

National Football League Athletes' Return to Play After Surgical Reattachment of Complete Proximal Hamstring Ruptures

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Abstract

Although hamstring strains are common among professional football players, proximal tendon avulsions are relatively rare. Surgical repair is recommended, but there is no evidence on professional football players return to play (RTP). We hypothesized that surgical reattachment of complete proximal hamstring ruptures in these athletes would enable successful RTP.

Ten proximal hamstring avulsions were identified in 10 National Football League (NFL) players between 1990 and 2008. Participating team physicians retrospectively reviewed each player's training room and clinical records, operative notes, and imaging studies.

The ruptures were identified and confirmed with magnetic resonance imaging. Of the 10 injuries, 9 had palpable defects. Each of the ruptures was managed with surgical fixation within 10 days of injury. All of the players reported full return of strength and attempted to resume play at the beginning of the following season, with 9 of the 10 actually returning to play. However, despite having no limitations related to the surgical repair, only 5 of the 10 athletes played in more than 1 game.

Most NFL players who undergo acute surgical repair of complete proximal hamstring ruptures are able to RTP, but results are mixed regarding long-term participation. This finding may indicate that this injury is a marker for elite-level physical deterioration.

is fully extended as the hamstring is maximally contracting.⁵ Most hamstring strains occur at the musculotendinous junction, about 12 cm distal to the ischium.^{6,7} NFL players have a favorable return to play (RTP) from musculotendinous injuries, with time to return dependent on magnetic resonance imaging (MRI) grade.⁸ Although much less common, complete ruptures of the hamstring tendons from the ischial tuberosity do occur. Poor results have been reported for nonoperative treatment of this type of hamstring injury,⁹ prompting several authors to perform surgical repair. Few studies, however, have specifically reviewed repair of acute ruptures in elite athletes.^{4,5,10-12} We conducted a retrospective review to assess the ability to return to play after proximal hamstring rupture among NFL athletes.

Materials and Methods

Using the NFL Injury Surveillance System, we retrospectively reviewed the cases of NFL players who sustained a unilateral proximal hamstring rupture between 1990 and 2008. After identifying the players, we asked active team physicians to complete a questionnaire asking for demographic information (including age), position, prodromal symptoms, prior injuries, physical examination findings, diagnostic studies, treatment, results, and RTP. Time missed and number of games played before and after injury were also recorded.

Final outcome measures included return to prior level of competition and subsequent injury. RTP was defined as returning to participate in at least 1 NFL game. In addition, player quality, determined by draft position, was analyzed as a predictor for RTP. As the NFL draft has 7 rounds, drafted players were assigned a number of 1 through 7, and undrafted players were automatically assigned an 8.

Statistical analysis was performed with Stata 10 (StataCorp LP, College Station, Texas).

Results

Ten complete proximal hamstring ruptures were identified and confirmed through the team physician questionnaires. Mean age at time of injury was 27.2 years (range, 23-30 years). All injuries occurred during the regular season; 8 of the 10

Hamstring strains are common among athletes, especially players in the National Football League (NFL).^{1,2} Strains usually occur from an eccentric load in sporting activities that require rapid acceleration and deceleration.^{3,4} The hip is forced into flexion while the knee

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Table I. Player Demographics by Draft Status and Return to Play Through 2010 Season

Position	Draft Round	No. of Games Played		Notes
		Before Injury	After Injury	
Quarterback	1	21	1	Played backup next season
Defensive lineman ^a	1	44	60	—
Wide receiver	1	58	1	Tore Achilles tendon on return
Linebacker ^a	1	134	76	—
Linebacker	3	27	1	Avulsed contralateral hamstring on return
Tight end	3	12	102	—
Defensive lineman	4	84	37	—
Running back ^a	7	12	30	—
Defensive back	8	34	1	—
Defensive back	8	46	0	—

^aPlayer still active.

Table II. Return to Play by Position

Position	Total	%
Quarterback	1/1	100
Defensive lineman	2/2	100
Tight end	1/1	100
Wide receiver	1/1	100
Running back	1/1	100
Linebacker	2/2	100
Defensive back	1/2	50

occurred after week 4. Overall, 10 players were injured: 2 defensive backs, 2 defensive linemen, 2 linebackers, 1 quarterback, 1 wide receiver, 1 running back, and 1 tight end. Six of the 10 players reported hip hyperflexion with the knee extended as the mechanism of injury; others reported running, jumping, and cutting. Three players identified prodromal symptoms of tightness and pain. No player received steroid injections before injury, and no player returned to play in the same game or the same season.

Initial physical examination revealed a palpable defect in 9 of the 10 injuries. There were no sciatic nerve symptoms. MRI confirmed the diagnosis; displaced complete hamstring avulsions were identified in all 10 cases, with more than 3 cm of retraction noted in 7 of the cases. The players underwent direct surgical repair without augmentation. Mean time to surgery was 7 days (range, 3-10 days). All patients were treated with hinged knee braces to limit knee extension for a minimum of 2 weeks after surgery. Specific rehabilitation depended on the treating physician. There were no thromboembolic events, wound complications, or other perioperative complications.

All 10 players attempted RTP at the beginning of the following season. Each regained 5/5 strength bilaterally by

Table III. Return to Play by Draft Round and Games Played Before and After Injury

	Return to Play	
	Yes	No
Mean draft round	3.25	5.5
Mean no. of games played		
Before injury	49.875	36.5
After injury	38.5	0

manual muscle testing, and the 3 players assessed using an isokinetic strength testing machine (Cybex International Inc, Owatonna, Minnesota) demonstrated symmetrical strength to the uninvolved side. Nine of the 10 players returned to play the next season; 1 player reported loss of speed, despite symmetric isokinetic strength testing to the uninvolved side, and was unable to return to competitive play. Four players returned to the active roster but played in only 1 game (Table I). One of these 4 was a quarterback who had no complaints about his hamstring and served as backup quarterback; 2 incurred serious unrelated injuries on RTP (Achilles tendon tear, contralateral hamstring avulsion); and the fourth was cut by the team. Player position did not influence ability to make a sustained RTP (Table II). Player draft status and correlation with RTP are listed in Table III. Neither of the 2 undrafted players returned to play in more than 1 game, whereas 5 of the 8 drafted players returned to play in more than 1 game (P = .11, trend toward significance).

Discussion

The hamstring muscle group consists of the biceps femoris, the semitendinosus, and the semimembranosus. Each of these 3 muscles spans 2 joints, making them more susceptible to

injury.¹ Although most of these injuries occur at the muscle–tendon junction, the patient must be thoroughly evaluated for a potential proximal hamstring avulsion, as many proximal hamstring avulsions are not identified acutely.⁴ In several case series, early surgical repair of ruptured hamstring tendons produced good functional outcomes.^{4,5,9,11–15}

The mechanism of injury typically is eccentric hamstring contraction with sudden forced hip flexion of an extended knee. The same mechanism was found in 60% of the patients in the present study. Patients often describe a pop or a stabbing pain in the back of the thigh, with an inability to continue their activity. Many develop thigh swelling and significant ecchymosis within 24 to 48 hours of injury. There is usually a palpable defect with a muscle bulge distally when the hamstring tendons rupture proximally. Patients also frequently report pain while sitting.

When a proximal hamstring rupture is suspected, full-length thigh MRI is needed.⁴ This type of MRI helps identify the injured tendon and provides information about tendon retraction. Because of its low sensitivity, ultrasonography is not recommended for evaluation of this injury. Koulouris and Connell¹⁴ documented a true positive rate of only 58% of patients examined with ultrasonography.

Nonoperative management tends to result in a poor prognosis. Sallay and colleagues⁹ reviewed nonoperative management of proximal hamstring injuries in water-skiers; 5 of 6 patients with complete ruptures were significantly limited and unable to return to sports or running. Several authors have reported poor outcomes after repair of chronic hamstring ruptures.^{5,11,12} Adhesions, fatty degeneration, and loss of excursion make repair of these injuries significantly more difficult. Orava and Kujala¹¹ noted that 3 of 4 repairs of chronic ruptures had fair or poor outcomes, whereas repairs of acute injuries had good results. Sarimo and colleagues¹² noted a statistically significant correlation between delay in surgical reattachment and final outcome. Wood and colleagues⁵ reviewed a large series of cases and noted that delay in surgical repair renders the repair more technically challenging, increases the likelihood of sciatic nerve involvement and the need for postoperative bracing, and reduces the strength and the endurance of the hamstring.

Early repair of proximal hamstring ruptures generally leads to good outcomes. Wood and colleagues⁵ reported on 72 cases of proximal hamstring ruptures (mean contralateral hamstring strength, 84%) in a study that included chronic repairs. Eighty percent of the patients, including 3 professional athletes, returned to preinjury level of sports within 6 months. Sarimo and colleagues¹² reviewed 41 proximal hamstring ruptures and noted that 27 recreational athletes in the group returned to their sport within 4 to 10 months after surgery. In addition, 1 national-level handball player returned to play 10 months after surgery.

Birmingham and colleagues¹⁶ evaluated functional outcomes at a mean of 43.3 months after repair. Twenty-one of 23 patients returned to 95% of preinjury activity level at a mean of 9.8 months and regained 90% to 93% of strength

(vs contralateral side) with use of a dynamometer. Contrary to previously referenced findings,^{1,5,11,12} the authors found no effect associated with time from injury to surgery. However, they did not evaluate elite athletes' RTP.

Konan and Haddad¹⁰ reported on a case series of 10 semi-professional and professional athletes who underwent repair of an acute proximal hamstring rupture. Nine of the 10 returned to their previous level of semiprofessional or professional sports within 9 months after surgery.¹⁰ Two patients were playing football, but specifics were not provided.

Our study is unique in that it evaluated this uncommon injury in a population of very elite athletes. These athletes face the challenges of recovery and potential replacement by younger athletes. These injuries are spread evenly throughout the season. In contrast, 57% of anterior cruciate ligament injuries occur before week 5 of the regular NFL season.¹⁷ We had speculated a temporal finding, given the physical breakdown that occurs throughout the season, but our study data did not support that conclusion.

This study had several limitations. As these injuries seldom occur at the elite level—our multicenter retrospective case series covered a 15-year period—there was no uniformity in postoperative rehabilitation, adequate follow-up evaluation using standardized outcome measures, and extensive statistical analysis. We believe, however, that RTP in the NFL provides a stringent objective measure of recovery and outcome, far exceeding that required of a recreational athlete. Use of this criterion has been supported by previous studies as an outcome measure for anterior cruciate ligament reconstruction and patellar tendon ruptures.^{18,19}

It is clear from the literature that early repair offers good-to-excellent recovery of hamstring strength and endurance. However, no study has specifically evaluated elite athletes' ability to return to play after this injury. The present case series was limited in sample size and did not objectively evaluate strength testing; instead, it focused on ability to return to play and specifically identified acute repairs in elite athletes in the NFL. Of our 10 players, 9 returned to their pre-injury level the next year. One athlete did not return despite reports of regaining full-strength in the injured hamstring. Although there was a 90% RTP, only 50% of patients played more than 1 game after injury. The discrepancy may represent the difficulty in maintaining the level of play needed in the NFL rather than the ability and willingness to participate, independent of previous injuries. Other studies have demonstrated lower RTP in elite players compared with recreational athletes,^{17,19} and this injury may follow those trends.

Conclusion

Although hamstring injuries are common in elite athletes, proximal hamstring avulsions are rarer and more severe. According to the literature, outcomes are significantly better for surgically repaired acute proximal hamstring injuries than neglected ruptures. Ninety percent of NFL players with repaired acute complete proximal hamstring ruptures returned to their same level of competition, but only 50% had

a sustained RTP. This finding may indicate that this injury is a marker for elite-level physical deterioration. Although draft status did not show a difference in RTP, there was a trend toward statistical significance ($P = .11$), and a larger series of players may show significance.

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