Case report

Clinical and ultrasonographic evidence of a proximal positional fault of the radius. A case report

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ABSTRACT

Positional faults are considered a possible underlying mechanism mimicking the symptoms of a joint sprain. Despite numerous clinical studies indicating the presence of positional faults, there is limited evidence of imaging studies confirming positional faults. This case report is a preliminary study that offers clinical and ultrasonographic evidence of a proximal positional fault of the radius, treated successfully with manual therapy techniques.

Three weeks after a bike fall on the outstretched hand, the patient in this study presented with right wrist pain and a lack of progress with conventional conservative treatment (NSAIDs, rest and immobilization). Clinical findings indicating a proximal positional fault of the radius included pain during active pronation increased by associating a passive movement of the radius in a proximal direction and it was reduced by associating a passive movement of the radius in a distal direction. Ultrasonographic (US) images showed a reduction of radio-capitellar distance on the right side (11.4 mm) compared to the left side (13.3 mm). A positive response with a distal mobilization of the radius supported the proximal positional fault of the radius.

After two manual therapy sessions, the patient had recovered normal asymptomatic function. The outcomes used to assess function and pain were active pronation range of motion, the Spanish version of the DASH questionnaire and a 0–10 numeric pain rating scale. Each measure was conducted prior and after each treatment session and one week post treatment. The patient was re-examined at 6 months follow-up, during which US images, demonstrated a normalization of the right radio-capitellar distance.

1. Introduction

Falls on an outstretched hand are a frequent injury mechanism of the wrist, forearm and elbow. Forearm joints have different stabilizing mechanisms, both active and passive, preventing abnormal movements (Watanabe et al., 2005). It has been hypothesized that in some cases an injury or strain of a joint produce minor positional faults, resulting in movement restrictions and/or pain (Mulligan, 1999).

Manual therapy techniques such as Mulligan’s mobilization-with-movement (MWM) or traction-manipulation seek to correct positional faults by restoring the normal position of the joint (Mulligan, 1999; Kaltenborn, 2008). MWM techniques apply a manual force, usually in the form of a joint glide, to a motion segment and sustained while a previously impaired action is performed. Several clinical studies have described the success of MWM in the management of different musculoskeletal conditions of the upper extremity (Vicenzino and Wright, 1995; Folk, 2001; Backstrom, 2002; Kochar and Dogra, 2002; Teys et al., 2008; Amro et al., 2010; Djordjevic et al., 2012), lower extremity (Hetherington, 1996; O’Brien and Vicenzino, 1998; Collins et al., 2004; Woodman et al., 2013) and spine (Exelby, 2001; Reid et al., 2008). However, its mechanism of action is in need of further evaluation (Vicenzino et al., 2007).

Despite numerous clinical studies indicating the presence of positional faults, there is only preliminary evidence of two imaging studies confirming positional faults. Hubbard and Hertelb (2008) showed radiographic evidence of a fibular positional fault in a case of “sprained ankle” and Hsieh et al. (2002), using magnetic resonance imaging, showed a positional fault of the proximal phalanx of the thumb.
This case report is a preliminary study that offers clinical and ultrasonographic evidence of a proximal positional fault of the radius, treated successfully with manual therapy techniques.

2. Patient presentation

2.1. History

The patient was a 24-year old right-handed male, who while practicing mountain biking, sustained a fall on the right outstretched hand on 21st October 2012. The patient reported wrist pain and some thoracic symptomatic wounds. The patient presented to the Primary Care Emergency Service where a “traumatic wrist sprain” was diagnosed. Prescribed treatment consisted of taking NSAIDs, rest and an immobilization of the right wrist and forearm with a compression bandage lasting 3 weeks.

After 3 weeks, the thoracic symptoms had disappeared, but the wrist pain persisted. At this point, the patient sought physical therapy intervention due to dissatisfaction with his progress. The patient reported pain on the dorso-ulnar side of the right wrist during daily life activities (0–10 Numeric Pain Rating Scale: NPRS = 1), car gear changing (NPRS = 4) and cycling (NPRS = 8), being unable to practice the latter due to the vibration transmitted from the handlebar.

2.2. Physical examination

On examination, the patient presented a normal and asymptomatic mobility (actively and passively) of the right wrist (flexion, extension and radial and ulnar deviation) and elbow (flexion and extension), and a normal joint play of radio-carpal and humeroulnar joints. Active and passive pronosupination movements of the right forearm were symptomatic and restricted (Table 1). Pain during active pronation (NPRS = 5) was increased by associating a passive movement of the radius in a proximal direction (NPRS = 9) and it was reduced by associating a passive movement of the radius in a distal direction (NPRS = 1). Joint play of the right distal radio-ulnar joint (DRUJ) was increased in dorsal direction (slight hypermobility). Joint play of the proximal radio-ulnar joint (PRUJ) was slightly decreased (slight hypomobility). Soft tissue examination revealed an increased tone of the pronator teres muscle.

Ultrasonographic (US) images of the radio-humeral joint and the DRUJ were performed using 8 MHz–13 MHz linear transducer (LOGIQ-e, GE Medical Systems). The radio-humeral joint was assessed in a longitudinal view at the lateral aspect of the elbow (Kosuwon et al., 1993; Koh et al., 2007), with the patient in a standing position, under loaded and unloaded conditions with the forearm in a standardized neutral position (Fig. 1, A and B). The lateral epicondyle of the humerus and the radial head were located by palpation and confirmed by US, and the distance between them (the radio capitellar distance, RCD) was measured (Kosuwon et al., 1993). Elbow US has shown to be a reliable tool to measure RCD (Kosuwon et al., 1993). DRUJ was assessed in unloaded conditions, with the forearm in a neutral position (Fig. 1, C). The vertical distance between the most superficial points of the distal radius and ulna was measured. The images (Fig. 2) were re-measured by an independent examiner who did not know the symptomatic side and the diagnostic hypothesis. Results are shown in Table 2. Under unloaded conditions, the RCD was 1.9 mm smaller on the right side (11.4 mm) compared to the left side (13.3 mm). There was no difference between the right and left sides in the RCD under loaded conditions (right and left = 11.0 mm) or in the DRUJ. Ultrasonographic and clinical findings indicated a proximal positional fault of the radius.

2.3. Outcome measures

Range of motion (ROM) and symptom behaviour during active pronation were used as the key sign and symptom in re-examination during the treatment process (Table 3). The Spanish version of Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire was used as indicator of functional status of the upper extremity of the patient (Hervás et al., 2006). The DASH questionnaire is a self-administered region-specific outcome instrument developed to measure self-rated upper-extremity disability and symptoms (Hudak et al., 1996). The DASH questionnaire is a reliable, valid and responsive instrument that can provide a standardized measure in Spanish patients with upper-extremity musculoskeletal conditions (Hervás et al., 2006).

2.4. Treatment

After examination, a trial treatment was performed based on the hypothesis of a proximal positional fault of the radius. The trial treatment consisted of a single mobilization of the radius in the
distal direction with fixation of the humerus and ulna, for 2 min (Fig. 3). After this mobilization, ROM and pain during active pronation were improved (Table 3), confirming the diagnostic hypothesis. Thus, a treatment plan was developed (Table 3).

The patient received two 30 min treatment sessions, one week apart, until full recovery of function was achieved. Each treatment session started with the assessment of the key sign (active pronation). Then, the main treatment was performed. The main treatment consisted of a mobilization of the radius in the distal direction with fixation of the humerus and ulna, for 2 min. Immediately after the mobilization technique, a reassessment of the key sign was performed (Table 3). Finally, the patient received an adjuvant treatment including MWM, soft tissue and taping techniques and a home-based self-mobilization programme (Table 3). The week after the first treatment session, the patient reported that he “could perform almost every daily life activity without any symptom” and that he “was able to ride his bike for 1 h until discomfort appeared”. After the second session, the patient had recovered full asymptomatic active pronation. One week after the second session, the patient maintained a complete asymptomatic mobility of the right forearm (NPRS = 0), being able to cycle for 2 h without any symptom, so he was discharged. The patient was instructed to continue with self-mobilization techniques during the next week and if symptoms re-appeared at anytime.

A six months follow-up examination was performed. The patient reported that he had not experienced any symptom and his functioning had been completely normal. An ultrasound examination was performed, evidencing a normalization of RCD in unloaded (right = 13.0 mm; left = 13.7 mm) and loaded (right = 11.5 mm; left = 11.4 mm) conditions.

3. Discussion

3.1. Hypothesis

In this case study, based on clinical and ultrasonographic findings during examination, a proximal positional fault of the radius was hypothesized. During pronation, the radius moves volar and
Table 2

US measurements of radio-humeral joint and distal radio-ulnar joint.

<table>
<thead>
<tr>
<th>Joint</th>
<th>Unloaded conditions</th>
<th>Loaded conditions</th>
</tr>
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<tbody>
<tr>
<td>Radio-humeral joint</td>
<td>13.3 mm</td>
<td>11.4 mm</td>
</tr>
<tr>
<td>(US distance between radius and humerus: radio-capitellar)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal radio-ulnar joint</td>
<td>3.3 mm</td>
<td>3.3 mm</td>
</tr>
<tr>
<td>(US distance between the most superficial radial and ulnar points)</td>
<td></td>
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proximally in relation to the ulna (Epner et al., 1982; Palmer et al., 1982; af Ekenstam and Hagert, 1985; Tomaino, 2000). The clinical findings in this case include symptom provocation/alleviation in active pronation while a proximal/distal movement of the radius was sustained, suggesting a proximal positional fault of the radius.

In addition to the clinical findings, the present case report used US to show a positional fault. The literature has reported different imaging procedures to evaluate elbow and wrist joints such as radiographs, CT or MRI (Mino et al., 1983, 1985; Wechsler et al., 1987; Lo et al., 2001; Ehman et al., 2011). US is a useful, valid and reliable imaging procedures to evaluate elbow and wrist joints such as radiographs, CT or MRI (Mino et al., 1983, 1985; Wechsler et al., 1987; Lo et al., 2001; Ehman et al., 2011). US is a useful, valid and reliable technique to evaluate elbow and forearm morphology (Kosuwon Lo et al., 2001; Ehman et al., 2011). Although US is an operator-dependent technique, it offers several key advantages over other imaging modalities including being non-invasive, cost-effectiveness, availability and ability to perform a dynamic examination with joint motion and in a comfortable position for the patient (Martinoli et al., 2001; Koh et al., 2007).

On initial examination, under unloaded conditions, RCD was 1.9 mm smaller on the right side (11.4 mm) compared with the left side (13.3 mm); but under loaded conditions RCD was similar in the right and left sides (11.0 mm). Under loaded conditions the RCD on the left side reduced 2.3 mm, functioning as a spring-mechanism. However, the RCD on the right side only reduced 0.4 mm. So it was hypothesized that a fall on an outstretched hand could generate a longitudinal force transmitted through the radius proximally, producing its positional fault.

3.2. Treatment basis

Manual therapy and taping techniques were used to improve function and relieve symptoms, based on the hypothesis of a proximal positional fault of radius.

The mechanism(s) by which the manual therapy techniques exert its ameliorative effects in clinical practice remains somewhat of an enigma (Vicenzino et al., 2007). Many authors speculate about the underlying mechanism of action of mobilization techniques, especially MWM techniques, with a tendency to conceptualize this as one of reducing or correcting minor positional faults at joints (Exelby, 1995, 1996, 2001; Hetherington, 1996; O’Brien and Vicenzino, 1998; Kavanagh, 1999; Mulligan, 1999; Folk, 2001; Vicenzino, 1998; Kavanagh, 1999).
Backstrom, 2002). Nevertheless, few studies have directly evaluated this proposal (Kavanagh, 1999; Hsieh et al., 2002), and currently, there is no substantive evidence that supports or refutes the hypothesis that a reversal of a positional fault is the predominant mechanism of action for MWM (Vicenzino et al., 2007).

Although some authors suggest that manual therapy effects are mainly mechanical, manual therapy most likely works not only through biomechanical but also via neurophysiological mechanisms (Biulosky et al., 2009). MWM treatment techniques have also been shown to produce hypoalgesia and concurrent sympathoexcitation (Paungmali et al., 2003a, 2003b). This hypoalgesic effect may be non-opioid in nature as well as exhibiting features that are complex and widely distributed to other systems, such as the motor and sympathetic nervous system (Vicenzino et al., 2007).

One explanatory mechanism underlying manual therapy induced pain modulation is the activation of the descending pain inhibitory system within the central nervous system, initiated by stimulation of the lateral-dorsal periaqueductal gray (Sterling et al., 2001; Paungmali et al., 2003b). Further work is urgently required in addressing this issue (Vicenzino et al., 2007).

Taping has been shown to improve proprioception, increase stability and reduce pain in several musculoskeletal conditions (Murray and Husk, 2001; Osterhues, 2004; Jaraczewska and Long, 2006; Thelen et al., 2008; Djordjevic et al., 2012). Furthermore, taping has been shown to change biomechanical parameters at different body parts (O'Brien and Vicenzino, 1998; Vicenzino et al., 2005; Radford et al., 2006; Franettovich et al., 2008, 2010; McConnell and McIntosh, 2009; Cordova et al., 2010) and augment the beneficial effects of mobilization techniques (Tey et al., 2013).

3.3. Limitations

Several limitations are inherent to this case report. Because of clinical conditions, it was not possible to perform a US examination immediately after the treatment. Nevertheless, long-term US measurements (6 months after) confirmed a normalization of RCD in the right elbow.

Furthermore, the elbow is a complex joint in three dimensions and should be better evaluated with US based on a standardized approach, including its anterior, lateral, medial and posterior aspects (Martinoli et al., 2001). The present case report measured RCD only in a longitudinal view at the lateral aspect of the elbow (Kosuwon et al., 1993; Koh et al., 2007).

Although US is not the optimal technique to measure bone distances, US offers several important advantages to physical therapy practice including non-invasivity, cost-effectiveness, availability and ability to perform a dynamic examination with joint motion and in a comfortable position for the patient (Martinoli et al., 2001; Koh et al., 2007). Nevertheless, further validity and reliability studies about RCD measurements are required.

This case report offers preliminary evidence of a proximal positional fault of the radius based on the clinical and US data. The lack of progress during the 3 weeks after the fall, clinical and US findings during examination, the rapid positive response with a single mobilization of the radius in the distal direction, and the recovery of normal asymptomatic function after two manual therapy sessions, supported the hypothesis of a proximal positional fault of the radius. At 6 months follow-up, clinical and US data demonstrated a normalization of the positional fault. The present case report shows that a possible injury caused by a fall on an outstretched hand is the presence of a proximal positional fault of the radius, which can be treated successfully with manual therapy techniques. Further clinical and imaging studies are needed to validate this hypothesis.

References


