Physiotherapy for neck pain in the horse

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Abstract

The aim of this review is to present the physiotherapy approach to assessment and treatment of neck pain in horses, supporting veterinary care as part of a multi-disciplinary team. Horses with neck pain form a high percentage of veterinary physiotherapists' caseload and physiotherapists are trained in specific assessment strategies to identify functional limitations in this region. After investigation and veterinary intervention, physiotherapy care can address factors such as pain, reduced range of motion and muscle weakness. Through the selection of appropriate manual therapy techniques and prescription of therapeutic exercises, a physiotherapist can assist restoring function and performance in the cervical region. Physiotherapy treatment of the neck should occur, along with consideration of the whole horse's musculoskeletal function, to support the veterinary medical or surgical intervention.

Introduction

The head and neck of the horse have a highly specialised structure to allow for the function of the region (Zsoldos and Licka 2015). Evolved to avoid predation, a horse in the grassland plains needed a long neck to reach the ground, due to lengthened limbs aiding fast movement. The recognition of a potential threat needed the horse to be able to switch from grazing to surveying the horizon and then high-speed locomotion almost in an instant. There is considerable variation in cervical anatomy between the cranial, mid and caudal regions which enables the range of movement but maintains stability and the neuromuscular control of this motion. It is not a surprise that the management of horses with head and neck pain and dysfunction was listed as the most common area for physiotherapy care, following back and pelvis region issues in a recent survey of veterinary physiotherapists (Tabor, 2020a). The aim of this review is to present the physiotherapy approach to assessment and treatment of neck pain in horses, supporting veterinary care as part of a multi-disciplinary team.

The anatomy of the equine cervical spine has been described with the structure of the vertebrae detailed, however knowledge of the anatomy of the head and neck region has expanded in the last decade with both necropsy, radiography, magnetic resonance and computed tomographical studies (Sleutjens et al 2014; Haussler et al 2019; Lindgren et al 2020). These imaging techniques have allowed visualisation of anatomic variation in horses with pathology and those considered to have normal anatomy. The absence of unilateral or bilateral absence of the C6 caudal ventral tubercle was discovered in 19 of 50 thoroughbred horses examined at post-mortem (May-Davis 2014) and in 79 of 81 modern horses the nuchal ligament lamellae did not attached onto C6 or C7 (May-Davis et al 2018). May-Davis and colleagues consider that these findings may be considered a contributing factor in caudal cervical osteoarthritis (OA) however no longitudinal studies of the relationship between nuchal ligament anatomy and pathology have been conducted and interestingly Veraa et al (2019) did not find a positive relationship between morphologic variations and clinical signs. Rombach et al (2013) and Haussler et al (2019) have shown that OA is symmetrically present with higher severity in the mid to caudal cervical regions and with higher prevalence in older and larger horses which would have relevance to sport horse populations. The presence of cervical facet OA should be considered in horses with neck pain, especially warmbloods training in dressage who present with neck muscle atrophy, neck stiffness, forelimb or hindlimb lameness, stumbling, neck and/or back pain as well as a reluctance to work (Koenig et al. 2020). These clinical signs could be a reason for referral to a physiotherapist. In contrast horses with neurological signs such as spinal ataxia and upper motor neuron paresis, will have compression of the spinal cord of the cervical spine and are unlikely to be an appropriate candidate for physiotherapy, which may indeed be contraindicated. This compression may be caused by conditions such as cervical vertebral stenotic myelopathy (Nout and Reed 2003). Horses seen to have episodes where they are unable to raise the head from an abnormally low position, fixed below the level of the carpus, as described by Down and Henson (2009), require veterinary investigation prior to consideration for referral for physiotherapy. Additionally, the presence of bony injury such a cervical fracture must also be excluded before physiotherapy (Rossignol et al 2016). Horses with wing of atlas fracture, one from a fall whilst point to point racing and one tripping whilst being lunged with a rope training aid on, have formed part of the author's caseload in the last twelve months. Reports of avulsion fracture of the nuchal crest with nuchal ligament desmitis have highlighted that the cause of head-shaking and neck pain should be fully investigated (Voigt et al. 2009). If there is a history of an incident such as a fall, collision or blunt trauma, which could be the result of the horse elevating the head suddenly and making contact with the top of the stable door frame, bone injury should be considered and excluded prior to physiotherapy.

Primary muscle injuries within the neck region are a likely of cause of pain however consideration of these seem to be underrepresented in the current literature. Whilst traumatic muscle lesions, due to strain and subsequent muscle fibre tearing and inflammation, can occur in any region of the body, observation of the kinematics of horse falls, especially at speed, reveals that the muscles are taken beyond their normal physiological range, exposing them to risk of muscle tears (figure 1). In addition to acute overload, chronic overload created due to overuse as a result of poor muscle strength, recurrent abnormal movement patterns or poor training and recovery planning, could also cause muscle pain in the epaxial and/or hypaxial cervical muscles.

Figure 1: Horse falls can result in bone and soft tissue injury. Even without bone injury, neck pain can be caused from the extreme positions that creates a movement force, beyond the normal physiological range, that overloads the soft tissues (Muscles, ligaments, neural and fascial).

Physiotherapy

Physiotherapy helps restore movement and function when an individual is affected by injury, illness or disability (Chartered Society of Physiotherapy [CSP], 2020) with treatments structured around the goal of restoration of painless optimal function as well as prevention of loss of function (McGowan et al, 2007). Physiotherapy includes treatments such as manual therapy, use of electrophysical modalities and exercise prescription, as well as encompassing on-going rehabilitation. In the context of musculoskeletal conditions, rehabilitation focusses on building capacity in tissues, using gradual overload, progressing intensity and complexity of movement or physical activity (Cook and Docking 2015).

Training to become a Chartered Physiotherapist requires a three-year undergraduate degree and to become a veterinary physiotherapist and category A member of the Association of Chartered Physiotherapists in Animal Therapy (ACPAT), a minimum of two years post graduate training at UK Higher Education level 7 (Masters degree) is required. It should be noted that in the UK in relation to treating animals the term physiotherapist is not a protected title, therefore currently 'physiotherapy' for horses can be provided by any member of the public regardless of their level of training. To ascertain the standard of training of an individual it is recommended to refer to an independent voluntary register such as the Register of Animal Musculoskeletal Practitioners (RAMP).

Physiotherapy is listed as a treatment in the Veterinary Surgeons Act (Exemptions) Order 2015 (UK Government, 2020) and within the Code of Professional Conduct of Veterinary Surgeons (Royal College of Veterinary Surgeons, 2019). It is therefore imperative that physiotherapists follow the law, working under the direction of veterinary surgeons, who must ensure the health and welfare of animals committed to their care and to fulfil their professional responsibilities

<u>Physiotherapy assessment</u>

Physiotherapy assessment of the neck region should take the subjective information gained from the owner and/or rider, forward to observation of static posture and active movement during a gait assessment. Head and neck posture in both both standing and dynamic conditions, in hand, on straight lines and the lunge, as well as ridden if appropriate, should be assessed. This will give an indication of longer term movement patterns and posture, acutely abnormal posture and neck position as well as the function of the neck during the movements witnessed. At this time both facial expressions (Gleerup et al. 2015) and whole horse behaviours should be noted to assess for signs of pain (Dyson et al. 2018). Further assessment should evaluate muscle development, the response to soft tissue palpation and cervical vertebral range of motion from the atlanto-occipital joint to the cervicothoracic junction. Baited stretches can be used to induce joint motion and can highlight pain and stiffness which can be a clinical sign of osteoarthritis of the cervical spine (Koenig et al 2020). On palpation pain may be displayed via behaviour signs such as aversive behaviours of the head and neck, e.g. withdrawal responses (head toss, bite threat; Rombach 2013) which should be recorded using an objective method such as a palpation scoring system. There are no published validated scoring systems for the cervical region but use of categorical scoring of responses similar to that used in the thoracolumbar region (Merrifield et al. 2019; table 1) would provide a more objective record as would pressure algometry (Haussler and Erb 2006).

Score	Description
0	Soft, low tone
1	Normal
2	Increased muscle tone but not painful

3	Increased muscle tone and/or painful (slight associated spasm on palpation, no associated movement
4	Painful (associated spasm on palpation with associated local movement, i.e. pelvic tilt, extension response),
5	Very painful (spasm plus behavioural response to palpation, i.e. ears flat back, kicking).

Table 1: Categorical scoring system used to document response to palpation. It is important to note the name and location within the specific muscle or region being palpated with the score.

In addition to pain, cervical arthropathies can cause altered muscle size, including atrophy and asymmetry (Koenig et al 2020; Dyson 2011). Clinical signs arising from the neck region should be considered along with the whole-body assessment. Neck pain may be because of gait changes due to a primary limb lameness where asymmetric head and neck motion is a compensatory strategy to reduced vertical force through a limb (Zsoldos and Licka 2015). Riders' anecdotally describe ridden horses 'reefing' at the reins, described as pulling the reins out of the rider's hands by taking the head forwards and out, combined with either elevation of lowering the head, which can be associated with the presence of back pain. During observation of training practices in the ridden horse, postures such as the use of a hyperflexed neck or high neck position might result in altered motion of the whole spine thus it is critical to assess the whole horse (Rhodin et al 2009).

If there are unexpected or worsening signs of neurological deficit, demonstrated by a reduction in limb proprioception, forelimb lameness or subtle hindlimb gait abnormalities, all of which are listed as potentially resulting from a compressive lesion of the spinal cord by Dyson (2011), the horse should be referred back to the veterinary surgeon. Neck dysfunction may be found during a routine physiotherapy assessment of the whole horse (Tabor 2020b). However, following diagnosis and veterinary intervention physiotherapy can be clinically reasoned to be appropriate to restore function and rehabilitate the horse back to optimal performance.

<u>Physiotherapy treatment</u>

Physiotherapy treatment may commence immediately following initial assessment, or at a later date, following veterinary intervention. For example, cervical facte OA might be treated by intra-articular injections of corticosteroids (Koenig et al. 2020) and after a short period of rest, physiotherapy would be indicated to assist return to function.

Manual therapy for neck pain is an option for pain relief and restoration of function. Bishop et al. (2015) define this as passive, skilled movement applied by clinicians that directly or indirectly targets a variety of anatomical structures or systems, used to create beneficial changes. These authors discuss that although historically joint mobilisations and manipulations as a form of manual therapy, were previously considered to alter position of articular structures, modern understanding to support the mechanism of effect is that the action of the mobilisation or manipulation modulates pain via neurophysiological factors. Manual therapy techniques that are directed at muscles and connective tissue, with massage and myofascial release being commonly reported in the lay media, would likely have a similar mode of action. Evidence for structural changes in tissues as a result of soft tissue therapy is lacking but certainly effects on hormonal levels, para-sympathetic activity system and blood flow have been reported (Weerapong et al. 2005). The resultant modulation of pain may allow for a change in muscle and joint function. If there is muscle spasm limiting movement or arthrogenic inhibition that is reducing muscle activity and power, the applied joint mobilisations and soft tissue treatments are aimed at returning to a more normal motor pattern. Change in the overlying muscle function plus reduction in joint pain would reduce the stiffness of the region and aid restoration of range of motion.

Joint mobilisations can be performed within the physiological range of motion or within the accessory range. Physiological range refers to joint motion that can be accessed actively by the patients own muscular activity within normal anatomic limits and therefore is flexion, extension, lateral flexion and rotation (Haussler, 2009). Accessory ranges are the gliding and rolling motions that occur during joint motion and during mobilisations pressure, via manual force, is used to induce these movements passively.

A technique that the author applies in the cervical region is to use a passively applied force to the joint whilst an active physiological movement occurs, termed a mobilisation with movement. An example to increase lateral flexion would be to apply a manual force to the left mid portion of the neck over the transverse process of C3 and use bait to induce active left side flexion. The hand on the neck provides a lateral accessory glide, and a fulcrum for the region cranial to the hand to move around. The hand can then be sequentially moved caudally as more lateral flexion is asked for with the bait. The resultant effect is a larger and improved quality (less stiff) range of lateral flexion when baited movements are used to re-assess lateral flexion.

The inability to measure patient expectations and outcomes directly from the horse may the reason for the limited empirical and scientific research into equine manual therapy compared to human studies, however their effect on spinal mobility and limb kinematics have been used to objectively record outcomes. Spinal manipulative therapy in the thoracolumbar region did increase dorsoventral displacement compared to a control group (Haussler et al. 2010) and had short term increase in flexion-extension movements between T10 to L1 (Alvarez et al. 2010). However, there are no studies measuring kinematics following similarly applied treatments to the cervical spine. Massage of the muscles in the equine hindlimb increased the passive range of protraction (Hill and Crook 2010) and although the exact mechanisms are unclear, based on the current understanding of the effects of massage (Weerapong et al. 2005), the resultant change in range of motion is likely to be from neurological modulation of factors that may be limiting range of motion in the first place.

Behavioural response to palpation can be measured objectively via by trained assessors with a tool called a pressure algometer and the threshold before the horse demonstrated nociception, where the pressure applied is considered to be felt as painful, can be used to evaluate effects of treatment. In a study of 38 horses divided into five group of treatment or control, horses that had instrument assisted chiropractic treatment and therapeutic massage to the thoracolumbar regions did show a raised nociceptive threshold (Sullivan et al. 2008). These results further support the use of manual therapy in treatment of horses.

Whilst there is a lack of studies reporting on the outcomes of manual therapy in the equine neck extrapolating from effects in the thoracolumbar region, it can be reasoned that as manual therapy has been shown to reduce pain and improve flexibility (Haussler 2010), it should also be advocated for use in the cervical region. The effects of manual therapy have only been demonstrated in the short term, therefore interventions to ensure ongoing management and maintenance of a state of reduced pain and increased range of motion should be considered. In human treatment a multimodal approach, which includes manual therapy, exercise and education, seems to provide better outcomes than manual therapy alone (Bishop et al. 2015). Therefore, specific therapeutic exercise that target the cervical region should be included within care of horses with neck dysfunction.

In the thoracolumbar spine osseous pathology is associated with atrophy of the *m. multifidus* which has a role as a stabiliser of the vertebral segments. In human patients the cross-sectionally area of *m. multifidus* cervicis has been shown to be smaller than in non-painful controls (Fernández-de-las-Peñas *et al*. 2008) and the size of *m. longus colli* altered in patients with chronic neck pain (Javanshir *et al*., 2011). Rombach (2013) established a reliable method, using ultrasound imaging, to measure the *m. multifidus cervicis* and *m. longus colli* cross sectional area and it could be reasoned that these muscles would reduce in size in the presence of pain in horses*. M. longus colli* provides sagittal plane intersegmental vertebral column stability therefore, as a deep stabiliser muscle, is likely to be subject to the same atrophic pattern as m*. multifidus.* Therefore, restoration of strength and resultant function of these deeper muscles which have shorter, slow-oxidative fibres that are more fatigue-resistant to provide segmental stabilization between individual joints, needs to be considered. In addition, the function superficial muscles, with longer fast-glycolytic fibres create a larger range of movement over multiple intervertebral joints (Schilling 2011) which may be visually observed as atrophied, should be addressed. Exercises that recruit postural muscle fibres include the form of dynamic mobilisation exercises evaluated by Stubbs et al (2011). These are low intensity isotonic and isometric muscle contraction based range of movement exercises performed with the horse stationary. There has been no evaluation of specific exercises or neck positions during gait but in theory increasing intensity, in terms of body weight forces during movement, could promote further adaptive muscular changes.

If exercises are to be successful, neuromotor control, which refers to the quality and optimal function of the muscle and associated afferent and efferent neural connections, need to be considered. Optimal neuromotor control requires the processing of the proprioceptive input and subsequent output that effects timing of muscle recruitment and therefore relates to the ability to maintain joints in their appropriate position through their range of motion during locomotion and other perturbations (McGowan and Hyytiäinen 2017). With the neck acting as a cantilever beam at the front of the body (Gellman and Bertrum 2002), the requirement for co-ordinated movement and stability would appear critical to normal function of the region. In practice this means that the selection of therapeutic exercises should be chosen to represent functional movements and those that will target activation of the desired set of muscles. Dynamic mobilisation exercises, in the form of baited 'carrot' stretches, are often selected for this purpose (figure 2). The cervical intervertebral angles have been described by Clayton et al. (2010 and 2012) and the effect on *m. multifidus* muscle cross-sectional area, in the thoracolumbar region, by Stubbs et al. (2011) and de Oliveira et al. (2015)

Figure 2: Dynamic mobilisation exercises: A – chin to knee; B – chin between fetlocks; C – chin to girth and D – chin to stifle. The horse is motivated, by using food bait, to move through a range of motion that results in cervical and thoracolumbar flexion (Pictures A & B) and lateral flexion (Pictures C & D).

Activation of the cervical musculature with the aim of hypertrophy and increased symmetry can be achieved by baited exercises to take the spine through ranges of flexion, extension, rotation and lateral flexion. Whilst evidenced to increase size and symmetry of *m. multifidus* in the thoracolumbar region (Stubbs et al. 2011), the dynamic mobilisation exercises used encourage the horse to follow a food reward to different positions, with the effect of a significant change of position of the joints in the cervical spine. In the study by Stubbs et al. (2011) the exercises were repeated five days a week for 12 weeks and each end of range posture was held for five seconds. This requires both concentric and isometric contractions of the agonist muscles, eccentric contraction of the agonist and a likely combination with the deep stability muscles. Following the principles of training (Castejon-Riber et al. 2017), progressive loading to stimulate adaption would result in development of the cervical musculature. However, it should be remembered that if there is pain from an underlying osseous condition there may be arthrogenic inhibiton of the muscle function (Hopkins and Ingersoll 2000) which will limit the effectiveness of therapeutic exercises until the pain is addressed.

Electrotherapy

In addition to manual therapy and exercise prescription, electrotherapy devices could be used as a passive adjunct within a treatment paradigm. To the authors knowledge there is no research for application of devices such as laser, therapeutic ultrasound and neuromuscular electrical stimulation (NMES) specifically for the cervical region. Translation from application in other body areas and from human studies would support the use of laser for pain relief (Chow et al 2009) although there is suggestion that the presence of hair may affect comparable penetration depths so treatment dose should be adapted. Therapeutic ultrasound would be more appropriate for high protein content connective tissues, such as ligament and tendons, and therefore would be less suitable for treatment in the neck region than injuries in the distal limb for example (Watson, 2008).

A good choice of adjunct would be NMES and small battery operated, portable devices are practical to use in clinical practice. NMES can be used to facilitate rhythmical muscle contraction in the neck muscles whilst may assist in restoration of normal activity, although to date there are no studies discussing this approach. However, a reduction of pain and muscle tone has been shown in the thoracolumbar region (Schils and Turner, 2014) and in practice the use of low frequency (less than 10Hz) NMES generates a contraction in the region of muscle underlying the electrodes. If the NMES has induced pain relief, which has been reported in humans for both transcutaneous nerve stimulation and H-wave therapy in the short term (McDowell et al, 1999) this would provide a timeframe in which to apply other elements of the treatment approach. The stimulated local muscle contraction could be followed with active movement, using voluntarily recruited musculature, to work towards restoration of full range of movement.

Advice and Education

Within the scope of physiotherapy is the delivery of advice to support the patient in their recovery and return to optimal function. This applies as much to the horse owner and rider, as to a human patient, despite the horse undergoing treatment in this case. The key points are to establish if there are any causative elements of the horse's daily activity or training that may be related to the presence of neck pain. In one recent case seen by the author, the addition of a hay feeder situated under a corner manger, required the horse to repetitively rotate his upper cervical spine during extension to reach the forage, inducing acute muscular pain. A further scenario involved a change of training intensity prior to a competition, which created the postural effect of increasing lower cervical extension and upper cervical flexion, aggravated the pre-existing facet OA and resulted in mild neurological signs and cervical muscle pain. Identification of risk factors and education on basic anatomy and function will aid prevention of onset and management of on-going neck pain.

Conclusion

The recent increase in publications of veterinary studies into neck pain and pathology would suggest an increased recognition of dysfunction of this region as a cause of performance loss in horses. Veterinary medical intervention should be supported by physiotherapy management to aid pain relief and increase muscle size. Manual therapy and therapeutic exercises should be considered as useful adjuncts to assist return to function and full performance.

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