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Research Article

Hamstring Injuries in Taekwondo: Injury Patterns and Performance Following Conservative Therapy-A Case Series Involving Four Elite Athlete

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Abstract

Background: Hamstring injuries frequently occur in sports involving explosive movement patterns and can cause lengthy downtimes. Data on hamstring injuries in Taekwondo is completely lacking. In a case study with four top Taekwondo athletes we describe the specific characteristics of this type of injury, the resulting downtimes and the athletes' performance following conservative treatment, for the first time.

Methods: In a retrospective study, the hamstring injuries of four top international athletes were examined. Injuries were diagnosed by means of MRI. All injuries were classified according to severity and given an MRI score (min. 3, max. 19 points). Performance parameters for assessment included the number match points achieved in the 12 months prior to and following injury, tournament participation and downtime. Recurrent ruptures and contra lateral injuries were also taken into consideration.

Results: Athletes were aged between 16 and 25 (average age 20.3 years).Injuries were exclusively proximal ruptures. The MRI score was between 5 and 9 (mean value 6.5 points). All injuries involved the semi membranous muscle. Ruptures did not extend significantly into the cross-section of the muscle. Manifestation of all injuries in the MRI was without retraction. The average downtime before returning to competition was 69.2 days. The number of match points gained in the 12 months following injury dropped by an average of 19.8. Two athletes suffered recurrent ruptures and two had contra lateral ruptures.

Conclusion: The most frequent form of hamstring injuries in Taekwondo appears to be the stretching type. They result in downtime and a considerable decline in performance. The high incidence of ruptures and the contralateral ruptures within the subsequent year emphasises the extreme biomechanical strain on this muscle group. Parameters are needed to determine the best time to return to the competitive level following conservative therapy.

Keywords: Conservative Treatment; Hamstring Injuries; Return to Competition Taekwondo

Introduction

Taekwondo (TKD) is a traditional martial art that originated in Korea. It is currently practiced in more than 200 countries throughout the world and became an Olympic discipline for the first time at the 2000 Games in Sydney. TKD is a full-contact martial art characterised by its emphasis on dynamic attack and kicking techniques requiring rapid reactions, speed, agility and endurance. TKD is a popular sport in Germany, where the number of active athletes has risen considerably in the last few years. Injuries to the hamstring group of muscles generally occur in the two-articulated sections following sudden over-extension of the muscles with a maximum degree of hip flexion and knee extension [1]. So far, sprint sports such as American football, in which the rapid changeover from muscle contraction to relaxation occurs, were known to be high-risk sports [2]. In TKD such movement patterns during explosive high kicks are especially important, as attacks to the opponent's head are only permitted with the feet and generally score highly. The frequency of general injuries to the hip is approx. 11 % [3-5] and to the lower extremities 44.5 % [6]. To date there is no explicit data on the frequency and patterns of hamstring injuries in TKD, as information on the occurrence of TKD injuries in the literature is unspecific [3,4]. This retrospective study is based

on a case series and describes injury patterns to the proximal hamstrings among top TKD athletes for the first time.

Materials and Methods

This retrospective study involves four top elite TKD athletes from an Olympic training centre who suffered hamstring injuries during training or a tournament between 2012 and 2016. All were top international athletes from the German national Taekwondo team with regular participation in national and international tournaments. The parameter for the athletes' performance was the number of World Taekwondo Federation ranking points attained twelve and six months prior to and after injury [8]. This ranking system allows the comparison of different athletes throughout the world. Each athlete is awarded competition points according to the place achieved in an international tournament. The more matches the athlete wins, the more points he is awarded in the tournament.

All athletes were examined by a qualified sports physician. In the case of suspected injury in the hamstring area an advanced MRI diagnosis was made within three days to allow scores and the time interval since injury to be compared [9]. A record was also made of athletes' other injuries. An experienced sports physician was in charge of the conservative therapy and treatment was based on an adapted training plan. This ensured the avoidance for six weeks of forced flexion in the region of the hip due to high kicks. This was accompanied by measures and exercises to reduce muscle tone in the affected area and stabilise the pelvic muscles. The MRI images were analysed retrospectively by a radiology specialist for musculoskeletal MRI diagnostics. Injuries were classified according to the radiological criteria of the MRI signal and a previously validated MRI score; which denoted the severity of the hamstring injury and was determined on the basis of age, number of injured muscles, and location of rupture, retraction, diameter of injury and intensity of T2 signal [10]. A minimum of 3 and maximum of 19 points were allocated depending on the severity of the injury (Table 1).

Table 1: Competition points 12 month bevor/ after Injury and time for return to competition.

Athlet	Competition points 12 month before injury	Competition points 12month after injury	Return to competition in days
I	82	61	28
II	19	32	158
III	102	32	30
IV	28	27	61

Results

Table 2: Characteristics of Hamstring Injuries and MRI scoring.

Athlet	Age	Injuredmuscles ,n	LocalisationofInjury	Localisation of Injury site /Avulsion	Extend of Muscle Injury in %	Retraction in cm	Extend of T2 signal in longitudinal axis	Score
I	1	1	1	2	0	0	1	6
II	1	1	1	2	0	0	0	5
III	1	1	1	2	0	0	1	6
IV	1	2	1	0	3	0	2	9

Table 3: Involved Muscles and Re-Injuries.

Athlet	InjuredMuscles	Re-injury ipsilateral	Re-injury contralateral	Time to re-injury in month
I	Semimembranous	-	-	-
II	Semimembranosus	-	Semimembranosus	43
III	Semimembranosus	-	Semimembranosus, Biceps femoris caput longum	7
IV	Semimembranosus Semitendinosus	Semitendinosus	-	38

The athletes examined were aged between 16 and 25 (average age 20.3 years). All athletes participated in international tournaments with points system during the examination period (Tables 2 & 3). The MRI score for the hamstring injury was between 5 and 9. The mean value for all athletes was 6.5 points. Injuries and partial injuries were also differentiated (Table 2). With one exception, all athletes suffered injuries to the proximal hamstrings at the tuber are chiadicum. The semi membranous free tendon was involved in all injuries. Ruptures did not extend significantly into the cross-section of the muscle. Just one athlete exhibited an ectasia >75% with an injury at the musculo tendinous junction, the diameters of other ruptures were <25%.Manifestation of all injuries in the MRI was without retraction (Table 2). The athletes competed in an average of 2.8 tournaments in the six months prior

to injury, this dropped to 2 tournaments, equivalent to a reduction of 29%, in the six-months following injury [8].

The interval between injury and the return to international competition was between 28 and 158 days (average 69.2 days) (Table 3). The average number of points scored in a tournament during the examination period dropped from 57.8 points before injury to 38 points in the 12 months after injury [8]. This is equivalent to an average reduction of 19.8 points. None of the athletes achieveda score that equal ledor exceeded this level of performance in the six months prior to injury. Just one athlete achieved a higher score in the 12 months after the injury compared to the 12 previous months. It was interesting to note that this athlete also took the longest break before returning to competition after injury (Table 4). One athlete suffered Re-Injury during the examination period, while two athletes suffered contralateral ruptures of the proximal hamstrings (Table 2). No further serious injuries requiring downtime were recorded for any of the athletes during the 12 months after the return to competition.

Discussion

Hamstring injuries are often found in sports requiring sudden sprints such as soccer, football [10,11] and track and field athletics [12]. The result for the athlete, depending on the sport, is often considerable downtime. Sprinting in these sports involves hamstring extension with increasing hip flexion, which is compensated by a relative decrease in knee extension. This means, the hamstrings have a braking effect on the knee during maximum sudden hip flexion [13]. This study deals exclusively with proximal hamstring injuries, which can only be explained as taking place during high kicks with eccentric muscle contraction, inflected hip and (hyper)extended knee [14,15].Hamstring injuries are known to occur often at the myotendinous junction [16].

Risk factors under discussion are insufficient warming up, malalignment of the pelvis, exhaustion and previous injury [17-20]. Due to the insufficient contraction potential, the ischiocrural muscle group does not attain its full range of movement in the hip and the knee joints at the same time [15]. In TKD the opponent is kept at a distance by raising the leg and slightly bending the knee, meaning that initial flexion is usually greater at the hip than at the knee. When the athlete aims for the opponent's head he or she adopts a position of full hip flexion to allow the leg to reach as high up towards the opponent's head as possible with almost simultaneous knee extension to make full use of the entire length of the leg. The high kick in TKD is therefore preceded by considerable pre-tension at the hamstring origin.TKD athletes often exhibit muscular imbalance in the hip to accommodate the heavy demands on the hip flexors. The quadriceps femoris and iliopsoas muscles are generally more developed. The resultant pelvic tilt also increases pre-tension in the proximal hamstrings.

In sprinting sports the most common injury is to the long head of biceps femoris [21]. In this study, however, it was found that almost all athletes suffered injury to the proximal free tendon of semi membranous, also known to be common amongst dancers. The reason for this injury pattern could lay in the small source area with additional muscle adduction moment. In TKD it could therefore more likely to be a stretching type injury rather than a high-speed type [22]. The general limitation of extension and retraction in the injured muscles is also consistent with this observation. A certain predisposition to this injury pattern could also be due to chronic pre-existing damage at the myotendinous junction of this muscle group. The fact that ruptures and injuries to the contralateral muscle group occurred during the study period supports this observation. In a study involving NFL players, the classification of hamstring injuries correlated strongly with the players' downtimes [23]. The average MRI score of 6.5 among TKD athletes is moderate but resulted in a relatively major downtime of 61 days, comparable to professional dancers with similar injury patterns [22]. The wide range of values (28-158 days) before returning to competition can be explained by the irregular tournament cycle and the systematic competition training plan before important tournaments. Downtimes are therefore more difficult to define than they are in sports with regular match schedules. No statistical correlation between the ascertained parameters could be shown due to the small number of cases.

In American football and rugby [23,24] it could be shown that players with moderate hamstring injuries did not necessarily have to miss an entire season. Good mid-term functional results have been achieved following surgical reification of the proximal hamstrings, however, this is only indicated for high-grade injuries (involvement of the conjoint tendon as avulsion at tuber ischiadicum and retraction > 2 cm) [25-27]. On average, a return to pre-injury performance was not possible until six months after surgery. There is no data whatsoever on outcomes following conservative treatment in TKD. In this study, top TKD athletes returned to the competitive level after an average of 61 days, albeit with significant performance deficits. The direct comparison with the results of surgical intervention is however futile, as injury patterns only exhibited minor retraction. It therefore remains to be seen whether a return to TKD competition is possible, despite the moderate severity of hamstring injuries in an MRI Score. A closer investigation of this question in Taekwondo would require a long-term follow-up study of the injured athletes taking all injuries into account.

Conclusion

There has been no study on the extent and effects of hamstring injuries in world-class TKD. This is the first study to describe in detail the injury patterns and effects on the competitive success of a small number of athletes following conservative treatment. All of them were found to be stretching-type proximal injuries with mid-range MRI scores, which resulted in less frequent participation in competitions and a significant drop in performance. The incidence of ruptures or injury of the contralateral muscles within

the subsequent year emphasises the extreme biomechanical strain on this muscle group in TKD. The provision of further recommendations for optimised treatment and parameters for the best time to return to competition in this sport requires the long-term functional follow-up study of a greater number of cases.

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