

Severe Injuries of Proximal Hamstrings in High-Performance Sport Climbers

Gravierende Verletzungen der ischiokruralen Muskulatur von Wettkampfklettersportlern

Summary

› **Injuries of the hamstrings** are well known in all kinds of sports. According to the associated mechanisms, literature divides between a running and a stretch type lesion. A variant of the stretch type has been observed in sports climbing based on two almost identical lesions of the hamstrings due to high-elevation heel hooking. This specific movement is characterised by isometric muscle tension in extensive hip flexion with a flexed knee. Even without an obvious trauma, we found severe injuries of the proximal hamstrings. These may cause serious consequences to the further career of a climber. Trainers and route setters should keep this in mind.

KEY WORDS:

Muskuloskeletal, MRI, Route Setting

Zusammenfassung

› **Auch im Sportklettern sind Verletzungen der ischiokruralen Muskulatur** bekannt. Entsprechend des Verletzungsmechanismus unterscheidet man zwischen einem „running“ bzw. einem „stretch“ Typ. Anhand von zwei annähernd identischen Verletzungen der ischiokruralen Muskulatur nach „heel hooking“ deutlich über Hüfthöhe fand sich im Sportklettern eine Variante des „stretch“ Typs mit isometrischer Muskelspannung unter hochgradiger Flexion der Hüfte bei gebeugtem Kniegelenk. Selbst ohne ersichtliches Unfallereignis kann dies zu gravierenden Verletzungen der proximalen, ischiokruralen Muskulatur und in Einzelfällen zum frühzeitigen Ende einer Sportkarriere führen. Trainer und Routenbauer sollte dieses Verletzungsmuster kennen.

SCHLÜSSELWÖRTER:

Muskuloskeletal, MRT, Routenbau

Introduction, Problems and Aim

Acute lesion of the hamstrings are well known injuries of athletes and middle aged patients, who sustain sudden hip flexion with knee extension causing hamstring contraction (5, 6). They were divided into a running type and a stretch type (2). The running type lesions usually affect the distal portion of the hamstrings. It most likely occurs due to excessive muscle strain caused by eccentric contraction during the

late phase of the running gait cycle. The stretch type is caused by extensive hip flexion with an extended knee. Acute proximal hamstring lesions are less frequent and more often belong to the stretch type. Both lesions respond to conservative treatment within 4 to 6 weeks. However, they may result in permanent weakness, pain, and sciatic neuralgia (11). To return to high level activities, surgical treatment must be >

CASE REPORT

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Figure 1

Heel hooking is a climbing technique which uses the leg as an extra pulling tool. It adds a third point of contact, takes weight off the arms, and allows reaching faraway holds.

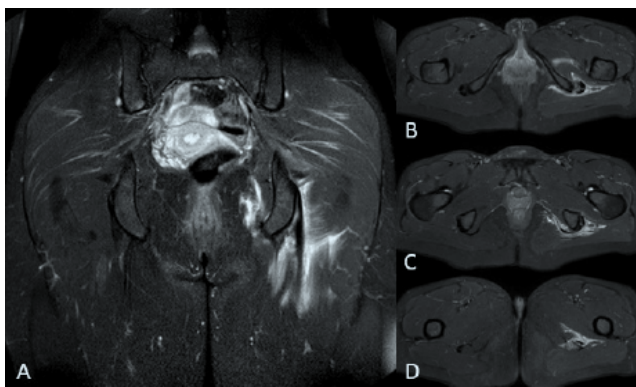


Figure 2

Fat-suppressed pd-weighted MR-images in coronal (A) and transversal (B-D) orientation show proximal strain of the hamstrings without retraction and additional affection of the quadratus femoris and the adductor magnus (courtesy of: A. Boberg, Frankfurt, G).

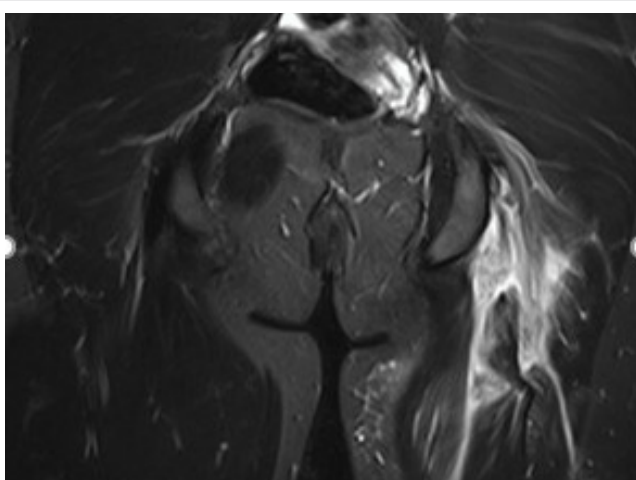


Figure 3

Fat-suppressed pd-weighted MR-image in coronal orientation shows proximal avulsion of the hamstrings (biceps femoris and semimembranosus) with retraction of 3 cm and perifocal hematoma (courtesy of: M. Kunisch, Bad Nauheim, G).

discussed if retraction reaches more than 2 cm or complete avulsion is shown on MR-images (9). Only few proximal hamstring avulsions have been reported in high performance sports climbers (12). We report two cases following high elevation heel hook. Heel hooking is a climbing technique which uses the leg as an extra pulling tool. It adds a third point of contact, takes weight off the arms, and allows reaching faraway holds. In contrast to the typical stretch type lesion, high elevation heel hooking is characterised by isometric muscle tension in extensive hip flexion with a flexed knee (Figure 1). The moment one arm reaches for the following hold the hamstrings get weight loaded and even minor trauma may cause catastrophic injuries as reported in the following.

Material and Methods

A 36 years-old (No. 1; Figure 1) and a 25 years-old (No. 2) female high level sport climber with no pre-existing, musculoskeletal conditions experienced acute pain following high elevation heel hooking during a lead climbing competition respectively. Both complained about immediate pain-associated restriction in movement and severe tenderness on palpation of the ischiatic tuber. Following further clinical examination both received MR-Imaging within 5 days. Thereby, a special focus was set on fat-suppressed sequences. Clinical data as well as training logs were analysed up to 18 months following the incidence.

Results

MRI of climber Number 1 disclosed proximal strain of the biceps femoris, the semimembranosus, the quadratus femoris and the adductor magnus (Figure 2). As no significant retraction was obvious, surgery was rejected. Following 12 weeks of conservative treatment weakness and sitting problems were still present. Although no restriction in everyday life was obvious, high level sport activities were unthinkable even 6 months after the incidence. The climber quit competitive sport.

MRI of climber Number 2 disclosed proximal avulsion of the biceps femoris and semimembranosus (Figure 3). 16 days following the trauma surgical refixation was done using 3 suture anchors, which was followed by a 6-month rehab.

9 months later competitive climbing was possible again (4 out of 10). However, the former performance level never was reached again.

Discussion

Injuries of the hamstring were divided into a running and a stretch type (2). In high elevation heel hooking we observed a third type, which seem to be a variation of the stretch type. It is characterised by isometric muscle tension during extensive hip flexion and flexed knee (Figure 1). As heel hooking serves as a third point of contact the hamstrings get weight loaded the very moment one arm reaches for the following hold (12).

Lesions of the running type usually affect the long head of the biceps femoris with inclusion of the musculotendinous junction. In stretch type injuries of the semimembranosus occur close to the ischiatic tuber. The most serious injury of this type is avulsion, which may include all three muscles of the hamstrings. In adult's avulsion usually is without an osseous fragment, whereas in adolescents, the apophysis is the weakest part of the musculotendinous unit (5, 6, 10). Complete proximal hamstring ruptures have been reported in water skiers and bull riders (4). A study of dancers disclosed simultaneous lesions of the quadratus femoris and adductor magnus with the hamstrings as in our case 1 (1) (Figure 2).

In case of a proximal avulsion treatment of a single tendon injury is nonoperative despite a retraction of more than 2 cm. Operative reconstruction of complete avulsion is advised to allow functional return including high level athletics. A difficult decision is, how to treat a two tendon rupture as semitendinosus and biceps femoris join a common tendon. Beside a variety of different operation techniques, the 5-anchor refixation seem to be the gold-standard (8).

Nonoperative treatment may result in weakness, sitting difficulty or affection of the sciatic nerve due to scar tissue. These symptoms are similar to what has been described as hamstring syndrome by Puranen (11). Therefore, MRI is an important tool to describe the whole complexity of an injury (9) (Figure 2, 3). T2-signal intensity on fat-suppressed images is highly sensitive for musculoskeletal lesions (9). Early diagnosis and subsequent operation of hamstring lesions are crucial for best possible results in functional outcome (3). However, there is no prognostic value of MRI in predicting reinjury (7).

In sport climbing both the running as well as the stretch type of hamstring lesions are known due to heel hooking (12). In high elevation heel hooking the stretch type variation reported by us, may cause serious injuries. Even following surgery, the expected time to function is up to 8,5 months (5). In the worst case, they may terminate the career of a high level sports climber. This should be in mind of trainers and route setters resulting in alternative climbing solutions. ■

Conflict of Interest

The authors have no conflict of interest.

References

- (1) ASKLING CM, TENGVAR M, SAARTOK T, THORSTENSSON A. Acute first-time hamstring strains during slow-speed stretching: clinical, magnetic resonance imaging, and recovery characteristics. *Am J Sports Med.* 2007; 35: 1716-1724. doi:10.1177/0363546507303563
- (2) ASKLING CM, MALLIAROPOULOS N, KARLSSON J. High-speed running type or stretching-type of hamstring injuries make a difference to treatment and prognosis. *Br J Sports Med.* 2012; 46: 86-87. doi:10.1136/bjsports-2011-090534
- (3) BEST R, EBERLE J, BECK F, HUTH J, BECKER U. Surgical refixation after proximal hamstring tendon avulsion injuries: Does the time of surgery influence functional outcome? *Sportverletz Sportschaden.* 2017; 31: 160-166.
- (4) CHAKRAVARTHY J, RAMISETTY N, PIMPALNERKAR A, MOTHADI NG. Surgical repair of complete proximal hamstring ruptures in water skiers and bull riders: a report of four cases and reviews of the literature. *Br J Sports Med.* 2005; 39: 569-572. doi:10.1136/bjism.2004.015719
- (5) COHEN SB, BRADLEY J. Acute proximal hamstring rupture. *J Am Acad Orthop Surg.* 2007; 15: 350-355. doi:10.5435/00124635-200706000-00004
- (6) DANIELSSON A, HORVATH A, SENORSKI C, ALENTORN-GELI E, GARRETT WE, CUGAT R, SAMUELSSON K, HAMRIN E. The mechanism of hamstring injuries – a systematic review. *BMC Musculoskelet Disord.* 2020; 21: 641-662. doi:10.1186/s12891-020-03658-8
- (7) GREENKY M, COHEN SB. Magnetic resonance imaging for assessing hamstring injuries: clinical benefits and pitfalls – a review of the current literature. *Open Access J Sports Med.* 2017; 8: 167-170. doi:10.2147/OAJSM.S113007
- (8) HAMMING MG, PHILIPPON MJ, RASMUSSEN MT, FERRU FP, TURNBULL TL, TRINDADE CA, LAPRADE RF, WIJDICKS CA. Structural Properties of the intact proximal hamstring origin and evaluation of varying avulsion repair techniques: a in vitro biomechanical analysis. *Am J Sports Med.* 2015; 43: 721-728. doi:10.1177/0363546514560878
- (9) KOULOURIS G, CONNELL D. Hamstring muscle complex: an imaging review. *Radiographics.* 2005; 25: 571-586. doi:10.1148/rg.253045711
- (10) ORAVA S, KUJALA UM. Rupture of the ischial origin of the hamstring muscle. *Am J Sports Med.* 1995; 23: 702-705. doi:10.1177/036354659502300612
- (11) PURANEN J, ORAVA S. Hamstring syndrome: a new diagnosis of gluteal sciatic pain. *Am J Sports Med.* 1988; 16: 517-521. doi:10.1177/036354658801600515
- (12) SCHÖFFL V, LUTTER CH, POPP D. The „heel hook“ – a climbing-specific technique to injure the leg. *Wilderness Environ Med.* 2016; 27: 294-301. doi:10.1016/j.wem.2015.12.007