

# Return to Sport After Proximal Hamstring Tendon Repair

## A Systematic Review

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**Background:** Previous studies have evaluated functional outcomes and return-to-sport rates after proximal hamstring tendon (HT) repair.

**Purpose:** To systematically review the literature in an effort to evaluate return-to-sport rates after proximal HT repair.

**Study Design:** Systematic review; Level of evidence, 4.

**Methods:** A systematic review was performed by searching PubMed, the Cochrane Library, and Embase to identify studies that evaluated postoperative lower extremity function and return-to-sport rates in patients after proximal HT repair. Search terms used were “hamstring,” “repair,” “return to sport,” and “return to play.” Patients were assessed based on return to sport, return to preinjury activity level, type of HT tear (complete or partial), and interval from injury to surgery. Patients were also divided into subgroups depending on timing of the surgical intervention: early, <1 month; delayed, 1 to 6 months; and late, >6 months from the time of injury.

**Results:** Sixteen studies (one level 2, five level 3, ten level 4) met the inclusion criteria, including 374 patients with a complete proximal HT tear (CT group) and 93 patients with a partial proximal HT tear (PT group), with a mean follow-up of 2.9 years. Overall, 93.8% of patients (438/467) returned to sport, including 93.0% (348/374) in the CT group and 96.8% (90/93) in the PT group ( $P = .18$ ). The mean time to return to sport was 5.7 months, and 83.5% of patients (330/395) returned to their preinjury activity level. The early group demonstrated the greatest rate of return to sport at 94.4% (186/197) as well as the quickest time to return at a mean of 4.8 months, although this was not found to be statistically significant.

**Conclusion:** Over 90% of patients undergoing repair of a complete or partial proximal HT tear can be expected to return to sport regardless of the tear type. Early surgical interventions of these injuries may be associated with a quicker return to sport, although the rate of return to sport does not differ based on timing of the surgical intervention.

**Keywords:** hamstring tendon repair; return to sport; complete tear; partial tear

Hamstring tendon (HT) injuries are among the most common musculoskeletal injuries in athletes.<sup>7</sup> Acute ruptures of the proximal HT are often the result of eccentric overloading of the tendon whereby the hip is hyperflexed and the ipsilateral knee is extended, which can lead to significant disability if left untreated.<sup>4,10,11</sup> Conditions such as femoroacetabular impingement may place a patient at an increased risk of proximal HT injuries by restricting hip range of motion and altering pelvic tilt.<sup>14</sup> HT repair involves the reattachment of a tendon that has been completely separated from the ischial tuberosity or the

restoration of a partial tear that is usually characterized by partial detachment from the bone while maintaining considerable continuity with the ischial tuberosity.<sup>16,27</sup> Surgical treatment is recommended when at least 2 tendons are ruptured, tendon retraction is  $\geq 2$  cm,<sup>1</sup> or in high-level athletes with chronic pain related to partial tears that do not involve any retraction of the tendon. Because HT ruptures disrupt posterior chain biomechanics, patients with HT injuries often experience decreased function of the affected lower limb and an inability to return to preinjury activity levels.<sup>9</sup>

Several studies have shown HT repair to increase patient satisfaction, pain relief, and strength when compared with nonoperative treatment,<sup>2</sup> although the data regarding return to sport are less consistent. The purpose of this

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study was to systematically review the literature in an effort to evaluate return-to-sport rates after proximal HT repair.

## METHODS

This systematic review was conducted according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines using a PRISMA checklist. Two independent reviewers (J.W.B., D.A.H.) searched PubMed, Embase, and the Cochrane Library up to September 10, 2018. The electronic search strategy used was the following: hamstring repair return to (sport OR play). A total of 121 studies were reviewed by title and/or abstract to determine study eligibility based on inclusion criteria. In cases of disagreement, a third reviewer (M.J.K.) made the final decision. The inclusion criteria were studies that evaluated return to sport in patients undergoing complete (CT group) or partial (PT group) proximal HT repair. Exclusion criteria included case reports, studies that treated HT tears nonoperatively, and studies that did not report return-to-sport data. Sixteen studies were determined to meet inclusion criteria (Figure 1).

Data extraction from each study was performed independently and then reviewed by a second author (M.J.K.). There was no need for funding or a third party to obtain any of the collected data. In analyzing return to sport based on timing of the surgical intervention, patients were divided into 3 subgroups: “early” was defined as less than 1 month from injury to surgery, “delayed” was defined as between 1 month and 6 months, and “late” was defined as more than 6 months.

## Statistical Analysis

A weighted mean was calculated for numerical demographics (age, follow-up). A chi-square test was used to compare rates of return to sport between the CT and PT groups and between the early, delayed, and late groups. A *P* value < .05 was considered statistically significant.

## RESULTS

A total of 467 patients were included in this systematic review (CT: *n* = 374; PT: *n* = 93), including patients in the early group, delayed group, and late group. The mean patient age at the time of surgery was 39.6 years (range,

13 to 74 years), and the mean follow-up time was 2.9 years (range, 6 months to 10 years) (Table 1). Twelve studies<sup>||</sup> specified the patients being involved in either professional or recreational sports, including 147 professional/competitive and 198 recreational athletes. Ten studies<sup>¶</sup> provided sport-specific data in which there were a total of 79 water skiers, 45 rugby players, 39 soccer players, 25 runners, 19 skiers, 13 ice hockey players, 12 football players, 10 martial artists, 8 tennis players, 7 handball players, 4 equestrians, 3 lacrosse players, 3 dancers, 3 basketball players, 2 pole vaulters, 2 gymnasts, 2 ultimate frisbee players, 2 cricket players, 2 road bikers, and 1 skydiver.

## Surgical Technique

All studies performed proximal HT repair with patients in the prone position and the affected limb partially flexed at the knee to avoid tension on the HT. In 6 studies<sup>3,4,6,13,21,23</sup> (37.5%), a transverse incision was made at the gluteal crease, and the caudal edge of the gluteus maximus was identified and retracted proximally to expose the injured HT. Six studies<sup>1,8,15,16,18,20</sup> (37.5%) performed HT repair with a vertical incision starting from the ischial tuberosity extending 5 to 15 cm distally, depending on the size of the patient, and 1 study<sup>25</sup> (6.3%) used a transverse incision for acute injuries (<6 months) and a vertical incision for chronic injuries (>6 months). Two studies<sup>12,24</sup> (12.5%) used a combination of vertical and transverse incisions but did not specify under what circumstances each type was used.

Regardless of the incision type, the HT sheath was then divided longitudinally, and the HT origin on the ischial tuberosity was visualized and prepared for the placement of various suture anchors depending on the size of the footprint and quality of the tendon. The proximal edge of the injured HT was retrieved, debrided to viable tissue, and sutured to the ischial tuberosity using 1 to 5 suture anchors, depending on the tear size and tissue quality. For acute injuries with minimal retraction, any existing hematoma was evacuated. For chronic cases (>6 months), considerable retraction and scarring were expected, in which case a vertical incision was used to better expose the affected HT. The sciatic and posterior cutaneous femoral nerves were identified and mobilized to prevent nerve damage. For patients with a chronic injury, 1 study<sup>20</sup> used an interposition graft to augment the considerable retraction

<sup>||</sup>References 3, 4, 6, 8, 13, 15-18, 21, 24, 25.

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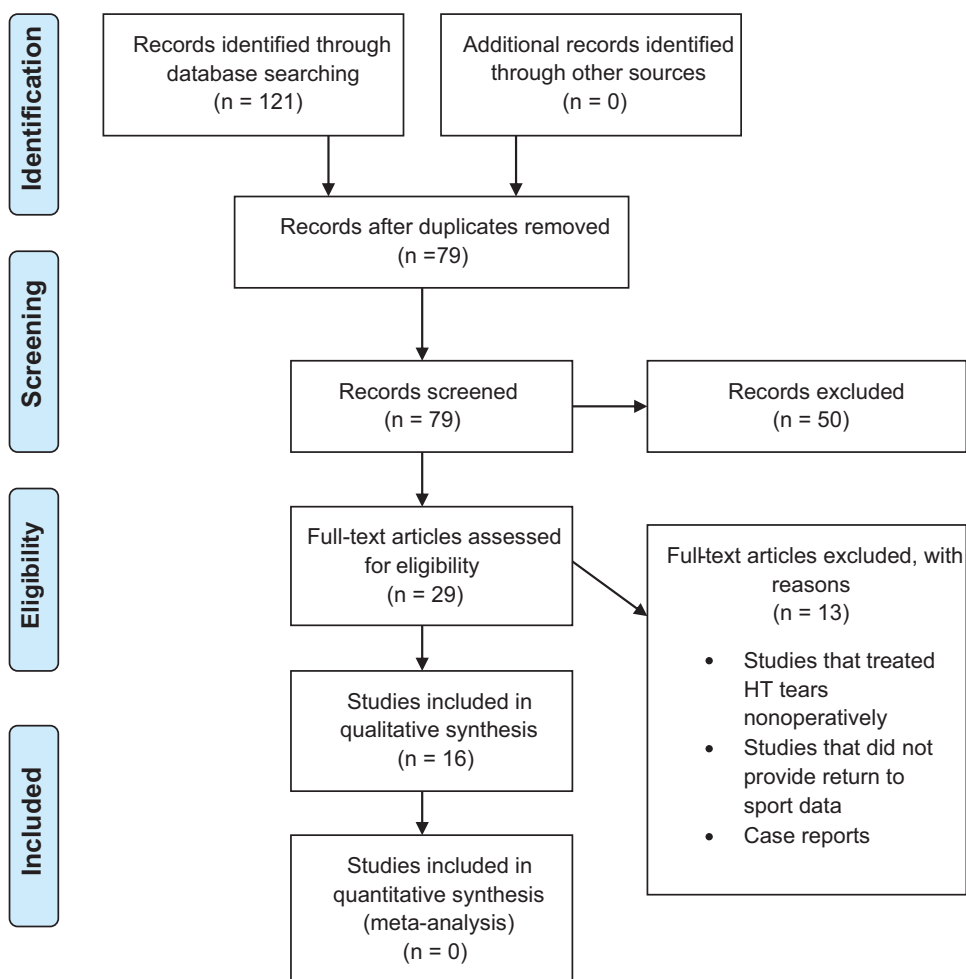


Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram. HT, hamstring tendon.

TABLE 1  
Included Studies<sup>a</sup>

Author (Year)	Level of Evidence	CT/PT, n	Patient Age, y	Follow-up, y
Birmingham et al <sup>1</sup> (2011)	4	23/0	46.0	3.6
Bowman et al <sup>3</sup> (2013)	4	0/17	43.0	2.7
Chahal et al <sup>4</sup> (2012)	4	13/0	44.6	3.1
Cohen et al <sup>6</sup> (2012)	4	23/0	47.7	2.8
Folsom and Larson <sup>8</sup> (2008)	2	26/0	44.0	1.7
Klinge and Sallay <sup>12</sup> (2002)	3	9/0	41.5	2.8
Konan and Haddad <sup>13</sup> (2010)	4	10/0	29.2	NR
Lefevre et al <sup>15</sup> (2013)	3	23/11	39.3	2.3
Lempainen et al <sup>16</sup> (2006)	4	0/47	33.0	3.0
Mansour et al <sup>17</sup> (2013)	4	10/0	27.2	NR
Orava et al <sup>18</sup> (2015)	4	7/4	18.1	4.7
Rust et al <sup>20</sup> (2014)	3	72/0	47.1	3.8
Sandmann et al <sup>21</sup> (2016)	3	15/0	46.8	4.7
Shambaugh et al <sup>23</sup> (2017)	3	14/0	47.0	3.6
Skaara et al <sup>24</sup> (2013)	4	17/14	51.0	2.5
Subbu et al <sup>25</sup> (2015)	4	112/0	29.0	2.0
Total	—	374/93	39.6	2.9

<sup>a</sup>Patient age and follow-up are reported as the mean, with total values reported as the weighted mean. CT, complete proximal hamstring tendon tear; NR, not reported; PT, partial proximal hamstring tendon tear.

TABLE 2  
Return to Sport<sup>a</sup>

Author (Year)	CT/PT, n	Returned to Sport, n (%)		Time to Return, mo	Returned to Preinjury Activity Level, n (%)
		CT	PT		
Birmingham et al <sup>1</sup> (2011)	23/0	21 (91.3)	—	9.8	19 (82.6)
Bowman et al <sup>3</sup> (2013)	0/17	—	17 (100.0)	NR	17 (100.0)
Chahal et al <sup>4</sup> (2012)	13/0	13 (100.0)	—	NR	8 (61.5)
Cohen et al <sup>6</sup> (2012)	23/0	23 (100.0)	—	6.6	16 (69.6)
Folsom and Larson <sup>8</sup> (2008)	26/0	21 (80.8)	—	NR	15 (57.7)
Klinge and Sallay <sup>12</sup> (2002)	9/0	7 (77.8)	—	6.0	7 (77.8)
Konan and Haddad <sup>13</sup> (2010)	10/0	10 (100.0)	—	7.5	10 (100.0)
Lefevre et al <sup>15</sup> (2013)	23/11	23 (100.0)	11 (100.0)	5.7	27 (79.4)
Lempainen et al <sup>16</sup> (2006)	0/47	—	45 (95.7)	5.0	41 (87.2)
Mansour et al <sup>17</sup> (2013)	10/0	10 (100.0)	—	5.0	9 (90.0)
Orava et al <sup>18</sup> (2015)	7/4	7 (100.0)	4 (100.0)	NR	7 (63.6)
Rust et al <sup>20</sup> (2014)	72/0	56 (77.8)	—	NR	NR
Sandmann et al <sup>21</sup> (2016)	15/0	15 (100.0)	—	6.0	14 (93.3)
Shambaugh et al <sup>23</sup> (2017)	14/0	14 (100.0)	—	NR	14 (100.0)
Skaara et al <sup>24</sup> (2013)	17/14	16 (94.1)	13 (92.9)	NR	18 (58.1)
Subbu et al <sup>25</sup> (2015)	112/0	112 (100.0)	—	5.0	108 (96.4)
Total	374/93	348 (93.0)	90 (96.8)	5.7	330 (83.5)

<sup>a</sup>Time to return is reported as the mean, with total values reported as the weighted mean. CT, complete proximal hamstring tendon tear; NR, not reported; PT, partial proximal hamstring tendon tear.

of the native HT. One study<sup>17</sup> (6.3%) did not describe the surgical technique for HT repair.

### Return to Sport

Fifteen studies<sup>#</sup> (93.8%) defined return to sport as a return to any sport, while 1 study<sup>17</sup> (6.3%) defined return to sport as a return to the same sport in which the patient was involved before the injury. Overall, 93.8% of patients (438/467) returned to sport, with 83.5% returning to their preinjury activity level (330/395). The mean time to return to sport was 5.7 months from the date of surgery. The proportion of patients who were able to return to sport did not significantly differ between the CT (348/374; 93.0%) and PT (90/93; 96.8%) groups ( $P = .18$ ) (Table 2).

When patients were subdivided into groups based on timing of the surgical intervention, there were 197 patients in the early group, 62 patients in the delayed group, and 78 patients in the late group. Overall, the early group demonstrated the quickest time to return to sport at a mean of 4.8 months postoperatively, although statistical significance could not be determined for this outcome, given a lack of complete reporting data. Furthermore, this group was found to have the highest rate of return to sport (186/197; 94.4%), although this was not statistically significant ( $P = .38$ ) (Table 3).

### DISCUSSION

The results of this systematic review suggest that patients undergoing repair of either a complete or partial proximal

HT tear can be expected to return to sport at a similar rate, and while early surgical interventions (<1 month from injury) are associated with a slightly quicker return to sport when compared with patients undergoing delayed or late repair, this could not be found to be statistically significant, given incomplete data reporting in the studies included. All 3 groups (early, delayed, late) can be expected to return to sport at a similar rate.

Nonoperative treatment has been recommended for single-tendon tears with or without retraction,<sup>6</sup> although recent studies<sup>2,9,11,23</sup> have associated HT tears treated nonoperatively with reduced postoperative functionality of the affected limb, lower rates of return to sport (as low as 71%<sup>2</sup>), and less patient satisfaction when compared with those treated surgically.<sup>2,9,11,23</sup> Consequently, both acute and chronic repair of complete and partial proximal HT ruptures have become more popular in recent years. Although HT repair is an invasive treatment option, it has many biomechanical benefits that should be considered when compared with nonoperative management. Repair of a complete or partial proximal HT tear offers anatomic restoration of the hamstring complex in an effort to re-establish pelvic and posterior thigh biomechanics. As a result of this, the procedure is nearly identical for both complete and partial tears, which could explain the similar rates of return to sport between the CT and PT groups. The risks associated with surgery should still be considered, however. Wound infections, nerve injuries, and adhesions are among the most common postoperative complications after this procedure and can significantly delay postoperative rehabilitation and overall recovery.<sup>1,25</sup> Unfortunately, the data on complications in each study were not specific enough to apply these complications to each group.

<sup>#</sup>References 1, 3-5, 8, 12, 13, 16-18, 20, 21, 23-25.

TABLE 3  
Return to Sport Based on Interval From Injury to Surgery<sup>a</sup>

Author (Year)	n	Interval From Injury to Surgery	Time to Return, mo	Returned to Sport, n (%)	Age, y
Early group (<1 mo)					
Konan and Haddad <sup>13</sup> (2010)	10	12.0 d	7.5	10 (100.0)	29.2
Lefevre et al <sup>15</sup> (2013)	34	13.6 d	5.7	34 (100.0)	39.3
Mansour et al <sup>17</sup> (2013)	10	7.0 d	5.0	10 (100.0)	27.2
Rust et al <sup>20</sup> (2014)	51	17.8 d	NR	41 (80.4)	49.8
Shambaugh et al <sup>23</sup> (2017)	14	28.1 d	NR	14 (100.0)	47.0
Subbu et al <sup>25</sup> (2015)	78	22.0 d	4.0	77 (98.7)	29.7
Total	197	18.6 d	4.8	186 (94.4)	37.6
Delayed group (1-6 mo)					
Birmingham et al <sup>1</sup> (2011)	23	4.0 mo	9.8	21 (91.3)	46.0
Sandmann et al <sup>21</sup> (2016)	15	2.0 mo	6.0	15 (100.0)	46.8
Subbu et al <sup>25</sup> (2015)	24	2.9 mo	5.8	21 (87.5)	28.6
Total	62	3.1 mo	7.3	57 (91.9)	39.5
Late group (>6 mo)					
Lempainen et al <sup>16</sup> (2006)	47	14.0 mo	5.0	45 (95.7)	33.0
Rust et al <sup>20</sup> (2014)	21	14.0 mo	NR	15 (71.4)	40.7
Subbu et al <sup>25</sup> (2015)	10	12.0 mo	7.3	10 (100.0)	30.7
Total	78	13.7 mo	5.4	70 (89.7)	34.8

<sup>a</sup>Interval from injury to surgery, time to return, and age are reported as the mean, with total values reported as the weighted mean. NR, not reported.

Despite an increased awareness of the outcomes of HT repair, delayed interventions of complete and partial HT tears are still common.<sup>27</sup> Nonoperative treatment of this injury often results in sciatica, posterior thigh pain, and muscle weakness, leaving patients with poor function and more extensive rehabilitation.<sup>6,19</sup> Consequently, timing of the intervention can directly affect postoperative mobility and ultimately return to sport.<sup>25</sup> Repair of chronic proximal HT tears has been associated with a decreased rate of return to sport and increased time to return when compared with repair of acute tears, although in our review the difference between the early and late groups was only 0.6 months.<sup>13,22,25</sup> This may in part be explained by the fact that a delay in treatment can result in tendon retraction, fibrosis, scarring, and more extensive nerve pain.<sup>8</sup> Surgically, this often requires larger incisions and more invasive exploration to identify the retracted tendon ends. With delayed surgical interventions, the sciatic nerve is often caught within scar tissue at the site of injury, occasionally requiring neurectomy. This often increases the surgical time and can lead to more extensive postoperative rehabilitation, thereby delaying mobilization and return to sport. Interestingly, although we did find a slightly longer time to return to sport among patients undergoing delayed and late repair of proximal HT tears, the rate of return to sport did not significantly differ based on timing of the surgical intervention. It should be noted that, in general, proximal HT injuries often occur in older, sedentary patients who sustain acute falls, and while the present study focuses on a younger, more active sample, this review does not address whether older patients should be treated operatively or nonoperatively.

The strengths of this study include a comprehensive systematic review performed by 2 independent reviewers. This is also the first systematic review to exclusively

examine return to sport and return to preinjury activity levels, and the first review since 2015<sup>26</sup> on surgically treated proximal HT tears, with 4 additional studies and 80 additional patients since the last systematic review on this topic. The limitations of this study should also be noted. In particular, none of the 16 included studies were classified as level 1 evidence, and only 1 was classified as level 2 evidence. HT repair techniques were not identical across studies, and not all studies defined return to sport in the same way. It should be noted that return to sport does not necessarily indicate a return to previous levels of function. Patient sex and sport-specific data were not consistent enough across studies to include in this review, and no objective measurements such as range of motion or strength testing were included. In addition, the nonrandomized design and demographic differences between patients represent appreciable limitations of this study. Finally, some studies did not report time to return to sport.

## CONCLUSION

Over 90% of patients undergoing repair of a complete or partial proximal HT tear can be expected to return to sport regardless of the tear type. Early surgical interventions of these injuries may be associated with a quicker return to sport, although the rate of return to sport does not differ based on timing of the surgical intervention.

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