Manual Therapy 19 (2014) 2–9

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Masterclass

Articular dysfunction patterns in patients with mechanical neck pain: A clinical algorithm to guide specific mobilization and manipulation techniques

Vincent Dewitte*, Axel Beernaert, Bart Vanthillo, Tom Barbe, Lieven Danneels, Barbara Cagnie [1]

Ghent University, Department of Rehabilitation Sciences and Physiotherapy, De Pintelaan 185 3B3, 9000 Ghent, Belgium

ARTICLE INFO

Article history:
Received 19 July 2013
Received in revised form
11 September 2013
Accepted 28 September 2013

Keywords:
Articular dysfunction patterns
Clinical reasoning
Cervical spine
Spinal manipulation

ABSTRACT

In view of a didactical approach for teaching cervical mobilization and manipulation techniques to students as well as their use in daily practice, it is mandatory to acquire sound clinical reasoning to optimally apply advanced technical skills. The aim of this Masterclass is to present a clinical algorithm to guide (novice) therapists in their clinical reasoning to identify patients who are likely to respond to mobilization and/or manipulation. The presented clinical reasoning process is situated within the context of pain mechanisms and is narrowed to and applicable in patients with a dominant input pain mechanism. Based on key features in subjective and clinical examination, patients with mechanical nociceptive pain probably arising from articular structures can be categorized into specific articular dysfunction patterns. Pending on these patterns, specific mobilization and manipulation techniques are warranted. The proposed patterns are illustrated in 3 case studies. This clinical algorithm is the corollary of empirical expertise and is complemented by in-depth discussions and knowledge exchange with international colleagues. Consequently, it is intended that a carefully targeted approach contributes to an increase in specificity and safety in the use of cervical mobilizations and manipulation techniques as valuable adjuncts to other manual therapy modalities.

1. Introduction

For centuries, spinal mobilization and manipulation techniques have been passed down from one generation of manipulators to the next. Although these techniques have undoubtedly evolved over time, their progression has largely been a culmination of imitation and iterative adaptation, leading to a great variety of spinal manipulation techniques (Evans, 2010). Nowadays, an eclectic approach is used in most of the manual therapy courses, including aspects of Maitland, Kaltenborn–Evjenth, Hartman and other philosophies and principles.

Although recent systematic reviews (Gross et al., 2010; Bronfort et al., 2012; Chaibi and Russell, 2012) have demonstrated evidence (low to moderate quality) that cervical manipulation and mobilization are beneficial, these reviews highlight the lack of knowledge on optimal techniques and doses.

In view of a didactical approach for teaching students as well as for daily practice, it is mandatory not only to learn advanced technical skills, but also to acquire sound clinical reasoning skills (Gifford and Butler, 1997; Kelly, 2003; Puentedura et al., 2012). Only if both aspects are integrated, spinal manipulation and mobilization may be considered proficient. In 2003, Hing et al. (2003) published a comprehensive paper in Manual Therapy to discuss manipulation of the cervical spine, detailing the teaching strategies developed for cervical spine manipulation in New Zealand, outlining the clinical assessment and providing examples of the procedures in practice. What is missing in this article, and in a lot of handbooks on manual therapy, is the sound clinical reasoning behind manipulation. It is mandatory to 1) recognize key features in subjective examination and clinical examination to identify patients likely to benefit from cervical mobilization and manipulation, and 2) to define optimal techniques pending on the individual presentation of the patient.

Therefore, the aim of this Masterclass is to present a clinical algorithm for guiding therapists in their clinical reasoning to identify patients with predominantly mechanical nociceptive pain

* Corresponding author. Tel.: +32 9 332 12 17; fax: +32 9 332 38 11.
E-mail addresses: vincent.dewitte@ugent.be (V. Dewitte), axel.beernaert@skynet.be (A. Beernaert), bart.vanthillo@ugent.be (B. Vanthillo), tom.barbe@ugent.be (T. Barbe), lieven.danneels@ugent.be (L. Danneels), barbara.cagnie@ugent.be (B. Cagnie).
[1] Tel.: +32 9 332 52 65; fax: +32 9 332 38 11.

1356-689X/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.math.2013.09.007

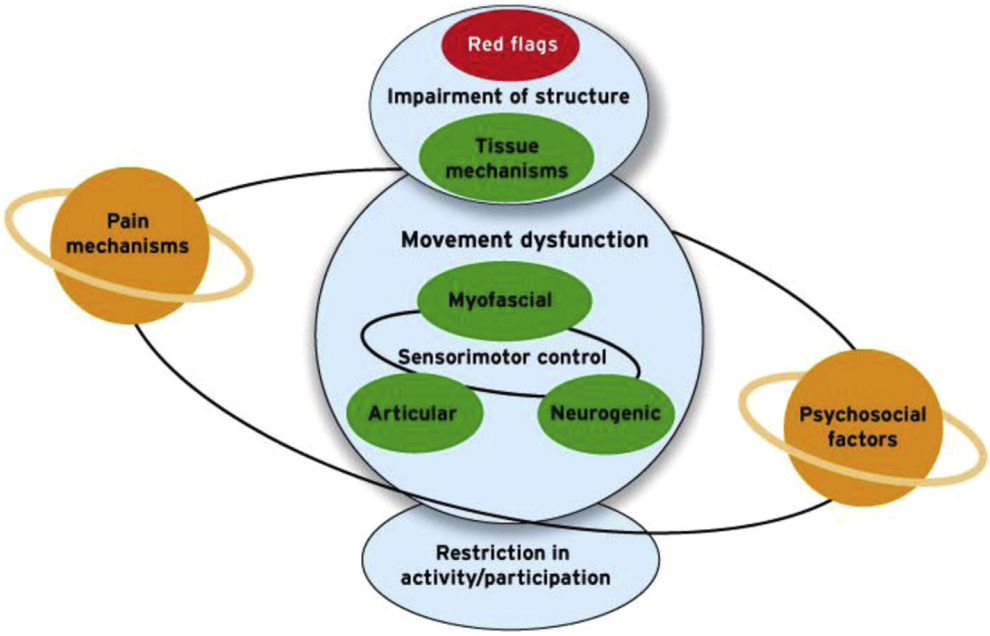

Fig. 1. Planetary model.

arising from the articular structures, who are likely to respond to mobilization and/or manipulation. This clinical algorithm is mainly based on many years of clinical experience using a standardized way in assessing and treating neck pain patients. According to Jones, a form of pattern recognition sprouts, when a well-structured approach is obeyed, and this for many years of clinical practice (Jones, 1992, 1995; Doody and McAteer, 2002). Considering the empirical foundation of this process, the desire to communicate these prototypes to (international) colleagues arose so that definition and interpretation of similar patterns could be modeled into a more comprehensive and refined form. To our knowledge these symptoms have not been clustered before in distinct dysfunction patterns along with specific treatment recommendations. Therefore the authors tried to describe specific findings per dysfunction pattern and, where possible, complemented them with the limited evidence available.

First the reasoning framework of interest to (articular) mechanical neck pain is outlined. In light of this reasoning process, an attempt is made to categorize subjects into a specific articular dysfunction pattern based on the characteristics identified during subjective examination and clinical examination. This is then linked to specific mobilization and manipulation techniques, which are summarized in a clinical algorithm to guide specific treatment. In the last part of this Masterclass, this clinical algorithm is illustrated by different case studies.

2. Articular dysfunctions in a broader perspective

Fig. 1 represents a model, that enables the therapist to systematically analyze and appraise the impact of the different components as a basis for clinical decisions and aims to contribute to a more efficient way of managing patients (Danneels et al., 2011). This planetary model is not a new model, but is a didactic representation mainly inspired by an adapted model of the International Classification of Functioning, Disability and Health (ICF). The structure of the ICF is reflected in a vertical plan, whereas the pain mechanisms and psychosocial factors surround this vertical structure reflecting their continuous interaction with the different components of the vertical axis. As musculoskeletal pain is multidimensional in nature (Smart and Doody, 2006, 2007) this planetary representation endeavors to capture the dynamic character of the reasoning process.

The process of clinical decision-making is preferably well structured and stepwise instead of vague and global. If a structured path is followed you can avoid gaps and enhance efficiency in the patient approach (Petty and Moore, 2001). After subjective examination different features should be interpreted. First of all, the importance of excluding red flags prior to further investigation to prevent misdirection and enhance safety is warranted (Barker et al., 2000; Childs et al., 2005; Alexander, 2011; Puentedura et al., 2012). Subsequently, the dominant pain mechanism should be defined (Gifford and Butler, 1997; Gifford, 1998; Jones et al., 2002). Pain mechanisms have been broadly categorized into: 1) input mechanisms, including nociceptive pain and peripheral neurogenic pain; 2) processing mechanisms, including central pain and central sensitization, and the cognitive–affective mechanisms of pain; and 3) output mechanisms, including autonomic, motor, neuroendocrine and immune system (Gifford and Butler, 1997; Gifford, 1998). In case of a dominant input component, hypotheses about the possible nociceptive sources of symptoms can be formulated (Alexander, 2011; Bogduk, 2011). Identifying impairments in activity and participation as well as contributing psychosocial factors are also an essential part to give the clinician a fairly comprehensive understanding of the patient's signs and symptoms. Clinical examination is mainly important to further confirm or reject the former formulated hypotheses regarding impairment in structure and function. From a compilation of the subjective examination analysis and the relevant clinical findings emerging from the examination, therapeutic goals and tools can be determined (Jones, 1995). Reassessment at subsequent treatment sessions is necessary to evaluate treatment progression and to readjust the treatment plan if needed. Moreover, the evaluation of perceived treatment effects is an integral part of the reflective reasoning process (Jones, 1992; Doody and McAteer, 2002; Smart and Doody, 2006).

Care is needed to avoid a preoccupation with one structure or diagnosis at the expense of others, as this will be reflected in the management (Jones, 1995). Nonetheless, given the context of this paper the presented clinical reasoning process is narrowed to and applicable in patients with a dominant input pain mechanism with mechanical nociceptive pain probably arising from articular structures. Even though minor symptoms coming from muscular or neurological structures might be present in patients suffering from mechanical neck pain, the dominant pain source should be articular to justify the use of specific mobilizations and/or manipulations. It is essential to rule out dominant processing mechanisms since manipulative therapy would not be the first choice of treatment in these patients. Furthermore, when there seems to be a dominant output component with maladaptive movement patterns as a generator of the patient's condition, manipulative therapy can be used only secondary to relief patients nociceptive symptoms. In the latter case, the focus should be on the motor control aspect since this might be the source of the vicious circle that could lead to a more chronic condition.

Based on clinical experience and available evidence in the literature, the type of clinical presentation that would suggest an amenity to manipulative therapy may include (McCarthy, 2001; Hing et al., 2003; Childs et al., 2008; Gellhorn, 2011; Dunning et al., 2012; Puentedura et al., 2012):

- primary complaint of neck pain (defined as pain in the region between the superior nuchal line and first thoracic spinous process);
- a problem that is mechanical in nature and fits with a biomechanical pattern that is regular and recognizable;
- a non-traumatic history of onset suggestive of mechanical dysfunction;
- a limited symptom duration (according to Puentedura et al. (2012) less than 38 days);
- limited range of motion (ROM) (direction specific), with a side-to-side difference in cervical rotation ROM of at least 10°;
- pain that has clear mechanical aggravating and easing positions or movements;
- local provocation tests produce recognizable symptoms;
- spinal movement patterns that, when examined actively and passively, suggest a movement restriction that is local to one or two functional spinal units;
- no neurological findings in clinical history or manual assessment;
- no signs of central hyperexcitability;
- no indication that referral to other health care providers is necessary (to exclude red flags);
- a positive expectation that manipulation will help.

The presumption of a predominant articular dysfunction as inherent cause of neck complaints is supported by the prevalence of several of the above listed findings. As there is no particular recipe or protocol for the 'articular patient', the key part in the clinical reasoning process is to make decisions based on information collected in both subjective and clinical examination. The hypothesis of an articular dysfunction is only valid if a cluster of articular symptoms is endorsed. A key reasoning issue is the relevance of an unique finding within the individual presentation of the patient (Gifford and Butler, 1997). For example, a stiff neck may be of little relevance in a patient with dominant processing mechanisms, since any attempt to "loosen the joints up" may simply be an additional input to the system that the body is unable to handle (Gifford and Butler, 1997). An overemphasis on findings which support the articular hypothesis, might lead to ignoring findings which do not support it, possibly leading to incorrect interpretations (Jones, 1992, 1995; Jones et al., 2002).

Given the amount of articular techniques available (Kaltenborn et al., 1993; Hartman, 1997; Hing et al., 2003; Evans, 2010; Gross et al., 2010; Williams and Cuesta-Vargas, 2013), it is crucial, to define optimal techniques pending on the individual presentation of the patient. In the next chapter we will propose a model of articular dysfunction patterns mainly based on years of clinical experience in treating neck pain patients. These patterns will guide the manual therapist to choose the appropriate mobilizations and manipulative techniques for the individual patient. This section specifically outlines the mid and lower cervical spine. As the anatomy and clinical biomechanics of the upper cervical spine is far more complex (Pal et al., 2001) and requires a different approach, this will not be discussed.

3. Clinical subgroups

Articular dysfunction patterns are clinically divided into two main categories: a 'convergence' pattern and a 'divergence' pattern. Table 1 gives an overview of the key clinical findings during the subjective and physical examination.

3.1. Convergence pattern

A monosegmental convergence pattern is characterized by pain provocation and motion restriction mainly during extension and ipsilateral side bending and rotation. This pattern is associated with unilateral compression pain that can appear at the start, mid- or end range of motion. This clinical pattern is further clarified by combined passive movement testing, which reproduces the patient's symptoms. This will generally be a combination of extension, ipsilateral side bending and rotation. The intervertebral movement tests may give additional information about the quality and quantity of the segmental joint play. Dorsocaudal (downslope) gliding is usually restricted at the same side of the compression pain.

Table 1
Features of mono-segmental cervical spine convergence and divergence patterns.

Cervical spine convergence pattern	Cervical spine divergence pattern
Subjective examination	*Subjective examination*
Feeling of locking	Feeling of painful strain at end ROM
Movement restriction	Movement restriction at end ROM
Unilateral compression pain	Unilateral stretch pain
Often in acute cases	High intensity or severity of symptoms is rare
Antalgic posture	Antalgic posture is uncommon
Physical examination	*Physical examination*
Active and passive combined extension, ipsilateral side bending, and rotation is limited and evokes comparable signs	Active and passive combined flexion, contralateral side bending, and rotation is limited and evokes comparable signs Passive shoulder elevation in this position does not result in increased ROM/decreased pain
Articular examination	*Articular examination*
Provocation tests (spring testing) are positive at the impaired segment(s)	Provocation tests are positive at the impaired segment(s)
Intervertebral Movement Tests: ipsilateral downslope restriction	Intervertebral Movement Tests: ipsilateral upslope restriction
Segmental distraction alleviates the pain	

Fig. 2. Upslope focus technique for the right C3/4 segment. The therapist positions the head and cervical spine (cradle hold) with the right hand contacting the articular pillar of the superior segment (C3). The head is positioned in left rotation and right side bending. Slight flexion can be added as a third component. The thrust is directed to the left eye (ventrocranial – white arrow).

A convergence pattern is often found in acute cases and is frequently characterized by a pronounced movement restriction and associated antalgic posture. The head is deviated in flexion and rotation away from the painful side to avoid closing of the zygapophysial (facet) joint. Extension and rotation are highly restricted and painful, associated with hypertonic muscles.

3.2. Divergence pattern

A monosegmental divergence pattern is rarely associated with an antalgic posture and high intensity or severity of symptoms is uncommon. This pattern is considered when pain is provoked and movement is restricted during flexion and contralateral side bending and rotation. The divergence pattern is associated with unilateral stretch pain originating from capsuloligamentous structures, usually appearing at the end range of motion. A passive combined movement, including flexion, (contralateral) side bending and rotation will increase the stretch on the capsuloligamentous structures and may produce pain or comparable symptoms.

Fig. 3. Upslope technique with caudal locking for the right C3/4 segment. The therapist stabilizes the caudal segments by placing them in a non-physiological position (slight extension, left rotation and right side bending). The affected C3/4 segment is placed in a physiological position (slight extension, left rotation and left side bending) and a translation is given in an upslope direction (white arrow).

Fig. 4. Downslope technique for the right C3/4 segment. The therapist positions the head and cervical spine (cradle hold) with the right hand contacting the articular pillar of the superior segment (C3). The head is positioned in left rotation and right side bending. Slight extension can be added as a third component. A translatoric thrust is given in the direction of the opposite inferior scapular angle (dorsocaudal – white arrow).

The intervertebral movement test, performing ventrocranial (upslope) gliding is usually restricted at the same side of the stretch pain.

In case of a divergence pattern special note is made to differentiate the stretch symptoms between articular and muscular/neural tissue.

3.3. Mixed pattern

Clinically a third pattern in the cervical spine can be described and added to the two regular patterns, which is called a 'mixed pattern'. This pattern is characterized by multisegmental and multidirectional dysfunctions that can be diagnosed in a degenerative cervical spine. A degenerative cervical spine is characterized by general stiffness, multisegmental movement restrictions, a mixed pattern of compression/stretch pain and a combination of convergence/divergence patterns.

Fig. 5. Distraction technique for the right C3/4 segment. The therapist positions the head and cervical spine (chin hold) with the right hand contacting the articular pillar of the superior segment (C3). The head is positioned in left rotation and right side bending. Slight flexion or extension can be added as a third component. The thrust direction is perpendicular to the joint plane with the right hand placed onto the articular pillar of the C3 segment (white arrow).

Fig. 6. Gapping technique for the right C3/4 segment. The therapist positions the head and cervical spine (cradle hold) with the left hand contacting the articular pillar of the superior segment (C3). The head is positioned in right rotation and left side bending. Slight extension can be added as a third component. The thrust direction is perpendicular to the contact point with the left hand placed onto the articular pillar of the C3 segment (white arrow).

4. Mobilization and manipulative techniques

Various segmental mobilizations and manipulative techniques co-exist and have been described in different ways regarding aim, nature and execution (Kaltenborn et al., 1993; Hartman, 1997; Williams and Cuesta-Vargas, 2013). Most manual therapists use the manipulative approach as a progression of localized mobilization techniques. This enables the therapist to work towards an articular barrier adding different components to the mobilization while sensing the tissue responses and the nature of the barrier. This will also enhance safety due to the careful interpretation of pre-manipulative local and general symptoms. In addition, it allows the patient to agree or disagree with the performed procedure through body symptoms (embodied consent), sending signals (implied consent) or verbally (express consent) (Fenety et al., 2009).

Different manipulative approaches can be distinguished, ranging from translatoric and distraction to gapping techniques. It is essential to use techniques that both limit ROM and the applied force in order to enhance safety. Roughly, two fundamentally different approaches can be distinguished: focus and locking approach.

In the focus approach the applied force and amplitude will be limited by adding concomitant components at the involved segment. The different components may consist of flexion or extension, contralateral rotation, ipsilateral side bending, with additional non-voluntary movements such as traction, side glide and compression. The affected segment is placed in a non-physiological position (side bending coupled with rotation to the opposite side) to more easily obtain the articular barrier (Hartman, 1997).

In the locking techniques the adjacent spinal segments caudal or cranial to the affected segment should be placed in a non-physiological position to constrain their movement, whereas the affected segment is placed in a physiological position (side bending coupled with rotation to the same side) so it is more effectively targeted (Kaltenborn et al., 1993).

The most frequently used manipulative procedures in the mid and lower cervical spine will be described briefly.

4.1. Translatoric techniques

Translatoric techniques are defined as an applied glide or thrust parallel to the zygapophysial joint plane and are referred to as ‘upslope’ or ‘downslope’ techniques depending on the direction of the thrust. These techniques are termed as such as the aim is to move the zygapophysial joint either up its slope simulating “opening” of the joint as would occur during flexion and contralateral rotation or down the slope simulating “closing” of the joint as would occur during extension and ipsilateral side bending (Hing et al., 2003; Williams and Cuesta-Vargas, 2013).

The *upslope focus technique* (Fig. 2) comprises of a cradle or chin hold to the head with the ipsilateral hand contacting the articular pillar of the superior segment. The head is positioned in contralateral rotation and ipsilateral side bending. Slight flexion can be added as a third component. The thrust is directed to the opposite eye (ventrocranial). While performing a manipulation in upslope direction an indirect downslope movement occurs on the opposite side of the same segmental level (=*indirect downslope technique*).

This upslope technique can also be performed while using a locking approach. An often-used *upslope technique with caudal locking* (Fig. 3) consists of stabilizing the caudal segments by placing them in a non-physiological position (rotation and contralateral side bending). The affected segment is placed in a physiological position and a translation is given in an upslope direction.

The *downslope focus technique* (Fig. 4) comprises of the therapist adopting a cradle or chin hold of the head with the ipsilateral hand contacting the articular pillar at the superior segment. The head is positioned in contralateral rotation and ipsilateral side bending. Slight extension can be added as a third component. A translatoric thrust is given in the direction of the opposite inferior scapular angle (dorsocaudal).

4.2. Distraction techniques

For the *distraction techniques* (Fig. 5) the premanipulative positioning is similar to the upslope technique, but the applied thrust direction is perpendicular to the joint plane with the contact hand placed onto the articular pillar of the superior segment.

4.3. Gapping technique

Gapping techniques (Fig. 6) are indirect techniques as the aim is to create a separation of the affected zygapophysial joint at the opposite side. The applied force is directed perpendicular to the contact point.

4.4. Therapeutic guidelines for mobilization and manipulative techniques

In the succeeding paragraph this selection of mobilizations and manipulative techniques will be linked to the aforementioned articular dysfunction patterns. This is summarized in a clinical algorithm that is presented in Fig. 7.

4.5. Convergence pattern

In a first phase of treating a convergence pattern any compression at the affected side should be avoided since this would aggravate the condition. Therefore, a direct distraction technique and an indirect gapping approach are both indicated. The primary goal in gapping techniques is to obtain pain relief (neurophysiological effect) as the effect on mobility is non-specific (Bialosky et al., 2009, 2012; Evans, 2010).

In the second stage the remaining function deficits should be addressed. First of all, the use of an indirect downslope technique to

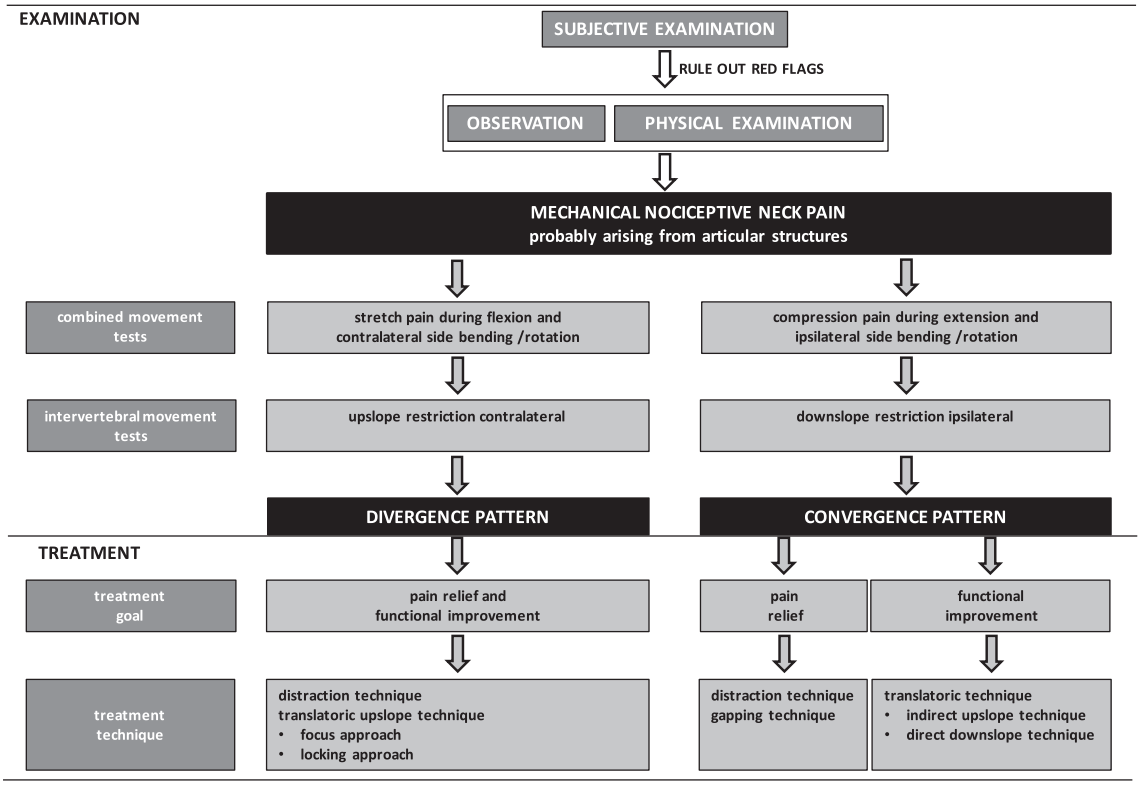

Fig. 7. Clinical algorithm.

restore downslope mobility at the affected side is appropriate. An added benefit in this approach is restoring mobility without creating excessive compressional force on the affected zygapophysial joint. Both the locking and focus upslope technique are applicable but the latter creates more cavitation at the opposite side.

In the final phase, when a painless end range downslope restriction is still present, a direct downslope technique might be

Table 2
Case study 1: convergence pattern.

Subjective examination	Physical examination	Hypothesis
A 37-year-old female office worker presented with a 2-week history of neck pain and movement restriction, upon referral of a GP. The pain developed gradually over time without a traumatic antecedent. There was no history of similar complaints. Her chief complaint was neck pain, localized at the right neck-shoulder border, mainly when performing specific neck movements to the right. The patient experienced a feeling of locking while looking over her right shoulder and moving her head towards extension and right rotation. There was no referred pain to the upper limbs. The pain at rest was scored 5/10 (VAS), rising to 7−8/10 during certain neck movements such as tilting the head backwards and rotation towards the right. Complaints were localized at the lower third of the Cx spine. There was no pain at night while sleeping. No technical investigations were performed. Medication was not recommended. None of the reported symptoms were considered to be of significant importance regarding YF or RF detection.	Observation Subtle antalgic posture: the head slightly bended forward, rotated and side bended to the left. The patient is not aware of this position, and is not able to actively correct her posture when instructed, because of the pain. Neck-shoulder muscles are hypertonic on both sides, although right more than left. Active and passive movement examination Extension, right side bending and right rotation are limited and provocative. End range side bending to the left feels restricted and causes muscle tension. Passive elevation of the right shoulder improves ROM during left side bending. Combined passive movement examination The combination of extension, right side bending and right rotation is limited and painful (comparable sign). Provocation tests Central PA on the spinous process at C5/6 segment and the UPA at C5/6 reproduce the symptoms on the right side with localized hyperalgesia only. Passive physiological intervertebral joint tests Restricted downslope gliding at the right C5/6 zygapophysial joint. Neurological examination Negative.	The key findings resulting from the subjective and clinical examination endorse the hypothesis for a dominant mechanical nociceptive cause assuming an articular convergence condition of the right zygapophysial joint. Management plan The nature of the patient's articular dysfunction indicates that a passive approach, using localized segmental mobilizations and manipulations, is appropriate to reduce symptoms and to increase mobility. Given the severity and intensity of the symptoms, our first technique of choice would be a gapping technique creating a cavity at the right C5/6 zygapophysial joint. This is to avoid compression in the affected zygapophysial joint and to alleviate the pain. In a second phase a translatoric (downslope) technique would be warranted to optimally normalize the downslope gliding.

Abbreviations are as follows; GP, general practitioner; VAS, visual analogue scale (0-10; 0 = no pain, 10 = worst pain ever); Cx, cervical; YF, yellow flag; RF, red flag; PA, posterior-anterior provocation; UPA, unilateral posterior-anterior provocation.

Table 3
Case study 2: divergence pattern.

Subjective examination	Physical examination	Hypothesis
A 45-year-old male plumber, presented upon doctor referral with an inconvenience at the Cx spine, which was present for about 2 months. This burden was localized at the left side of his neck and became painful when performing specific neck movements. The pain developed gradually, without trauma in history. There was no history of similar complaints. The patient described his complaint as a bothersome sensation of strain and movement restriction at end range Cx flexion and while bending the head to the right side. The last 3 days preceding the consultation, the complaint emerged on the left side during functional activities. The pain at rest was scored 4/10 (VAS), rising to 6/10 during neck flexion and right side bending. The symptoms were localized at the upper third of the neck on the left side. No other complaints such as headache, temporo-orofacial pain, dizziness, or symptoms in the upper limbs were present. There was no pain at night while sleeping. No technical investigations were performed. Medication was not recommended. None of the reported symptoms were considered to be of significant importance regarding YF or RF detection.	Observation Forward head posture when seated. The patient can actively correct posture to good position when facilitated. Active and passive movement examination Flexion, right side bending and right rotation are limited at end range of movement and provocative. Passive left shoulder elevation does not alter the restriction nor the symptoms. Combined passive movement examination The combination of flexion, right side bending and right rotation is limited at end range of motion and painful (comparable sign). Provocation tests The central PA on the spinous process of C2 and the left UPA at C2/3 reproduce the symptoms on the left side. Passive physiological intervertebral joint tests Restricted upslope gliding at the left C2/3 zygapophysial joint. Neurological examination Negative.	The key findings resulting from the subjective and clinical examination suggest a dominant mechanical nociceptive cause assuming an articular divergence condition of the left zygapophysial joint. Management plan The nature of this articular dysfunction allows us to choose a passive approach, using localized specific mobilizations and manipulations to reduce the patient's symptoms and increase segmental mobility. In this case a translatoric technique (upslope) is preferred to avoid excessive stretch on the capsuloligamentous structures of the left zygapophysial joint capsula and to normalize the upslope gliding.

Abbreviations are as follows; GP, general practitioner; VAS, visual analogue scale (0-10; 0 = no pain, 10 = worst pain ever); Cx, cervical; YF, yellow flag; RF, red flag; PA, posterior-anterior provocation; UPA, unilateral posterior-anterior provocation.

warranted. The use of segmental traction as an additional component is often needed to cope with the compressional forces related to this technique.

4.6. Divergence pattern

In case of a cervical divergence pattern, the main goal is to restore the upslope translation. Creating a separation by an indirect gapping technique is contraindicated in this case, since this would create unnecessary tension onto the capsuloligamentous structures. Translatoric techniques in the upslope direction are the first choice of treatment in order to restore upslope translation. Both focus and locking techniques can be carried out.

If necessary, one could start off with a distraction manipulation since this does not create an end range distension of the zygapophysial capsula due to the positioning in ipsilateral side bending and contralateral rotation.

5. Case studies

Tables 2–4 represent three case studies of individuals with mechanical nociceptive neck pain, each illustrating the importance

Table 4
Case study 3: mixed pattern.

Subjective examination	Physical examination	Hypothesis
A 62-year-old male engineer presented with a 5-month history of neck pain. He mainly complained of rigidity associated with bilateral neck-shoulder pain, which was more pronounced on the right side compared to the left. The pain was predominantly located at the lower Cx spine without irradiating symptoms to the upper limbs. Two years before the current consultation he received PT intervention for similar complaints with beneficial results on symptom reduction. There were no traumas in the past. All end range movements were limited and provocative, scored 4/10 (VAS). The most limited movement was neck extension followed by flexion and rotation without differences between sides. The patient did report having trouble finding a good night's rest, albeit related to frequent urge to urinate (established prostate problem). Plain radiographs revealed degenerative changes at the lower Cx spine, mainly present at the C5/6/7 level. Apart from the known prostate problem, the patient reported good physical health. No systemic diseases were documented and based on the patient's subjective examination no other signs of specific pathology could be detected. No pain medication was taken. None of the reported symptoms were considered to be of significant importance regarding YF detection.	Observation Forward head posture and protracted shoulders when seated. The patient has difficulties actively correcting his posture, even when facilitated. Active and passive movement examination All neck movements elicit pain and are restricted. Combined passive movement examination No clear pattern of restriction and/or pain. Provocation tests The central PA on the spinous process of C5 and C6 and both left and right UPA's at C5 and C6 reproduce the symptoms. Segmental traction on C5/6 and C6/7 along the longitudinal axis alleviates the symptoms. Passive physiological intervertebral joint tests Up and downslope gliding are restricted at the hypomobile C5/6 and C6/7 segments. Neurological examination Negative.	The key findings resulting from the subjective and clinical examination put up evidence for a dominant mechanical nociceptive cause, assuming a mixed pattern of articular convergence and divergence conditions of the zygapophysial joints. Management plan The nature of the articular dysfunction demands a more gentle approach and indicates the use of (segmental) traction and/or (midrange) translatoric mobilizations. Given the degenerative condition of the spine, even though medical imagery is present, this does not preclude the possibility of side effects or adverse responses to spinal manipulations. Therefore specific midrange mobilizations should take precedence on more cumbersome end range mobilizations or (in)direct thrust techniques. Distraction manipulations could be indicated if used with caution.

Abbreviations are as follows; GP, general practitioner; VAS, visual analogue scale (0-10; 0 = no pain, 10 = worst pain ever); Cx, cervical; YF, yellow flag; RF, red flag; PT, physical therapy; PA, posterior-anterior provocation; UPA, unilateral posterior-anterior provocation.

of subjective examination and clinical examination to guide treatment.

Within the scope of this Masterclass, the analysis of examination findings and therapeutic interventions is limited to those of interest to the discussed pattern. The reader is referred to several more thorough and technical accounts for additional information (Beernaert et al., 2006; Alexander, 2011; Danneels et al., 2011; Gellhorn, 2011; Puentedura et al., 2012). The management plan is also directed to the scope of this article, so other interventions will not be discussed.

6. Conclusion

The intention of this Masterclass was to propose a clinical algorithm to guide (novice) therapists in their clinical reasoning to identify patients with predominantly mechanical nociceptive pain arising from the articular structures, who are likely to respond to mobilization and/or manipulation. This clinical algorithm is the corollary of empirical expertise (collected during years of clinical fieldwork) and complemented by gathered wisdom ranging from in-depth discussions and knowledge exchange with international colleagues.

One could argue that the established framework is a simplified and therefore incorrect image of reality. However, the authors do emphasize that the added value of the proposed articular dysfunction patterns can only be fully appreciated when this is considered within a broader perspective (as stated in Section 2). Nevertheless, treating patients requires a sense of awareness for subtle distinctions, where adaptation entails the key to success.

References

Alexander EP. History, physical examination, and differential diagnosis of neck pain. Phys Med Rehabil Clin North America 2011;22:383–393, vii.

Barker S, Kesson M, Ashmore J, Turner G, Conway J, Stevens D. Professional issue. Guidance for pre-manipulative testing of the cervical spine. Man Ther 2000;5:37–40.

Beernaert A, Cagnie B, Vanthillo B. Mobilisaties en manipulaties van de wervelkolom. Antwerpen: Standaard Uitgeverij nv; 2006.

Bialosky JE, Bishop MD, Price DD, Robinson ME, George SZ. The mechanisms of manual therapy in the treatment of musculoskeletal pain: a comprehensive model. Man Ther 2009;14:531–8.

Bialosky JE, Simon CB, Bishop MD, George SZ. Basis for spinal manipulative therapy: a physical therapist perspective. J Electromyogr Kinesiol 2012;22:643–7.

Bogduk N. The anatomy and pathophysiology of neck pain. Phys Med Rehabil Clin North America 2011;22:367–382, vii.

Bronfort G, Evans R, Anderson AV, Svendsen KH, Bracha Y, Grimm RH. Spinal manipulation, medication, or home exercise with advice for acute and subacute neck pain: a randomized trial. Ann Intern Med 2012;156:1–10.

Chaibi A, Russell MB. Manual therapies for cervicogenic headache: a systematic review. J Headache Pain 2012;13:351–9.

Childs JD, Cleland JA, Elliott JM, Teyhen DS, Wainner RS, Whitman JM, et al. Neck pain: clinical practice guidelines linked to the international classification of functioning, disability, and health from the orthopedic section of the American physical therapy association. J Orthop Sports Phys Ther 2008;38:A1–34.

Childs JD, Flynn TW, Fritz JM, Piva SR, Whitman JM, Wainner RS, et al. Screening for vertebrobasilar insufficiency in patients with neck pain: manual therapy decision-making in the presence of uncertainty. J Orthop Sports Phys Ther 2005;35:300–6.

Danneels L, Beernaert A, De Corte K, Descheemaeker F, Vanthillo B, Van Tiggelen D, et al. A didactical approach for musculoskeletal physiotherapy: the planetary model. J Musculoskelet Pain 2011;19:218–24.

Doody C, McAteer M. Clinical reasoning of expert and novice physiotherapists in an outpatient orthopaedic setting. Physiotherapy 2002;88:258–68.

Dunning JR, Cleland JA, Waldrop MA, Arnot CF, Young IA, Turner M, et al. Upper cervical and upper thoracic thrust manipulation versus nonthrust mobilization in patients with mechanical neck pain: a multicenter randomized clinical trial. J Orthop Sports Phys Ther 2012;42:5–18.

Evans DW. Why do spinal manipulation techniques take the form they do? Towards a general model of spinal manipulation. Man Ther 2010;15:212–9.

Fenety A, Harman K, Hoens A, Bassett R. Informed consent practices of physiotherapists in the treatment of low back pain. Man Ther 2009;14:654–60.

Gellhorn AC. Cervical facet-mediated pain. Phys Med Rehabil Clin North America 2011;22:447–458, viii.

Gifford L. Pain, the tissues and the nervous system: a conceptual model. Physiotherapy 1998;84:27–36.

Gifford LS, Butler DS. The integration of pain sciences into clinical practice. J Hand Ther 1997;10:86–95.

Gross A, Miller J, D'Sylva J, Burnie SJ, Goldsmith CH, Graham N, et al. Manipulation or mobilisation for neck pain: a Cochrane review. Man Ther 2010;15:315–33.

Hartman L. Handbook of osteopathic technique. 3rd ed. Chapman & Hall; 1997.

Hing WA, Reid DA, Monaghan M. Manipulation of the cervical spine. Man Ther 2003;8:2–9.

Jones M. Clinical reasoning and pain. Man Ther 1995;1:17–24.

Jones M, Edwards I, Gifford L. Conceptual models for implementing biopsychosocial theory in clinical practice. Man Ther 2002;7:2–9.

Jones MA. Clinical reasoning in manual therapy. Phys Ther 1992;72:875–84.

Kaltenborn F, Evjenth O, Baldauf Kaltenborn T, Vollowitz E. The spine, basic evaluation and mobilization techniques. Oslo, Norway: Olaf Norlis Bokhandel; 1993.

Kelly P. Cervical manipulation requires advanced technical skills plus sound clinical reasoning (Comment on Refshauge K et al, Australian Journal of Physiotherapy 48: 171-179 and Jull G et al, Australian Journal of Physiotherapy 48: 180-183). Aust J Physiother 2003;49:63.

McCarthy CJ. Spinal manipulative thrust technique using combined movement theory. Man Ther 2001;6:197–204.

Pal GP, Routal RV, Saggu SK. The orientation of the articular facets of the zygapophyseal joints at the cervical and upper thoracic region. J Anat 2001;198:431–41.

Petty NJ, Moore AP. Neuromusculoskeletal examination and assessment: a handbook for therapists. Churchill Livingstone; 2001.

Puentedura EJ, March J, Anders J, Perez A, Landers MR, Wallmann HW, et al. Safety of cervical spine manipulation: are adverse events preventable and are manipulations being performed appropriately? A review of 134 case reports. J Man Manip Ther 2012;20:66–74.

Smart K, Doody C. Mechanisms-based clinical reasoning of pain by experienced musculoskeletal physiotherapists. Physiotherapy 2006;92:171–8.

Smart K, Doody C. The clinical reasoning of pain by experienced musculoskeletal physiotherapists. Man Ther 2007;12:40–9.

Williams JM, Cuesta-Vargas AI. An investigation into the kinematics of 2 cervical manipulation techniques. J Manipulative Physiol Ther 2013;36:20–6.