-week follow-up, the DASH-JSSH disability/symptom score in each patient was not different from that of the 3-week follow-up, and all patients noted neither reproduction of pain during functional activity nor limited range of motion of the thumb and wrist. Consequently, patients were discharged from physiotherapy. All patients maintained pain-free normal upper limb function at 1-year follow-up.

**DISCUSSION**

This case series suggests the beneficial effects of taping for the management of intersection syndrome. It should be noted that the taping technique reported in this study is unlikely to be effective for other forearm pain syndromes, such as De Quervain’s disease and entrapment neuropathy of the superficial radial nerve, due to differences in underlying pathophysiology. Hence, an accurate diagnosis of intersection syndrome is important to identify those likely to respond to this form of management. In the current case series, a comprehensive physical examination and MRI were used to establish the diagnosis of intersection syndrome.

All patients experienced rapid improvement of upper limb function with the application of tape, despite the duration of symptoms having been present for up to 90 days in 1 patient. Although this finding suggests the positive effect of taping in individuals with intersection syndrome, a cause-and-effect relation-
ship cannot be established from a case series. Some studies have demonstrated a positive effect of taping on pain reduction, and Mulligan suggests that this positive effect of taping on pain reduction and soft tissue healing may be related to the alteration of soft tissue biomechanics. Yet the ability of taping to change the alignment of anatomical structures is debatable. In the current case series, all patients experienced reduction of crepitation induced by thumb movements when a force to shift the skin was applied manually. This suggests that taping might induce alteration of soft tissue alignment of the APL, EPB, ECRL, and/or ECRB. Nevertheless, it is uncertain whether taping actually changes soft tissue alignment, particularly when these muscles are contracting. MRI evaluation of muscle alignment before and during taping would be necessary to support such a hypothesis.

In addition, 5 is an insufficient number of patients to clearly establish that an ulnarly directed force is necessary to obtain reduction or disappearance of the crepitation in patients with this condition. Further studies with bigger sample sizes would be required to confirm this finding.

All patients demonstrated considerable improvement of upper limb function over the 3-week taping period, as well as maintenance of upper limb function at the 1-year follow-up. This indicates the potential usefulness of taping for the management of intersection syndrome. In future clinical studies, it would be interesting to compare the effectiveness of taping to other treatment approaches, such as splint therapy and steroid injection, in terms of time to recovery, cost effectiveness, quality of life, satisfaction of treatment, long-term functional ability of the upper limb, and recurrence rate. For example, splint therapy restricts normal wrist/hand movements and may lead to a decrease in quality of life and/or low satisfaction with treatment. Also, in the management of shoulder and elbow tendinitis, steroidal injection has poorer long-term outcomes in pain and physical function than conservative treatments without injection. With these considerations, taping may be a useful approach for intersection syndrome.

It should be noted that there may be more effective taping approaches than the technique reported here. We did not compare different methods of taping, for example, different tape width, length, and properties (eg, stretch or nonstretch). These points merit further investigation to find the optimal application of tape in the management of intersection syndrome.

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REFERENCES


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