Diagnosis of cervical and thoracic musculoskeletal spinal pain receptive to mechanical movement strategies: a multicenter observational study

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Diagnosis of Cervical and Thoracic Musculoskeletal Spinal Pain Receptive to Mechanical Movement Strategies: A Multi-Center Observational Study

Background The McKenzie's Mechanical Diagnosis and Therapy (MDT), which uses a combination of repeated movements and sustained positions to affect signs and symptoms, is commonly used for the conservative evaluation and management of cervical and thoracic spinal conditions.

Objective Report a consecutive cohort of neck and thoracic pain patients managed using MDT and to record their classifications and physiotherapy management strategies.

Methods Therapists provided demographic data on themselves and the patients, clinical data on the patients, and Neck Disability Index scores at baseline and final visit.

Results Sixteen therapists collected data on 138 patients at baseline, of who 120 (87%) were followed up three to five visits later; these were patients with 131 cervical and seven thoracic problems. The therapists and patients are described. Regarding MDT classifications 83% were recorded as cervical and 100% as thoracic Derangement; there was a Directional Preference for extension in 80% of cervical spine patients, and 100% of thoracic spine patients. In addition 13% of cervical spine patients were classified as OTHER, for which specific classifications were given. Classifications remained stable between initial and discharge sessions in 94% of patients. Neck Disability Index scores reduced from a mean of 24 to 12 at discharge ($P < 0.001$).

Conclusions Routinely collected data can describe both therapists and patients involved, demonstrate the MDT classification clinical utility in terms of prevalence and stability between visits, provide information on the clinical course of this patients' population, which could help establish treatment efficacy. Randomized controlled trials are needed to test for efficacy.

Key words: cervical and thoracic spine, neck pain, McKenzie method, Neck Disability Index

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Introduction

Neck pain is a common problem in the adult population, with a point prevalence of 10% and yearly prevalence of 37% [1]. Although it can be a transient problem, over 50% of those with neck pain at baseline report persistent symptoms at 12 months [2]. Female gender, older age, high job demands, low social support and previous back or neck pain are associated with the onset of neck pain; and older age, longer duration, previous neck pain and other musculoskeletal disorders are associated with the persistence of neck pain [3,4]. It is a problem that is associated with disability and an impact on people's quality of life and working ability [5]. There is no known cure for the problem, but a systematic review found that management strategies involving exercises and manual therapy were associated with more improvement than manual therapy alone [6]. However, it is not known which exercises are most effective.

Data on the prevalence of musculoskeletal thoracic pain is even sparser than that relating to the cervical spine. There is confusion about pain located in the thoracic region perhaps being referred from the cervical spine, or initially being regarded as from visceral origin [7-9]. One survey reported that only 2.6% patients with a musculoskeletal problem in a physiotherapy outpatient department had pain of thoracic origin [10], which would approximate to less than 10% of all patients with spinal pain.

The McKenzie Method of Mechanical Diagnosis and Therapy (MDT) is a comprehensive approach that uses exercises, possibly with additional use of manual therapy, to find an individualized management strategy derived from the assessment process [11,12]. The assessment consists of detailed history taking and physical examination to evaluate patients with musculoskeletal problems in the spine and extremities. The history aims to understand the nature of the problem: area of symptoms, onset and duration, what are the aggravating and relieving factors, ensure it is a problem that is receptive to mechanical movement and loading strategies, and that there are no suspicions of serious spinal pathology. The physical examination is focused on the effect of repeated spinal movements and sustained positions on the patients' symptoms and movements.

The aim of assessment is to classify the patient into a subgroup or "syndrome", with a group of clinical characteristics used to determine this category: Derangement, Dysfunction, or Postural Syndrome (Appendix A). The McKenzie Method uses a logical clinical reasoning process, which includes progression of forces in assessment and management process. The Method can be applied to lumbar, cervical and thoracic spines [11,12], as well as upper and lower extremity conditions [13]. In the cervical spine physical examination uses repeated movements: flexion, extension, protrusion, retraction, side-flexion and rotation; but will usually initially focus on movements in the sagittal plane. The most commonly used repeated movements for both classification and management in cervical spine is retraction [12]. This is a combination of upper cervical flexion and partial lower cervical extension [14], and is important because in order to attain full-range extension of the lower cervical spine retraction should be achieved first. In thoracic spine repeated movements used are flexion, extension, and rotation [12].

Derangement Syndrome is the most common MDT syndrome in the spine [15,16] and is recognized when symptoms are reduced, abolished or centralized with repeated movements. Centralization only occurs in the Derangement Syndrome and describes abolition of the most peripheral symptoms in response to repeated movements or sustained positions. The direction in which reduction, abolition or centralization of symptoms occurs is called Directional Preference and is an essential feature of this Syndrome. Thus Centralization and Directional Preference are related, but separate phenomena, with Directional Preference including all three positive symptom responses. Centralization has been shown to be a positive prognostic factor, and both appear to be useful treatment effect modifiers, in other words they help to guide the appropriate management strategy [17]. The opposite effect, Peripheralization, is known as a negative prognostic and management indicator [12, 13], but there is little documented evidence about this, whereas non-centralization is associated with negative outcome prediction [17]. The less common Dysfunction and Postural syndromes are managed with repeated movements into the painful and restricted range to remodel impaired tissues, and education in postural correction, respectively. All patients who cannot be classified in one of three McKenzie Syndromes are classified in seven OTHER sub-groups, for which operational definitions are also available (Appendix B). The prevalence of each of OTHER sub-groups has not been documented in the cervical and thoracic spines. The reliability of classifying patients with neck pain in MDT subgroups and identifying Directional Preference has been shown to display moderate reliability [18].

The prevalence of Centralization has been commonly described; a systematic review included 54 articles on Centralization and eight on Directional Preference [17]. Nearly all studies looked at these phenomena in the lumbar spine; only four investigated Centralization or Directional Preference in the cervical spine, and none in the thoracic spine. The mechanisms by which Centralization occurs are unknown, however prior work in manual therapy points to possible local, spinal and cortical mechanisms [19]. Manual therapy mechanical forces initiate a cascade of neurophysiological responses from both peripheral and central nervous systems, which are then responsible for clinical outcomes [19]. In other words responses from mechanical forces, delivered as exercises or as manual therapy, are likely to be more complex than simple mechanical responses.

The evidence, although more limited, shows that the phenomena of Centralization and Directional Preference are equally common in the cervical spine [17]. Furthermore MDT syndromes have been documented in the cervical and thoracic spines [15,16]. Thoracic pain is less commonly reported, but in 23 patients with thoracic spine pain, 20 were classified Derangement, two Dysfunction, and one OTHER [15]. The third MDT classification, Postural Syndrome, which was not particularly the focus of this study, is rarely found in the clinical setting [11, 15]. More recently prevalence of Centralization and Directional Preference in 304 patients with neck pain was demonstrated as 40% and 70%, respectively, with both associated with improvements in function, but no pain improvement [20].

MDT classification guides the clinician in management: for Derangement, movements in the Directional Preference that centralizes, abolishes or decreases the pain are used; for Dysfunction, movements that reproduce symptoms, to produce a gradual lessening of

symptoms over time. Repeated movements are used by the patient a number of times each day for both Derangement and Dysfunction syndromes. Extension is used most commonly (70% to 85% in different parts of the spine), next are lateral movements (15% to 24%), which includes rotation, if indicated, and lastly flexion (0% to 9%) [15]. However, there is limited information about the specific Directional Preference movements in the cervical and thoracic spines, the specific OTHER sub-groups in these areas, and the stability over time of the initial classifications.

The aims of the present study were as follows: in a multi-center, consecutive, consenting cohort of patients with neck and thoracic pain to determine the prevalence of the different mechanical Syndromes, and OTHER sub-groups; and specifically what those OTHER sub-groups were as the data in the literature are limited. Secondarily, patients classified as Derangement were further sub-classified for their Directional Preference.

Methods

Study design

This was a multi-center observational study of consenting, consecutive cervical and thoracic patients undergoing MDT assessment.

Settings

The assessment took place in 16 private physiotherapy clinics and public health centers in Italy.

Therapists

The 16 physical therapists collecting the data had a mean of 22 years of clinical experience and had MDT credentialing for a mean 11.9 years; other therapists' details are in Table 1.

Data collection

Each participating therapist collected data on up to 20 consecutive and consenting patients with cervical or thoracic symptoms, with or without referred pain into the arm or head. Classification was recorded at baseline and confirmed after three to five sessions; collection occurred during a five-month period starting in February 2016. Once therapists had collected data on 20 patients' or the five-month data collection period had ended, data were collated by an independent group who then entered into SPSS for data analysis.

Inclusion criteria were as follows: > 18 years of age; informed consent to have their anonymous data included; presenting with local neck pain, possibly with referral to head or upper limb, or pain in the thoracic spine area, possibly with referral anteriorly. Exclusion criteria were dichotomous to the inclusion criteria plus: undergoing other manual treatment for the problem, or previous surgery in that area.

The researchers collected data on the following: the therapists' and patients' demographic data and informed consents, the McKenzie cervical or thoracic assessment form (as appropriate), the Neck Disability Index at baseline and discharge for both cervical and thoracic patients, and details on the Mechanical Syndrome or OTHER, and Directional Preference at first and last assessment to monitor if it was stable over time.

Treatment

Treatment was provided solely according to the McKenzie method, in which the first appointment is to take history, conduct physical examination, and then determine provisional classification, which is confirmed at the subsequent appointments according to

the patient's response. The classification determines the management approach; if Derangement, repeated movements are used to abolish, centralize of decrease symptoms in the Directional Preference; if Dysfunction, repeated movements are used to remodel painful and impaired tissue [13]. The third McKenzie classification, Postural Syndrome, requires postural correction only, and demonstrates no signs during the physical examination. If one MDT classification is not deemed relevant then the patient might be classified with one of the OTHER classifications. Operational definitions for MDT and OTHER classifications were available to the therapists (Appendix A and B). For this study a maximum of five treatment sessions was suggested. The mean number of treatment sessions was 3.6 with a mean duration of of 20-30 minutes per session.

Outcome

The main emphasis of the study was to document MDT classification and OTHER prevalence in a cohort of cervical and thoracic patients. However besides the descriptive statistics the before-after outcome measure used was the Italian version of the Neck Disability Index, a 10-item scoring tool for establishing self-reported functional loss due to neck pain [21]. The Neck Disability Index is easy to apply in clinical and research settings, it has strong psychometric properties, and is the most widely used and most strongly validated instrument for assessing self-rated disability in patients with neck pain [22]. Maximum total score is usually 50, interpreted as follows: 0-4 = no disability; 5-14 = mild disability; 15-24 = moderate disability; 25-34 = severe disability; over 35 = complete disability [22].

Data analysis

Descriptive data were computed for therapists and patients. The Neck Disability Index was also recorded at baseline and discharge, and non-parametric Wilcoxon matched pairs test used (IBM SPSS (version 23) for data analysis by independent researchers not involved in data collection.

Ethical and write-up process

Before data collection the study protocol was approved by the participating clinics, and approval was obtained from Sheffield Hallam University, Sheffield, UK. STROBE guidelines [23] for writing up Observational studies were used (Appendix C).

Results

A total of 16 therapists took part and collected data on a total of 138 patients; the flow chart in Figure 1 depicts the sample frame and recruitment. Therapists had been qualified a mean of 21.6 years and had been McKenzie credentialed therapists for 11.9 years (Table 1). The mean age of the patients was 48.5, 73% were female, 95% had neck pain, 68% had acute or sub-acute symptoms, and mean duration of symptoms was 6.2 weeks (Table 2 for patients' details).

The patients were predominantly (83%) classified as Derangement: 81.5% in cervical spine, and 100% in thoracic spine. Of 114 patients with a Directional Preference, 91 (80%) had a Directional Preference for extension, but 100% in thoracic spine; 3 (2.5%) for flexion, and 20 (17.5%) for lateral movements. In the cervical spine 13% were classified with an OTHER, non-Mechanical syndrome, over half of who were classified as Mechanical Inconclusive or Mechanically Unresponsive Radiculopathy; but none in the thoracic spine. Classification remained the same at the last or fifth visit in 94% of cases. In terms of functional

improvement, Neck Disability Index scores were taken at the first (N =138) and last visit (N = 120), from a mean of 12.0 (SD 7.7) to 6.1 (SD 5.8) ($P < 0.001$).

Discussion

Certain aspects of this study are unique: reports on patients with neck, and especially thoracic pain, are much less frequent than patients with lumbar problems; the proportions with specific Directional Preference, and of those with McKenzie OTHER syndromes has not been so detailed before in these spinal areas; and the stability of the classification system was vindicated in the majority of cases. This paper reported routinely collected information on a cohort of patients with neck and thoracic pain who provided demographic and clinical data, and also completed baseline and discharge data using Neck Disability Index (NDI) scores. The majority (83%) of patients was classified with Derangement in the McKenzie system, and 80% of these patients had a Directional Preference for extension repeated movements. The second biggest classification group was OTHER (13%), for which specific classifications were provided; furthermore classifications remained stable over time in most cases (94%). Obviously the stability of any classification system over time is an important characteristic if it is to be clinically useful.

Hefford (2008) reported on data from multiple therapists in New Zealand on 321 spinal patients of who 134 had cervical or thoracic problems, of who 81-87% were classified with Derangement, 8-9% with Dysfunction, and about 3% with Postural Syndrome [15]. Seven percent and 4% of cervical and thoracic were classified as OTHER respectively, but details were not provided. Extension was the most common Directional Preferences (72% and 85% respectively); 19% and 15% responded to lateral movements; and 9% and 0% responded to a flexion Directional Preference. In a survey of 578 spinal patients collected from multiple

therapists around the world 78% were classified as Derangement, 4% with Dysfunction, 1% with Postural Syndrome, and 17% with OTHER [16]. In a survey in France (reported in French) data from 34 therapists on 297 cervical patients were reported: 92%, and 2% were classified respectively as Derangement and Dysfunction [24]. In the Derangement classification 84%, 14% and 3% had a Directional Preference for extension, lateral movements and flexion respectively. One patient was reported with Postural Syndrome and about 7% with OTHER classifications, though sub-classification details were not given. Classifications were recorded at first and fifth visit and showed that 92% of classifications remained the same [24].

Thus this description of the application of the McKenzie Method of Mechanical Diagnosis and Therapy to cervical and thoracic disorders is not unique, but is far less frequently reported than for patients with lumbar disorders, especially regarding patients with thoracic disorders. This is not surprising and simply reflects the clinical epidemiology of the different spinal areas. As highlighted above different reports have very similar proportions with the different McKenzie syndromes; namely about 80% classified as Derangement, of which about 80% are extension responders [15,16]. Reaching similar classifications is not an inevitable conclusion, but this actually happened with these different studies. This helps to validate the MDT assessment process and classification system. However it appears that extensive involvement in the MDT education system is necessary for therapists to be able to make these classification decisions. The amount of training that post-graduate students require relative to their ability to deliver cost-effective treatment is certainly an area that needs further research.

Recent systematic reviews of randomized controlled trials are cautiously optimistic about exercise, education and mobilization interventions for patients with neck pain [25-27]. MDT trials are included in these reviews, but do not gain a specific mention. Exercise and education are the core of MDT management, which has its emphasis on encouraging patients in self-management, but mobilization by the therapist is an option if progress is slow or ceases. Based on MDT theory loading strategies can then be progressed so that an optimal outcome is achieved as quickly as possible [12].

This study reinforces certain aspects of the management of musculoskeletal problems, in this case for neck and thoracic problems. The MDT classification systems can categorize patients who are assessed, using a classification that for the majority (94%) remained stable over time, and can allow their efficient management, within a limited number of treatment sessions. It also highlights the small proportion of patients who cannot be categorized within this particular classification system, but also suggests areas where more directed and non-classification management should be focused.

The strengths of the paper are that data were collected independently by multiple therapists with a reasonable level of training and experience in the MDT assessment and classification process. The patient data collected were consecutive and non-selected thus eliminating bias in the data collection process. Clear-cut operational definitions for the different syndromes were available to the therapists, although they would have been aware of the definitions prior to this study given their previous training. As already made clear, the results are consistent with previous studies, which helps to further validate the present findings.

The limitations of the paper are that 16 therapists from only one country collected data on 138 patients, rather than the 20 each they were asked to submit data on, but some therapists found it hard in the time scale to complete this number. Furthermore 13% did not collect discharge data for the Neck Disability Index. The paper is largely descriptive in nature, but it is thought that such routinely collected clinical data is valuable as a mapping of normal clinical practice, and so is helpful to provide potential clues for routine assessment and data collection in the future. The Neck Disability Scale collected at baseline and discharge, showed significant change over time. However, it was used for patients with thoracic conditions, for whom it has not been validated; and no long-term outcome measure was collected beyond the period when patients attended the clinics. Despite reporting minimal disability, the patient population commonly indicated previous history of neck pain or chronic symptoms. The 13% dropout rate, for whom discharge data were not available, could have biased the overall outcomes, though this is unknown, it cannot be discounted. Patients for whom final outcomes were not available may have improved or worsened; this information is unknown. Ideally an intention-to-treat analysis would be used to try to determine the outcomes of those who did not provide follow-up outcomes. This was not done. The long-term outcome of patients who received physical therapy, but did not maintain adherence to exercise prescription or therapy attendance are critical issues, but beyond the scope of this paper. Furthermore this was not a randomized controlled trial, which is the ideal to evaluate clinical interventions; lacking a control group, change could have been the result of passage of time, chance, or regression to the mean.

In conclusion, the majority of patients were classified with a McKenzie syndrome, most commonly Derangement with a Directional Preference for extension in both cervical and thoracic spines. Over time patients demonstrated a significant change in the primary outcome, the Neck Disability Index, but there was no control group, and there was a 13% dropout rate.

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Tables

Table 1. Demographics of the therapists (N = 16)

				Mean (SD)
Workplace	Private = 11 (67%)	Public = 5 (31%)		
Years qualified	< 10 = 3 (19%)	11-20 = 4 (25%)	> 21 = 9 (56%)	**21.6 (10.4)**
Years credentialed	< 10 = 7 (44%)	11-20 = 7 (44%)	> 21 = 2 (12%)	**11.9 (7.5)**

Table 2. Demographic and classification of the patients (N = 138)

				Mean (SD)
Age of patients	< 35 = 22 (16%)	36-55 = 75 (54%)	> 56 = 41 (30%)	**48.5 (14.2)**

(years)				
Symptom duration (weeks)	< 1 week: 14%	> 1 week, < 7 weeks: 54%	> 7 weeks: 32%	**6.2 (5.5)**
Gender	Male = 37 (27%)	Female = 101 (73%)		
Spinal area	**Cervical** = 131 (95%)	**Thoracic** = 7 (5%)		
MDT classification	Derangement = 114 (83%): DP: 91 (80%) Extension; 3 (2.5%) Flexion; 20 (17.5%) Lateral, including Rotation Dysfunction = 5 (3.5%) PS = 1 (0.5%) OTHER = 18 (13%)	Derangement = 7 (100%): DP: 7 (100%) Extension		
Cervical specific OTHER	MI = 6 (4.5%); MUR = 4 (3%); WAD = 3 (2%); Shoulder = 2 (1.5%); CPS = 2 (1.5%); OTHER = 1 (<1%)			
Cervical symptom distribution	Central / symmetrical = 34 (32%); unilateral above elbow = 43 (41%); unilateral below elbow = 28 (27%)			
Symptom onset	Trauma = 20 (14.5%); NAR = 118 (85.5%)			
N previous episodes	None = 25 (18%); 1-5 = 45 (32.5%); 6-10 = 16 (11.5%); > 11 = 52 (38%)			
Medication this episode	Yes = 57 (41%); No = 81 (59%)			
NDI score* - mean (SD)	Pre: 12.00 (7.7)		Post: 6,1 (5.8)	

DP = Directional Preference; MDT = Mechanical Diagnosis and Therapy; PS = Postural Syndrome; MI = Mechanical Inconclusive; MUR = Mechanically Unresponsive Radiculopathy; WAD = whiplash associated disorder; CPS = chronic pain syndrome; NAR = no apparent reason; NDI = Neck Disability Index; * = significant difference between pre and post treatment ($p<0.001$); SD = standard deviation

Appendix A - Operational Definitions

McKenzie Classification Operational definitions for MDT classifications and OTHER

- Derangement - lasting abolition or decrease of symptoms, and/or an increase in restricted range of movement in response to repeated movements
- Articular Dysfunction - intermittent pain consistently produced at a restricted end-range with no rapid change of symptoms or range
- Contractile Dysfunction - intermittent pain, consistently produced by loading the musculotendinous unit, for instance with an isometric contraction against resistance
- Postural Syndrome - only produced by sustained loading, which once avoided, the rest of the physical examination would be normal
- OTHER refers to failure to classify as one of the above mechanical syndromes and considered to be non-mechanical according to operational definitions (see below), such as recent trauma, post-surgery or chronic pain state.

Appendix B - OTHER Categories

Before any of these OTHER categories are considered a full mechanical evaluation must be conducted, which may occur over several days. The Mechanical Syndromes (Derangement, Articular Dysfunction, Contractile Dysfunction, and Postural Syndrome) must be absolutely rejected before any of these categories are considered.
To meet OTHER categories patients must fail to meet operational definitions for Mechanical Syndromes AND meet Operational Definitions for other categories as described below.

Category	Definition	Criteria	Clinical Examples

Common to all body sites:

Chronic pain syndrome	Pain-generating mechanism influenced by psychosocial factors or neurophysiological changes	Persistent widespread pain, aggravation with all activity, disproportionate pain response to mechanical stimuli, inappropriate beliefs and attitudes about pain.	
Inflammatory	Inflammatory arthropathy	Constant, morning stiffness, excessive movements exacerbate symptoms	RA, sero-negative arthritis
Mechanically inconclusive	Unknown musculoskeletal pathology	All other classifications excluded Symptoms affected by positions or movements BUT no recognisable pattern identified Or inconsistent symptomatic and mechanical responses on loading	
Mechanically unresponsive radiculopathy	Radicular presentation consistent with a currently unresponsive nerve root compromise	Symptoms presenting in a radicular pattern in an extremity. Accompanied by varying degrees of neurological signs and symptoms. There is no centralisation and symptoms do not remain better as a result of any repeated movements, positions or loading strategies	
Post-surgery	Presentation relates to recent surgery	Recent surgery (Individual post-surgery protocols may apply)	
Spinal stenosis	Symptomatic degenerative restriction of spinal canal or foramina	Cervical Spine: arm symptoms consistently produced with closing foramen, abolished or decreased with opening	Lumbar stenosis, cervical lateral foraminal stenosis
Trauma / recovering trauma	Recent trauma associated with onset of symptoms	Recent trauma associated with onset of constant symptoms / recent trauma associated with onset of symptoms in previous 6 weeks now intermittent and improving	Post whiplash

Appendix C

STROBE: guidelines for reporting observational studies (von Elm et al., 2007)

Item		**Reported on page:**
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Funding	NA

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