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Position statement:
International Framework for Examination of the Cervical Region for potential of vascular pathologies of the neck prior to Musculoskeletal Intervention: International IFOMPT Cervical Framework

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International Framework for Examination of the Cervical Region for potential of vascular pathologies of the neck prior to Musculoskeletal Intervention: International IFOMPT Cervical Framework

Synopsis / Abstract

This position statement, stemming from the international IFOMPT (International Federation of Orthopaedic Manipulative Physical Therapists) cervical framework, was developed based upon the best contemporary evidence and expert opinion to assist clinicians during their clinical reasoning process when considering presentations involving the head and neck. Developed through rigorous consensus methods the international IFOMPT cervical framework guides assessment of the cervical spine region for potential vascular pathologies of the neck in advance of planned interventions. Within the cervical spine, events and presentations of vascular pathologies of the neck are rare but are an important consideration as part of patient examination. Vascular pathologies may be recognisable if the appropriate questions are asked during the patient history, if interpretation of elicited data enables recognition of this potential, and if the physical examination can be adapted to explore any potential vasculogenic hypothesis.

BACKGROUND

Vascular pathologies of the neck and head are rare[32] but are an important consideration for clinicians managing people with neck and/or head pain. Identifying vascular pathologies of this region is a complex process. There are a range of potential vascular pathologies and dysfunctions relating to the arterial system which supply blood to the brain. Their relevance for clinicians who treat musculoskeletal conditions is two-fold. First, clinical and empirical history stemming from the early days of manual therapy linked neurovascular patient safety incidents with therapeutic interventions. Second, in recent years, it has become more evident that there are a range of arterial pathologies with the potential to present as musculoskeletal pain and dysfunction - so-called vascular masqueraders – meaning patients present to the clinician with a vascular pathology of the neck/head region manifesting as neck pain and/or headache.[9] Headache and/or neck pain are features of a range of vascular pathologies of the neck and head, including dissection and non-dissection events.[1,8,17,34,46,] For ease, we use the term 'vascular pathologies' to refer to the wide range of distinct pathological process, as well as non-disease based mechanical dysfunctions such as non-specific mechanical neck pain.

Many clinicians erroneously believe that there are no distinguishing features between patients presenting with vascular pathologies of the neck and patients who present with features of a musculoskeletal disorder. This position statement, stemming from the international framework developed through the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT), was developed in response to a call for guidance from professional bodies to address decades of uncertainty and clinician anxiety due to inconsistent knowledge and practice. This position statement, based upon the best contemporary evidence and expert opinion, aims to

summarise the IFOMPT 2020 framework and assist clinicians during their clinical-reasoning process when considering presentations involving the head and neck.

The IFOMPT framework can support healthcare professionals who are working with cervical musculoskeletal conditions by supporting early identification of vascular pathologies, ensuring the best possible outcome for patients. It is based upon the best contemporary evidence and expert opinion, to assist all clinicians during their clinical-reasoning process. This position statement has moved from the IFOMPT language of 'OMT' (Orthopaedic Manual Therapy) to musculoskeletal intervention, to ensure (i) clarity for all clinicians and (ii) the revised framework completes a planned update of the original (2012) framework to ensure access to the contemporary evidence for clinical reasoning.

Consensus methodology

We present the IFOMPT cervical framework as a consensus document developed through rigorous methods. The framework is not intended as a compilation of systematic reviews designed to answer specific questions. The consensus process considered the breadth and complexity of evidence, clinical reasoning, and facilitated recommendations where there was a lack of published material and considerable uncertainty.

For each section of the framework, discrete substantive areas were identified, and relevant electronic databases, reference lists, key journals, existing networks, and relevant organisations and conferences were searched. Study selection and charting of data and information was undertaken within each section in-line with its focus. There were 4 stages to developing the framework:

- **Stage 1:** A survey to evaluate the previous 2012 cervical framework was distributed to all Member Organisations and Registered Interest Groups of IFOMPT in 2016. The survey explored the perceived value of the framework, its strengths and limitations, and examples of its clinical and legal use.
- **Stage 2:** The key issues identified in the survey were initially explored at the IFOMPT Conference in 2016 in Glasgow. Findings from the evaluation survey were presented to facilitate discussion and debate through platform presentations. We confirmed the need for an updated version of the framework. The session generated considerable discussion to inform the first revisions of the framework. Guidelines, systematic reviews and individual studies were used to inform the draft. When no evidence was available, we used expert consensus. We adapted terminology (OMT to musculoskeletal) and included six new case studies to support knowledge translation.
- **Stage 3:** Through an iterative consultative process, drafts of the framework were developed and circulated for review and feedback to: Member Organisations and Registered Interest Groups of IFOMPT, International experts / authors, nominated experts within IFOMPT countries, and professional organisations across physical therapy, osteopathy and chiropractic. Each stage included an email including previous feedback, changes made, and a rationale for changes made / not made based on feedback. The final version was reviewed and appraised by a medical practitioner specialist in stroke and interventional neurology.
- **Stage 4:** The framework was voted on and accepted unanimously at the IFOMPT General Meeting in November 2020 by 22 Member Organisations (countries) as an international position statement for musculoskeletal clinicians.

Clinical reasoning and shared decision-making

The IFOMPT cervical framework is intended to be informative and not prescriptive - supporting clinical reasoning during assessment and treatment.[25,44,53,62] The current framework builds on the previous 2012 framework[54] (first version) and addresses concerns of the earlier framework highlighted through the consensus methodology and empirical work.[13] The framework requires sound clinical reasoning to enable effective, efficient and safe assessment and management of the cervical spine region. It is clear that some recorded safety incidents could have been avoided if more thorough clinical reasoning had been exercised by the clinician.[49] The framework is designed to aid patient-centered clinical reasoning in a subject area where uncertainty is an important consideration.

Shared decision-making fosters patient-centered "care that is respectful of and responsive to individual patient preferences, needs, and values" and ensures "that patient values guide all clinical decisions".[27] The Informed Medical Decision-Making Foundation[11] describes shared decision-making as a dynamic two-way process. The clinician communicates personalised information about the options, outcomes, probabilities, and scientific uncertainties of available treatment options to the patient, while the patient communicates their values and the relative importance they place on benefits and harms. Shared decision-making is an effective means for reaching agreement on the best strategy for treatment. The framework adopts the Agency for Healthcare Research and Quality's 5-step **SHARE** approach: **S**eek your patient's participation; **H**elp your patient explore and compare treatment options; **A**ssess your patient's values and preferences; **R**each a decision with your patient; **E**valuate your patient's decision, to achieve patient-centred practice: https://www.ahrq.gov/professionals/shareddecisionmaking/tools/tool-1/share-tool1.pdf **FIGURE 1** summarises the shared decision-making.

How an international framework can help clinicians

The priority for the clinician in this context is to first do no harm, and second, to excel in clinical reasoning and differential diagnosis. These two dimensions overlap and are important in the context of the known association between seeking care for neck pain and headache, and the natural history and progression of vascular pathologies of the neck.[9] Incidents that occur following musculoskeletal treatment are generally believed to manifest in people with vascular pathologies or who have a vascular predisposition (e.g. elongated styloid process). There are also rare exceptions where the incident might seem unpredictable (e.g. spontaneous cervical artery dissections).

The IFOMPT cervical framework guides assessment of the cervical spine region for potential vascular pathologies of the neck in advance of planned interventions inclusive of mobilisation, manipulation and exercise. Within the cervical spine, events and presentations of vascular pathologies of the neck are rare,[33] but are an important consideration as part of patient examination. **TABLE 1** details the range of vascular pathologies of the neck. Vascular pathologies may be recognisable if the appropriate questions are asked during the patient history, if interpretation of elicited data enables recognition of this potential, and if the physical examination can be adapted to explore any potential vasculogenic hypothesis. The framework reflects best practice and aims to place risk in an appropriate context informed by the evidence. In this context, the framework considers ischaemic and non-ischaemic presentations to identify risk in a patient presenting for cervical examination and management. **FIGURE 2** summarises the purpose of the framework.

Risk and context

One of the goals of the IFOMPT cervical framework is to ensure that clinicians understand risk in both its epidemiological and individual contexts. Epidemiologically, the risk of a vascular incident related to therapeutic interventions is extremely small. Despite this, clinicians must do everything in their power to mitigate and limit that risk. Individual patients differ with regard to risk (chance, high or low, that any hazard will actually cause somebody harm) and hazard (something that can cause harm) profile (predisposition to arterial pathology) or existence of vascular pathology (masquerading as a musculoskeletal dysfunction).

Important underlying principle of the framework

Clinicians cannot rely on the results of a single test to draw conclusions. Understanding the patient's presentation following an informed, planned and individualised assessment is essential. There are multiple sources of information available from the process of patient assessment to improve the confidence of estimating the probability of vascular pathologies of the neck. Data available to inform clinical reasoning will improve and change with ongoing research. The framework provides a starting point, while encouraging clinicians to stay current in the topic area, to enable support for their clinical decisions. The following sections summarise the key issues for each stage of the clinical reasoning process: listening to the patient history, planning the physical examination, conducting the physical examination, planning the intervention, and evaluating the intervention. Case histories illustrate the clinical reasoning required for safe and effective practice.

A visual tool (**FIGURE 3**) to illustrate the level of support for a vasculogenic hypothesis is used throughout (i.e. the index of suspicion for vasculogenic pathology). All levels of support (low, moderate or high) influence the subsequent decision-making processes.

Case A illustrates an example narrative associated with managing people seeking advice without a formal process of patient examination. It highlights a "best guess" by the therapist based on limited, but informative, information.

Case A

Synopsis:

A headache described as "unusual" with progressive signs of likely central ischemia (slurred speech, lethargy, fatigue, confusion) is sufficient information for the therapist to recommend emergency medical attention.

Telephone History:

A 50-year-old male brick layer complains of a headache. His headache is similar 'but different' to previous 'migraine' headaches that he intermittently experiences. This is different in that he also feels lethargic and 'run down'. With this in mind he decides to go to bed sure that he will feel better in the morning as he does feel fatigued and 'sleepy'. Upon waking his headache is still present. He thinks that he needs to exercise and 'get out for some fresh air' (similar to previous headaches) so he walks to the shops to get some essentials. The checkout operator says that she cannot understand what he is saying and that his speech is slurred. He is confused as he knows what he is saying and feels this is due to his 'over-doing it'. He reflects and cannot understand why he is still lethargic and cannot concentrate on things. Upon his wife arriving home from work she also comments that he is difficult to understand and that he needs to concentrate on their conversation as 'he is he not listening to her.' She calls a physical therapist friend to seek advice.

Clinical Reasoning:

As a result of the discussion and reflection on the slurring of words and general description of his complaint, the physiotherapist friend recommends that the patient's wife take him to the hospital emergency department for assessment. Reasoning specifically based on fatigue, slurred speech (dysarthria), atypical headache 'similar but not like' previous headaches (with no subjective cause).

Support for vascular hypothesis: HIGH

Action:

Urgent medical investigation. Magnetic resonance arteriography reveals an established distal left M2 (the Sylvian fissure segment of the middle cerebral artery (MCA)) embolic ischaemic thromboembolus within the left M2 MCA superior division with evidence of an established acute cerebral infarct involving the anterior left MCA Territory. Transthoracic echocardiogram (TTE) report shows the presence of a shunt Patent Foramen Ovale (PFO) at atrial level upon Valsalva.

PATIENT HISTORY

The patient history is used to establish, and test hypotheses related to either the predisposition of vascular pathologies of the neck, or the presence of frank vascular pathologies of the neck.

There are very limited diagnostic utility data for physical examination tests. Therefore, the clinician's aim is to use the patient history to make the best judgment on the *probability* of either contraindications to treatment or serious pathology. Subtle signs and symptoms of suspected pathologies should be recognised in the patient history. It is also important to recognise risk factors indicating the *potential* for neuro-vascular pathology.

Considering risk factors

The aetiology of a vascular pathology of the neck event is complex and multi-factorial. Rarely is an event associated with a single causal factor. However, there are several factors known to be associated with an increased risk of arterial pathologies related to either internal carotid or vertebrobasilar vessels. These should be thoroughly considered during the patient history. Recent data analysis allows some degree of understanding as to the degree of risk of certain factors. **TABLES 2 and 3** detail retrospective and prospective data,[64-67] complemented and supported by other available reviews,[52] including the most contemporary reviews.[10,28,57,58] **TABLES 2 and 3** detail risk factors for dissection and non-dissection vascular events (combining vertebrobasilar and internal carotid artery pathologies). The percentages refer to the proportion of all observed patients (from the studies above) with the specified condition (e.g. 'dissection event') who exhibit the specific risk factor stated in the first column. As no meaningful reference class data exist for these specific factors, these data are not intended to be used to judge relative risk. Rather, they indicate the known proportionality of observed features in each condition, thereby giving the clinician a developing idea of clinical patterns. The key message from these data is the general difference between the characteristics of dissection and non-dissection events. It is equally important to note that spontaneous dissection events are not associated with these

historical risk factors detailed in **TABLE 3**. Clinical reasoning must recognise that absence of risk factors does not necessarily rule out the risk of serious neurovascular event.

Presenting features of vascular pathologies of the neck

It is important to recognise elements of a clinical pattern that may further support or refute a vascular hypothesis. Again, due to the extremely low prevalence, range of pathologies, and high variation of the presenting features of vascular pathologies of the neck, a definite clinical pattern is not possible to identify. However, certain consistent features of clinical presentation do emerge from historical case reports which are supported by observations from systematic reviews.[33,64] These features are presented in **TABLES 4 to 8** allow the clinician to begin to understand the way in which different vascular pathologies of the neck are most likely to present. These estimates are again split between dissection and non-dissection events. For the list of clinical features, data are presented also by separating vertebrobasilar (VBA) dissection from internal carotid (ICA) dissection as there is wide variation of clinical features. **TABLES 4 and 5** detail the reported features for dissection and non-dissection vascular events in the neck.[33,64] The percentage figures refer to the proportion of all observed patients with the specified condition (e.g. dissection vascular event) who exhibit the specific features stated in the first column. **TABLES 6, 7 and 8** detail reported clinical features in the dissection and non-dissection patients.[64] The percentage figures refer to the proportion of all observed patients (from the quoted studies, above) with the specified condition (e.g. ICA dissection) who exhibit the specific feature stated in the first column. These data are intended to contribute to the clinician's reasoning regarding the developing clinical pattern, not inform a judgement about relative risk.

Importance of observation throughout history

Signs and symptoms of serious pathology and contraindications / precautions to treatment may manifest while the clinician obtains the patient history. This is an opportunity to observe and recognise possible red flag indicators such as gait disturbances, subtle signs of disequilibrium, upper motor neuron signs, cranial nerve dysfunction, and behaviour suggestive of upper cervical instability (e.g. anxiety, supporting head/neck) early in the clinical encounter. **FIGURE 4** summarises the patient history.

Case B illustrates an example narrative associated with the patient history.

Case B

Synopsis:

Progressive “unusual” headache with emerging hind brain / central neurology with history of trauma indicates additional testing to support a medical referral.

Patient History:

A 46-year-old female supermarket worker presents for physical therapy with left-sided head (occipital) and neck pain described as “unusual”. She reports a 10-day history of the symptoms following a road traffic accident. The symptoms are progressively worsening. The pain is eased by rest. The patient reports an onset of new symptoms after about 7 days including “feels like might be sick”, “throaty” and “feels faint” – especially after performing gentle exercise. Two days after this, she reports a stronger feeling of nausea, loss of balance, swallowing difficulties, speech difficulties and acute loss of memory. She reports a history of previous road traffic

accidents. Past medical history included hypertension, headaches, high cholesterol, and a maternal family history of heart disease and stroke.

Clinical Reasoning:

The history reveals an emerging pattern of vascular risk factors for a possible arterial dissection. For this type of pathology, and in this age-group, trauma is a primary risk factor. In this case there are reports of repeated trauma (road traffic accidents), together with a classic pain distribution for vertebral arterial somatic pain that was worsening. There are also cardio-vascular risk factors that, although have been found to absent in some dissection cases, can add strength to a vascular hypothesis. The patient reports a history of headaches, and it is important to explore the nature of these as migraine is a risk factor for dissection. She reports worsening and changing symptoms and signs, which are consistent with known descriptors for dissection events.

Support for vascular hypothesis: HIGH

Action:

Physical examination including blood pressure measurement and cranial nerve testing, and avoiding provocative head and neck movements is indicated. These finding may add support to a referral for urgent medical investigation.

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283 **PLANNING THE PHYSICAL EXAMINATION**

Careful planning of the physical examination is a necessary step. Interpretation of the data from the patient history and defining the main hypotheses will help guide an effective physical examination to further explore a possible vasculogenic contribution.[37,43,53] Prior to starting the physical examination, it is important to reflect on the completeness of the patient history data and its quality with the following questions:

- Are there any precautions to physical examination / intervention?
  e.g. precaution owing to vasculogenic hypothesis.
- Are there any contraindications to physical examination / intervention?
  e.g. avoiding end of range movements.
- What physical tests should be included or excluded in the physical examination, with consideration of any risks associated with performing the tests?
  e.g. blood pressure needs to be tested.
- What is the priority for these physical tests for this specific patient? This is to inform decisions regarding the order of testing and to determine which tests should be completed at the first visit.
  e.g. neurological examination required first.
- Do the physical tests need to be adapted for this specific patient?
  e.g. change in position.

Once the physical examination has begun, a process of refining, evaluating, re-ranking and rejecting hypotheses facilitates optimal clinical reasoning in musculoskeletal practice.[29] New data obtained during the physical examination is interpreted in the context of the existing hypotheses, to re-evaluate the level of support for a vasculogenic hypothesis.

Specifically, the therapist needs to consider if the new data supports, negates or does not make any difference to the vasculogenic hypothesis.

PHYSICAL EXAMINATION

The results of the history and physical examination serve to determine whether a medical referral for further vascular workup is warranted or whether the clinician can proceed with physical intervention. Unfortunately, data regarding the diagnostic utility of many of the recommended tests are often lacking. However, existing data support the use of conventional vascular examination[17] where blood pressure, neurological examination and examination of the carotid artery have moderate to good utility in supporting further investigation. Existing data evaluating *functional positional tests* for the identification of vertebral artery pathology does not support recommending these tests.[25] Clinicians should, as with any area of competence, reflect on their ability and seek additional training if unfamiliar with any test.

Blood pressure

Examination of blood pressure informs clinical reasoning in 2 ways:

1. Assess the risk for stroke, particularly from carotid origin[10,28,57,58]
2. Assess for acute arterial trauma *in situ*. An increase in blood pressure may be related to acute arterial trauma, including of the internal carotid and vertebral arteries.[2]

Blood pressure measurement is reliable and valid if done well with the right equipment.[30] Updated guidelines provide a useful and comprehensive resource.[39] Hypertension is a strong predictor of cardiovascular disease.[55] There is no discreet threshold and interpretation of readings must be in the context of other findings, and sound clinical reasoning. There is a positive correlation between

increased systolic and diastolic pressure and risk of stroke: the higher the pressure, the greater the risk. Vascular disease is an interplay between many factors, of which hypertension is just one. However, prospective data[64] suggests that in a sub-population of dissection events in patients younger than 38 years, cardiovascular markers such as hypertension were not associated with the pathological event. Patients with hypertension who have not been previously identified should be advised to discuss the implications with their primary care provider.

Neurological examination

Examination of peripheral and cranial nerves for an upper motor neuron lesion will assist in evaluating the potential for neuro-vascular conditions. Knowledge of a wide range of testing procedures is required owing to the diversity of possible clinical presentations associated with vascular pathologies of the neck, including balance and coordination tests. There are many useful resources to help with developing neurological examination skills, including Fuller[20] and: https://learninglink.oup.com/access/the-neuroexam-video#tag_01-introduction-to-the-neurological-exam

Cranial nerve examination is particularly important,[41,47] and a useful summary of examination based on nerve function is provided by Taylor et al.[63] An increasing body of literature details clinical cases of arterial pathology with cranial nerve involvement to inform pattern recognition. Examples include Peltz and Köhrmann,[42] Fujii et al[19] and Hennings et al.[23] Moderate reliability and validity of cranial nerve examination is supported (for example, Damodaran et al,[12] Koch et al,[32] Schmid et al[56]). Importantly, the absence of clinical findings in these examinations does not rule out an underlying pathology or impending dissection, and should therefore be viewed with caution.

Examination of the carotid artery

Auscultation and palpation of the common and internal carotid arteries is possible due to the size of these vessels and their relatively superficial anatomy.[45] There is some evidence to support an alteration of pulse as a feature of internal carotid disease.[41] Asymmetry between left and right vessels is considered significant. A pulsatile, expandable mass is indicative of arterial aneurysm.[17] A bruit on auscultation (controlling for normal turbulence) is a significant finding and should be considered in the context of other clinical findings. It is possible for dissections and steno-occlusive disease of the carotid arteries to exist in the absence of aneurysm formation. Therefore, a negative finding does not rule out the hypothesis of arterial dysfunction. In isolation, pulse palpation is neither sensitive nor specific, but it can offer important data leading to specific diagnoses and treatment.[3,45] Pulse auscultation is informed by use of appropriate anatomical landmarks and vessel palpation.[48] Understanding of both normal and pathological pulse quality is recommended. **FIGURE 5** summarises the physical examination.

Differentiation during the patient examination

Differentiation of a patient's symptoms originating from a vasculogenic cause with complete certainty is not currently possible from the physical examination, and as discussed earlier, headache / neck pain may be the early presentation of an underlying rare vascular pathology.[49,61] The task for the clinician is therefore to differentiate the symptoms by:

1. Having a high index of suspicion
2. Testing the vascular hypothesis.

This process of differentiation should take place from early in the patient history as symptomatology and history of a patient experiencing vascular pathology may alert the clinician to the underlying problem.[49,61] A high index of suspicion of cervical vascular involvement is required when acute neck/head pain is described as "unlike any other".[61]

Refer on for further investigation

It is recommended that clinicians refer for immediate medical investigation when their clinical suspicion supported by the reasoned patient history and physical examination findings suggest vascular pathology. Conventionally, duplex ultrasound, magnetic resonance imaging/ arteriography, and computed tomography are used

Case C illustrates an example narrative associated with the physical examination.

Case C

Synopsis:

Neck pain and temporal headache related to sustained neck extension in a male with cardio-vascular profile. Physical examination findings support vascular hypothesis and indicate urgent medical referral.

Patient History:

A 42-year-old accountant presents to physical therapy with a 5-day history of unilateral (left-sided) neck and jaw pain, as well as temporal headache, following decorating the ceiling (sustained head/neck extension). The following day, the patient's pain is worse, and he has

developed a left-sided ptosis. The patient had underlying risk factors for arterial disease, and the historical presentation was typical of internal carotid artery dissection, with a key differentiator being the ptosis.

Physical Examination:

A physical examination focussed on refuting a vascular hypothesis is indicated by the history. The physical examination should be conducted to acquire as much useful information as possible in the least provocative way. This information can then be used to support/refute the vascular hypothesis, and as a tool to strengthen a medical referral. At rest, the patient's blood pressure is unusually high (210 systolic/175 diastolic). Left pupil dilation is substantially less than the right. There is a pulsatile mass of the left internal carotid artery with an unusually turbulent bruit on auscultation.

Clinical Reasoning:

Clear and coherent data from the patient history and physical examination, indicative of possible carotid pathology. The patient is in the age-group where dissection events are more probable than atherosclerotic events, and the examination findings suggest aneurysm formation, which is commonly associated with dissection events.

Support for vascular hypothesis: HIGH

Action:

Urgent medical investigation. Magnetic resonance arteriography is indicated.

PLANNING INTERVENTION

This section relates to patients who are *not* presenting with a discrete vascular pathology, but rather with neuromusculoskeletal cranio-cervical dysfunction suitable for musculoskeletal intervention inclusive of mobilisation, manipulation and exercise intervention. Therefore, this assessment of risk and benefit relates to the risk associated with treatment, not misdiagnosis.

Framework for evaluating risk

Given that serious adverse events are (extremely) rare, it is difficult to express the association between risk and benefit as this would require a large, prospective observational study including (potentially) hundreds of thousands of participants.

The risks of a serious adverse event from musculoskeletal intervention (manual and/or exercise interventions) are extremely low in comparison to other non-invasive treatments and vary depending on the patient's individual clinical presentation and presence of known risk factors. The clinician must recognise and consider whether a patient is at increased risk, and work to minimise the risk. In the context of the IFOMPT cervical framework, there are two substantive, but related, risks:

1. Misdiagnosis of an existing vascular pathology
2. Serious adverse event following intervention.

Misdiagnosis occurs, although it is difficult to assess quantitatively. The current hypothesis is that patients presenting with neck pain and headache who go on to develop a serious adverse event, such as a dissection, have underlying pathology that is subsequently aggravated by treatment. These patients present with a clinical condition that appears musculoskeletal-related, but is a different pathology. The majority of the existing literature focuses on spontaneous dissection, of which physical treatments represent a small proportion. The framework attempts to summarise these risks and provide balance against known benefits.

Risk

The rate of vertebral artery (VA) dissections in the general population is estimated at 0.75–2.9 per 100,000 people.[5,7,9,33,35,51,68] Internal carotid artery (ICA) dissections occur more frequently than VA dissections in a general population.[14,15] In contrast, the vast majority of serious adverse events associated with physical treatments involve the vertebral artery rather than the ICA.

The best data available regarding prevalence of VA dissections associated with physical treatments suggest the rate is approximately 0.4:100,000 to 5:100,000 patients (converted for comparison from Nielsen et al[40]). The relative risk of stroke following physical treatment varies between 0.14 and 6.66. These broad estimates suggest both a reduced or much greater risk of stroke, which indicates a fundamental problem with definitions and identification of cases, and bias in the design of studies that have examined this issue. **TABLE 9** shows known risk of management options for those with headache and/or neck pain. This table presents meaningfully comparable adverse events for the outcomes of quality of life, morbidity and mortality, and uses the baseline prevalence of these events to calculate absolute risk given the intervention. Due to the very low

444 baseline prevalence of vascular pathologies of the neck, the absolute risk of physical treatments is
445 much less than that of comparable therapies (e.g. pharmacotherapy).
446
447 While those exposed to physical treatments have a potentially increased risk, physical treatment
448 in those presenting with neck pain and headache does not increase the risk compared to a visit to
449 the general practitioner. The underlying hypothesis is that patients present with an existing or
450 impending vascular pathology, which is subsequently aggravated by treatment.[9] This might
451 suggest that physical intervention, as part of treatment, does not result in vascular pathology in
452 those who are otherwise 'healthy'. Additionally, biomechanical studies in healthy individuals
453 suggest that physical treatment itself – especially if undertaken in a combination of mid-range
454 positions of the neck, cannot generate sufficient vessel stress or haemodynamic changes to
455 singularly explain the onset of a dissection event.[59]
456
457 There are fewer data examining non-dissecting events following physical treatments, primarily due
458 to a lack of proper reporting. Although this is likely to be higher than dissection events (because
459 non-dissection pathology are generally more prevalent), it is likely that the overall absolute risk is
460 extremely low.[60]
461
462 **Benefit of physical interventions**
463
464 The benefits of mobilisation and manipulation are supported by high-quality systematic reviews
465 and meta-analyses (summarised below). Mobilisation, manipulation and exercise interventions are
466 also included in the most recent Clinical Practice Guidelines linked to the International
467 Classification of Functioning, Disability and Health.[6] The known effectiveness of interventions for
468 neck pain and associated disorders (headache, radiculopathy) are presented below.

Mobilisation and manipulation

Mobilisation and manipulation for neck pain[21] has moderate to large clinically beneficial effects compared to inactive or active interventions for pain and functional outcomes. These benefits were independent of follow-up (short-, intermediate- or long-term) and duration of the neck pain (acute, sub-acute, or chronic). For tension-type headache, there are more favourable outcomes from mobilisation and manipulation.[36] However, data were clinically heterogeneous, and the methodological quality varied greatly across the trials, precluding strong recommendations. Nevertheless, this conclusion is supported by the updated Bone and Joint Decade Task Force on neck pain and associated disorders.[69] Cervical manipulation had an immediate effect with moderate to large effects on cervical radiculopathy compared to no treatment, placebo, or traction interventions.[71]

Adding exercise to mobilisation and manipulation

There is moderate to strong quality evidence suggesting various forms of mobilisation and/or manipulation in combination with exercise results in better outcomes (i.e. pain relief, improvement in physical functioning, greater patient satisfaction and quality-of-life) than exercise alone for people with sub-acute and chronic non-specific neck pain.[24] Approximately half the included trials demonstrated moderate to large clinically beneficial effects when mobilisation and/or manipulation was added to the treatment at short- and medium-term follow-up. These findings were, however, not supported by another review[18] reporting moderate quality evidence that the addition of mobilisation and/or manipulation to exercise therapy did not provide additional benefit for pain, disability, or quality-of-life in adults with low-grade neck pain. The evidence is, therefore, conflicting.

In summary, the risks of serious adverse events following mobilisation and manipulation are very small and related to some known risk factors. As such, risk can be somewhat mitigated via a thorough history taking and physical examination. No specific data exist for risk following exercise. The benefits of mobilisation, manipulation and exercise are largely positive, with many interventions resulting in moderate to large effects sizes for meaningful outcomes, with some moderate quality evidence suggesting effects are long-term. **FIGURE 6** summarises risk versus benefit.

Person-centred decision-making

From an individual level, based on the background literature, which highlights various risk factors for specific pathologies in specific people, the epidemiological data must be contextualised to the specific patient encounter, as illustrated by the cases. This is also the case for decision-making regarding choice of intervention and its predicted benefit. Accurate data to inform precise level of risk at an individual level are lacking, so it is not possible to develop valid clinical prediction rules for risk nor benefit. An absolute risk judgement cannot be made by the clinician. The clinician must accept that the clinical decision is made in the absence of certainty and a decision based on a *balance of probabilities* is the aim of analysis. When in doubt about intervention, the clinician should consider not intervening, and assess the chance of natural recovery of pain and function (assuming a musculoskeletal dysfunction). **FIGURE 7** summarises the decision-making process. It is the responsibility of the clinician to make the best decision regarding intervention in these situations using their clinical reasoning skills.[25,29,31]

Cases D and E illustrate key issues associated with decision-making for intervention.

Case D

Synopsis:

History of headaches indicates focussed questioning that fails to support vascular hypothesis. Further findings are consistent with musculoskeletal disorder.

Patient History:

A 45-year-old male is referred with a 6-month history of gradual onset unilateral neck pain, and more recently, headaches. The pain is manageable and not worsening, but the patient is worried that the pain has not resolved. Focussed questioning for vascular pathology and dysfunction does not indicate a vascular hypothesis: no trauma, no history of migraine, no significant cardio-vascular factors. The nature of the pain is consistent with typical musculoskeletal dysfunction, and there are no signs and symptoms associated with vascular pathology or dysfunction.

Physical Examination:

There is no indication from the history that any part of the physical examination should be focussed on testing for vascular pathology or dysfunction. There is sufficient information to proceed with a conventional musculoskeletal examination.

Clinical Reasoning:

Neck pain and headache, not worsening and no symptoms of vascular pathology or dysfunction. A reasonable hypothesis is a musculoskeletal disorder affecting the cervical and cranial regions.

Support for vascular hypothesis: LOW

Action:

Begin a trial of therapy for neck pain / headache with no avoidance of cranio-cervical movements

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Case E

Synopsis:

Patient history and physical examination findings support a vascular hypothesis but an alternative, more likely explanation for the presenting complaint is also supported. There are insufficient data to support medical referral. Safety netting is indicated.

Patient History:

A 72-year-old female is referred with episodic neck pain and headache. She has responded very well to manual therapy in the past. This episode is described as very severe and very irritable, like previous episodes. She has a cardio-vascular history of hypertension, high cholesterol levels, and two previous strokes (last one was 3 years ago).

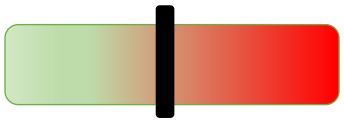
Physical Examination:

On examination, the patient's resting blood pressure is high: 165 systolic / 96 diastolic, but normal for her. All cranial testing is negative, and there are no abnormal findings on palpation and ascultation of the carotid arteries. She had a movement restriction typical of cervical musculoskeletal dysfunction.

Clinical Reasoning:

Although there are several cardio-vascular risk factors, the episodic neck pain is not unusual for this patient, and although severe, it is not worsening or changing. It is prudent of the therapist to consider further questioning, and a vascular hypothesis is warranted in the physical examination, focused on establishing what is normal for the patient. On the balance of probabilities, the patient is presenting with musculoskeletal dysfunction, but she does have risk factors for a further vasculogenic episode (stroke).

Support for vascular hypothesis: MODERATE



Action:

Safety netting is required. It is important that the patient knows that she must act immediately if new signs and symptoms present. The clinical evidence suggests the presenting pain is more likely to be musculoskeletal. This is supported by the known low prevalence of vascular pathology and dysfunction. Therapeutic advice and interventions can be trialled during safety netting, but these interventions must avoid known vasculo-provocative positions (end of range rotation and extension). A shared decision-making conversation should be developed which includes full and explicit informed consent, expressing all known risk and benefits of management options.

Shared decision-making is an effective means of reaching agreement on the best strategy for treatment. The SHARE framework provides a step-by-step guideline to having these conversations. Like any new skill, if a clinician is not currently using this it is recommended to practice this format with a colleague prior to implementing it. Using the SHARE framework, **TABLE 10** details a possible SHARE conversation relating to cases D and E:

https://www.ahrq.gov/professionals/shareddecisionmaking/tools/tool-1/share-tool1.pdf

EVALUATING AN INTERVENTION

Clinical reasoning should enable effective, efficient and safe management of the cervical spine. Using the principles described in the IFOMPT cervical framework to aid patient centred clinical reasoning through intervention, evaluation and progression is important.

Case F illustrates key issues associated with evaluation of intervention.

Case F

Synopsis:

Young patient with a history of migraine and recent trauma presents with "unusual" headache. Onset of vascular signs and symptoms during care should alert the therapist to test a vascular hypothesis in line with best practice guidance and refer appropriately.

Patient History:

A 33-year-old male presents with right-sided sub-occipital neck pain/headache. Worse in the mornings and aggravated by left rotation of neck. Symptoms began 2 weeks ago (he recalls

'cricking' his neck in a football tackle) – they are gradually worsening. No previous similar episode of this type of pain, although some lower neck pains several years ago. Good health; history of migraine. The patient had manual therapy 5 days ago (soft tissue massage to his bilateral neck and shoulder; dry needling / acupuncture to his right trapezius; mobilisation of the upper cervical spine (C0-C2)). Immediate increased pain in left cervical spine and episode of feeling very unsteady/dizziness. The therapist attempted to continue with soft-tissue massage when the dizziness settled, but the patient then became unwell and vomited.

Physical examination:

Mild restrictions of cervical movement. The previous therapist had performed functional positional testing when patient reported changing 'red flag' symptoms, which was negative. No other neurological or vascular examination was performed.

Clinical reasoning:

Worsening neck pain with neuro-vascular symptoms following therapy. History of trauma and migraine, and 'unusual' neck pain. The progressive onset of signs and symptoms indicate vascular pathology and should trigger an urgent change in management. It is not possible to understand whether or not the early presentation was a masquerading vascular pathology, but therapists should be alert to changes of signs and symptoms following interventions and over time.

Support for vascular hypothesis: HIGH

Action:

When the patient became unwell, an emergency medical referral (ambulance) should have been made.

CONCLUSION

The IFOMPT cervical framework provides a starting point to guide clinical reasoning when clinicians are assessing and managing patients who are presenting with potential vascular pathologies. **FIGURE 8** summarises the framework. While evaluation of the measurement properties of a starting point framework is challenging, a recent study identified support for the framework's inter examiner reliability.[13] The IFOMPT framework is important for all clinicians.[26] It identifies priorities for future research including diagnostic utility of history and physical data clusters of information to prioritise.

Study details

Author contributions

All authors provided substantial intellectual content contributions to the conception and development of the framework document during early draft and revision stages. All authors provided final approval of the manuscript to be published and have agreed to be accountable for all aspects of the work to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Data sharing

No data are available. Feedback on iterative drafts of the framework were provided confidentially from IFOMPT Member Organisations.

Patient and public involvement

Patients/athletes/public partners were not involved in this consensus process.

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Infographics by:

902 **TABLE 1, Range of vascular pathologies of the neck**
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Structure/site	Pathology	Symptoms/Presentation
Carotid artery	Atherosclerosis Stenotic Thrombotic Aneurysmal	Carotidynia, neck pain, facial pain, headache, cranial nerve dysfunction, Horner's Syndrome, transient ischaemic attack (TIA), stroke
Carotid artery	Hypoplasia	Commonly silent, rare cerebral ischaemia
Carotid artery	Dissection	Neck pain, facial pain, headache, TIA, cranial nerve palsies, Horner's syndrome
Vertebral artery	Atherosclerosis	Neck pain, occipital headache, possible transient ischaemic attack (TIA), stroke
Vertebral artery	Hypoplasia	Commonly silent, rare cerebral ischaemia
Vertebral artery	Dissection	Neck pain, occipital headache, TIA, cranial nerve palsy
Temporal/ Vertebral/ Occipital/Carotid arteries	Giant cell arteritis	Temporal pain (headache), scalp tenderness, jaw and tongue claudication, visual symptoms (diplopia or vision loss – may be permanent)
Cerebral vessels	Reversible cerebral vasoconstriction syndrome (RCVS)	Severe 'thunderclap' headaches
Subarachnoid	Haemorrhage	Sudden severe headache, stiff neck, visual disturbance, photophobia, slurred speech, sickness, unilateral weakness,
Jugular vein	Thrombosis	Neck pain, headaches, fever, swelling around neck/angle of jaw
Any other cervico-cranial vessel	Vascular anomaly or malformation	Possible headache/neck pain i.e. un-ruptured carotid aneurysm (inclusive of anomaly arising from vascular vessel interface e.g. vessel entrapment)

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907 **TABLE 2, Risk factors for dissection vascular events**
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Risk Factor - in order of most-to-least common	Dissection event (%)
Recent trauma	40 - 64
Vascular anomaly	39
Current or past smoker	30
Migraine	23
High total cholesterol	23
Recent infection	22
Hypertension	19
Oral contraception	11
Family history of stroke	9

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TABLE 3, Risk factors for non-dissection vascular events

Risk factor - in order of most-to-least common	Non-dissection event (%)
Current or past smoker	65 - 74
Hypertension	53 - 74
High total cholesterol	53
Migraine	19
Vascular anomaly	16
Family history of stroke	14
Oral contraception	9
Recent infection	9
Recent trauma (mild-moderate, which may include recent OMT)	7

TABLE 4, Reported clinical features for dissection events

Clinical features - in order of most-to-least common	Dissection vascular event %
Headache	81
Neck pain	57 - 80
Visual disturbance	34
Paraesthesia (Upper Limb)	34
Dizziness	32
Paraesthesia (face)	30
Paraesthesia (Lower Limb)	19

TABLE 5, Reported clinical features for non-dissection events

Clinical features - in order of most-to-least common	Non-dissection vascular event %
Headache	51
Paraesthesia (Upper Limb)	47
Paraesthesia (Lower Limb)	33
Visual disturbance	28
Paraesthesia (face)	19
Neck pain	14
Dizziness	7

TABLE 6, Clinical features of VBA dissection

Clinical features - in order of most-to-least common	VBA Dissection %
Unsteadiness/ataxia	67
Dysphasia/dysarthria/aphasia	44
Weakness (Lower Limb)	41
Weakness (Upper Limb)	33
Dysphagia	26
Nausea/vomiting	26
Facial palsy	22
Dizziness / disequilibrium	20
Ptosis	19
Loss of consciousness	15
Confusion	7
Drowsiness	4

TABLE 7, Clinical features of ICA Dissection

Clinical features - in order of most-to-least common	ICA Dissection %
Ptosis	60 - 80
Weakness (Upper Limb)	65
Facial palsy	60
Weakness (Lower Limb)	50
Dysphasia/dysarthria/aphasia	45
Unsteadiness/ataxia	40
Nausea/vomiting	30
Drowsiness	20
Loss of consciousness	20
Confusion	15
Dysphagia	0.5

TABLE 8, Clinical features of non-dissection event (VBA or ICA)

Clinical features - in order of most-to-least common	Non-dissection vascular event %
Weakness (Upper Limb)	74
Dysphasia/dysarthria/aphasia	70
Weakness (Lower Limb)	60
Ptosis	5 - 50
Facial palsy	47
Unsteadiness/ataxia	35
Confusion	14
Nausea/vomiting	14
Dysphagia	5
Loss of consciousness	5
Drowsiness	2

TABLE 9, Comparative risks of commonly used therapeutic interventions for head and neck pain

Intervention	Adverse Event	Baseline prevalence (events occurring without any intervention) per 100,000[a]	Absolute Risk (absolute percentage increase if intervention is given)
NSAIDS (non-specific)	Myocardial infarct[4] Gastrointestinal bleed[38]	2,400 87	5.95% - 6.6% 0.46%
NSAIDS (Cox-2)	Myocardial infarct[4] Gastrointestinal bleed[38]	2,400 87	6.19% - 8.67% 0.34%
Aspirin	Bleed[b]	87	0.21% - 0.35%
Paracetamol[50,70]	Cardiovascular events[c] Gastrointestinal bleed[d] Renal	2,400 (e.g. of MI) 87 1,350	5.26% - 6.43% 0.18% - 0.27% 3.24% - 4.30%
Cervical OMT[e]	Stroke (VBA)	0.79	0.005%

[a]: based on UK government data;
[b]:intra- and extracranial, and gastrointestinal;
[c] Including MI; cerebrovascular accidents and hypertension;
[d] Specifically reductions in estimated glomerular filtration rate, increases in serum creatinine concentration and the need for renal replacement therapy;
[e] using a 'worse-case' scenario of lowest baseline (0.79/100,000) and highest OMT-prevalence (5/100,000).

1022 **TABLE 10, The SHARE Conversation**
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STEP	Clinician
1 **S**eek your patient's participation	CASE D- The good news despite suffering from this for the last 6 months is that your nerves, muscles, and arteries are healthy, and you should respond very well to therapy. CASE E- I know you have responded very well to manual therapy in the past. However, your overall health status of your cardiovascular system puts you at higher risk for experiencing safety incidents with this type of therapy.
2 **H**elp your patient explore & compare treatment options	CASE D- There are several treatments that have been shown to rapidly improve your discomfort. Today I would recommend we begin with some manual therapy and exercise. Before I begin you should know there is some risk involved when treating neck pain with movement therapies. These include minor worsening of symptoms and in extremely rare instances a vascular pathology such as a stroke. However, these risks are extremely low, and when compared to many pharmaceuticals or invasive procedures to your neck, manual therapy and exercise are much safer. The good news is these types of problems get better quickly with the plan we have outlined. CASE E- Given your overall health status you are a greater risk of a stroke, and this risk could be increased with manual therapy to your neck. The good news is that on balance, these risks are extremely low and when compared to many pharmaceuticals or invasive procedures to your neck, they are likely much safer.
3 **A**ssess your patient's values & preferences	CASE D- Do you have any questions or concerns before we get started? CASE E- Do you have any questions or concerns before we begin our treatment today?
4 **R**each a decision with your patient	CASE D- It appears that we both feel this approach would be of benefit so let's begin. CASE E- Given that you have responded to this in the past and you want to try this therapy again we can proceed.
5 **E**valuate your patient's decision	CASE D- Throughout your care we will be continuously seeing how you respond and adjust our therapies based on this. CASE E- It is important that we monitor your cardiovascular system and your overall response to therapy on an ongoing basis. If you have any new or unusual symptoms or • Numbness or weakness of face, arm, or leg, especially on only one side of the body • Confusion or trouble speaking or understanding • Trouble seeing in one or both eyes • Trouble walking, dizziness, or loss of balance or coordination

	• Severe headache with no known cause you need seek immediate medical attention. Also, I want you to monitor your blood pressure daily.

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FIGURE 1: Shared decision-making infographic

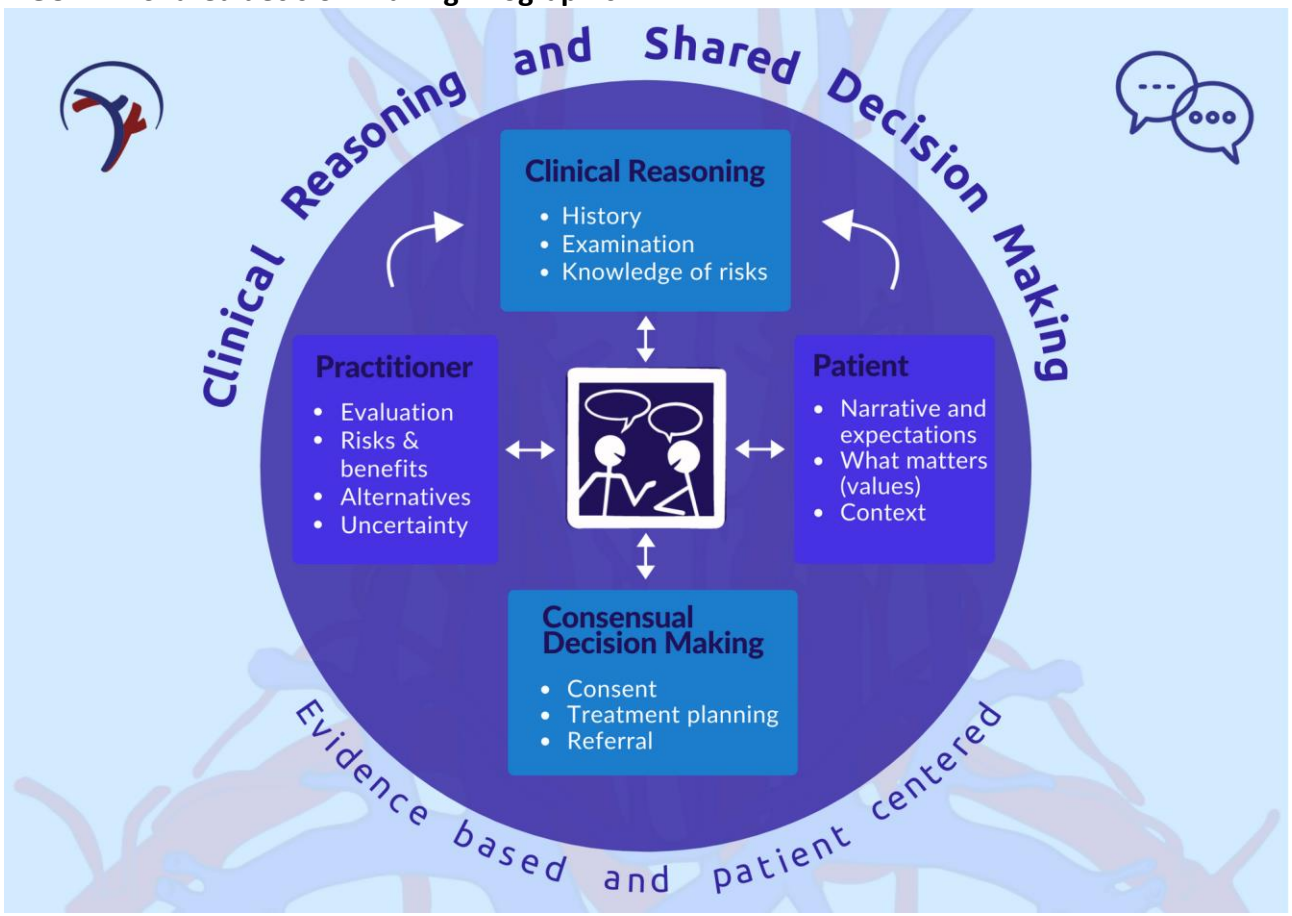


FIGURE 2: Purpose of the framework infographic

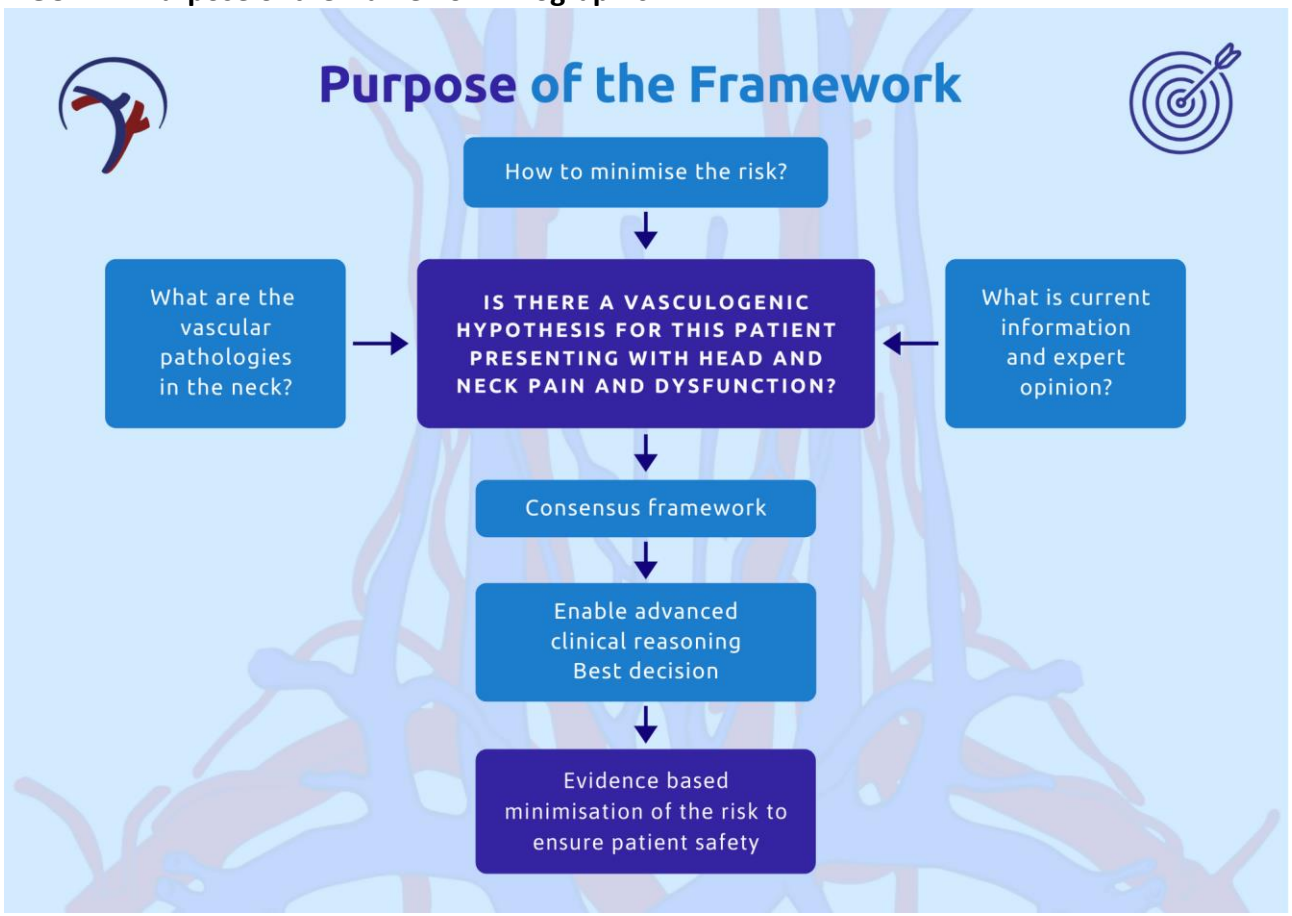
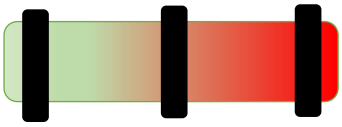


FIGURE 3. Clinical reasoning tool to illustrate level of support for a vasculogenic hypothesis



LOW	**MODERATE**	**HIGH**
None or minimal data supporting vasculogenic hypothesis	Mixed data supporting and refuting vasculogenic hypothesis	Data supporting vasculogenic hypothesis

FIGURE 4: Patient history infographic

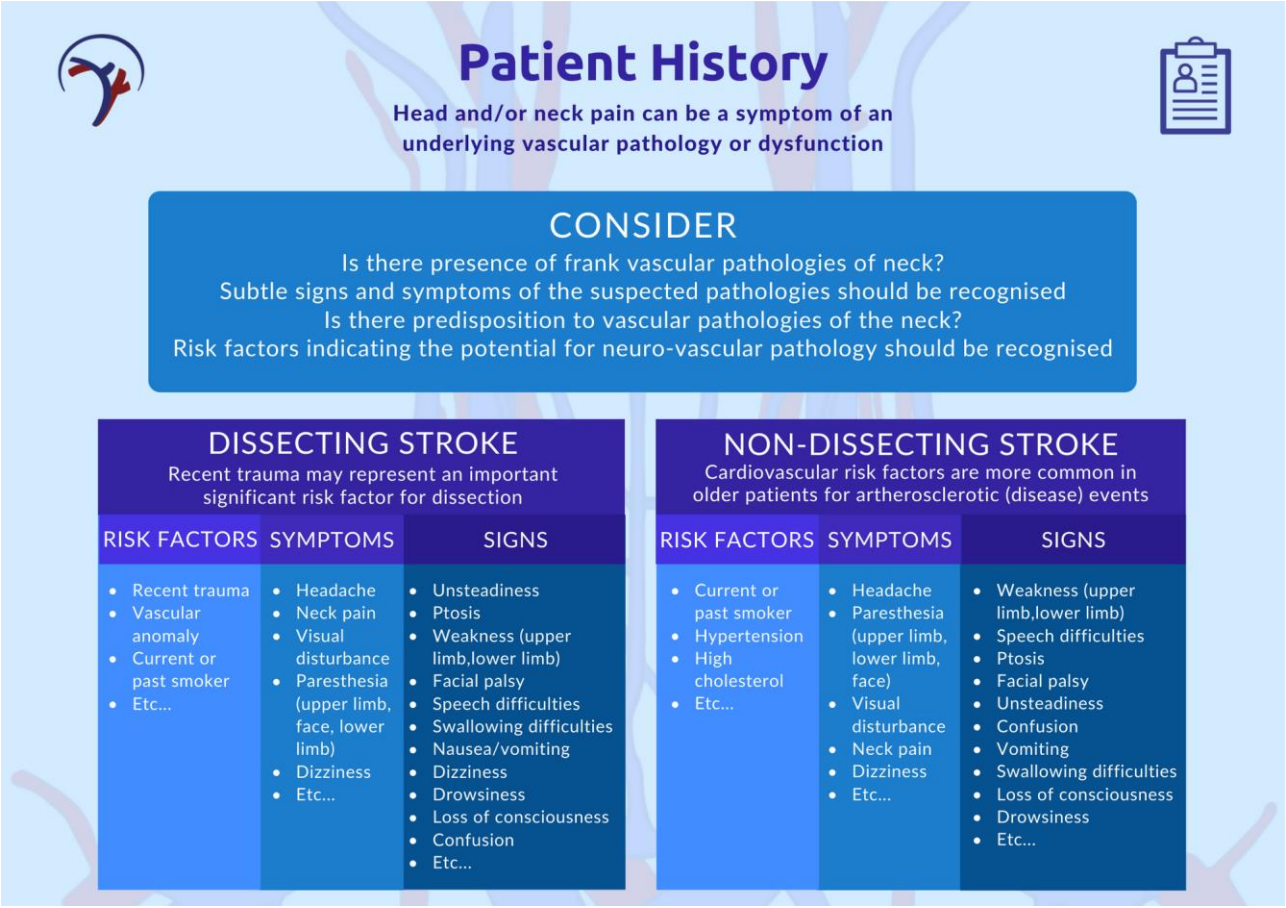


FIGURE 5: Physical examination infographic

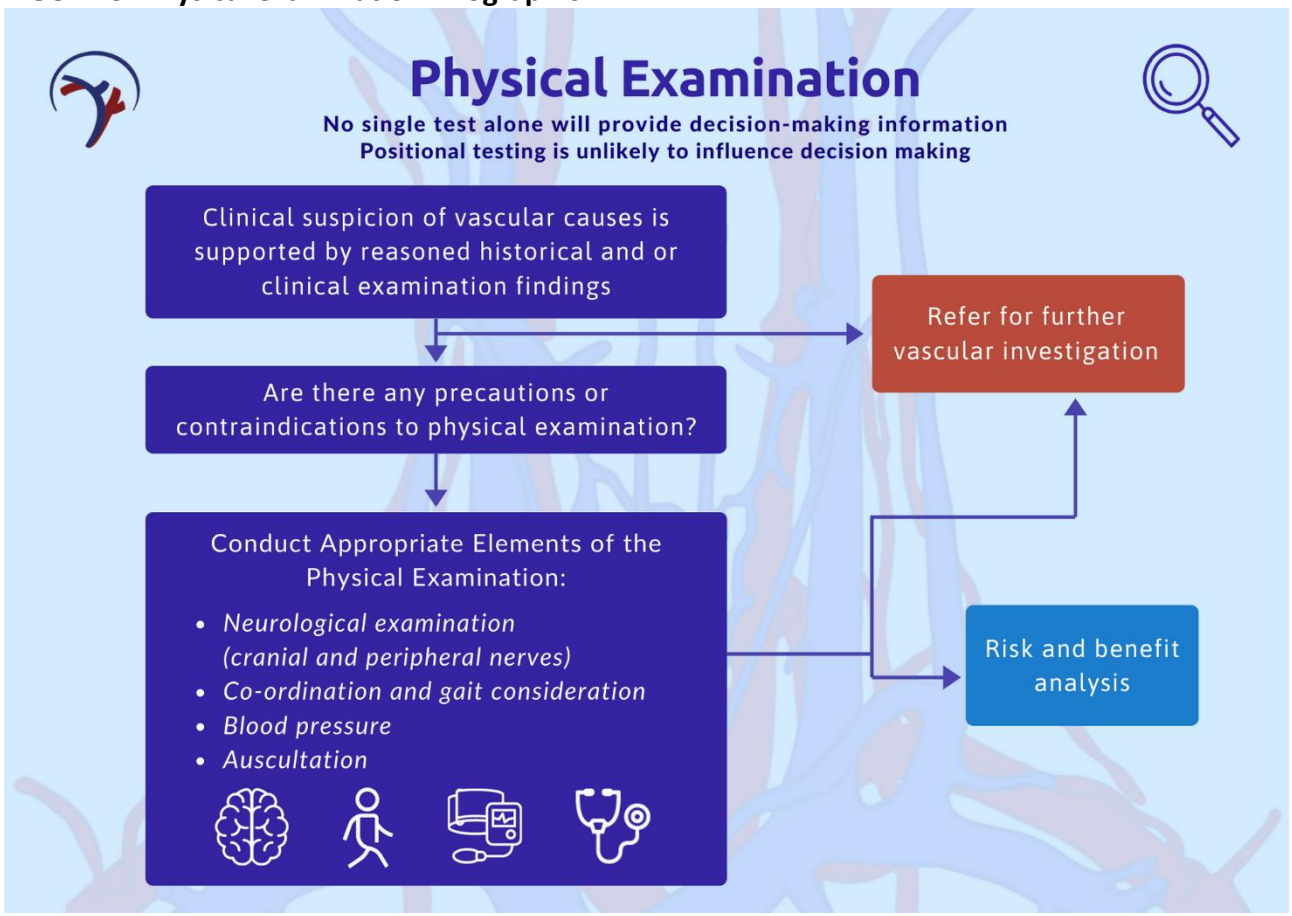


FIGURE 6: Risk versus benefit infographic

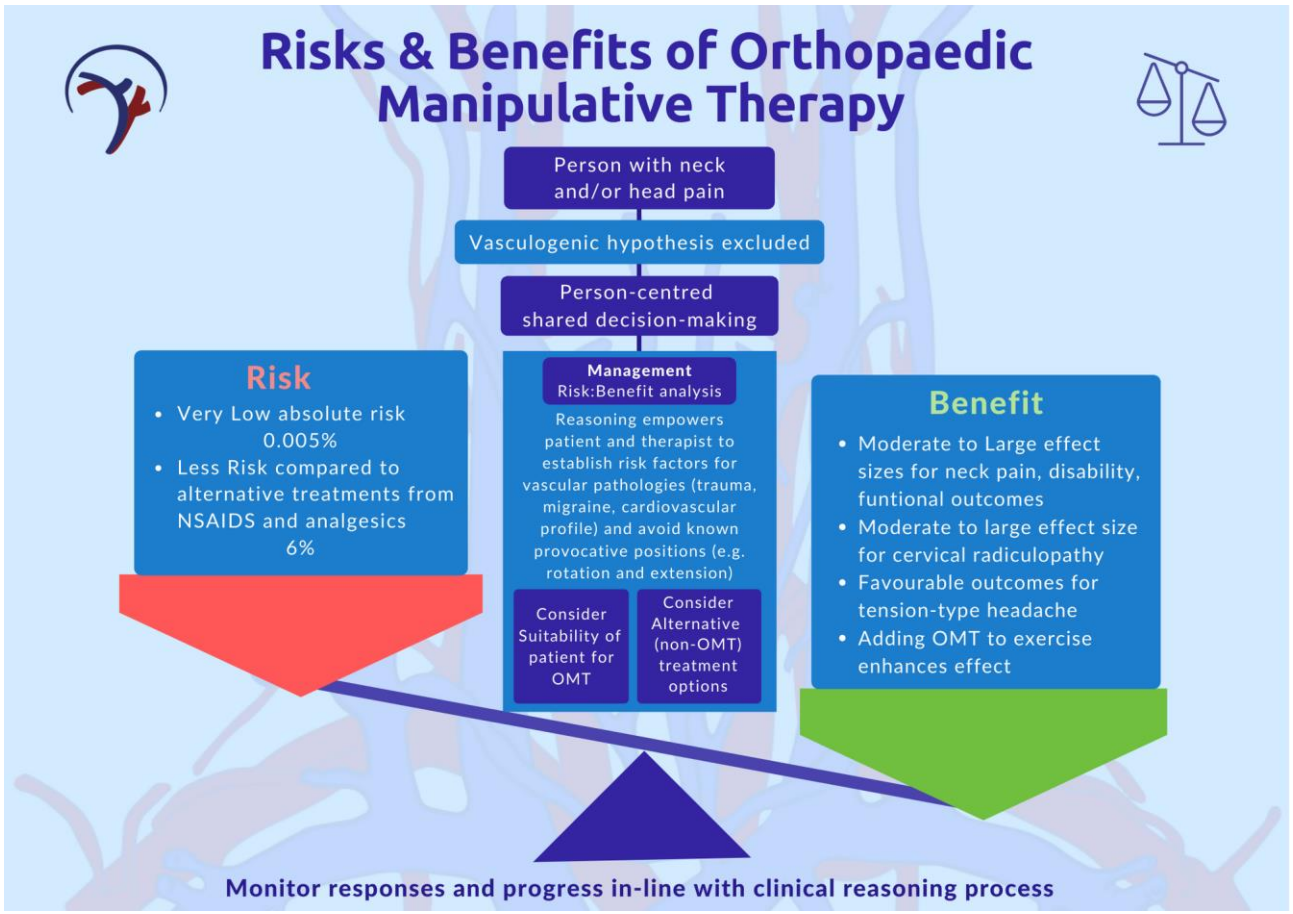


FIGURE 7. Clinical reasoning flowchart for risk assessment prior to musculoskeletal intervention (adapted from Hutting et al, 2018[25])

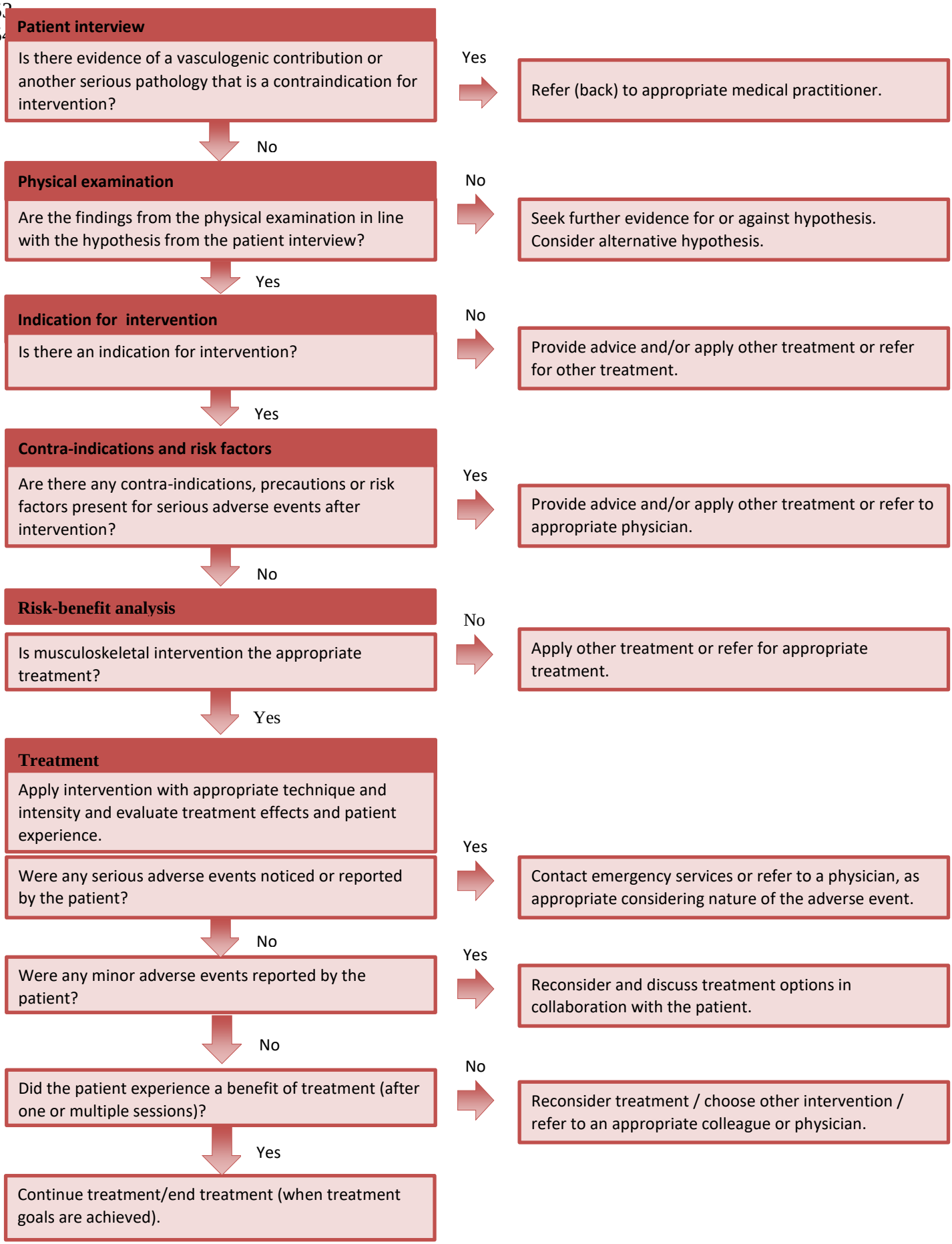


FIGURE 8: Summary poster of the framework infographic