

CASE REPORT

Exact moment of a gastrocnemius muscle strain captured on video

J W Orchard, E Alcott, T James, P Farhart, M Portus, S R Waugh

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A left gastrocnemius strain was sustained by an elite cricket batsman while he was taking off to run. The exact moment of injury, captured by a camera in the middle stump, appears to correspond to the sudden appearance of a deficit in the gastrocnemius muscle, seen through the player's trousers. The strain occurred when the entire body weight was on the left foot with the centre of mass well in front of the leg. The injury probably occurred close to the time when the gastrocnemius complex was moving from an eccentric to an isometric phase.

Lower limb muscle strains are common injuries in many sports, although the exact mechanisms have not been clearly established.^{1,2} It is commonly believed that they occur during eccentric contractions.³ Calf muscle strains are thought to usually occur during acceleration (take off) movements,² particularly when the knee is extending.⁴ Some authors believe that hamstring muscle strains occur during the early stance phase of ground contact, when the hamstring muscle complex is actually shortening.⁵ Others think that they may occur in sprinting during either the late swing phase (eccentrically) or early stance phase (concentrically).⁶ However, there is virtually no scientific evidence indicating the timing of injury during the gait cycle.^{1,7} Hamstring strains can also occur during water skiing and are due to stretching beyond maximal length; this mechanism is thought to be quite different from the usual injury mechanism during sprinting.⁸ Quadriceps strains commonly occur during kicking, although it has not been established whether the rectus femoris is strained during a ground contact phase or when shortening at the time of ball contact.²

CASE HISTORY

The injury occurred to the last author (SRW), a 36 year old right handed batsman and captain of the Australian cricket team. He had a past history of multiple left hamstring strains, bilateral shin anterior compartment syndrome (treated surgically), and left L5 pars stress fracture. He was playing in the third Test of the 2001 Ashes series at Trent Bridge, Nottingham. A week before the Test match, he had played an exhibition squash match, which resulted in some minor tightness of the calf muscles; this was only considered significant after retrospective analysis of the injury. He had batted on the first day of the Test without incident, and then fielded for most of the second day. He started the third day playing in the field during England's second innings; after their innings had finished, he waited in the dressing room to bat at number five in the order. His wait to bat was punctuated by the lunch break and rain interruptions. He came in to bat with the score on 3/88 and was injured on the first ball he faced. He struck the delivery to the leg side with his weight on the back (right) foot and then set off to take a run. The injured leg was his front (left) leg, which had been brought back

to take his weight as the right foot had pushed off (see video 1 on www.bjsportmed.com). He was unable to continue after the injury and retired hurt.

The injury was caught on film by cameras from the right side (showing a sagittal view), front (coronal view), and obliquely from the front and right side, all at 25 frames per second, and by a "stump cam" immediately behind the batsman at 12.5 frames per second. The exact moment of injury appears to correspond to the sudden appearance of a deficit in the medial fibres of the lateral gastrocnemius muscle (at 37.40 seconds on the video during stump cam view). After viewing the video, the player (SRW) felt "100% certain" that this was indeed the moment of injury, and the treating physiotherapist (EA) believes that the location of the deficit on the video corresponded to the clinical location of the strain. It appears therefore that the strain occurred between 37.32 and 37.40 seconds on the stump cam view, which correlates with 28.44 and 28.52 seconds on the right sagittal view. The muscle strain occurred when the entire body weight was on the left foot (the right foot has clearly just left the ground) with the centre of mass well in front and to the right of the left leg. On the sagittal view, in the frames just before 28.44 seconds, the left leg is partially obscured, but its appearance is approximately as follows: the left foot is at an angle of 0–5° to the ground in equinus (weight on the toes), the left ankle is between 10° and 15° of dorsiflexion, and the left knee is between 0° and 5° of flexion. Although it is impossible to make fully accurate statements, at the time of injury, the knee joint appears to be very slowly flexing or having no angular velocity and the ankle joint appears to be very slowly dorsiflexing, suggesting that the overall muscle-tendon length of the gastrocnemius is almost constant, or perhaps minimally lengthening. The player's weight is probably on the front of his left foot, and, as he is wearing spiked cricket boots, his front spikes have probably penetrated the surface at the time of injury. One to two frames after the injury, the knee appears to extend minimally (perhaps as a recoil from the torn fibres), while the ankle joint angle stays constant. The left heel leaves the ground about 0.5 seconds after the injury, by which stage the ankle is plantar flexing.

A magnetic resonance imaging scan showed a tear to both the lateral and medial gastrocnemius muscles at the musculotendinous junction. The player recovered quickly from the injury and was able to play in the fifth Test 19 days later.

DISCUSSION

We believe that this is the first video documentation of a muscle strain at the exact moment of occurrence, through the use of a unique form of technology in cricket, the stump cam. The gastrocnemius strain occurred when the entire body weight was on the left foot with the centre of mass well in front of the leg. The gastrocnemius muscle-tendon complex was at close to maximum length, and muscle-tendon length was almost constant at the time of injury. Therefore the injury probably occurred just as the muscle-tendon complex was moving from an eccentric to an isometric phase.

Take home message

A gastrocnemius muscle strain can occur during the push off phase of running when the gastrocnemius muscle-tendon complex is at almost constant muscle length.

Recent ultrasound images of gastrocnemius muscle-tendon units during jumping have shown that the length of the muscular and tendon components can be changing even when the overall muscle-tendon complex length is not.⁹ This study showed that muscle fascicle shortening preceded tendon shortening.⁹ It is perhaps between these two phases (muscle-tendon complex length relatively constant, muscle fascicles contracting and shortening, tendon structures lengthening and generating passive elastic recoil) that the strain at the musculotendinous junction is maximal. A study that measured the Achilles tendon force using an implanted optic fibre transducer during jumping found that the force could continue to increase after the muscle-tendon complex had changed from an eccentric to concentric phase.¹⁰ This case shows that high velocity (change of length) of the muscle-tendon complex is not necessary for a muscle strain to occur.

A further discussion point to arise from this case is the difficulty that batsmen face because of lack of warm up. A batsman waiting to bat cannot know whether he will be called in the next minute or in many hours, so cannot warm up effectively. Although lack of warm up has not been proved to be a risk factor for muscle strain, it has often been proposed from anecdotal clinical evidence.⁷

Authors' affiliations

J W Orchard, E Alcott, T James, P Farhart, M Portus, S R Waugh,
Australian Cricket Board, Australia

Correspondence to: Dr Orchard, South Sydney Sports Medicine, 111

Anzac Parade, Kensington, NSW 2033, Australia;
johnorchard@msn.com.au; www.johnorchard.com

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The video of this incident can be viewed on www.bjsportmed.com