

# Diagnosis and rehabilitation of gastrocnemius muscle tear: a case report

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**Objective:** *This case study presents the epidemiology, etiology, diagnostic criteria, and therapeutic interventions for a common clinical condition – gastrocnemius injury.*

**Clinical Features:** *A 44-year old male presented with acute calf pain with a palpable defect, loss of range of motion, and loss of strength after sustaining a soft tissue injury to the lower leg. The differential diagnosis of tear of the medial head of the gastrocnemius was confirmed by physical examination and diagnostic ultrasound imaging.*

**Intervention and Outcome:** *The patient was treated over a 6 week period. Initially, rehabilitation was approached using the PRICE principles for symptomatic relief, followed by stretching, strengthening, proprioception, and conditioning exercises. At 9-month follow-up post injury, there was no residual impairment in the gastrocnemius muscle function.*

**Summary:** *This case demonstrates the importance of epidemiology, clinical assessment, and the use of diagnostic ultrasound and MRI imaging in the diagnosis of a tear of the medial head of the gastrocnemius muscle. With an accurate diagnosis and comprehension*

**Objectif :** *cette étude de cas présente l'épidémiologie, l'étiologie, les critères diagnostiques et les interventions thérapeutiques pour une affection clinique courante – la blessure du muscle gastrocnémien (muscles jumeaux).*

**Caractéristiques cliniques :** *un patient de 44 ans a présenté des douleurs aiguës au mollet avec une anomalie palpable, une perte d'amplitude de mouvement et une perte de tonus après avoir subi une blessure aux tissus mous de la jambe inférieure. Le diagnostic différentiel de la déchirure du chef médial des muscles jumeaux a été confirmé par un examen physique et une échographie diagnostique.*

**Intervention et résultat :** *le patient a été traité pendant une période de 6 semaines. Au début, la réadaptation a été abordée selon les principes PRICE du soulagement symptomatique, suivi par de l'étirement, d'exercices de musculation, de la kinesthésie et d'exercices de mise en forme. Au suivi, neuf mois après la blessure, on n'a révélé aucune détérioration résiduelle dans la fonction des muscles jumeaux.*

**Résumé :** *ce cas démontre l'importance de l'épidémiologie, de l'évaluation clinique et de l'utilisation de l'échographie diagnostique et de l'imagerie IRM dans le diagnostic d'une déchirure du chef médial des muscles jumeaux. Grâce à un diagnostic précis et la compréhension de la classification des*

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*of classification of muscle injuries, management of gastrocnemius tears is straightforward.*

(JCCA 2013;57(4):327-333)

KEY WORDS: injury, muscle, gastrocnemius, diagnosis

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## Introduction

Muscle injuries in the calf are a relatively common clinical condition<sup>1-6</sup>, and are also termed “tennis leg” in general because of the prevalence in that sport<sup>3,7</sup>. However, middle-aged or older patients, usually over the age of 40, often present with lower leg muscle injuries following strenuous exercise or sometimes innocuous activity.<sup>5</sup>

There is a consensus to classify myotendinous strains as first degree (stretch injury), second degree (partial tear), and third degree (complete rupture).<sup>5,8</sup> This type of classification takes into consideration the physical findings and pathological correlation as described above, and the disabilities that is, absent, mild, or complete loss of muscle function.<sup>6,7</sup> The term strain does not accurately reflect the structural characteristics of injuries of muscles; rather it is more of a biomechanical description of the mechanism of injury<sup>9</sup>, and as such, the term tear should be used as it more accurately describes the structural injuries of muscle fibres<sup>8</sup>. Mueller-Wohlfahrt et al.<sup>8</sup> discusses the use of a classification system that describes four types of indirect (acute) muscle injuries, and recommends the use of the term tear to describe the injuries of muscle fibres and bundles (Table 1).

A tear to the gastrocnemius muscle is, more often than not, implicated in lower leg trauma and is considered at high risk of injury because of its position spanning across two joints: the knee and ankle, and because of the high density of type-two fast twitch muscle fibres.<sup>2,3,6</sup> The gastrocnemius muscle functions to plantar flex the foot at the ankle joint and flex the leg at the knee joint in the non-weight-bearing state.<sup>7</sup> Although studies documenting the injury rates of calf muscle tears are limited<sup>7</sup>, a 5-year study of European soccer players revealed that 12% of the muscle injuries sustained were injuries to the gastrocn-

*lésions musculaires, la gestion des déchirures des muscles jumeaux est simplifiée.*

(JCCA 2013;57(4):327-333)

MOTS CLÉS : blessure, muscle, muscles jumeaux, gastrocnémien, diagnostic

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emius muscle, and the gastrocnemius was categorized as one of the top five muscles injured<sup>5</sup>.

The diagnosis of the gastrocnemius tear is often clinical. Sudden onset of pain, tenderness localized to the musculotendinous junction of the medial head of the gastrocnemius, and a palpable defect in the medial belly of the gastrocnemius just above the musculotendinous junction are pathognomonic for a gastrocnemius tear.<sup>4,10</sup>

Muscle tears located in the calf region are often associated with other pathologies such as thrombophlebitis, soleus tear, Achilles tendon rupture, and posterior compartment syndrome, making it more difficult for the practitioner to formulate a correct diagnosis, despite performing an accurate clinical examination.<sup>1</sup> Researchers concur that conservative management is effective in the treatment of gastrocnemius tears.<sup>1,4,5,7,10</sup>

This paper will draw attention to the diagnostic and therapeutic procedures associated with gastrocnemius tears. A case will be presented which emphasizes the use of advanced imaging to reach an accurate diagnosis which aides in the process of developing an appropriate course of treatment.

## Case

A 44-year old male presented with a chief complaint of right posterior calf pain, and provided consent to the use of specifics related to his clinical information. He reported the onset of symptoms a few days prior during a dancing session. He stated that he experienced a sudden and sharp sensation at the back of his calf as he extended the leg backwards while planting the heel on the ground. He stated “I thought someone kicked the back of my leg...but when I turned around, there was no one there”. The pain was located along the medial aspect of

Table 1:  
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Comprehensive muscle injury classification: type-specific definitions and clinical presentations						
Type	Classification	Definition	Symptoms	Clinical signs	Location	Ultrasound/MRI
1A	Fatigue-induced muscle disorder	Circumscribed longitudinal increase of muscle tone (muscle firmness) due to overexertion, change of playing surface or change in training patterns	Aching muscle firmness. Increasing with continued activity. Can provoke pain at rest. During or after activity	Dull, diffuse, tolerable pain in involved muscles, circumscribed increase of tone. Athlete reports of 'muscle tightness'	Focal involvement up to entire length of muscle	Negative
1B	Delayed-onset muscle soreness (DOMS)	More generalised muscle pain following unaccustomed, eccentric deceleration movements.	Acute inflammatory pain. Pain at rest. Hours after activity	Oedematous swelling, stiff muscles. Limited range of motion of adjacent joints. Pain on isometric contraction. Therapeutic stretching leads to relief	Mostly entire muscle or muscle group	Negative or oedema only
2A	Spine-related neuromuscular muscle disorder	Circumscribed longitudinal increase of muscle tone (muscle firmness) due to functional or structural spinal lumbopelvic disorder.	Aching muscle firmness. Increasing with continued activity. No pain at rest	Circumscribed longitudinal increase of muscle tone. Discrete oedema between muscle and fascia. Occasional skin sensitivity, defensive reaction on muscle stretching. Pressure pain	Muscle bundle or larger muscle group along entire length of muscle	Negative or oedema only
2B	Muscle-related neuromuscular muscle disorder	Circumscribed (spindle-shaped) area of increased muscle tone (muscle firmness). May result from dysfunctional neuromuscular control such as reciprocal inhibition	Aching, gradually increasing muscle firmness and tension. Cramp-like pain	Circumscribed (spindle-shaped) area of increased muscle tone, oedematous swelling. Therapeutic stretching leads to relief. Pressure pain	Mostly along the entire length of the muscle belly	Negative or oedema only
3A	Minor partial muscle tear	Tear with a maximum diameter of less than muscle fascicle/bundle.	Sharp, needle-like or stabbing pain at time of injury. Athlete often experiences a 'snap' followed by a sudden onset of localised pain	Well-defined localised pain. Probably palpable defect in fibre structure within a firm muscle band. Stretch-induced pain aggravation	Primarily muscle-tendon junction	Positive for fibre disruption on high resolution MRI*. Intramuscular haematoma
3B	Moderate partial muscle tear	Tear with a diameter of greater than a fascicle/bundle	Stabbing, sharp pain, often noticeable tearing at time of injury. Athlete often experiences a 'snap' followed by a sudden onset of localised pain. Possible fall of athlete	Well-defined localised pain. Palpable defect in muscle structure, often haematoma, fascial injury Stretch-induced pain aggravation	Primarily muscle-tendon junction	Positive for significant fibre disruption, probably including some retraction. With fascial injury and intermuscular haematoma
4	(Sub)total muscle tear/ tendinous avulsion	Tear involving the subtotal/complete muscle diameter/ tendinous injury involving the bone-tendon junction	Dull pain at time of injury. Noticeable tearing. Athlete experiences a 'snap' followed by a sudden onset of localised pain. Often fall	Large defect in muscle, haematoma, palpable gap, haematoma, muscle retraction, pain with movement, loss of function, haematoma	Primarily muscle-tendon junction or Bone-tendon junction	Subtotal/complete discontinuity of muscle/tendon. Possible wavy tendon morphology and retraction. With fascial injury and intermuscular haematoma
Contusion	Direct injury	Direct muscle trauma, caused by blunt external force. Leading to diffuse or circumscribed haematoma within the muscle causing pain and loss of motion	Dull pain at time of injury, possibly increasing due to increasing haematoma. Athlete often reports definite external mechanism	Dull, diffuse pain, haematoma, pain on movement, swelling, decreased range of motion, tenderness to palpation depending on the severity of impact. Athlete may be able to continue sport activity rather than in indirect structural injury	Any muscle, mostly vastus intermedius and rectus femoris	Diffuse or circumscribed haematoma in varying dimensions

\*Recommendations for (high-resolution) MRI: high field strength (minimum 1.5 or 3 T), high spatial resolution (use of surface coils), limited field of view (according to clinical examination/ultrasound), use of skin marker at centre of injury location and multiplanar slice orientation.

the posterior calf and extended upwards toward the knee and distally towards the ankle. He described the pain as tight and throbbing. The pain was aggravated with general ankle movements.

Examination revealed an antalgic gait, favouring the right leg. He was unable to balance on the right leg unassisted. Inspection revealed moderate soft tissue swelling of the right calf with discoloration and bruising extending to the posterior aspect of the foot. Measurement of the calf was 41 cm on the right and 38.5 cm on the left, measured 10 cm below the patella. A visible defect of the medial gastrocnemius muscle was evident and was palpable at this juncture. In addition, a mass was palpated at the posterior calf, likely the rupture of the gastrocnemius muscle. Palpation revealed tenderness along the entire medial gastrocnemius muscle, particularly at the musculotendinous junction.

The Thompson Squeeze Test was negative for an Achilles tendon rupture, as it was painful but produced plantar flexion. Active and passive ankle dorsiflexion produced moderate pain. Resisted plantar flexion of the ankle also reproduced the symptoms. There was mild pain with active knee flexion. There was difficulty performing a single leg calf raise with the affected leg.

The patient was referred for a venous doppler of the right lower leg that normal compressibility, phasic flow and augmentation in the deep veins of the lower extremity from the common femoral vein to the popliteal confluence below the knee. A diagnostic ultrasound study of the right calf revealed an abnormality at the medial aspect of the gastrocnemius muscle, described as “a complex cystic structure at the medial aspect of the gastrocnemius muscle...adjacent to the plantaris tendon/muscle”. There was concern of a soft tissue hematoma with a partial thickness tear of either the medial gastrocnemius muscle or the plantaris tendon/muscle. Based on the epidemiology, mechanism of injury, clinical findings, and diagnostic ultrasound findings, the patient was diagnosed with a type 3 tear of the medial gastrocnemius muscle.

Bleakley<sup>11</sup> elaborates on the widely accepted approach in the treatment of soft tissue injuries as protection, rest, ice, compression, and elevation, commonly shortened by the acronym ‘PRICE’. Campbell<sup>4</sup> suggests that rest, ice, compression, and elevation, along with the use of protection may be required for symptomatic relief of gastrocnemius tears. The components of the PRICE principle were

applied during the first phase of therapy (week 1-2) to minimize pain and discomfort.

At the onset of treatment, the patient was advised to limit activities. The use of a compression sleeve for the calf was recommended to decrease the hemorrhaging. He was directed to apply ice to the area with 10 minutes on, 10 minutes off and then repeat for symptomatic relief. He was educated on the proper technique of elevating the limb slightly above the level of the heart to reduce the swelling. The patient was comfortable with weight-bearing and declined the use of crutches and/or walking boot to assist his mobility.

In phase 1 of rehabilitation (week 1-2), the patient commenced active range of motion exercises for the knee and ankle in the pain-free range. Chiropractic treatments included gentle mobilization of the knee and ankle joints. In addition, associated lumbo-pelvic dysfunction and pain, likely due to altered gait mechanics, were addressed.

The second phase of therapy (week 3-4) consisted of progression from active range of motion exercises to isometric exercises and exercises against resistance. There was a specific focus on plantar flexor strengthening exercises, in conjunction with general strengthening exercises of the quadriceps, hamstrings, and lateral and anterior compartment muscles. In addition, the patient was encouraged to begin stationary biking to improve aerobic fitness. Furthermore, he commenced various proprioception exercises such as balancing with one leg on the floor, and progressing to balancing with both legs on a wobble board. Chiropractic treatments included mobilization of the knee and ankle joints, soft tissue therapy of the calf musculature, and treatment to the lumbo-pelvic region. The treatment modality of choice for this particular patient was Low Level Laser Therapy (LLLT), with parameters set for anti-inflammatory and biostimulatory effects.

During the third phase of therapy (week 5-6), return to pre-injury sport activities was initiated. The patient continued range of motion and strengthening exercises, and added calf raises and leg presses to his program. The proprioception exercises progressed to rocking the board and performing one-leg balance exercises. Chiropractic treatment of joint mobilization, soft tissue techniques, lumbo-pelvic treatments, and the use of LLLT was continued. He was gradually introduced to sport-specific movements, specifically eccentric movements of the calf, quick pivots, jumping, and squatting. He achieved pain-free full

range of motion in the affected leg. Manual muscle testing showed MRC grade five strength in all major muscle groups of lower limbs, including hip, knee, and foot muscles. There were no signs of giveaway weakness from pain inhibition noted in the muscle testing of the affected limb.

At 9-month follow-up post injury, there was no residual impairment in the gastrocnemius muscle function, however, palpation and inspection revealed a slight defect of the medial wall of the gastrocnemius tendon. The strengthening and stretching exercise routine was continued to reduce the risk of re-injury.

## Discussion

The tear of the gastrocnemius muscle is sometimes termed “tennis leg”, due to its frequent occurrence in younger athletes involved in the sport.<sup>1,2</sup> This injury, however, is not limited to the athlete, and is commonly seen in middle-aged or older patients, usually over the age of 40<sup>1,2,4</sup> participating in physically demanding activities despite suboptimal physical presentation<sup>10</sup>. In this category, the muscle may become predisposed to injury as a result of certain factors such as physiologic changes associated with muscle aging and a general loss of flexibility.<sup>4</sup> The mature athlete may experience gastrocnemius muscle tears while performing maneuvers that require sudden and swift changes in direction leading to overstretching of the muscle.<sup>2</sup>

The mechanism of a gastrocnemius tear is related to the extension of the knee with simultaneous forced dorsiflexion of the ankle.<sup>2</sup> In an effort to contract, the forces of the eccentric movement on the already lengthened gastrocnemius muscle lead to injury at the myotendinous junction.<sup>12</sup>

In the pathogenesis of this injury, studies have associated the tearing of the medial head of the gastrocnemius muscle at the musculotendinous junction.<sup>1</sup> Several factors have been documented to contribute to the susceptibility of a muscle to tear including the composition of type II fibres (fast contracting), extension across two joints, eccentric action, and fusiform stretch.<sup>4,5,6,9</sup> The gastrocnemius muscle injury is caused by the combination of its “biarthrodial architecture” and “rapid forceful contraction of type two muscle fibers”.<sup>7</sup>

In an effort to identify the nature of the injury, a thorough interview may reveal that the patient is able to clear-

ly recall the single major traumatic event at the source of the pain.<sup>6</sup> In addition, there is a significant decrease in the level of function of the patient immediately following the specific moment of injury. With a muscle tear or rupture, the patient is likely to have difficulty continuing with the sport or action.<sup>13</sup> The patient may make it known that there was sudden calf pain with a concomitant audible “pop”.<sup>4</sup> The patient may also report the feeling of being physically struck in the lower calf.<sup>4</sup>

Observation of the patient typically shows an antalgic gait, bruising in the calf area, visible ecchymosis and significant swelling.<sup>4,10</sup> The physical examination aids in clinical diagnosis and may reveal a palpable defect in the medial belly of the gastrocnemius just above the musculotendinous junction.<sup>2</sup> There is usually muscle weakness with plantar flexion in the affected leg.<sup>12</sup>

Research has established that it is more common to find the involvement of the medial head of the gastrocnemius muscle in calf muscle tear injuries.<sup>1,2,5,10</sup> However, injuries to other soft tissue elements of the lower leg can lead to a differential diagnosis of tear to the plantaris tendon, soleus tendon, or peroneus longus.<sup>2,4,12,13</sup> The lateral head of the gastrocnemius has also been found to be involved in calf muscle tear injuries, although, rarely.<sup>4</sup> Clinical presentation may also suggest Achilles tendon strain or deep vein thrombosis or thrombophlebitis.<sup>4,9,10,14</sup> Likewise, the findings can often implicate a ruptured Baker’s cyst as the source of the pain.<sup>1</sup>

The differential diagnoses can present a challenging obstacle for the practitioner and further imaging is often required.<sup>15</sup> Radiological examinations can prove invaluable in order to confirm the diagnosis and prepare an appropriate course of therapy.<sup>10</sup> The practitioner will find plain x-rays of no benefit as muscle tears in the calf do not affect the bones.<sup>4,13</sup>

Diagnostic ultrasound imaging can be considered the modality of choice to confirm or exclude gastrocnemius tear, to determine the extent of soft tissue injury, and to evaluate possible hematomas.<sup>1</sup> Diagnostic ultrasound technique can differentiate partial tears from complete tears of the muscle rupture, and detect the size of the defect.<sup>4</sup> When there is a question of possible deep vein thrombosis, Doppler ultrasound investigation is very useful for diagnostic clarification.<sup>4</sup> Diagnostic ultrasound imaging may reveal discontinuity of muscle fibres associated with extensive edema and hematoma and hypoechogenic-

icity indicative of intramuscular fluid collection.<sup>9</sup> Some studies have concluded that the presence of a hematoma at the musculotendinous junction suggests that the tear is located at the medial head of the gastrocnemius muscle as opposed to the plantaris tendon which is an avascular structure.<sup>5</sup>

Magnetic resonance imaging (MRI) is most often used to delineate muscle injuries and allows differentiation between gastrocnemius and other soft tissue injuries, improving treatment management.<sup>4</sup> MRI imaging often reveals intramuscular or musculotendinous junction hyperintensity, indicative of edema and hemorrhage and hematoma at the musculotendinous junction is pathognomic.<sup>9</sup>

When considering the use of imaging, cost and availability are limiting factors that may determine the selection of certain diagnostic imaging modalities. There are advantages and disadvantages of diagnostic ultrasound and MRI investigations<sup>12</sup>, but both can be used to confirm the tear, localize the injured muscle and determine extent of injury<sup>7</sup>. However, affordability and accessibility make diagnostic ultrasound the modality of choice.<sup>5,16</sup>

The literature supports the conservative treatment of gastrocnemius tears<sup>1,4,5,7,10,13,17</sup> with healing occurring anywhere from 3–6 weeks<sup>2</sup> with comprehensive rehabilitation. Factors such as non-compliance to treatment and the presence of widespread bruising for days preceding treatment have been demonstrated to delay recovery.<sup>13</sup> Henning et al.<sup>18</sup> emphasized that with respect to the natural history of the gastrocnemius tear, there are no clear patterns. While research has demonstrated that rehabilitation can facilitate return to function, the threat of re-injury remains. In addition, the patient may experience long term symptoms of pain and limited function based on the severity of the injury and success of therapy.<sup>7</sup>

Initial intervention includes limitation of activities and the use of crutches or a cane to assist with mobility, and this can be useful for the first 1–2 weeks. This can help control hemorrhaging and pain.<sup>7</sup> In addition to protection of the lower leg, researchers recommend rest, ice, compression, and elevation.<sup>4,5,7,10,13</sup> Neoprene sleeves are useful for early compressive treatment to decrease in the amount of hemorrhage following the injury amount and facilitate early ambulation.<sup>10,19</sup> However, studies have shown that the application of heat and soft tissue techniques such as massage are contraindicated in the initial

phase of therapy as these therapeutic interventions may increase the risk of hemorrhage.<sup>7</sup>

In the sub-acute phase, rehabilitation should consist of passive and active stretching program, soft tissue techniques, and proprioception training.<sup>7</sup> The use of modalities such as low level laser therapy, therapeutic ultrasound, and electrical stimulation are appropriate as part of the treatment plan.<sup>7</sup> In addition, friction massage may help decrease the formation of adhesions.<sup>7</sup> As range of motion improves, the patient may progress from isometric and isotonic exercises, to dynamic training exercises.<sup>7</sup> The general conditioning exercises, closed-chain exercises, and sport-specific exercises helped the patient gain strength and agility.<sup>7</sup>

Orchard et al.<sup>20</sup> concluded that there is a lack of agreement in the current research regarding guidelines for return-to-sport following muscle tears. An appropriate benchmark for return to pre-traumatic activity level is the ability to ambulate without pain.<sup>10</sup>

Medical management is required if a large hematoma is present and requires drainage or there is the development of myositis ossificans that complicates the clinical presentation.<sup>7,13</sup> Surgical intervention, such as a fasciotomy, is considered when there is an associated acute compartment syndrome.<sup>8,13,21</sup> In fact, some studies have shown the inability to perform a single heel rise is an indicator for surgical intervention.<sup>13</sup>

## Conclusion

Calf muscle tear injury, also termed “tennis leg”, is a relatively common clinical condition involving damage to the medial head of the gastrocnemius muscle. Understanding the epidemiology and obtaining a comprehensive clinical history can aid in the diagnosis. The physical exam, including observation, palpation, orthopedic testing, and gait analysis, allows the practitioner to localize the area of injury and assess the severity of soft tissue damage. Both diagnostic ultrasound and MRI imaging allow the practitioner to rule out other pathologies and provide useful information to direct therapeutic management. MRI imaging is considered the gold standard in suspected gastrocnemius tears due to the better-quality soft tissue contrast and spatial resolution, in addition to greater reproducibility.<sup>5</sup> The diagnostic ultrasound, however, is more accessible and cost effective, perhaps making it the preferred modality for evaluating injuries to soft tissue structures.<sup>5</sup>

With an accurate diagnosis and comprehension of classification of muscle tear injuries, management of gastrocnemius tears is straightforward. Applying the principles of protection, rest, ice, compression, and elevation at the onset of injury is critical. Rehabilitation in the subacute phase facilitates the healing process and timely return to pre-accident activities.

The possibility of an isolated tear of the medial gastrocnemius tendon should be considered in a patient presenting with posterior lower leg pain and a palpable defect in the posterior aspect of the calf.

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