Manual Therapy 19 (2014) 222–228

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original article

International framework for examination of the cervical region for potential of Cervical Arterial Dysfunction prior to Orthopaedic Manual Therapy intervention

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ARTICLE INFO

Article history:
Received 7 August 2013
Received in revised form
11 November 2013
Accepted 16 November 2013

Keywords:
Cervical
Arterial
Examination
Manual therapy

ABSTRACT

A consensus clinical reasoning framework for best practice for the examination of the cervical spine region has been developed through an iterative consultative process with experts and manual physical therapy organisations. The framework was approved by the 22 member countries of the International Federation of Orthopaedic Manipulative Physical Therapists (October 2012). The purpose of the framework is to provide guidance to clinicians for the assessment of the cervical region for potential of Cervical Arterial Dysfunction in advance of planned management (inclusive of manual therapy and exercise interventions). The best, most recent scientific evidence is combined with international expert opinion, and is presented with the intention to be informative, but not prescriptive; and therefore as an aid to the clinician's clinical reasoning. Important underlying principles of the framework are that 1] although presentations and adverse events of Cervical Arterial Dysfunction are rare, it is a potentially serious condition and needs to be considered in musculoskeletal assessment; 2] manual therapists cannot rely on the results of one clinical test to draw conclusions as to the presence or risk of Cervical Arterial Dysfunction; and 3] a clinically reasoned understanding of the patient's presentation, including a risk:benefit analysis, following an informed, planned and individualised assessment, is essential for recognition of this condition and for safe manual therapy practice in the cervical region. Clinicians should also be cognisant of jurisdictionally specific requirements and obligations, particularly related to patient informed consent, when intending to use manual therapy in the cervical region.

1. Introduction

Cervical Arterial Dysfunction (CAD) in patients presenting with neck complaints is a rare event, but a critical consideration as part of a comprehensive Orthopaedic Manual Therapy (OMT) assessment. Vascular pathologies, such as arterial dissection, are generally recognisable if appropriate questions are asked, data is interpreted correctly during the patient history, and if the physical examination is adapted to test a potential vasculogenic diagnostic hypothesis. An important underlying principle of the patient assessment is that physical therapists cannot rely on the results of one test to draw conclusions regarding the presence or risk of CAD, and therefore development of a clinically reasoned understanding of the patient's presentation, including risk:benefit analysis, following an informed, planned and individualised assessment is essential. There are multiple sources of information available from the patient assessment that can assist clinical reasoning and the confidence of estimating the probability of the patient presenting with or developing CAD. The provision of specific, prescriptive guidance is limited by the inadequacies of the current evidence base (that will progress with ongoing research), and therefore manual therapists need to critically appraise the literature and combine this with their own clinical experience and patient preferences to facilitate optimal clinical decision-making for each patient individually.

In 2008, the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT) convened an expert working

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http://dx.doi.org/10.1016/j.math.2013.11.005

group to create a resource for best practice in cervical region examination in individuals with neck complaints that may present with CAD or be at risk of developing CAD. The vision statement of IFOMPT is the "*world-wide promotion of excellence and unity in clinical and academic standards for manual/musculoskeletal physiotherapists*", reflecting an international organisation aiming to promote and maintain high standards of specialist education and clinical practice, promote and facilitate evidence based practice, communicate widely the purpose and level of the specialisation, and to work towards international unity/conformity of postgraduate educational standards of practice. As of 2013, IFOMPT consists of 22 Member Organisations (MOs)/countries meeting IFOMPT's documented standards in postgraduate education in OMT and 11 Registered Interest Groups (RIGs) aspiring to the same.

The aim of the framework development was to guide clinical reasoning for the assessment of the cervical spine region for potential of CAD prior to planned OMT interventions focussing on techniques occurring in end range positions, notably during passive joint mobilisation, exercise, and high velocity thrust manipulation interventions. The framework is designed to be reflective of best practice, intending to place risk in an appropriate context that is informed by the available evidence. In this context, the framework considers both ischaemic and non-ischaemic CAD presentations to identify risk, prior to any overt symptoms and signs in a patient presenting for cervical management. The framework is designed to be informative, not prescriptive and is intended to enhance the clinician's clinical reasoning as part of the process of patient assessment and management. The framework is not complex, but it is flexible; allowing the clinician to apply it based on an individual patient's presentation and preferences, thereby facilitating patient-centred practice.

2. Methods

2.1. Project group

An international collaboration of the Standards Committee of IFOMPT and invited international subject experts.

2.2. Consensus method

2.2.1. Stage 1

The issues central to the framework were initially explored at the World Confederation for Physical Therapy Congress (June 2007, Vancouver). An IFOMPT coordinated session focused on vertebrobasilar insufficiency, an issue that had generated many questions from MOs of IFOMPT and individual physical therapists. The session generated robust discussion related to pre-manipulative screening in the cervical spine, and as a result, the IFOMPT Standards Committee was asked to take the key issues forward.

A descriptive survey exploring current practice in cervical spine pre-manipulative screening and manipulation technique applications was sent to all MOs and RIGs of IFOMPT. The findings of this survey have been published elsewhere (Carlesso and Rivett, 2011) and informed this framework.

2.2.2. Stage 2

The structure and content of the framework was further informed by a consensus forum held at the IFOMPT Conference in Rotterdam (June 2008) where nominated experts from each MO of IFOMPT were invited to participate. Findings from the survey were presented to facilitate discussion. The forum concluded that an international framework was needed and agreed its constituent sections, with the following guiding principles agreed to inform its development:

- To use existing MO documents, specifically Rivett et al. (2006) and Kerry et al. (2007) which were widely adopted by MOs.
- To consider pre-manipulative provocative positional tests and craniovertebral ligament testing.
- To ensure that recommendations regarding informed consent be sufficiently flexible for use in different jurisdictions (so as to be inclusive of all MOs/countries).
- Preferred considerations for manipulative (high velocity thrust) practices be included to address the identified variability of practice.
- An IFOMPT endorsed framework must be: reflective of best practice and research, flexible and simple in application, suitable for individual MO jurisdictions, and an informative aid to patient-centred clinical reasoning, but not prescriptive.

As a consequence of the discussion, the framework moved beyond the previous issues of vertebrobasilar insufficiency to CAD, and beyond a focus on manipulation to planned OMT interventions encompassing a range of treatment approaches.

2.2.3. Stage 3

Drafts of the framework were subsequently developed through an iterative consultative process with experts in the field and all MOs of IFOMPT.

2.3. Definition of consensus

Consensus was defined as approval of the framework document by all of the 22 member countries/MOs of IFOMPT.

3. Findings

Consensus and approval of the framework by the 22 MOs of IFOMPT was achieved in October 2012 at the IFOMPT Conference in Quebec City. The framework is based on best available evidence at the time of writing, and is to be used in conjunction with the IFOMPT Standards (IFOMPT, 2008) and with the key literature sources identified. Central to the framework are sound clinical reasoning and evidence based practice. The framework is divided into key sections which are outlined below. The complete framework is available at: www.ifompt.com/ReportsDocuments.html

3.1. Context to assessment of the cervical region/clinical reasoning as a framework

The concept of clinical reasoning underpins the framework (Jones and Rivett, 2004). The cognitive and metacognitive processes of reasoning, using evidence-informed knowledge within OMT are the central components of expertise in the practice of OMT (Rushton and Lindsay, 2010). The framework requires effectiveness in the clinical reasoning competencies detailed in the IFOMPT Standards Document (2008) to enable effective, efficient and safe patient management. It has been shown that previously reported adverse events involving CAD and following application of cervical manipulation, could have been avoided if a more accurate and thorough clinical reasoning process had been used by the clinician (Rivett, 2004).

3.2. *Patient history*

The patient history is essential to establish and test hypotheses related to potential adverse events of OMT, and its importance in clinical reasoning for example, for the assessment of CAD and its associated risk factors has been well reported (Sweeney and Doody, 2010). There is limited diagnostic utility data related to many

Table 1
Differential diagnosis.

	Internal carotid artery disease	Vertebrobasilar artery disease	Upper cervical instability
Early presentation	Mid-upper cervical pain, pain around ear and jaw (carotidynia), head pain (fronto-temporo-parietal); Ptosis; Lower cranial nerve dysfunction (VIII–XII); Acute onset of pain described as "unlike any other".	Mid-upper cervical pain; occipital headache; Acute onset of pain described as "unlike any other".	Neck and head pain; Feeling of instability; Cervical muscle hyperactivity; Constant support needed for head; Worsening symptoms.
Late presentation	Transient retinal dysfunction (scintillating scotoma, amaurosis fugax); Transient ischaemic attack; Cerebrovascular accident.	Hindbrain transient ischaemic attack (dizziness, diplopia, dysarthria, dysphagia, drop attacks, nausea, nystagmus, facial numbness, ataxia, vomiting, hoarseness, loss of short term memory, vagueness, hypotonia/limb weakness [arm or leg], anhidrosis [lack of facial sweating], hearing disturbances, malaise, perioral dysthaesia, photophobia, papillary changes, clumsiness and agitation); Cranial nerve dysfunction; Hindbrain stroke (e.g. Wallenberg's syndrome, locked-in syndrome).	Bilateral foot and hand dysthaesia; Feeling of lump in throat; Metallic taste in mouth (VII); Arm and leg weakness; Lack of coordination bilaterally.

factors. Therefore, the clinician's aim during the patient history is to make the *best* judgement on the probability of serious pathology and contraindications to treatment based on available information. Many red flags that contraindicate or limit OMT treatment manifest in an obvious way (Moore et al., 2005), such as worsening neurological function, and unremitting, severe, non-mechanical pain. However, there are serious conditions that could compromise the vascular and neurological structures, which may mimic musculoskeletal dysfunction in the early stages of their pathological progression, including CAD (e.g. vertebrobasilar insufficiency due to dissection (Kerry et al., 2008)) and upper cervical instability (Niere and Torney, 2004). For example, a patient experiencing one of these conditions may seek OMT for pain relief (Murphy, 2010; Taylor and Kerry, 2010). It is therefore important that the subtle symptoms of these pathologies are recognised in the patient history. It is also important to recognise risk factors indicating a potential for neurovascular pathology, and these should be thoroughly assessed during the patient history (Arnold and Bousser, 2005; Kerry et al., 2008). Additionally, a history of trauma (e.g. whiplash, rugby neck injury) and congenital collagenous disorders are associated with the potential for bony or ligamentous compromise of the upper cervical spine (Cook et al., 2005). The patient history is therefore an opportunity for the astute clinician to observe signs and symptoms of serious pathology and contraindications or precautions to treatment early in the clinical encounter.

Table 1 provides key information to assist in the differential diagnosis of musculoskeletal dysfunction from more sinister pathologies masquerading as musculoskeletal dysfunction (Arnold and Bousser, 2005; Arnold et al., 2006; Kerry et al., 2008; Kerry, 2011); enabling their consideration in the context of known risk factors.

Box 1 is an example case history of an internal carotid artery dissection presenting to a physical therapist.

3.3. *Planning the physical examination*

Interpreting data from the patient history and defining the main hypotheses is essential to an effective physical examination (Maitland et al., 2005; Rushton and Lindsay, 2010; Petty, 2011). Hypothesis generation from the history, and refining, re-ranking and rejecting of these hypotheses in the physical examination is necessary to facilitate optimal clinical reasoning in OMT (Jones and Rivett, 2004). Therefore careful planning of the physical examination is required (Fig. 1). Specific to this framework, the possible vasculogenic (cervical arterial) contribution to the patient's presentation needs to be evaluated from the patient history data. An important component of planning is the identification of whether there are gaps in the information obtained, and if the quality of the information obtained is sufficient.

3.4. *Physical examination*

Hypertension is considered a risk factor for carotid and vertebral artery disease. More acutely, an increase in blood pressure may be related to acute arterial trauma, including of the internal carotid and vertebral arteries (Arnold and Bousser, 2005). Evaluation of blood pressure may therefore be a valuable test to inform clinical reasoning. Although hypertension is undoubtedly a strong predictor of cardiovascular disease, interpretation of readings must be in the context of other findings (Nash, 2007), and sound clinical reasoning. Vascular disease is an inter-play between various factors, of which high blood pressure is just one (albeit a consistently important one).

Instability of the craniovertebral ligaments could compromise the vascular and neurological structures in the upper cervical region (Savitz and Caplan, 2005; Thanvi et al., 2005), and cause spinal cord compression (Bernhardt et al., 1993; Rao, 2002). Whether or

Box 1
Case history of an internal carotid artery dissection

Case:

A 42 year-old accountant presents to physical therapy with a 5 day history of unilateral neck and jaw pain, as well as temporal headache, following a rear-end motor vehicle collision. There is a movement restriction of the neck and the physical therapist begins to treat with gentle passive joint mobilisations, and advises range of movement exercises. The following day, the patient's pain is worse, and he has developed an ipsilateral ptosis. The patient's blood pressure is unusually high.

Synopsis:

On medical investigation, an extra-cranial dissection of the internal carotid artery was found. The patient had underlying risk factors for arterial disease, and the presentation was typical of internal carotid artery dissection, with a key differentiator being the ptosis. A dramatic systemic blood pressure response was a result of this vascular insult.

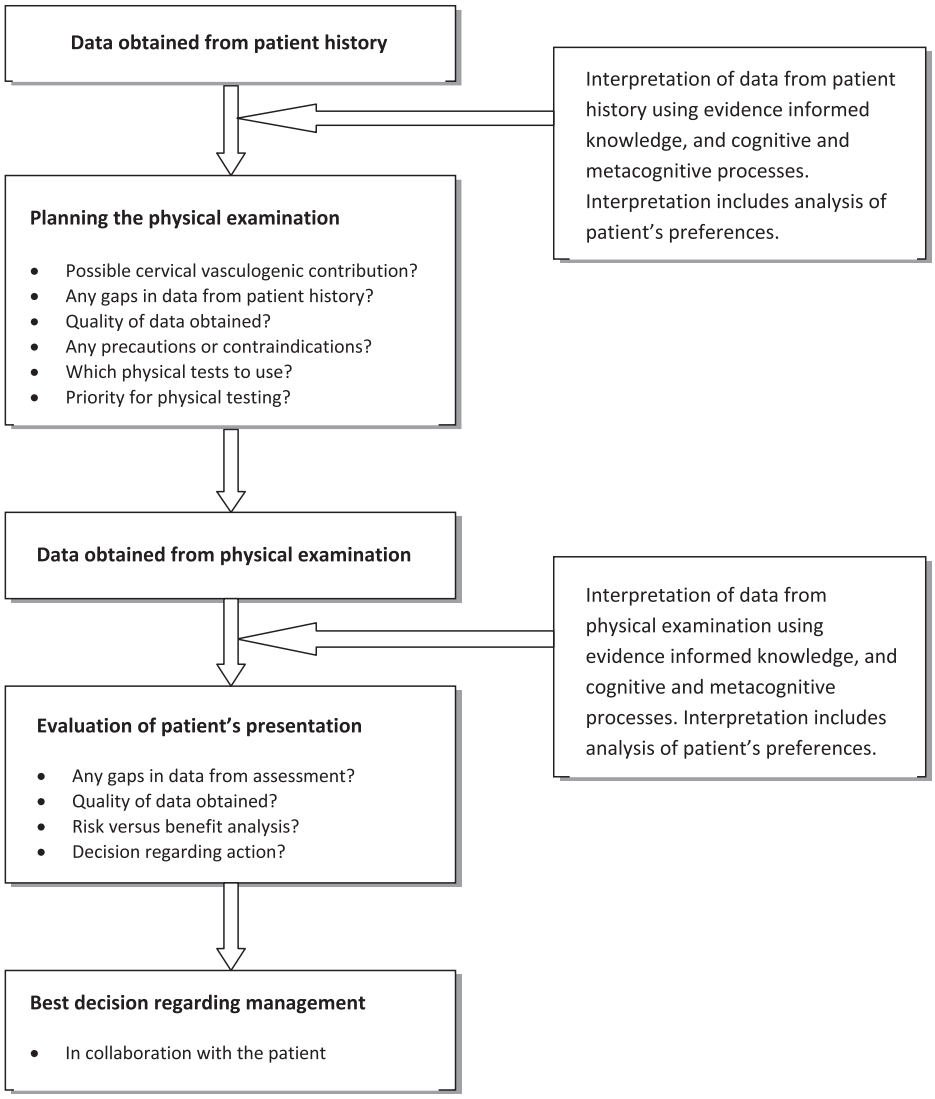

Fig. 1. Flowchart of clinical reasoning.

not to test for cervical instability is therefore an important decision when suspecting pathology. Traditional instability testing included the anterior shear test (transverse ligament), tectorial membrane distraction, and alar ligament tests (Cattrysse et al., 1997; Gibbons and Tehan, 2005). The construct validity of these tests provides support that testing evaluates ligamentous integrity and may reproduce the patient's symptoms (Osmotherly et al., 2012a, 2012b). Recently it has been proposed that assessment of ligament stability progresses systematically through a sequence of active patient generated movements, to passive therapist generated (with overpressure) loads, and finally passive accessory movement tests. For each individual patient, a decision needs to be made regarding the value of performing any craniovertebral ligament tests in the context of risks:benefits of an individual test, using current evidence from research investigating validity of testing (e.g. Kaale et al., 2008). Currently, the evidence of the predictive ability of these tests to identify instability is lacking and the clinician should carefully consider whether physical testing is prudent or safe in the presence of symptoms of instability identified from the patient history.

Examination of the peripheral nerves, cranial nerves, and for an Upper Motor Neuron lesion (Fuller, 2008; www.neuroexam.com) will assist in evaluating the potential for neuro-vascular conditions.

Provocative positional testing of the cervical spine is intended to temporarily compromise the vascular supply to the brain, and the presence of signs or symptoms of cerebrovascular ischaemia during or immediately post testing is interpreted as a positive test. Sustained end-range rotation has been advocated and described as the most provocative and reliable test (Mitchell et al., 2004). However, the diagnostic accuracy data calls into question the utility of these tests (Hutting et al., 2012) and therefore any interpretation is limited. The sustained pre-manipulative test position (i.e. placing the head and neck in the position of the selected manipulative technique) has also been advocated (Rivett et al., 2006). However, the predictive ability of either of these tests to identify at risk individuals is lacking.

Palpation of the common and internal carotid arteries is possible due to the size of these vessels and their relatively superficial anatomy. Currently no meaningful diagnostic utility statistics exist in relation to the predictive ability of carotid palpation to identify potentially adverse outcomes from cervical treatment. Carotid palpation is considered a standard component of a clinical work-up for carotid artery dysfunction (Cournot et al., 2007; Cury et al., 2009; Atallah et al., 2010). Asymmetry between left and right vessels is assessed, and a pulsatile, expandable mass is typical of arterial aneurysm. Such a finding should be considered in the

context of other clinical findings. It is possible for dissections and disease of the carotid arteries to exist in the absence of aneurysm formation, therefore a negative finding should not be used to refute the hypothesis of arterial dysfunction.

Differentiating a patient's symptoms from a vasculogenic cause with complete certainty is not possible from the physical examination. Physical therapists must understand that headache and/or neck pain may be the early presentation of an underlying vascular pathology (Rivett, 2004; Taylor and Kerry, 2010) and therefore need to differentiate the origin of symptoms by either having a high index of suspicion or testing the vascular hypothesis. Kerry and Taylor (2006) provide a summary of key physical examination tests and their value for differentiating vasculogenic head and neck pain.

3.5. *Risk:benefit analysis*

The risk associated with OMT intervention for musculoskeletal cervical spine disorders should be considered within a clinical reasoning framework. That is, the risk, albeit likely extremely low in general and in comparison to some other conservative treatments (Rivett, 2004), will vary depending on the patient's individual clinical presentation and in particular in the presence of risk factors. It is therefore the responsibility of the physical therapist to recognise and consider whether the risk for a particular patient is increased, and to do whatever is reasonable to minimise any risk associated with OMT intervention.

Data and evidence surrounding the clinical concern of this framework are incomplete and often contradictory. It is important to appreciate that an absolute diagnosis cannot be made by the clinician. The clinician must accept that the clinical decision is made in the absence of certainty and that the aim of the assessment is to make a decision based on a *balance of probabilities*. Although some presentations absolutely contraindicate OMT intervention, others suggest risk factors for potential adverse events and may co-exist with treatable musculoskeletal dysfunction. It is the responsibility of the clinician to make the best decision regarding treatment in these situations using their clinical reasoning skills and consideration of patient preferences (Jones and Rivett, 2004; Kerry and Taylor, 2009). The model detailed in Table 2 provides a simple framework for decision-making regarding risk:benefit but should not be considered prescriptive.

3.6. *Flowchart of clinical reasoning*

Fig. 1 details a flowchart of advocated clinical reasoning processes throughout the process of assessment.

3.7. *Informed consent and medico-legal framework*

Informed consent is comprised of both ethical and legal components. Patient consent to treatment is a standard of physical therapy practice. Clinicians are advised to check local laws and health regulations affecting the informed consent process. The following pertains to any physical therapy intervention: the information must be specific to the proposed treatment, cover alternative treatment options and benefits and risks of the proposed treatment and alternatives (Applebaum et al., 1987; Wear, 1998). Omission of any of the above information may invalidate consent. It is the responsibility of the clinician to ensure that the patient fully understands the information that has been given and to provide further information requested by the patient, answering all questions in a manner that the patient considers satisfactory (Wear, 1998). It is recommended that informed consent be obtained explicitly either verbally or in writing and that it be recorded in a standardised manner.

3.8. *Safe OMT practice, including emergency management of an adverse situation*

OMT practice encompasses a wide range of therapeutic procedures. Reports of patient harm from OMT in the cervical region have typically been in the practice of cervical manipulation. Considerations for the physical therapist during the selection and application of cervical manipulation (Rivett, 2004; Childs et al., 2005) are presented in the framework along with the considerations for alternative approaches to direct cervical treatment, frequency of treatment, minimising end-range cervical techniques, force minimisation, and monitoring for adverse effects. For example, the influence of cervical spine segments not included in the manipulation can be used to direct loads to the segment to minimise stress on the rest of the neck and thus eliminate cervical spine locking positions (Hing et al., 2003).

3.9. *Teaching OMT for the cervical region*

A variety of manual assessment and intervention techniques are being used in the assessment and management of the cervical spine internationally. As cervical manipulation has been at the centre of reports of patient harm from OMT, the teaching of cervical manipulation is a focus, and teaching of OMT for the cervical region therefore requires experienced and qualified instructors. Based on the literature, instruction should emphasise the continuum of the amplitude, velocity, patient comfort, and sensitivity and specificity of handling during manipulation tutoring (Flynn et al., 2006; Mintken et al., 2008). This continuum reflects excellence in manual skills to enable clinicians to perform manipulation efficiently and effectively.

3.10. *Proposed response to the media: key messages to communicate*

Occasionally physical therapists are approached by the media to comment on cervical manipulation and its associated risks. Key points are provided to support a response, and key references are recommended (Bronfort et al., 2004; Rubinstein et al., 2005; Gross et al., 2007; IFOMPT, 2008; Kerry et al., 2008).

4. Discussion

It has been a challenging process to produce an international agreed framework; emphasising the importance for MOs of IFOMPT

Table 2
Decision-making framework for analysing risk:benefit.

Risk	Benefit	Action
High number/severe nature of risk factors	Low predicted benefit of manual therapy	Avoid treatment
Moderate number/moderate nature of risk factors	Moderate predicted benefit of manual therapy	Avoid or delay treatment/monitor and reassess
Low number/low nature of risk factors	Low/moderate/high predicted benefit of manual therapy	Treat with care/continual monitoring for change/new symptoms

to now operationalise the framework in line with their national legislative, regulatory, and professional bodies in order to support individual clinicians. The framework is structured to enhance the clinician's clinical reasoning to be an aid to patient-centred clinical reasoning. A generic flowchart of clinical reasoning is provided rather than a prescriptive algorithm. This is intentional, as the data are not available to support a prescriptive algorithm. The framework offers a review of the current best evidence which physical therapists can use to guide their practice and contextualise their data for individual patient presentations and preferences.

The clinician's aim during the patient history is to make the *best* judgment on the probability of serious pathology and contraindications to treatment. The evidence suggests that presentations of CAD and instability may at some course in their pathology, mimic or co-exist with musculoskeletal presentations. An evidence-informed history-taking process is an opportunity for the therapist to consider the likelihood that such a condition is present.

Planning the physical examination will enhance its effectiveness through interpretation of data from the patient history and definition of the main hypotheses. It is important for the clinician to prioritise clinical examination procedures related to the generated hypotheses. If serious pathology is suspected, priority should be given to procedures that may inform this probabilistic judgement. Many testing procedures lack the diagnostic utility required to confidently rule-in or rule-out pathologies when used in isolation. However, use of procedures is indicated based on evidence related to best practice, patho-mechanisms, and the on-going accumulation of clinical data to support or refute a hypothesis.

A risk:benefit model can provide a simple framework for decision-making through consideration of risk factors, predicted benefit of OMT intervention, and analysis of possible action. Clinical decision making guided by this framework may result in the patient continuing with a musculoskeletal treatment plan; one which may require modification due to moderate/high vascular risk factors; or being referred for further medical opinion due to suspicion of serious pathology. These decisions are probabilistic and made in a context of uncertainty. By considering this decision through a risk:benefit analysis, confidence can be gained by understanding that the decision is the best option, given the evidence and alternative choices.

The strengths of this framework are that it provides a useful resource for the assessment of the cervical spine for potential of CAD in advance of planned OMT interventions, using the best available evidence at the time of writing. The achievement of consensus for a framework to guide practice in this difficult area is important. The key limitation is reliance on expert contributions in the absence of adequate data. Nonetheless, this framework is based on a rigorous process of integration of the best available evidence with expert opinion and should help inform best practice decisions.

5. Conclusions

The purpose of this framework is to guide the clinician's process of assessment of the cervical spine to evaluate the potential for CAD. An informed, planned and individualised assessment of the patient is advocated, with multiple clinical findings combined to inform a risk:benefit analysis regarding management. CAD is an area of increasing interest and the evidence base continues to develop. Therefore, this framework will be reviewed and updated within 5 years.

Acknowledgements

The following organisations for permitting the authors to adapt their existing work with permission:

Canadian Physiotherapy Association's Manual Therapy Steering Committee

Musculoskeletal Association of Chartered Physiotherapists, United Kingdom (formerly the Manipulation Association of Chartered Physiotherapists).

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