HAMSTRING INJURIES

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ABSTRACT

Hamstring injuries are common and have a significant impact on athletic performance. Hamstring tightness is a contributing factor in pathological conditions of the knee and spine in non-athletic individuals. This article discusses the anatomy, physiology and pathology of hamstring injuries and related conditions. We also identify the injury patterns that respond to conservative therapy and those which require surgical intervention.

ANATOMY

The Hamstring muscle group consists of the Biceps Femoris, Semimembranosus and the Semitendinosus (1). The hamstrings form the bulk of the posterior femoral muscles. One of their major characteristics is that they cross two major joints, the hip and the knee. The hamstring muscles are the major flexors of the knee and also aid hip extension. They are supplied by the Sciatic nerve (L5, S1,2) and branches of the circumflex vessels of the Femoral artery.

PHYSIOLOGY

The amplitude of a muscle is the change in length from its state of full contraction to full stretch. Physiologically full stretch occurs in the hamstrings group only if the knee is fully extended with the hip fully flexed. Complete contraction occurs when the knee is fully flexed and the hip fully extended. Complete contraction and stretching rarely occur in normal daily activity and the hamstrings are therefore rarely put through their full physiological amplitude. This is a common phenomenon with ‘two joint muscles’. For this reason ‘two joint muscles’ are the ones most commonly injured in sport during acute stretching.

Biomechanically the synchronisation between two joints is a complicated proprioceptive and mechanical problem. This is complicated further when muscle units cross both joints. Muscles, which have not been trained to employ their full amplitude, may fail when required to pass through their full amplitude under rapid and stressful situations. This results in varying degrees of muscle damage. Specific stretching programs are needed on a daily basis in all athletes in order to prevent injury.

Study of injury patterns helps us understand how the muscle unit fails under stress. This is best seen in the severest injury, complete hamstring avulsion from the ischium. This commonly occurs when water-skiing. As the boat pulls forward and the ski tips get caught there is a sudden hyperflexion of the hip with the knee fully extended. Severe pain and often a tearing feeling are experienced as the muscles rupture completely at their proximal end.

CONDITIONS ASSOCIATED WITH HAMSTRING TIGHTNESS

Hamstring tightness, the inability to stretch the muscle through its full range of amplitude, is associated with several conditions of the knee and spine.

Anterior Knee Pain

Adolescents with bilateral anterior knee pain often have hamstring tightness. Bone growth particularly during the pubescent growth spurt often occurs more rapidly than muscle growth. This produces relative hamstring tightness, which results in a flexion moment about the knee and thus excessive patello-femoral forces. The patho-mechanics are equivalent to walking on flexed knees and this in time will produce pain. Stretching of the hamstrings will help reduce the pain in most circumstances.

Cerebral Palsy

Pathologically tight hamstrings are found in Cerebral Palsy, which can lead to flexion contracture of the knee (1). Concomitant Quadriceps spasticity can cause patella tendon lengthening producing gross patella alta. However in this group of patients the low demand placed on the knees avoids major symptoms of patella pain and instability.

Scheurmanns' Disease

Hamstring tightness has been documented in 75% of all cases of Scheurmanns' disease. Excessive hip flexion forces decreasing lumbar lordosis and leading to increasing thoracic flexion (1). This increases the anterior forces on the discs producing mechanical and pathological changes. Similar muscle imbalance can aggravate vertebral disc degeneration in the older population. It is therefore important to check for hamstring tightness in all patients with back pain.

MECHANISM OF HAMSTRING MUSCLE INJURY

The synchronous flexion and extension of the lower limb joints propels the athlete forwards. Trunk rotation and upper limb movement aid this process. The coordination of this complex activity has many influences including genetic, neurological, visual, auditory, proprioceptive and mechanical factors. Training through repetitive actions aids this process.

If a two-joint muscle is stretched in an un-coordinated manner it may exceed its physiologic amplitude and tear. The severity of the muscle tear is dependent on the force applied. Hamstring strain result from small forces producing tears of the muscle fibre bundles. These can be treated by ice and early mobilisation. More severe forces will tear large muscle bundles and disrupt vessels causing intramuscular haemorrhage. These tears result in residual scar tissue within muscle, which act as stress risers, and may precipitate recurrent injury. Muscle tightness through inadequate warming up, or training, can aggravate injury as the muscle lacks the necessary flexibility. Major forces are rare but can result in complete muscle rupture or tendon avulsion. Such forces can occur however in water-skiing and competitive sprinting injuries.

Hamstring Rehabilitation

Treatment includes prevention and therapy. Early recognition and immediate treatment help the outcome. Ice therapy is required to prevent swelling and decrease haemorrhage. Graduated stretching and exercise, depending on the degree of injury, follow initial rest. Excessive early stretching and exercise of large intramuscular tears is not recommended as there is a risk of further haematoma formation which may calcify leading to Myositis Ossificans. The effects of warming-up, muscle temperature and stretching all have beneficial effects on the mechanical properties of muscle potentially reducing the risk of strain injury. Factors protecting muscle such as strength, endurance and flexibility are fortunately also essential for peak performance (2).

Recurrent Hamstring Tears

Approximately one-third of hamstring injuries are recurrences (3). Hamstring weakness is a risk factor for hamstring strain and there remains an increased risk of re-injury for at least a month after *return to play* (4). This is the result of increased susceptibility during the remodelling phase of healing and may not be apparent from conventional fitness testing.

TENDINITIS

Ischial Tendinitis

Acute tendon inflammation of the hamstring origin produces pain and tenderness localised to the ischial tubercle. Resisted hip extension or tendon stretching by fully flexing the hip reproduces the pain. Radiographs may reveal a cortical avulsion or local periosteal reaction. An acute avulsion may be seen in young athletes whilst sprinting. (5)

Bicipital Tendinitis

Inflammation of the biceps tendon insertion into the fibula head. This may result from an overuse injury and may be accompanied by a bursitis. Tenderness is localised and pain is reproduced on resisted knee flexion. (5)

Semimembranosus Tendinitis

Semimembranosus tendinitis results from the chronic irritation as the tendon slides over the medial corner of the medial femoral condyle. It produces pain over the posteromedial corner of the knee and may be located to the tendon itself, or the teno-osseous insertion (6). Treatment involves rest, anti-inflammatories and training modification.

BURSITIS

Ischial Bursitis

Chronic inflammation at the ischial origin of the hamstrings resulting from prolonged sitting. Pain is exacerbated by sitting and relieved by standing. Tenderness is localised to the ischial tuberosity and pain is reproduced by straight leg raising. (5). The bursitis is aggravated by tight hamstrings, sprint exercise, excessive hill running and cycling. (6).

Pes Anserinus Bursitis

The pes anserinus bursa lies between the tibial attachment of the medial collateral ligament and the overlying insertions of sartorius, gracilis and semitendinosus. Bursitis is most commonly caused by an overuse injury but may also result from direct trauma. Pain, tenderness and swelling are well localised. Resisted knee flexion exacerbates the pain.

Semimembranosus Bursitis (Popliteal Cyst)

The Semimembranosus bursa is found between the medial head of gastrocnemius and the semimembranosus tendon. It usually connects with the knee joint. Thus it is associated with any condition producing synovial inflammation. Synovial fluid tracks into the semimembranosus bursa producing a popliteal cyst. The bursa is best felt whilst standing with the knee in extension. (5)

Bicipital Bursitis

The biciptal bursa is found between the lateral collateral ligament and the overlying biceps insertion into the fibula head. Bicipital bursitis may result from an overuse injury of the biceps tendon or a ligament sprain. The bursa is most prominent on resisted knee flexion.

AVULSION INJURIES

Ischial Avulsion

Complete hamstring avulsion from the ischial tuberosity is a rare but serious injury and warrants early surgical repair (7). The mechanism of injury is involves a violent eccentric hamstring muscle contraction with the knee extended and the hip flexed. Clinically patients have a posterior midthigh mass and a palpable proximal defect, which is accentuated by hamstring muscle contraction in the prone position. Magnetic Resonance Imaging is useful in estimating the extent of injury.

Avulsion of the Ischial Apophysis

The ischial apophysis may avulse from the innominate bone from around puberty up to 25 years age (8,9,10). The injury mechanism is usually sudden hamstring contraction whilst engaged in strenuous activity such as sprinting, long jump or hurdling (11,9). Minimally displaced apophyseal avulsions can be managed conservatively with good results (12,13). However wide seperation (>2cm) of fracture fragments should be treated by early open reduction and internal fixation to avoid a painful fibrous non-union and significant weakness of knee flexion (14). In chronic cases with disability the same treatment can relieve symptoms and restore function (14).

Biceps Avulsion

The biceps femoris muscle has a long head originating from the ischial tuberosity and a short head originating medial to the linea aspera of the distal femur. These two heads converge forming the tendon of biceps femoris, which has multiple insertions. These include the head of the fibula, the proximal tibia, postero-lateral capsule and ilio-tibial band. Injury to the biceps femoris insertion can result in avulsion of one or all of these components (15). Associated avulsion fractures of the fibula head or anterior rim of proximal tibia (Segond fracture, [16]) may be seen on radiographs of the injured knee. These avulsion fractures rarely occur in isolation and are indicative of a more significant ligamentous/capsular injury (15). Clinical examination after injury, with the knee in 30 degrees flexion, reveals increased anterior tibial translation and adduction laxity. This confirms the importance of the biceps femoris musclulo-ligamentous complex as an important static, as well as dynamic stabiliser of the postero-lateral aspect of the knee.

Clinically significant biceps femoris avulsions require operative exploration and repair. Post-operatively, as with ischial hamstring avulsion, the knee should be braced in 90 degrees flexion for up to 6 weeks to enhance the surgical repair.

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