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Directional preference of the wrist: a preliminary investigation

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ABSTRACT

Background: Directional preference is a phenomenon that occurs in musculoskeletal disorders. It is associated with improved symptomatic and functional outcomes. Research has shown a 90% increase in the identification of directional preference in the peripheral joints between 2006 and 2012. There is currently no research analyzing if predictive variables exist for establishing directional preference.

Case Description: This report presents 19 consecutive patients with wrist pain. These patients were evaluated using a mechanical diagnosis and therapy (MDT)-based assessment. Patients were classified into the mechanical syndromes Derangement, Dysfunction, Postural, and Other. Patients classified with wrist Derangement were assessed for the presence of directional preference. Secondary analysis of predetermined variables was performed for association with directional preference. One case description was included to demonstrate MDT assessment, treatment, and clinical reasoning.

Results: Of the 19 patients evaluated, 15 (79%) were classified as having wrist Derangement. All patients with wrist Derangement demonstrated directional preference. Eight movements were found to establish directional preference. Each was unique with varying degrees of direction, load, and force.

Discussion: This report found directional preference to be higher (79%) than previously reported values. Historical and physical examination findings were analyzed to determine if there were associated variables of directional preference. Excessive mechanical stress was found to be the most associated factor in predicting directional preference. These findings may lead to a greater understanding of peripheral MDT assessment, which may lead to increased identification of directional preference and improved patient outcomes.

Level of Evidence: 4.

KEYWORDS

MDT; McKenzie; extremity; wrist; directional preference; derangement; classification

Introduction

Directional preference is a phenomenon that occurs in musculoskeletal disorders when one specific movement causes an improvement in pain, range of motion, strength, or function [1]. Directional preference is associated with improved symptomatic and functional outcomes in spinal and extremity disorders [2–5]. Research shows the prevalence of directional preference in spinal disorders range from 60 to 78% [6]. The prevalence of directional preference in extremity disorders has been less researched. A survey of extremity disorders has shown a 90% increase in the identification of directional preference from 19 to 37% between 2006 and 2012 [7]. No research has directly investigated if there are predictive variables associated with the establishment of directional preference in extremity disorders. This lack of research may contribute to the significantly lower prevalence rate of directional preference in extremity disorders when compared to spinal disorders.

Directional preference was first described by Robin McKenzie in the management of spinal disorders [8] and has been researched extensively since [6]. Directional preference is also used in the McKenzie methods: mechanical diagnosis and therapy (MDT) for the management of extremity disorders [1]. MDT is an evaluation and treatment system that uses symptomatic and mechanical responses, rather than patho-anatomical diagnosis. Through repeated movement testing, musculoskeletal disorders are classified into the following syndromes: Derangement, Dysfunction, Postural, and Other [1].

- Derangement is defined as an internal dislocation of articular tissue of unknown origin which causes a disturbance in the normal resting position of the affected joint surface, resulting in pain, and obstruction to movement. Treatment of Derangement involves repeated movement in one direction (directional preference). Directional

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preference is associated with improvement in symptoms, and/or mechanical presentation (i.e. range of motion, strength, and function), and is only present in Derangement syndrome. Directions of movement in the opposite direction may cause movement or symptoms to worsen. This is referred to as directional vulnerability [1].

- Dysfunction syndrome is defined as mechanical deformation of structurally impaired soft tissue which results in pain and limited range of motion. Dysfunction is subcategorized into Articular Dysfunction and Contractile Dysfunction. Treatment of Dysfunction involves progressive tissue loading to remodel the articular or contractile tissue [1].
- Postural syndrome is defined as mechanical deformation of normal soft tissues or vascular insufficiency arising from prolonged positional stresses resulting in pain. The primary intervention for postural syndrome is patient education and avoidance of the offensive position [1].
- Other refers to conditions of non-mechanical origin. Examples of conditions classified as 'Other' include, but are not limited to, cancer, fracture, vascular pathology, trauma, soft tissue pathology, post-surgical, chronic pain states, and inflammatory conditions [1].

MDT demonstrates acceptable reliability in spinal and extremity disorders when utilized by well-trained clinicians [9–13]. Two publications have reported MDT in the management of the wrist. The first is a survey that found two patients with wrist pain, classified as wrist Derangement with directional preference of extension [7]. The second was a case study involving a patient diagnosed with DeQuevain's syndrome. The patient was successfully managed (short and long term) with MDT after other failed conservative treatment. The patient's directional preference was ulnar deviation with radio-carpal distraction [14].

The aims of this report were to (1) examine the prevalence of MDT syndromes in consecutive patients with wrist pain; (2) establish directional preference in patients classified as wrist Derangement; (3) analyze if predetermined variables were associated in establishing directional preference; (4) provide a case description including the clinical reasoning involved in finding directional preference.

Methods

Four examiners were used for data collection, evaluation, and treatment. The lead author (JRM) holds a doctorate in physical therapy and Diploma in MDT. Two co-examiners were third-year students of a doctoral physical therapy program at the time of examination, and now hold doctorates in physical therapy, and are licensed practitioners. One student (CN) had taken the introductory lumbar (A) and cervical (B) MDT courses. The other student (CV) had taken no formal MDT coursework. The fourth examiner (SF) was a recent graduate of a doctoral physical therapy program, who had taken McKenzie course A, B, and advanced lumbar and lower extremity management (C). Students were trained by the lead author in MDT wrist evaluation as part of a 12-week clinical affiliation prior to data collection. All patient management was overseen by the lead author. Patients were recruited through the normal business operations of a private certified McKenzie spine and extremity outpatient clinic.

Consecutive patients with wrist pain greater than 3/10 on a 0–10 Numeric Pain Rating Scale (NPRS) [15,16] were eligible for inclusion in the study. The NPRS is an 11-point scale where 0 designates 'No pain' and 10 designates 'The worst pain imaginable'. No other inclusion or exclusion criteria were implemented. Data collection was performed over a two-month period. Patients were evaluated using a MDT-based assessment. MDT assessment involves the use of repetitive and sustained movements while monitoring symptomatic (e.g. pain), and mechanical responses (e.g. strength, range of motion, and functional movements). Range of motion loss was categorized as, nil, minimal, moderate, and major loss [1].

Spinal involvement was assessed first using repeated end-range cervical and thoracic movements [1]. If symptomatic or mechanical wrist baselines were altered as the result of spinal movements, or neurologic involvement was present, patients were determined to have spinal involvement. These patients were treated although not used in data collection for this report. If the wrist baselines were unaffected through the spinal assessment, the patient was considered to have no spinal involvement and repeated end-range wrist movements were then tested. In an MDT examination, mechanical or symptomatic responses are tested first in the sagittal plane. If there is not a favorable response, then alternative strategies are employed using repeated movement testing in the transverse or frontal planes. The examiners were instructed to perform movement testing until pain was abolished. If abolishment of pain did not occur, the movement that had the greatest reduction in pain was chosen as the patient's directional preference. If pain was not altered, the movement that had the greatest increase in range of motion or functional activity was chosen as the patient's directional preference. The lead examiner reviewed all of the patient's testing results before directional preference was prescribed. The repeated wrist movements are referred to as loading strategies, which are intended to be end-range, self-joint mobilization techniques. They are described by the amount of weight-bearing (e.g. loaded, partially loaded, un-loaded), the direction of movement (e.g. extension, flexion), and the external force (e.g. traction, over-pressure, mobilization, manipulation).

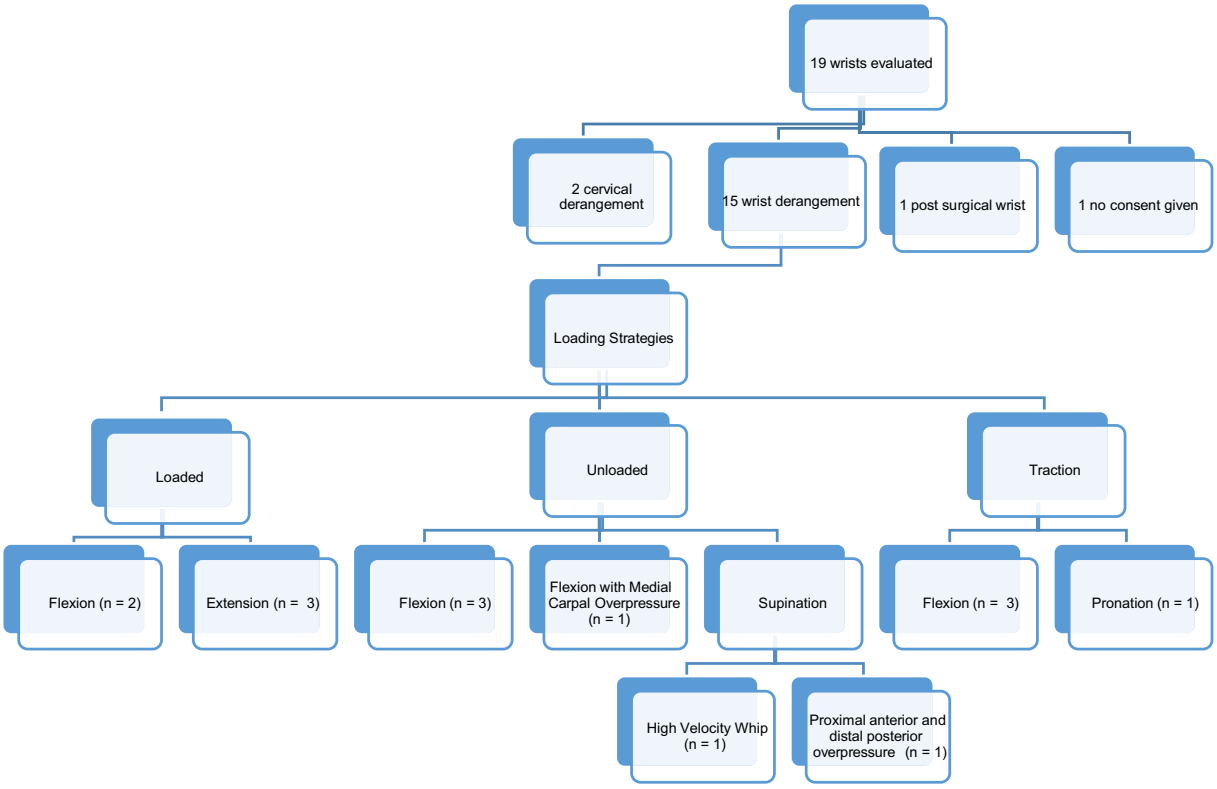

Figure 1. Patient classification and loading strategies.

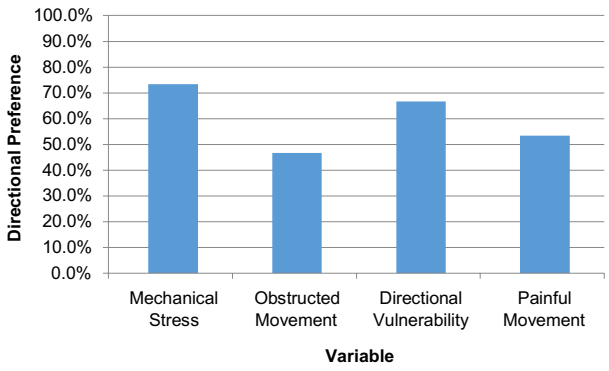

Figure 2. Variables associated with directional preference.

Patients were classified into mechanical syndromes and managed without alteration of normal practice. Signed consent was obtained from all but one patient who has not been included in data collection. No other patients were excluded. The predetermined variables analyzed for association with directional preference were mechanical stress, directional vulnerability, painful movement, and obstructed movement. These variables were decided upon by previous evidence and clinical experience of the lead author (JRM).

Operational definitions of analyzed variables:

- Mechanical Stress – a repeated or sustained wrist movement that the patient performs more often than any other wrist movement.
- Directional Vulnerability – a repeated movement or sustained wrist position the patient reports to reproduce their symptom.
- Painful Movement – the most painful movement rated on the NPRS.
- Obstructed Movement – the range of motion that is most limited when compared to the asymptomatic wrist.

Criteria for establishing directional preference included improvement of one or more of the following, as a direct result of repeated movement testing:[1]

- Improvement in resting pain, pain with active, passive or resisted movement ≥2/10 NPRS.
- Range of motion improvement ≥50%.
- Improvement in ability to perform a functional task by 50% (as reported verbally by the patient) or change in associated pain by ≥2/10 NPRS.

Results

Nineteen patients were evaluated. Patient age ranged from 15 to 69 years (mean 34.4 ± 14.1). Duration of symptoms ranged from 2 to 52 weeks (mean 23.5 ± 21.7). NPRS ranged from 3/10 to 9/10 (mean 5.9 ± 1.7/10). Of the 19 evaluated patients, 15 were classified as wrist Derangement syndrome (79%), two as cervical

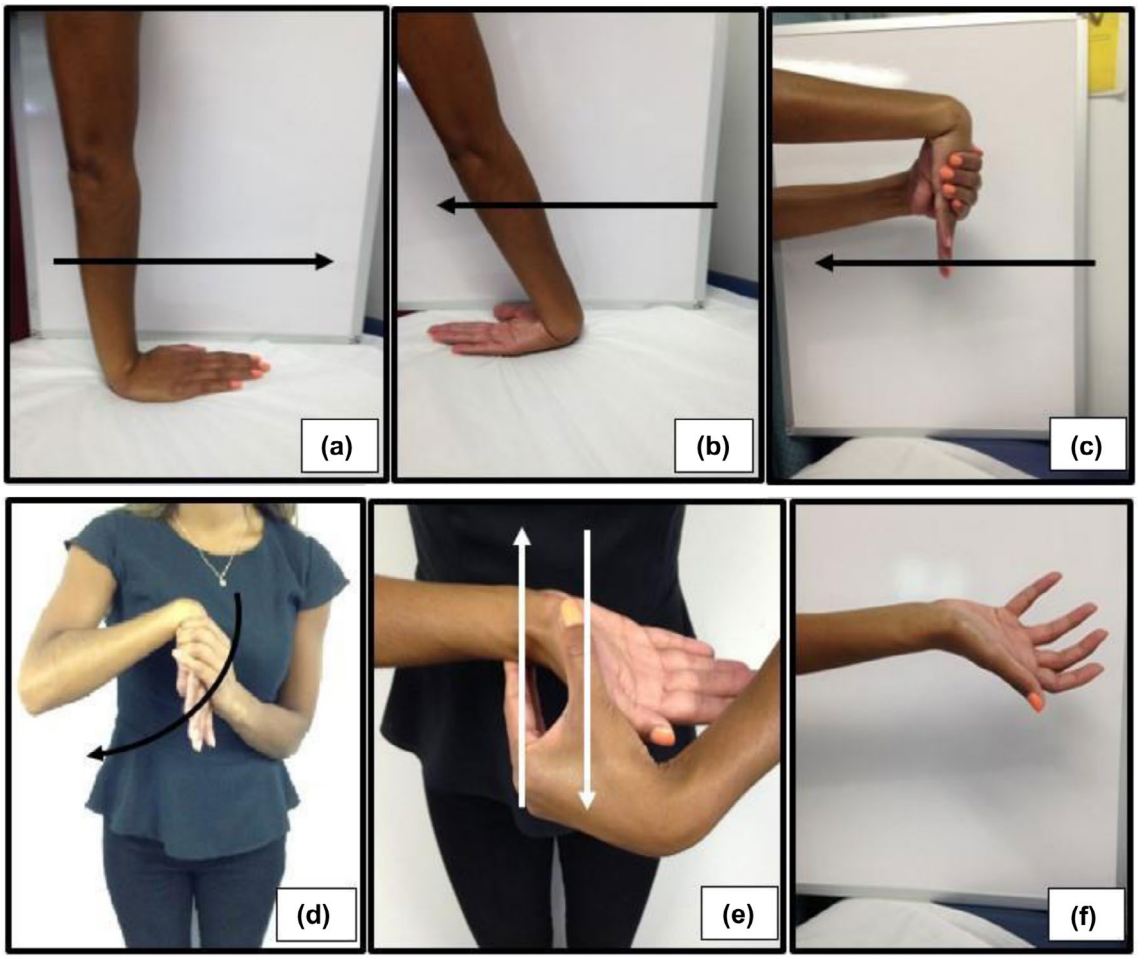

Figure 3. (a) Loaded wrist extension. (b) Load wrist flexion. (c) Unloaded wrist flexion. (d) Wrist flexion with traction. (e) Wrist supination with proximal anterior and distal posterior over-pressure. (f) Unloaded supination with high velocity whip.

Derangement (10.5%), two as Other (10.5%) (1 s/p surgery, 1 lack of signed consent). No Articular or Contractile Dysfunction, or Postural Syndromes were identified.

Patient classification and loading strategies of patients classified with wrist Derangement are listed in Figure 1.

Upon secondary analysis of collected patient data, classified with Derangement syndrome, the highest association of directional preference prediction was mechanical stress (Figure 2). Mechanical stress was inversely related to directional preference by 73.3% (11/15). Forty-six percent (7/15) of patients had an association of most obstructed movement matching directional preference. Sixty-six percent (10/15) of patients had directional preference opposite of their reported directional vulnerability. Fifty-three percent (8/15) of patient's most painful movement matched directional preference.

All wrist patients with central symmetrical symptoms required loading strategies only in the sagittal plane (Eg. flexion, extension). Symptoms with radial or ulnar wrist location responded to both sagittal and frontal or transverse loading strategies (Eg. pronation, supination, radial, ulnar deviation).

On initial examination, in response to repeated movement testing, all patients classified as Derangement met the criteria for establishing directional preference. Seven patients demonstrated abolishment of all pain. Eight patients demonstrated reduction of pain by ≥2 points on the NPRS. Ten demonstrated increased range of motion ≥50%. Three demonstrated change in reported functional deficits (Eg. Gripping, lifting, exercise) ≥50% or reduction in associated pain ≥2 points on the NPRS.

Of the 15 patients classified with wrist Derangement, five required a change in directional preference direction upon re-evaluation secondary to a plateaued or worsened symptomatic or mechanical presentation. Ten patients required no change in direction or load. They were able to effectively manage their condition and discharged at re-evaluation (Visit 2) to an independent management strategy. Patients were given instruction to contact the treating clinician if symptoms worsened or did not resolve completely. No patients contacted the treating clinicians after discharge. The five patients requiring direction and load changes were seen between three and six visits until successful discharge.

Case report

To best illustrate MDT extremity evaluation, clinical reasoning, and treatment, a case report of one patient who required multiple loading strategies has been included.

The patient was a 25-year-old male accountant, who presented with an average NPRS of 5/10 radial wrist pain, present for two weeks, which commenced for no apparent reason. Symptoms were intermittent, worse with activities and exercise involving end-range wrist extension, specifically, a handstand push-up (an exercise in which the participant bears full bodyweight through their wrists in an upside down position while pushing upward). Symptoms could remain over 20 min after being provoked. The patient reported no previous history of these symptoms and general health was otherwise good. He sought no other medical consultation or diagnostic imaging and took no pain medication.

The patient's history allowed the treating clinician to begin differential diagnosis. A time frame of two weeks ruled out the possibility of both a Contractile and Articular Dysfunction, as both require an eight-week time frame. Symptoms that are predominately intermittent made an inflammatory state unlikely. The lack of trauma reduces the likelihood of fracture or structurally compromised tissue. Symptoms could linger for over 20 min which rules out Postural syndrome, leaving Derangement, and Other as possible classifications [1].

Upon physical examination, the patient's most obstructed movement was wrist extension (moderate loss). Painful movements were wrist flexion and supination, both 7/10 on the NPRS. The patient reported 7/10 pain with one handstand push-up, which was his greatest functional limitation and set as a functional baseline. These findings were used as concordant signs, pre-set painful baselines that are tested pre- and post-repeated movement testing.

The patient reported in his history that end-range loaded wrist extension (Figure 3(a)) worsened his symptoms, and this movement was suspected to be his directional vulnerability. This was confirmed by a worsening of the patient's symptoms after performing 20 repetitions of end-range loaded wrist extension (Figure 3(a)). Because wrist extension worsened the patient's symptoms, the opposite direction of wrist flexion was then tested.

Loaded wrist flexion (Figure 3(b)) was tested first because the opposite movement (loaded extension) worsened the patient's symptoms. The patient was unable to tolerate this movement secondary to pain. Unloaded flexion (Figure 3(c)) was less painful to perform although resulted in no positive symptomatic or mechanical changes**.**

The treating clinician felt wrist flexion was likely to be the directional preference secondary to worsening of symptoms with wrist extension. To exhaust sagittal plane movement, flexion with therapist-generated traction was tested. Repeated movement testing of flexion with traction abolished end-range flexion pain, restored extension range of motion to normal limits, and abolished pain with a handstand push-up.

The rapid abolishment of pain with wrist motion and function confirmed the classification of Derangement with the directional preference of wrist flexion with traction (Figure 3(d)). The patient was instructed to perform wrist flexion with self-traction for every one to two hours until re-evaluation. It was recommended that he continues his prior strength and conditioning program without restriction. He was instructed to test the prescribed loading technique in the presence of pain to determine if pain could be consistently reduced or abolished.

Re-evaluation (Visit 2) was performed 48 h from the initial evaluation. The patient reported an 80% improvement in the pain associated with his greatest functional deficit, handstand push-ups. He reported only minimal pain during the previously provocative exercise and the ability to reduce or abolish symptoms by performing wrist flexion with self-traction (Figure 3(d)).

Despite significant functional improvement and no pain with passive or active flexion, supination remained painful. Further movement testing was initiated to determine if a more effective loading strategy was present. All flexion loading strategies were exhausted in an attempt to abolish pain with supination, which had no effect. Extension had already proven to worsen symptoms, so it was determined that sagittal plane movement had been exhausted. Alternative loading into the now only painful movement of supination, was explored next.

Repeated supination with patient overpressure had no effect, so alternative force was included. Supination with therapist generated traction-abolished pain while the movement was under traction although pain returned immediately after traction was released. Compression had no effect. Applying anterior force to the distal radius and posterior force to the first metacarpal during supination (Figure 3(e)) abolished the patient's symptoms during movement with a significant reduction in pain after. More repetition was performed in an attempt to generate more pain reduction. Pain with supination was abolished fully after 30 repetitions of this technique and the previously painful baselines could no longer be provoked. Repeated supination with proximal anterior and distal posterior force (Figure 3(e)) was confirmed as the directional preference. The patient was instructed to perform this loading strategy for 10 repetitions, every one to two hours until re-evaluation in one week.

Upon the second re-evaluation (Visit 3) in one week, the patient reported 100% perceived improvement. He reported no pain in the last week. He was able to perform multiple workouts involving hand-stand push-ups and other wrist extension-based exercise without onset of symptoms. He was discharged to prophylactically continue his home exercise program twice daily, and before and after exercise. A verbal re-evaluation was performed for one month and one year after discharge. The patient reported having no re-occurrence of symptoms, no functional limitations, and no longer needing to perform his home program.

Discussion

Prior to this report, the only two published wrist directional preference procedures were wrist extension [7] and ulnar deviation [14]. If these procedures were solely used with our patient sample, only 20% (3/15) of patients with wrist Derangement would have matched directional preference. Through the use of additional loading strategies, this report found 79% of consecutive patients to have matched directional preference. This is far greater than the currently established extremity derangement prevalence rate of 37% and previous 19% [7]. It has been theorized this increase may be the result of a learning curve [7]. The learning curve can be attributed to the relative newness of MDT extremity evaluation, lack of MDT extremity curriculum in Diplomats receiving training prior to the mid-1990s, as well as the historical bias of MDT clinicians treating predominantly spinal conditions [7]. This finding is significant because the classification of derangement with directional preference is associated with a good prognosis [2–5]. It appears as MDT extremity assessment matures, derangement prevalence continues to increase.

Clinically, relevant findings were the lack of associated obstructed movement (46.6%) and painful movement (53.3%). This is relevant for clinicians who intuitively restore range of motion with the restricted movement. In the previously reported case, using wrist extension to restore wrist extension worsened the patient's symptoms. Further management using this intuitive concept would likely lead to a poor outcome. If 53.3% of patient's directional preference was their most painful movement, clinicians should not necessarily avoid movement testing into a patient's most painful movement, as this may become the patient's directional preference. Further research needs to be performed in larger samples of wrist and other extremity joints. Understanding how to better find directional preference, may lead to higher prevalence.

MDT is a classification-based system that uses patient response to movement rather than patho-anatomical diagnosis. Despite the lack of concern for the anatomical cause in the MDT classification system, it has been theorized the cause of Derangement in the peripheral joint is due to displaced articular structures. Through anatomical dissection, Mercer and Bogduk found a displacement of fat-pads, fibro-adipose meniscoids, and capsular rims in the elbow [17]. These structures are innervated and mobile, having the ability to cause obstruction to movement and pain [17]. The obstruction and pain with movement caused by these displaced structures [17] are theorized to be a cause of the MDT syndrome, Derangement [1]. Repositioning of these structures may explain why certain movements (directional preference) are capable of causing rapid improvement in many of the patients in this report. Research identifying the exact anatomical structures or mechanism should be tested in subjects with Derangement classifications. Greater understanding of this phenomenon may improve clinical application and guide future research.

In the lumbar spine, a common presentation is a patient who is exposed to excessive lumbar flexion force developing a posterior intra-discal displacement resulting in pain and obstruction to movement in lumbar extension [8]. This patient is commonly managed with MDT extension principle, which is believed to cause mechanical effects on displaced disk material [8]. The most common finding in this report was the inverse relationship between excessive mechanical stress and directional preference. This opposite mechanical relationship is of interest to the authors, given the high prevalence {75% (9/12)} of patients exposed to excessive wrist extension. These patients required a form of the opposite movement (wrist flexion) to improve their condition. Two similar cases were documented in our findings. One, an elderly woman, who spent her leisurely hours crocheting, a pastime she described as putting her wrist into excessive flexion. Her directional preference was the opposite, wrist extension (Figure 3(a)). Another, a fry cook who spent most working hours pronating her wrist. Her directional preference was also opposite, wrist supination with a high velocity whip (Figure 3(f)).

Although wrist and lumbar anatomy differs greatly, there appears to be a similar correlative bio-mechanical relationship present which may be more easily recognized from thorough understanding of the mechanical stresses patients are more frequently exposed to. If a larger population of people with orthopedic disorders have the ability to rapidly improve with self- management strategies, a reduction in expensive diagnostic testing, invasive treatment procedures, and addictive narcotics, could lead to larger societal implications. Randomized control trials should be performed to determine the efficacy of MDT to other conservative musculoskeletal treatment. The use of students in this report could be a potential limitation in the reliability of patient management. Bybee and Dionne [13] found acceptable reliability when students were well-trained in cervical MDT evaluation, although this has not been examined in extremity assessment. Further research of student reliability for extremity evaluation should be performed.

Conclusion

This report provides preliminary evidence that may assist those less familiar with MDT extremity management in finding directional preference of the wrist. If directional preference can be more easily identified in the extremities, its prevalence should continue to increase. This style of treatment may also improve short- and long-term outcomes secondary to the rapidly reducible characteristic associated with derangement syndrome and the self-management strategies incorporated with MDT.

Disclosure statement

No potential conflict of interest was reported by the authors.

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