

SURGICAL MANAGEMENT OF PROXIMAL HAMSTRING RUPTURE

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INTRODUCTION

Proximal hamstring ruptures are a less common injury than muscle and musculotendinous strains, but may account for up to 12% of hamstring complex injuries and can result in debilitating outcomes in active patients if left untreated¹. In recent years, there has been heightened awareness of proximal hamstring ruptures allowing more expedient diagnosis and treatment but there remain very few robust scientific criteria to aid the decision-making process as to who will benefit from surgery. As a result, the management of these serious injuries has typically varied from centre to centre. It has previously been proposed that management of proximal hamstring ruptures involving 1- or 2-tendons with ≤ 2 cm of retraction be non-operative. By contrast, surgery is advocated for 2-tendon avulsions with > 2 cm of retraction and all complete 3-tendon tears¹.

Unfortunately, the indications for surgical treatment are not entirely clear or well supported by Level I or II evidence². Most studies involve small patient numbers with differing methodology, treatment indications and protocols. There are also discrepancies in the methods of describing the type of avulsion, differing athletic requirements of patients and conflicting opinions on the need and timing for surgery.

Generally, it is accepted that an acute avulsion of the entire hamstring complex with retraction should be treated surgically³. The surgery becomes technically more difficult with time due to tendon retraction and sciatic nerve tethering within scar tissue^{2,4}. While predicting who will benefit from surgery is difficult, given the potential for poor results from chronic repairs, there is an ethical issue in denying surgery in the acute phase. Subsequently, from our experience of treating over 600 cases of

proximal hamstrings ruptures (450 treated surgically), we advocate that the decision to offer surgery be based on both clinical and radiological findings.

Unfortunately, there is even less evidence available on the surgical or non-surgical management of partial avulsions/incomplete injuries and the natural history of this condition remains unclear. What is clear is that those patients with unremitting symptoms of sitting pain, inability to run and perform sporting activities at the desired level can be treated operatively with symptomatic and functional improvement⁵. However, these patients should have exhausted non-operative treatment involving rehabilitation and alternative therapies such as corticosteroid or Platelet Rich Plasma (PRP) injections as the results of surgery are not as good as for complete ruptures. The pathology of partial avulsions is undoubtedly disparate to acute, complete



Figure 1: Marked bruising which indicates proximal hamstring rupture.

Figure 2: Extensive bruising indicating proximal hamstring rupture.

Figure 3: Clinical deformity with prominence of hamstring muscle belly due to complete tendon avulsion with retraction.

avulsions and for this reason any surgery must be carefully considered.

This article presents our surgical technique, the review of the literature and proposes a surgical algorithm for the treatment of this complex injury.

HISTORY

Mechanism of action

The most common mechanism of action for this injury is a combined sudden hyperflexion of the hip with knee extension. The most common causative activity found by the senior author in his series is water-skiing. Other common causes with

similar mechanisms include going into the splits (either on purpose as in dancing or accidentally) or slipping on a step.

Symptoms

Patients report a sudden onset of sharp pain at the proximal hamstring or buttock. This is sometimes accompanied by a “pop” or tearing sensation. There is rapid development of severe pain and marked bruising usually, with weakness and an antalgic gait (Figure 1).

In late or chronic presentation patients complain more about sitting pain and an inability to run/sprint. They can also have

sciatica-like symptoms, weakness and pain with walking, especially up hills or stairs.

Clinical examination in an acute presentation is difficult to miss, due to the history, gross bruising, marked weakness on hamstring contraction, tenderness at the proximal hamstring origin (lateral aspect of the ischial tuberosity) and sometimes a palpable gap. Chronic presentations or partial tears can be more subtle. There is still often weakness on hamstring contraction, pain on passive straight leg raise testing, localised tenderness but no bruising. In retracted avulsions there may be a palpable mass as seen in Figure 3.

WOOD CLASSIFICATION OF PROXIMAL HAMSTRING RUPTURES

Classification	Pathological appearance	Preferred Management
Type 1	Osseous avulsions	Displacement greater than 1 to 2 cm warrants surgical reduction and internal fixation to avoid the risk of symptomatic non-union ¹² .
Type 2	Musculotendinous junction injuries	Difficult to treat surgically. Conservative management is recommended.
Type 3	Incomplete avulsions	Healing may occur with rehabilitation alone Some may need adjunctive, non-surgical treatment such as PRP. Some will require surgery for ongoing symptoms and failure to return to pre-injury activity levels. Typically these present to the surgeon as chronic injuries with symptomatic patients having undergone a plethora of investigations and treatments.
Type 4	Complete avulsion with no/minimal tendon retraction	Effective treatment prevents excessive scarring and nerve tethering. Surgery nearly always successful. With most patients wanting a guaranteed return to pre-injury activity levels, there will tend to be an unavoidable bias towards early surgery.
Type 5a	Complete avulsion with tendon retraction with no sciatic nerve involvement	Those with ongoing sitting or driving pain that is impeding normal activities and those unable to return to desired sporting activities should be offered surgery.
Type 5b	Complete avulsion with tendon retraction and sciatic nerve tethering	These tend to be more chronic cases. Chronic patients tend to self-select for surgery.

Table 1: Wood classification of proximal hamstring ruptures.

If in doubt, MRI scan is the best imaging modality (Figure 4). If unavailable, ultrasound in experienced hands is usually also diagnostic.

WOOD CLASSIFICATION OF PROXIMAL HAMSTRING RUPTURES

In order to obtain more useful information from studies, it is important that researchers and clinicians are clear on the types of avulsions and that a universal classification be accepted so that accurate and comparable literature reviews can be performed. Wood et al⁶ have classified proximal hamstring injuries in Table 1, which is useful for both clinical and research purposes.

SURGICAL TECHNIQUE

The patient is positioned prone under general anaesthesia, with protection of pressure areas. The leg is prepared and draped to allow unrestricted knee flexion to allow hamstring tendon apposition at surgery. Bony landmarks are located and a longitudinal incision is made from the ischial tuberosity inferiorly over the defect. The senior surgical author prefers a longitudinal incision due to its extensile properties, allowing improved surgical exposure as required. Some use a transverse incision in the gluteal crease¹, whereas others use a combination as required to allow adequate exposure⁸. The superficial soft tissues are incised in line with the incision, protecting

the posterior cutaneous femoral nerve as much as possible. The inferior margin of gluteus maximus is identified and retracted cranially. The avulsed proximal end of the conjoint hamstring tendon is identified and mobilised.

The sciatic nerve is identified and a thorough neurolysis performed. The nerve is protected throughout the procedure. Occasionally, identification of the nerve is extremely difficult due to encasement in scar tissue; a nerve stimulator can be useful in such instances. The lateral wall of the ischial tuberosity is exposed using Hohmann retractors and scar tissue cleared. Three Mitek SuperAnchors (DePuy Mitek, Raynham, Massachusetts) are inserted into

the exposed lateral wall of the tuberosity and the suture ends are passed through the tendon end using a modified Mason-Allen sliding knot technique. The sutures are then individually tied ensuring the avulsed conjoint tendon is apposed completely. If knee flexion is required to relieve tension on the surgical repair, a hinged knee brace is required with the knee immobilised in as much as 90° of flexion for up to 6 weeks. Unlike other units^{8,9}, we do not feel a knee brace is necessary for all cases. Some units routinely use a hip orthosis to prevent strain on the surgical repair^{1,3} which we have never had to use. If full knee extension is attained at surgery without undue tension on the repair, there is no requirement for bracing. This can and should be achieved with diligent sciatic neurolysis and comprehensive mobilisation of the hamstrings complex.

POST-OPERATIVE REHABILITATION

During the first 2 weeks, therapy should concentrate on pain and swelling control, as well as wound care with avoidance of massage until after 4 weeks (Table 2). Exercises to maintain or improve core stability may be commenced. Neural mobilisation techniques may be employed ensuring no tension is placed on the repair. A partial weight-bearing status using crutches should be maintained.

During the next 4 weeks, full weight bearing and a normal gait pattern should



Figure 4: Post-surgical repair.

be the aim. Using non-resistance exercises, full active hip motion with the knee flexed greater than 90° and full active knee motion with the hip neutral should be the goal.

During the next 6 weeks, hamstring strengthening using non-resistance methods can begin. Core stability, gluteal strength and proprioceptive work can progress at this stage.

After 3 months, hamstring stretches and strengthening using weight resistance can

commence. Full hip and knee motion should be achieved.

Jogging can be introduced at 16 weeks aiming to achieve 60 to 70% strength in the injured hamstrings compared to the uninjured limb.

After 24 weeks, patients can return to sports including sprinting, after having achieved greater than 80% of the contralateral strength.

RESULTS OF SURGERY

A systematic review of 300 proximal hamstring injuries from 18 level I-IV studies indicated that surgical repair is significantly ($P < 0.05$) associated with better outcomes, greater rate of return to pre-injury level of sport and greater strength/endurance compared to non-surgical management. Acute surgical repair (within 4 weeks of the injury) had significantly better patient satisfaction, subjective outcomes, pain relief, strength/endurance and higher rate of return to pre-injury level of sport compared to chronic (beyond 4 weeks) repairs ($P < 0.001$), with reduced risk of complications and re-rupture ($P < 0.05$). Non-operative management is associated with less patient satisfaction, reduced hamstring muscle strength and significantly lower rates of return to pre-injury sporting level¹⁰. The risk of a moderate/poor result is 28-fold in patients where surgery has been delayed

POSTOPERATIVE REHABILITATION GUIDELINES

<i>Rehabilitation period</i>	<i>Pathophysiology</i>
<i>0-2 weeks</i>	<i>Acute Healing Phase</i>
<i>2-6 weeks</i>	<i>Continued Healing and Repair Phase</i>
<i>6-12 weeks</i>	<i>Continued Repair Phase</i>
<i>12-16 weeks</i>	<i>Remodelling Stage</i>
<i>16-24 weeks</i>	<i>Continued Remodelling and Strengthening Stage</i>
<i>24+ weeks</i>	<i>Sport-Specific Stage</i>

Table 2: Postoperative rehabilitation guidelines.

greater than 6 months compared to those undergoing surgery within 3 months¹¹. This has been postulated to be due to a number of reasons including fatty atrophy of the muscle, adhesions and retraction making reattachment more difficult or irreversible damage to branches of the sciatic nerve due to distal muscle retraction or from surgical neurolysis

The healing relies on osseotendinous incorporation, which has not been investigated for this particular injury, but in accordance with such healing processes in other procedures, one should expect this to be at the very least 6 to 8 weeks. Post-operative rehabilitation protocols should be cognizant of this.

Approximately 80% of patients are able to return to athletic activities after an average 5 to 6 months postoperatively and the same number will resume sports at the same level. However, there are no known predictive factors to indicate which individuals will return to the same level of activity⁴.

In one of the largest reported single centre, single surgeon series, the mean post-operative isotonic hamstring strength and the mean postoperative hamstring endurance were 84 and 89% respectively, when compared to the contralateral uninjured side after an average of 2 years follow-up⁶. Isokinetic muscle testing studies have shown that an average peak torque of nearly 83% can be achieved in the operated hamstrings muscles compared to the contralateral side as early as 6 months post-operatively⁸.

COMPLICATIONS OF SURGERY

Surgery is not without risk and complication. Other than general surgical complications, specific ones include haematoma, sciatic nerve injury with consequent paralysis, re-rupture, muscle fat atrophy and ongoing symptoms of residual pain, weakness, cramps, neuralgia and difficulty walking¹¹.

TREATMENT ALGORITHM

Applying the Wood Classification⁶ a literature-based treatment algorithm has been proposed for these injuries.



Figure 5: Proximal Hamstring rupture and haematoma.

Type 1

These are typically apophyseal injuries in skeletally immature patients. Displacement greater than 1 to 2 cm warrants surgical reduction and internal fixation to avoid the risk of symptomatic non-union¹².

Type 2

These are injuries at the musculo-tendinous junction. Injuries in this zone are difficult to treat surgically throughout

the body and conservative management is advocated.

Type 3

These constitute incomplete hamstring avulsion from the ischial tuberosity. MRI reveals an inflammatory focus between the bone and the partially avulsed tendon, which most probably represents an attempted reparative response. In some, healing may occur with rehabilitation alone,

Common causes include going into the splits on purpose or accidentally, or slipping on a step.

others may respond to adjunctive, non-surgical treatment such as PRP, whereas a third group will require surgery for ongoing symptoms and failure to return to pre-injury activity levels. Identifying those that will definitely require early surgery remains challenging and has no evidence base. Typically then, these present to the surgeon as chronic injuries with symptomatic patients having undergone a plethora of investigations and treatments.

Type 4

These are acute injuries with minimal tendon retraction. Expedient treatment prevents excessive scarring and nerve tethering and results of surgery are nearly always successful. Undoubtedly, there will be a group of patients that will do well without surgery but, as with Type 3, identifying this group is extremely difficult. With most patients wanting a guaranteed return to pre-injury activity levels, there will tend to be an unavoidable bias towards early surgery.

Type 5

These are complete avulsions with tendon retraction. This group is divided depending on sciatic nerve involvement. Those with sciatic nerve tethering tend to be more chronic cases but nerve tethering can still occur in the acute phase after injury⁸. Chronic patients tend to self-select for surgery. Those with ongoing sitting or driving pain that is impeding normal activities and those unable to return to desired sporting activities should be offered surgery. They should be appropriately counselled regarding expectancy of outcomes. As with Type 4 injuries, determining which patients with an acute injury will benefit from surgery remains elusive and needs to be investigated further.

CONCLUSION

A proximal hamstring rupture is a significant injury, which can permanently impede return to high level sporting activity. It is important to be vigilant and maintain a high index of suspicion in order to obtain a prompt and accurate diagnosis and to expedient definitive treatment. Acute surgical repair within 4 weeks is

recommended for complete tears in all athletes who harbour hopes of returning to competitive sports, especially those sports involving sprinting. Identifying that subset of patients that could do well with non-operative treatment remains challenging with no obvious predictive factors. Undoubtedly until it becomes possible to identify this group, there is an ongoing risk of over-operating, but this has to be balanced against the patients desire to return to sport - as the outcome after delayed repair may not be as good as acute surgical intervention.

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