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SYSTEMATIC REVIEW

Outcomes following surgical management of proximal hamstring tendon avulsions

A SYSTEMATIC REVIEW AND META-ANALYSIS

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Aims

Avulsion of the proximal hamstring tendon origin can result in significant functional impairment, with surgical re-attachment of the tendons becoming an increasingly recognized treatment. The aim of this study was to assess the outcomes of surgical management of proximal hamstring tendon avulsions, and to compare the results between acute and chronic repairs, as well as between partial and complete injuries.

Methods

PubMed, CINAHL, SPORTdiscuss, Cochrane Library, EMBASE, and Web of Science were searched. Studies were screened and quality assessed.

Results

In all, 35 studies (1,530 surgically-repaired hamstrings) were included. Mean age at time of repair was 44.7 years (12 to 78). A total of 846 tears were acute, and 684 were chronic, with 520 tears being defined as partial, and 916 as complete. Overall, 92.6% of patients were satisfied with the outcome of their surgery. Mean Lower Extremity Functional Score was 74.7, and was significantly higher in the partial injury group. Mean postoperative hamstring strength was 87.0% of the uninjured limb, and was higher in the partial group. The return to sport (RTS) rate was 84.5%, averaging at a return of 6.5 months. RTS was quicker in the acute group. Re-rupture rate was 1.2% overall, and was lower in the acute group. Sciatic nerve dysfunction rate was 3.5% overall, and lower in the acute group ($p < 0.05$ in all cases).

Conclusion

Surgical treatment results in high satisfaction rates, with good functional outcomes, restoration of muscle strength, and RTS. Partial injuries could expect a higher functional outcome and muscle strength return. Acute repairs result in a quicker RTS with a reduced rate of re-rupture and sciatic nerve dysfunction.

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Introduction

The hamstrings are the most commonly injured group of muscles in professional athletes, accounting for between 12% and 26% of all injuries occurring during sporting activities.[1] The majority of these injuries are strains of the muscle or myotendinous junction, which may be treated non-surgically with a satisfactory outcome after rehabilitation.[2] Avulsion of the proximal hamstring origin from the ischial tuberosity is less common, representing 3% to 11% of all hamstring injuries.[3] These injuries, however, can result in significant functional impairment, which can be career threatening for athletes.[3]

Surgical treatment of these injuries with re-attachment of the avulsed tendon or tendons is becoming an increasingly recognized treatment option to prevent ongoing weakness, and the so called “hamstring syndrome”.[3] This has been described as pain

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in the lower gluteal area radiating down the posterior thigh.[4] These sciatica-type symptoms are often seen, and may represent scar tissue from the injury tethering the nearby sciatic nerve.[5]

Typically, surgery is recommended for patients with a complete three tendon tear or those with two tendon tears with more than 2 cm of retraction.[6] The aim of surgery is to achieve an objectively and subjectively restored hamstring muscle in terms of strength and function, leading to a patient who is satisfied with their outcome.[7] A restored muscle should also reduce the risk of injury recurrence and enable the patient to return to sport. In addition, surgery should aim to prevent the "hamstring syndrome", leaving patients with reduced levels of sciatica type symptoms.

The outcome of surgery versus non-surgical management of proximal hamstring tendon avulsions has been previously assessed through systematic review. Harris et al[8] concluded that surgical repair resulted in significantly ($p < 0.05$) better subjective outcomes, a greater rate of return to pre-injury level of sport, and greater strength/endurance than non-surgical management. Similarly, Van der Made et al[3] concluded that surgical repair of proximal hamstring tendon avulsions appeared to result in a subjective highly satisfying outcome. Bodenforfer et al[9] also concluded that repair resulted in superior outcomes compared with nonoperative treatment. All three reviews reported a low re-rupture rate following surgical repair (2.7%,[8] 3.0%,[3] and 2.2%[9]) which could be a significant driver in the decision to treat this injury surgically.

The aforementioned systematic reviews have addressed the question regarding surgical versus non-surgical treatment all concluding in favour of surgery. Surgical management has subsequently become an increasingly recognized treatment option, and there have been numerous additional reports of surgical outcomes. The purpose of this meta-analysis was to look solely at the outcomes of surgically-treated patients. This is relevant to the patient, as well their medical professionals, as outcomes both positive and negative need to be carefully considered in the decision-making and consent for surgery processes.

The relevant outcomes of surgical treatment include patient satisfaction, functional outcome, postoperative hamstring strength, rates of return to sport (RTS), rates of re-rupture, and the prevalence of sciatic nerve symptoms following repair. This review assessed all of these outcomes and compared the results between ruptures repaired acutely versus those repaired chronically. It also compared the outcomes of partial versus complete injuries.

Methods

Search strategy. A systematic literature search was performed by the first author (RHS) up to 18 May 2021 in PubMed, CINAHL, SPORTdiscuss, Cochrane library, EMBASE, and Web of Science. The following keywords and Boolean operators were used: "Proximal hamstring" AND (surgery OR repair) NOT ACL. This returned 294 results.

Eligibility criteria. Articles were included if they reported outcomes following surgical treatment of proximal hamstring tendon avulsion injuries. Reports of non-avulsion or myotendinous injuries (Wood type 1 and 2)[10] were not included. Case reports or cohorts which included fewer than five patients were excluded. Papers describing surgical techniques only were not included. Review articles, non-surgical treatments, and papers not published in the English language were excluded.

Study selection. The first author (RHS) reviewed the studies returned from the initial search. Studies were included based on the eligibility criteria (Figure 1). Throughout the search, the content of each study, as well as the reference lists, were screened for patient overlap from other studies.

Quality assessment. The level of evidence, according to the Oxford Centre for Evidence-Based Medicine,[11] was recorded from I to IV for each study.[12] The quality of the studies was then further assessed by the author (RHS) using the Physiotherapy Evidence Database (PEDro) scale.[13] This scores 11 items: 1) eligibility criteria; 2) random allocation; 3) concealed allocation; 4) similarity at baseline; 5). participant blinding; 6) therapist blinding; 7) assessor blinding ; 8) > 85% follow-up for at least one key outcome; 9)intention-to-treat analysis; 10) between group statistical comparison for a least one key outcome; and 11) point and variability measures for at least one key outcome as either present or absent. The final score is then the number of positive answers for items two to 11. This scale has been validated,[14] and a score of ≥ six can be considered to represent a high-quality study and a score of < six represents a low-quality study.[15]

Data extraction. Data from the studies was extracted by the author (RHS) using a standardized extraction form. The number of patients undergoing surgery, sex, mean age, and mean duration of follow-up in years was extracted from every study. Where patients had outcomes recorded at multiple follow-up visits, the most recent result was included.

Patient satisfaction. Patient satisfaction was recorded as the total number of patients reporting their outcome as "good" or "excellent" or reporting that they were "satisfied" or "very satisfied" with their surgery at their final follow-up. This was then summarized as a percentage of patients satisfied out of those asked for their level of satisfaction.

Functional outcome scores. There were numerous different functional outcomes scores reported in the included studies. The most frequently reported was the Lower Extremity Functional Scale (LEFS), a validated

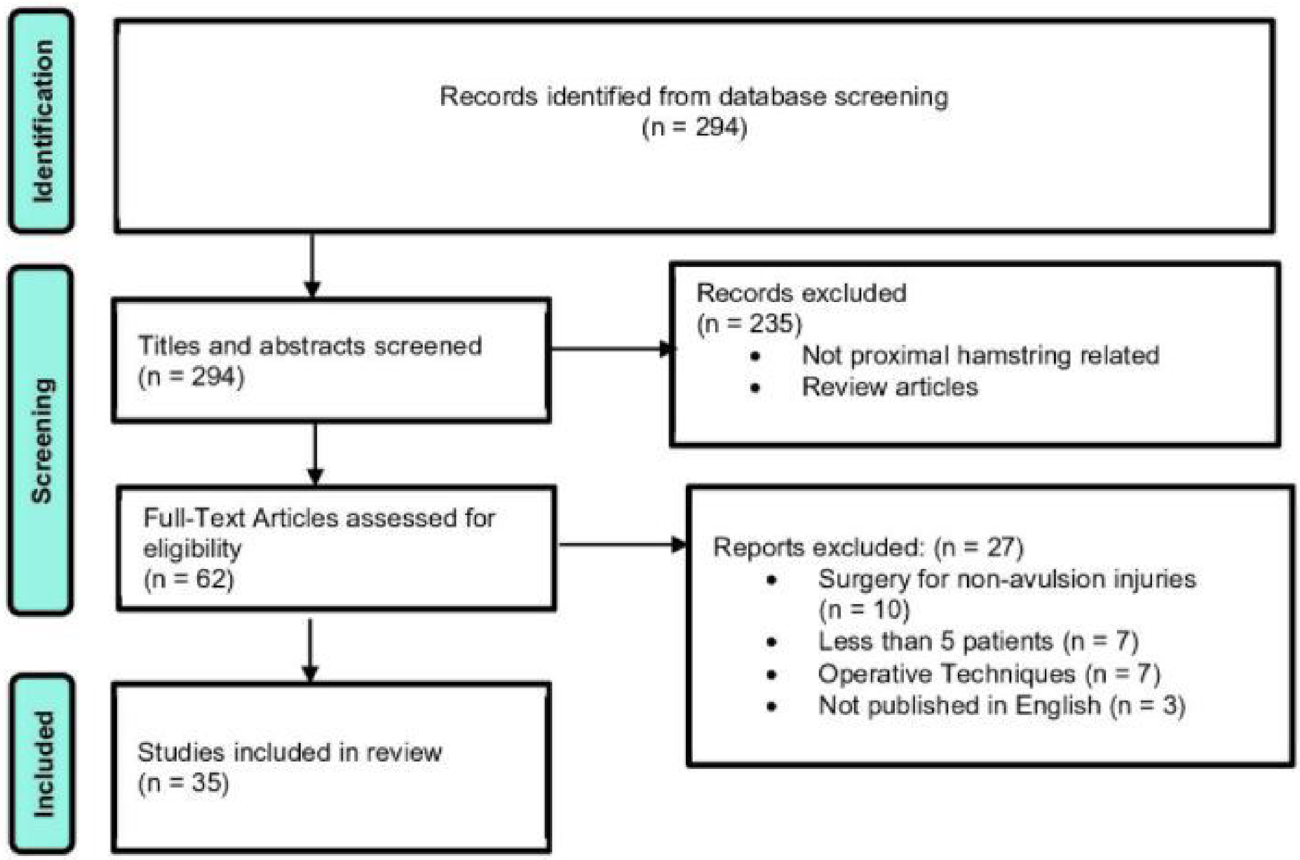

Fig. 1

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram.

patient-reported outcome measure.[16] Therefore, this review focused on LEFS. It is widely used and there is a good correlation between LEFS and the objective function after proximal hamstring tendon avulsion.[17] It contains 20 questions about a patient's ability to perform everyday tasks and physical activity. The maximum score is 80 and the lower the score the greater the degree of disability.

Postoperative hamstring strength. A number of the included studies tested their patients postoperatively for objective hamstring muscle strength and reported this as a percentage of the strength of the uninjured limb. Reports of perceived strength or strength graded from one to five on the Medical Research Council grading system were not included.

RTS was recorded as the number of patients returning to sport out of the number asked. The mean time for RTS was also recorded. In addition, where reported, it was recorded if the patient returned to the same level of sport or if they had to return at a lower level following their surgery.

Re-rupture rate. The total number of re-ruptures at final follow-up was recorded from each of the studies.

Sciatic nerve symptoms. The total number of patients complaining of sciatic nerve symptoms at follow-up was recorded. These symptoms included sciatic pain, tingling, or parasthesias. Peri-incisional skin numbness alone was not included as a sciatic nerve symptom.

Chronicity of injury. There is a lack of consensus as to the optimal timing of surgery for proximal hamstring repairs.[18] Acute injury has been defined most frequently as less than four, six, eight, or 12 weeks.[9] Acute injury was most commonly described in the included studies as being operated on within four weeks. Therefore, if a study did not define chronicity, then any repair that was performed within four weeks was considered acute and any after four weeks was considered to be chronic. If a study defined an injury as acute or chronic by another definition (e.g. six weeks), then the study's definition of chronicity was used.

Type of injury. Complete injuries were defined as complete three tendon avulsions whereas partial injuries were defined as < three tendon avulsions. Where a study did not specify the type of injury, then that study's results were excluded from the partial versus compete comparisons.

Statistical analysis. Where studies reported results as means, then weighted means were calculated for each study. This was because the number of surgical repairs

Table I. All studies included for meta-analysis.

Study	Level*	PEDro score†	Repairs, n	Chronicity	Injury type
Aldridge et al[19]	IV	< 6	23	Chronic	Partial
Arner et al[20]	IV	< 6	64	Acute and chronic	Partial
Barnett et al[5]	IV	< 6	132	Acute and chronic	Partial and complete
Best et al[21]	IV	< 6	49	Acute	N/S
Birmingham et al[22]	IV	< 6	23	Acute and chronic	Complete
Blakeney et al[23]	II	< 6	96	Acute and chronic	Partial and complete
Bowman et al[24]	IV	< 6	17	Chronic	Partial
Bowman et al[25]	IV	< 6	58	Acute and chronic	Partial and complete
Brucker & Imhoff[26]	IV	< 6	8	Acute and chronic	Complete
Chahal et al[27]	IV	< 6	13	Acute and chronic	Complete
Cohen et al[28]	IV	< 6	52	Acute and chronic	Partial and complete
Cross et al[29]	IV	< 6	9	Chronic	Complete
Ebert et al[30]	IV	< 6	6	Chronic	N/S
Folsom & Larson[31]	II	< 6	26	Acute and chronic	Complete
Haus et al[32]	IV	< 6	15	Chronic	Complete
Kayani et al[33]	IV	< 6	41	Chronic	Partial
Klingele & Sallay[34]	III	< 6	11	Acute and chronic	Complete
Konan & Haddad[35]	IV	< 6	10	Acute and chronic	Complete
Kurowicki et al[36]	IV	< 6	20	Chronic	N/S
Lefevre et al[37]	III	< 6	34	Acute	Partial and complete
Lempainen et al[38]	IV	< 6	48	Acute and chronic	Partial
Mansour et al[39]	IV	< 6	10	Acute	Complete
Mica et al[40]	IV	< 6	6	Acute	Complete
Pihl et al[17]	III	< 6	33	Acute	Partial and complete
Rust et al[14]	III	< 6	72	Acute and chronic	Complete
Sallay et al[41]	IV	< 6	25	Acute and chronic	Complete
Sandmann et al[42]	III	< 6	16	Acute and chronic	N/S
Sarimo et al[43]	IV	< 6	41	Acute and chronic	Complete
Shambaugh et al[44]	III	< 6	14	Acute	Complete
Shambaugh et al[45]	III	< 6	93	Acute and chronic	Partial and complete
Skaara et al[46]	IV	< 6	31	Acute and chronic	Partial and complete
Subbu et al[47]	IV	< 6	112	Acute and chronic	Complete
Willinger et al[48]	IV	< 6	94	Acute and chronic	Partial and complete
Wood et al[2]	IV	< 6	72	Acute and chronic	Partial and complete
Wood et al[18]	IV	< 6	156	Acute and chronic	Partial and complete

*Level of evidence (I to IV), according to the Oxford Centre for Evidence Based Medicine.[12]
†Quality assessment using the Physiotherapy Evidence Database (PEDro) scale.[13]
N/S, not specified.

Table II. Overall results summary.

Variable	N (%)
Repairs	1,530
Mean age, yrs	44.7
Mean follow-up, yrs	3.2
Sex	
Male	808 (54.6)
Female	671 (45.4)
Tear type	
Acute	846 (55.3)
Chronic	684 (44.7)
Partial	520 (36.2)
Complete	916 (63.8)

Table III. Results for all repairs.

Variable	Total tested, n	Data
Satisfaction, n (%)	726	92.6
Mean LEFS (SD)	361	74.7 (1.7)
Strength, n (%)	460	87.0 (6.4)
RTS any level, n (%)	1,014	84.5
RTS same level, n (%)	738	94.6
Mean RTS, mnths (SD)	529	6.5 (2.1)
Re-ruptures, n (%)	1,530	1.2
Nerve symptoms, n (%)	1,530	3.5

LEFS, Lower Extremity Functional Scale; RTS, return to sport; SD, standard deviation.

included in the studies ranged from six up to 156 repairs. As an example, if three studies had means of three, five, and eight, and these three studies had respective sample sizes of four, five, and six, then their weighted means would be obtained by multiplying the means by each

Table IV. Results comparting acute versus chronic repairs.

Variable	Acute tested, n	Data	Chronic tested, n	Data	p-value*
Satisfaction, n (%)	177	90.4	199	93.5	0.273
Mean LEFS (SD)	134	74.5 (1.2)	119	74.7 (1.9)	0.320
Strength, n (%)	81	89.8 (7.8)	75	90.8 (10.6)	0.504
RTS, n (%)	144	88.2	158	87.3	0.821
Mean RTS, mnths (SD)	112	4.5 (0.8)	75	5.5 (0.5)	0.000
Re-ruptures, n (%)	846	0.2	684	1.0	0.045
Nerve symptoms, n (%)	846	0.7	684	5.1	0.000

*Student *t*-tests (for continuous variables) and chi-squared tests (for categorical variables).
LEFS, Lower Extremity Functional Scale; RTS, return to sports.

Table V. Results comparing partial versus complete injuries.

Variable	Partial tested, n	Data	Complete tested, n	Data	p-value*
Satisfaction, n (%)	253	91.7	272	94.1	0.279
Mean LEFS (SD)	147	76.4 (1.0)	92	73.3 (1.0)	0.000
Strength, n (%)	90	90.5 (6.0)	227	84.4 (7.0)	0.000
RTS, n (%)	239	86.6	461	85.7	0.737
Mean RTS, mnths (SD)	141	7.6 (3.0)	146	5.3 (1.9)	0.000
Re-ruptures, n (%)	520	1.0	916	1.3	0.557
Nerve symptoms, n (%)	520	1.5	916	3.6	0.024

*Student *t*-tests (for continuous variables) and chi-squared tests (for categorical variables).
LEFS, Lower Extremity Functional Scale; RTS, return to sports; SD, standard deviation.

respective sample size, pooling the sums, and dividing by the total sample. This example would yield a weighted mean of 5.67. Using SPSS software version 27.0 (IBM SPSS Statistics for Windows, USA). Overall, p-values for continuous variables were obtained using Student *t*-tests, and p-values for categorical data were calculated using chi-squared tests. A p-value < 0.05 was considered to be statistically significant.

Results

Included studies. Overall, 35 studies were included for review (Table I). The majority of the studies were evidence levels III and IV and all studies scored < six on the PEDro scale.

A total of 1,530 repairs were included (Table II). The mean age at time of surgery was 44.7 years (12 to 78) There were 808 males and 671 females. One study did not specify sex.[21] The mean duration of follow-up was 3.2 years after surgery. There were 846 acute injuries (55.3%) and 683 chronic injuries (44.7%). Where injury type was specified, there were 520 repairs for partial injury (36.2%) and 916 repairs for complete injury (63.8%).

Patient satisfaction. Out of the 726 patients who were asked to rate their satisfaction with surgery, 92.6% rated their outcome at final follow-up as "good" or "excellent" or said that they were "satisfied" or "very satisfied" (Table III). Out of 177 patients who had undergone surgery acutely and were asked for their level of satisfaction, 90.4% were satisfied compared to 93.5% of 199 patients who had chronic injuries (Table IV). This difference was not statistically significant (p = 0.273). Similarly, 91.7% of 253 partial injuries and 94.1% of 272 chronic injuries were satisfied with no significant difference between the two groups (p = 0.279) (Table V).

Patient outcome scores. LEFS was tested in 361 patients, which represented 23.5% of the total cohort. The mean LEFS was 74.7 (50 to 80). There was no statistically significant difference between acute (74.5) and chronic (74.7) repairs (p = 0.320). LEFS was statistically higher for partial injuries (76.4) compared to complete injuries (73.3) (p = 0.000).

Postoperative hamstring strength. Objective postoperative hamstring strength was tested and compared to the contralateral, uninjured limb in 460 patients, with a mean percentage muscle strength of 87.0% at final follow-up. There was no significant difference between acute (89.8%) and chronic repairs (90.8%) (p = 0.504). Partial injuries achieved a greater strength (90.5%) compared to the complete group (84.4%) (p = 0.000).

Return to sport. Out of the 1,014 patients asked, 84.5% were able to RTS. The level at which they returned was not specified by every study, and could only be reported for 738 of the patients. Of this number, 94.6% returned to the same level with 5.4% returning to sport, but at a reduced level.

The rate of RTS was not significantly different between acute (88.2%) and chronic injuries (87.3%) (p = 0.821). Similarly, there was not a significant difference between partial (86.6%) and complete injuries (87.4%) (p = 0.762).

The mean time taken to RTS was 6.5 months (1 to 36) overall. This was significantly quicker in the acute group (4.5 months) compared to the chronic group

(5.5 months) (p = 0.000). It was also significantly quicker in the complete group (5.3 months) compared to the partial group (7.6 months) (p = 0.000). However, this comparison of partial versus complete was affected by an outlying study, which reported only partial repairs and had a RTS duration of 11.1 months.[20] This paper did not differentiate RTS for acute versus chronic, and so did not impact on this comparison.

Re-rupture rate. At a mean final follow-up of 3.2 years the overall re-rupture rate was just 1.2%. This was significantly lower in the acute group (0.2%) compared to chronic group (1.0%) (p = 0.045). It was not significantly different between partial (1.0%) and complete (1.3%) injuries (p = 0.557).

Sciatic nerve symptoms. Sciatic pain, tingling or parasthesias were reported post-operatively in 3.5% of all repairs. Chronic repairs reported a higher rate of these symptoms (5.1%) compared to acute repairs (0.7%) (p = 0.000). Similarly, these symptoms were more prevalent following complete injuries (3.6%) when compared to partial injuries (1.5%) (p = 0.024).

Discussion

This is the largest meta-analysis of outcomes following surgical management of proximal hamstring tendon avulsions. It includes 35 original studies and 1,530 patients who all underwent surgical repair. Previous reviews by Harris et al,[8] Van der Made et al,[3] and Bodendorfer et al[9] included 95, 387 and 767 surgically managed patients, respectively. While this is a high number of cases assessed in this analysis, it must be recognized that the data comes from studies of low methodological quality (PEDro scores < six) with level III and IV evidence providing the majority of the results.

The mean age of the patients at time of surgery in this analysis was 44.7 years (12 to 78). This is in keeping with previous systematic reviews, which had mean ages of 39.7 years[8] and 41.4 years,[9] respectively. This finding illustrates the point that these injuries are not exclusive to elite athletes. They are becoming increasingly common in older populations as people remain physically active and participate in recreational sporting activities.[1]

Overall, patient satisfaction with surgery was 92.6%, which is similar to the rates found in the previous systematic reviews (88% to 100%[3] and 90.81%[9]). This analysis found no significant difference in satisfaction rates between acute (90.4%) compared to chronic (93.5%), and partial (91.7%) compared to complete (94.1%) injuries. This would suggest that patients can be re-assured that they are likely to be satisfied with the results of their surgery independent of the type or chronicity of their injury.

The mean results of the validated functional outcome score suggests good outcome at the latest follow-up (LEFS of 74.7). LEFS was significantly higher in the partial type (76.4) injuries compared to the complete (73.3). This would be in keeping with the significance of injury in the complete group. It could therefore be suggested to patients that they should expect a good functional outcome in both partial and complete injuries, but those with partial injures might achieve an even greater functional recovery. There was no significant difference found between acute (74.5) and chronic (74.7) LEFS scores. However, it has been suggested that the LEFS score may not be effective as an outcome measure for this type of injury due to its high ceiling effects.[3] In addition, the minimal detectable clinical change is nine scale points and the difference in LEFS between partial and complete injuries was only 3.1. Only 23.5% of patients were assessed using this tool with a wide variety of different scores being reported but not as frequently. This suggests that there is a need for a more applicable score to be developed that that might be used more uniformly by different studies.

One of the main objectives of surgery is to restore muscle architecture and function. The mean postoperative strength of 87.0% would suggest that surgery is able to achieve this in both acute and chronic as well as partial and complete injuries. The statistically significant higher strength score achieved by the partial group (90.5%) compared to the chronic group (84.4%) would again imply that the severity of initial injury does have an impact on final function after surgery. However, it must be considered that there is a possibility that other muscles are recruited to compensate for the injured hamstring which may contribute to the final strength.

One aspect of treatment which was poorly reported in all studies was the postoperative rehabilitation protocol which would likely have contributed to strength return. This was often not reported at all, or limited to timing for weightbearing postoperatively. There is a marked variability in both the composition and timing of published rehabilitation components following proximal hamstring repair.[49] Such variability represents an opportunity for future research to improve standardization of rehabilitation and patient care following surgery.

The mean RTS rate of 83.7% and the mean time taken to RTS of 6.5 months should give medical professionals and patients an idea of how likely and how soon they might RTS. These results are similar to those reported in a review by Coughlin et al,[50] who found a RTS rate of 87.0% at a mean time of 5.8 months after surgical management. Overall, the RTS rate in this analysis is high for both acute (88.3%) and chronic (87.3%) injuries, but acute repairs resulted in a quicker RTS (4.5 months) compared to chronic injuries (5.5 months). This was statistically significant. In a systematic review of RTS rates after surgery, Belk et al[51] divided proximal hamstring tendon avulsion injuries in terms of interval from injury to surgery and described early (< one month), delayed (one to six months), and late (> sx months) groups. They found the RTS time to be 4.8 months in the early group, 7.3 months in the delayed group, and 5.4 months in the late group, but were unable to find a statistically significant difference between the groups.

The high rate of RTS in both partial and complete injuries should reassure those involved that RTS can be achieved with these significant injuries. However, not all studies reported at what level the patient returned to sport. RTS does not necessarily mean return to performance, and in particular high-speed running performance.[52] Successful RTS metrics should be expanded from simple time taken to include performance.[52]

Re-rupture can be a devastating complication which can necessitate further surgery and the inevitable morbidity associated with this. In this analysis, the re-rupture rate after surgical repair at a mean follow-up of 3.2 years was low at 1.2% overall. The re-rupture rate was statistically higher in chronic injuries (1.0%) compared to acute (0.2%). Injury type did not appear to affect re-rupture rate.

Sciatic nerve symptoms can be particularly intrusive and lead to the development of the “hamstring syndrome”. The results of this analysis suggest that developing these symptoms is more likely if the repair is delayed until the injury is chronic (5.1%) when compared to treating it in the acute stage (0.7%). It is also more prevalent in complete injuries (3.6%) compared to partial injuries (1.5%).

While this analysis assessed a large number of surgically treated cases, it does have a few limitations. First, the quality of the included studies is of a low methodological standard. In addition, only one author was involved in the process of article screening, quality assessment, and data extraction. Another limitation is that there is not a universal definition of acute or chronic injuries. While efforts were made to categorize in this analysis, it cannot be guaranteed that the acute and chronic groups were entirely representative with some studies defining acute as < four weeks and some < eight weeks. There are also other outcome measures which could be analyzed beyond the discussed LEFS, which may have afforded different outcomes. Equally, re-rupture and sciatic nerve symptoms were considered as the major complications of this injury, but other complications, such as infection and venous thromboembolism rates following surgery, should also be considered.

In conclusion, surgical treatment of proximal hamstring tendon avulsions results in high patient satisfaction rates with good functional outcomes, good restoration of muscle strength, and good rates of RTS. Partial ruptures could expect a higher functional outcome and muscle strength return than complete ruptures following surgery. Acute surgical repairs result in a quicker return to sport. Acute repairs also appear to have a reduced the rate of complications, such as re-rupture and sciatic nerve symptoms.

This analysis has pulled together nearly all the available observational data available for the surgical management of these injuries. There appears, however, to be a gap in the literature regarding the outcomes of nonoperative care. The long-term results for surgical management of proximal hamstring tendon avulsions documented here can be used to compare to other treatment options and perhaps plan adequately powered randomized controlled trials.

Take home message

- Surgical treatment of proximal hamstring avulsions is becoming an increasingly recognised treatment option. It results in high satisfaction rates with good functional outcomes, good restoration of muscle strength and return to sport.
- Partial ruptures could expect a higher functional outcome and muscle strength return when compared to complete ruptures.
- Acute repairs result in a quicker return to sport. They also appear to have a reduced rate of complications such as re-rupture and sciatic nerve dysfunction.

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