Clinical Journal of Sport Medicine, 11:274–276

CASE REPORT

Hamstring Muscle Strain Injury Caused By Isokinetic Testing

John Orchard, MBBS, PhD, BA, Elizabeth Steet, BAppSc (Physio), *Craig Walker, BSptSc, MSptSc
Ameer Ibrahim, MBBS, †Luke Rigney, BAppSc (Physio), and Michael Houang, MBBS

*South Sydney Sports Medicine, Kensington; *Sydney Roosters Rugby League Football Club, Bondi Junction; and †New South Wales Institute of Sports Medicine, Concord, New South Wales, Australia*

INTRODUCTION

This case involves a professional rugby league player who suffered a magnetic resonance imaging (MRI)-proven primary *right* hamstring injury, caused by an eccentric isokinetic Kin-Com test.

CASE REPORT

The patient was a 25-year-old (height: 183 cm, weight: 86 kg) professional rugby league winger. He had suffered a recurrent episode of a *left* hamstring (biceps femoris) injury at a training drill late in the season (Day 0). This occurred suddenly while changing direction at pace. The player felt the degree of pain when injured to be very similar to his previous episode earlier in the season, which had taken 2 weeks to resolve. The initial clinical signs were consistent with a routine low-grade hamstring strain, with local tenderness in the midlateral hamstring and moderately decreased stretch and power on the left side compared with the right. He was ruled out for a scheduled match on Day 1.

On Days 2–3 the player did not undertake any running activity and was treated with physiotherapy and ice. Over this period the player was pain free on walking. On the morning of Day 4, the player had an MRI scan that confirmed a grade 1 strain of the left biceps femoris muscle (Figure 1). The length of the right hamstring was visualized by the scan and was normal.

On the afternoon of Day 4, the player underwent a concentric and eccentric bilateral isokinetic strength test using a KinCom dynamometer (Chattecx; Chattanooga, TN, U.S.A.). He had no previous experience with using this machine. The initial protocol was to test endurance and was performed in a seated position with a slow acceleration phase. There were 15 repetitions bilaterally of knee extension and then flexion at 180° per second. He completed this section of the test, but felt mild pain when testing his left hamstring and mild-to-moderate pain when testing his *right* hamstring muscle. He had not previously injured the right hamstring. Due to the pain, he did not undergo a maximal peak torque test that was planned to follow. After the test he felt pain on walking in both hamstring muscles and felt as though the test may have worsened his left hamstring strain and also caused a similar injury in his right hamstring muscle.

The results of the testing are detailed in Table 1.

On day 5, examination revealed very similar findings in the right and left hamstring muscle, with local tenderness, slightly reduced stretch, reduced power on clinical examination, and pain on resisted contraction. He continued physiotherapy treatment and ice, but was not prescribed nonsteroidal antiinflammatory drugs (NSAIDs). At this stage, the diagnosis was resolving left hamstring strain and probable muscle soreness in the right hamstring following the isokinetic testing.

On day 7 the player attempted a light jog and felt sore in both hamstring muscles. Because of this symptom, he was told not to attempt further running and was ruled out of the weekend's match, scheduled for day 10.

On day 14 the player underwent an MRI scan, which showed signs of the original left hamstring strain with signal intensity that was markedly reduced. It also showed an unexpected finding of a strain of the right hamstring muscle of much greater signal intensity than the left side (Figure 2). The right hamstring strain involved 20% of the cross-sectional area of the semitendinosus muscle over a distance of 10 cm.

On day 17 (17 days after the left hamstring injury and 13 days after the right hamstring injury) he successfully played a match, and had no further incidence of hamstring injury for the remainder of the season.

DISCUSSION

The authors feel that this was unequivocally a case of right hamstring muscle strain injury caused by an isokinetic test protocol that involved an eccentric phase. We do not believe that such a case has been reported before. A previous study had noted a theoretical and perceived risk of injury on an eccentric Kin-Com machine among elite sprinters, without citing any actual incidence of such an injury occurring.[1]

The evidence for this mechanism of injury was that the right hamstring had incidentally been scanned using an MRI protocol earlier that day and was seen to be normal. The player first reported an onset of significant pain in

Received December 2000; accepted September 7, 2001.
Address correspondence to John Orchard, MBBS, PhD, South Sydney Sports Medicine, 111 Anzac Parade, Kensington, NSW 2033, Australia. E-mail: johnorchard@msn.com.au

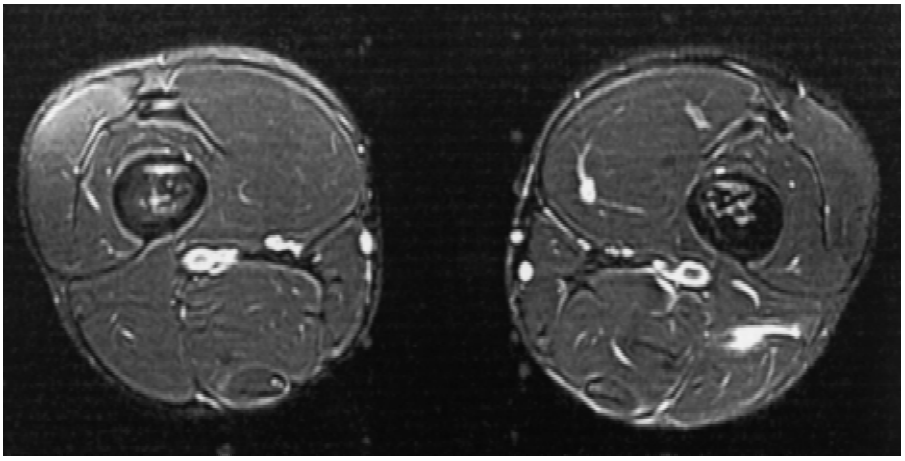

FIG. 1. Day 4 axial fast spin echo T2-weighted magnetic resonance imaging scan showing grade 1 (10% cross-sectional area) strain of left biceps femoris muscle, long head (on right side of figure).

the right hamstring during the isokinetic test protocol, and due to this pain, did not stress the muscle thereafter. There was evidence of extensive right hamstring muscle damage present on an MRI scan 10 days after the injury. There are reports of quite extensive changes on MRI scans in cases of delayed onset muscle soreness (DOMS), a known consequence of unaccustomed eccentric exercise.[2] However, in this case the degree of damage was more severe than two clinically and MRI-positive previous hamstring muscle strains on the opposite side in the same player. Given that the muscle damage occurred suddenly and instantly, we feel that this was certainly a muscle strain rather than a case of DOMS. It is not certain whether the muscle strain was caused by the concentric or eccentric phase of the testing protocol in this case, but it is more likely that it was the eccentric phase, as muscle is under stretch during this phase.

The recommended timing of isokinetic testing after injury has not been extensively studied. The landmark study on this issue recommended that high-speed isokinetic strengthening commence on the third day after injury with maximal testing performed on the fifth day.[3] This was done with a concentric protocol only, and although only six injured players were treated with this protocol, no injury recurrences or complications were reported.[3]

We feel this case report of a clinically significant hamstring strain caused by isokinetic testing has the following implications:

1. Eccentric isokinetic tests are not without side effects or risks. Even though this may not be a common mechanism of injury, this case proves previous suspicion that a mild hamstring muscle injury may be a consequence of testing.
2. Because this test was able to induce injury in a healthy player, it casts doubt on the reliability of eccentric peak torque testing. If mild but somewhat painful muscle damage is occurring during testing, it may be a natural reaction of the patient to reduce from a maximal effort to a submaximal effort.

The relationship between muscle strength and hamstring injury is still not fully understood. After hamstring muscle injury, decreased muscle strength has been reported,[4] and in the acute stages after injury, decreased power is one of the most recognized clinical signs. Previous studies have reported a prospective association between hamstring muscle weakness and hamstring injury.[5–7] These studies used varying protocols for measuring hamstring muscle strength, but none of them used an eccentric protocol.

A recent study failed to show a prospective association between hamstring weakness using an eccentric and concentric testing protocol and hamstring muscle injury.[8] This study had greater statistical power than all of the studies that had shown an association between hamstring weakness and injury. Although the inclusion of an eccentric protocol was seen to increase the scientific validity of this paper, it is possible that it may have caused some subjects to subconsciously not produce maximal efforts during testing. None of the studies regarding strength have taken all confounding factors into account, which may be needed to fully appreciate the role of weakness in causation of hamstring muscle strain. The best-known risk factor for hamstring strain is past history of injury.[8,9]

If eccentric loading causes initial weakness, followed by hypertrophy, then the relationship between strength and injury risk may be regularly confounded by eccentric exercise. There is evidence that the degree of cross-sectional damage on MRI scan is useful in prognosis for

TABLE 1. *Results of testing*

	Eccentric		Concentric	
Knee flexion	Right	Left	Right	Left
Average power (w or Nm/s)	147.7	159.8	115.8	45.4
Total work (J)	2,467.1	1,536.5	1,437.3	447.1
Peak torque (Nm)*	167.04	113.39	168.20	68.44

* This was not a maximal peak torque test, but was the peak torque measured during the endurance protocol that was undertaken.

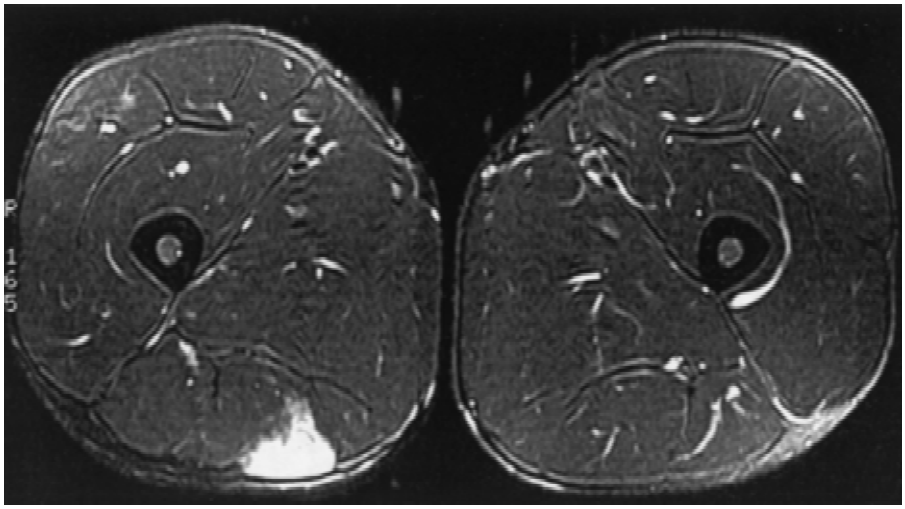

FIG. 2. Day 14 axial fast spin echo T2-weighted magnetic resonance imaging scan showing grade 1–2 (20% cross-sectional area) strain of right hamstring muscle (semitendinosus). This scan is approximately 15 cm higher in the thigh than the section in Figure 1.

hamstring injuries.[10] There is also evidence to suggest that (concentric) isokinetic testing may be useful in determining fitness to return,[3] although this case suggests that eccentric testing may carry a risk of injury recurrence, and perhaps be less reliable due to athlete perception of this risk.

CONCLUSION

Eccentric isokinetic testing carries a risk of muscle strain injury. Athlete perception of this risk may affect the reliability of this form of testing.

REFERENCES

1. Alexander M. Peak torque values for antagonist muscle groups and concentric and eccentric contraction types for elite sprinters. *Arch Phys Med Rehabil* 1990;71:334–339.
2. Bennell K, Wajswelner H, Lew P, et al. Isokinetic strength testing does not predict hamstring injury in Australian Rules footballers. *Br J Sports Med* 1998;32:309–14.
3. Burkett LN. Causative factors in hamstring strains. *Med Sci Sports Exerc* 1970;2:39–42.
4. Heiser TM, Weber J, Sullivan G, et al. Prophylaxis and management of hamstring muscle injuries in intercollegiate football players. *Am J Sports Med* 1984;12:368–370.
5. Jonhagen S, Nemeth G , Eriksson E. Hamstring injuries in sprinters. The role of concentric and eccentric hamstring muscle strength and flexibility. *Am J Sports Med* 1994;22:262-266.
6. Orchard J. Intrinsic and extrinsic risk factors for muscle strains in Australian footballers. *Am J Sports Med* 2001;29:300–303.
7. Orchard J, Marsden J, Lord S, et al. Preseason hamstring muscle weakness associated with hamstring muscle injury in Australian footballers. *Am J Sports Med* 1997;25:81–85.
8. Pomeranz SJ, Heidt RS Jr. MR imaging in the prognostication of hamstring injury. Work in progress. *Radiology* 1993;189:897–900.
9. Shellock F, Fleckenstein J. Magnetic resonance of muscle injuries. In: Stoller D, ed. *Magnetic Resonance Imaging in Orthopaedics and Sports Medicine*. 2nd Ed. Philadelphia: Lippincott-Raven Publishers, 1997:1341–1362.
10. Yamamoto T. Relationship between hamstring strains and leg muscle strength. A follow-up study of collegiate track and field athletes. *J Sports Med Phys Fitness* 1993;33:194–199.