CANINE QUADRICEPS CONTRACTURES

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Pathophysiology

Quadriceps contraction is essentially a muscular contracture and adherence to the underlying bone following a femoral fracture with or without surgical fixation, whereby the muscle become taut and adherent, resulting in a characteristic hind limb hyperextension. The pathophysiology behind this condition includes the presence of fibrous adhesions that cause a 'tie down' of the vastus intermedius muscle over the fracture site, muscle atrophy, disuse osteoporosis and degenerative joint changes.[2, 3, 4, 10] The adhesions of the muscle result in stiffness within the muscle and the adjacent stifle joint.[2, 3, 4]

Lack of movement and muscular unloading will cause a disuse osteoporosis. In disuse osteoporosis there appears to be a decreased number of osteoblasts and an increased recruitment of oestoclasts.[2, 3, 4] Disuse osteoporosis can been seen as early as 2 weeks following immobilization.[2, 3, 4]

Further to the fibrous adhesion in the muscle is the occurrence of muscle disuse atrophy.[2, 3, 4] The muscle atrophy is most pronounced in the type I muscle fibres of the vastus lateralis muscle.[2, 3, 4]

Immobilizations will also result in joint changes.[2, 3, 4] Within 4 days, the articular surfaces in apposition display microscopic changes such as deep fibrillation, and deep erosion of the cartilage.[2, 3, 4] By day 6 there is a massive decrease in cartilage proteoglycan synthesis and content with subsequent cartilage softening.[2, 3, 4] As early as two weeks following immobilization, non-contact articular interfaces can be replaced by pannus (which matures to fibrous tissues) and fibrous ankylosis and occasional cartilaginous and bony ankylosis may occur after months of immobilization.[2, 3, 4] The immobility may also lead to a progressive contracture of the joint capsule and periarticular fibrous connective tissue, patellar tendon, ligaments and fascia.[2, 3, 4]

Lastly, growth disturbances can ensue following a quadriceps contracture. Multiple changes throughout the affected limb in a young animal can include hip subluxation, bone hypoplasia, increased femoral torsion, hypertrophy of the ligament of the femoral head, significant decreases in blood flow of the femoral head and progressive degenerative changes in the hip joint.[2, 3, 4]

Reversibility of some of these signs can be attained if the condition is detected early enough. Joint changes can be reversed is the immobilization period is less than 4 weeks.[2, 3, 4] Muscular disuse atrophy can also be reversed, but the recovery period may

be 2 – 4 times longer than the period of immobilization.[2, 3, 4] As well, disuse osteoporosis may take as much as 5 – 10 times longer than the period of immobilization for recovery and may be of some degree of permanence if the immobilization lasts longer than 12 weeks.[2, 3, 4] Growth disturbances are likely to be permanent.

Predispositions

There are a few factors which may predispose the animal to developing a quadriceps contracture. At greatest risk of developing this condition are young animals, often 3 – 6 months old.[2, 3, 4, 13, 18] Trauma to the quadriceps muscle, femoral artery and nerve as well as comminuted fractures, incomplete fracture reduction, fracture instability or osteomyelitis have been sited to heighten the occurrence of quadriceps contractures.[2, 3, 4, 13] Additionally, this problem may ensue following casting, traction, bandaging or other forms of prolonged immobilization in an extended limb position or pain that limits stifle flexion following surgical repair of the fracture site.[2, 3, 4, 13]

a) Prevention

Identification and management of those animals at risk (see above) may aid in prevention of the formation of a quadriceps contracture. Incorporated into the surgical repair could be a plastic sheeting over the femur and under the quadriceps muscles that would disallow attachment of the muscle mass to the bone.[2, 3, 4, 18] A 90/90 flexion bandage for the stifle and hock may be utilized for animals at risk or routinely for 10 days post operatively following femoral fracture repair.[13] Alternately a dynamic flexion apparatus which incorporates an external fixateur to the pelvis or femur and elastic bandages attached to the distal limb that promote hind limb flexion while allowing active extension for ambulation have been described in the literature as effective preventions or treatments for these cases.[10, 16]

b) Physiotherapy management in a developing quadriceps contracture

When in suspect of the development of a quadriceps contracture, physiotherapy can be utilized to draw attention to the condition and alert the veterinary surgeon to the need for a short term 90/90 flexion bandage.[13] Physiotherapy can then endeavour to address and/or prevent issues such as disuse atrophy, joint nutrition, joint range of motion and disuse osteoporosis. Neuromuscular electrical stimulation (NMES) may be utilized over the hamstrings (biceps femoris, semitendinosis and semimembranosis) in order to enhance stifle joint flexion[1], or over the quads (vastus lateralis in particular) to improve muscular strength and prevent disuse atrophy.[6] The NMES may also aid in fracture healing and hence prevent the disuse osteoporosis.[15] Joint nutrition may be enhanced by physiological and accessory motion joint mobilizations.[11, 18] Disuse osteoporosis could be combated with facilitated periods of limb use and early mobilization which have the potential to result in earlier recovery of mobility and strength, facilitation of an earlier return to activities and should not affect fracture alignment.[5,7, 9, 11, 14] This might accomplished by forced ambulation when the 90/90 bandage is off, perhaps utilizing a

noxious or aggravating stimuli to the non-affected limb or other weight shifting exercises.[8]

Summary

Physiotherapy should be an integral part of fracture management, both to optimize healing and return to function but also for early identification of complications such as quadriceps contractures. It is imperative that animals at greatest risk of developing this condition be put on a physio treatment regime immediately post-operatively.

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