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Surgical Release for Proximal Hamstring Syndrome

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Background: Pain in the buttock radiating to the popliteal fossa associated with hamstring weakness can be caused by tethering of the sciatic nerve to the proximal hamstring tendons. Contraction of the hamstring muscles produces traction on the sciatic nerve and subsequent symptoms.

Hypothesis: Surgical release of the proximal hamstring tendons, in particular from the sciatic nerve, will improve symptoms and function.

Study Design: Case series; Level of evidence, 4.

Methods: Forty-seven proximal hamstring surgical releases were performed in 44 patients (28 males, 16 females). The initial clinical findings and imaging were obtained from the medical notes, and additional data were obtained from a later questionnaire. The average age at the time of surgery was 29 years (range, 15-58 years). All patients were involved in high-level sports. Long-term follow-up was with a comprehensive postal questionnaire.

Results: Full follow-up was obtained in 43 patients (46 operations). Average follow-up was 53 months (range, 9-110). No major complications were encountered from the surgery. The average visual analog scale pain score decreased from 6.5 preoperatively to 2.0 ($P < .001$). Two patients had increased pain, and pain was unchanged in 4. The average subjective weakness score decreased from 6.6 to 2.8 ($P < .001$). Three patients reported increased weakness at follow-up, and 3 patients reported that the hamstring muscles felt equally weak. Thirty-four patients (77%) had returned to their previous sporting activities, with 30 patients still competing at or above state level, or professionally, after surgery. The average satisfaction score was 7.8. Six patients (14%) were not satisfied with the outcome of the procedure, 5 patients (11%) were somewhat satisfied, and 33 patients (75%) were very satisfied.

Conclusion: Proximal hamstring syndrome occurs mainly in patients participating in competitive sports. Release of the proximal hamstring tendons in this active group resulted in decreased pain and increased strength, and the majority of patients were satisfied with the procedure.

Keywords: hamstring; release; sciatic nerve; entrapment; gluteal pain

The "hamstring syndrome" was initially described by Puranen and Orava[2] in 1988. They reported a group of patients with pain in the lower gluteal area radiating down the posterior thigh to the popliteal fossa. In this article, a series of 59 patients was operated on to loosen the sciatic nerve from adhesions in the proximal hamstring region and to divide tight tendinous structures at the lateral insertion of the hamstring tendons to the ischial tuberosity. This condition was thought to be the result of scarring or a fibrotic band between the proximal hamstring tendons and the sciatic nerve.[1] It is a chronic condition where the patient experiences often ill-defined pain in the buttock region that radiates distally toward the popliteal fossa. The pain occurs with exercise, mainly running, and there is often a report of some associated weakness in the hamstring region. The condition influences running ability, particularly sprinting and acceleration. Most patients have tenderness in the proximal hamstring region around the ischial tuberosity.[2] We have renamed this condition "proximal hamstring syndrome" to more accurately describe the location of the problem within the hamstring muscles.

It is postulated that the symptoms of proximal hamstring syndrome are caused by tethering of the sciatic nerve to the hamstring muscles and that the pain from sitting or stretching is caused by sciatic nerve traction, compression, or

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TABLE 1
Sports of the 44 Patients With Proximal Hamstring Syndrome Showing the Highest Competition and Professional Level Achieved by the Athletes Before Surgical Release

		Competition Level			Professional Level		
Sport, n		International	National	State/Local/Other	Professional	Semiprofessional	Amateur/ Recreational/Other
Australian football	15		4	11	4	4	7
Bodybuilding	1		1				1
Calisthenics	1			1			1
Cricket	2	1	1				2
Hurdling	1	1					1
Javelin	1			1			1
Long-distance running	1			1			1
Long jump	1	1					1
Middle-distance running	3		1	2			3
Netball	1		1				1
Rowing	1		1				1
Speed walking	2	1	1				2
Sprinting	7	4		3		3	4
Squash	2			2			2
Steeplechase	1		1				1
Swimming	1	1					1
Triathlon	2	1	1			1	1
Water skiing	1						1
Total	44	10	12	22	4	7	33

irritation.[2] The condition may develop after a single acute hamstring injury or develop slowly in the patient with chronic, recurrent hamstring tears. The differential diagnosis includes sciatica, piriformis syndrome, neuropathy, or hamstring muscle tear. With the proximal hamstring syndrome, pain is experienced within the proximal hamstrings at the gluteal-hamstring region around the ischial tuberosity. This differs from those of hamstring tears alone where the pain is usually more distal in the muscle belly itself and where there is commonly a palpable defect from the previous tear. With piriformis syndrome,[3] the clinical features are different, with tenderness located more proximally with deep gluteal palpation just lateral to the greater sciatic notch over the belly of piriformis and positive results from specific provocative tests such as the FAIR test[3] and the Freiberg sign.[2] The goal of this study is to assess and discuss the results of release of the sciatic nerve and proximal hamstrings in patients with proximal hamstring syndrome.

MATERIALS AND METHODS

A retrospective database search by the senior author identified 47 surgical release operations for proximal hamstring syndrome in 44 patients between 1995 and 2004. Medical notes were analyzed for symptoms, clinical examinations, and investigations before surgery. A specifically designed questionnaire was sent to all patients to provide more detailed information on preoperative sporting activities, level of competition, and symptoms. The 2 main symptoms of pain and weakness were assessed subjectively with a visual analog scale (VAS) ranging from 0 (no pain or weakness) to 10 (severe pain or weakness). This was correlated with the symptoms recorded in the original medical notes.

Indications for Surgery

The diagnosis of proximal hamstring syndrome, and the subsequent decision to operate, was based predominately on appropriate history and clinical examination findings. This evolved over the 10 years of the study as the senior author assessed the results of the surgery and correlated this with the clinical presentation. In general, patients with chronic proximal hamstring syndrome had significantly impaired performance in their chosen sport, in particular with acceleration or maximum speed when running. They related this to either pain in the proximal hamstring region or weakness of the hamstrings, or both. Examination usually revealed tenderness in the proximal hamstring region or ischial tuberosity and weakness at 30° of resisted knee flexion. Patients with diagnoses of, for example, radiculopathy or piriformis syndrome were excluded from the surgery.

Patient Demographics

Forty-seven procedures were performed by a single surgeon in 44 patients. Three patients (2 males, 1 female) had staged bilateral proximal hamstring releases, with the contralateral surgery at 7, 24, and 50 months after their initial surgery. Of the 44 patients, 28 were males and 16 were females, and the average age at the time of surgery was 29 years (range, 15-58). Forty-three patients played competitive sports, with 32 patients performing at or above state level. One patient was a noncompetitive long-distance runner. Table 1 shows the

TABLE 2
Summary of Investigations Performed and Relevant Clinical Findings

Variable	Number of Patients	Abnormal Results
Ultrasound	18	13
Magnetic resonance imaging	34	20
Nerve conduction studies	27	18
Bone scan	7	2

	Recorded	No Tenderness	Proximal Hamstring	Ischial Tuberosity	Muscle Defect
Tenderness, n (%)	47 (100)	5 (10.6)	23 (48.9)	15 (31.9)	4 (8.5)
	Recorded	Weakness at 30°	Weakness at 90°		
Strength test of hamstrings, n (%)	41 (87.2)	39 (95.1)	12 (29.3)		
	Recorded	Restricted	Normal	Increased	
Straight-leg raising, n (%)	42 (89.4)	14 (33.3)	22 (52.3)	6 (14.3)	
	Recorded	Positive	Negative		
Lasègue test, n (%)	38 (80.8)	12 (31.6)	26 (68.4)		

number of patients per sport played. Eleven patients were professional or semiprofessional athletes, and only 7 patients considered their sporting activities to be purely recreational. Three of the 44 patients smoked cigarettes, and none of the patients were diabetic.

The right side was operated in 25 patients and the left side in the remaining 22, including the 3 patients having bilateral surgical release. Three patients, who had a unilateral procedure, were lost for follow-up and are not included in the outcome assessment of our patient cohort. The data for these patients are included in demographics, preoperative investigations, preoperative clinical assessment, operative findings, and early postoperative follow-up. All the other 41 patients (44 extremities) consented to being included in the outcome assessment portion of the study and returned the questionnaire.

History and Symptoms Assessment

All patients had chronic pain in the proximal hamstring region that had been refractory to nonoperative treatment. Fifteen patients reported a previous hamstring tear. Symptoms had persisted for less than 6 months in 8 extremities, between 6 and 12 months in 15, between 12 and 18 months in 10, and more than 18 months in 14. No patients were operated on for acute injuries or for symptoms in the region of chronic hamstring tears. All patients had posterior thigh pain and/or weakness.

Preoperative VAS pain scores were from 2 to 10, with an average of 6.5. Preoperative hamstring weakness VAS scores ranged from 2 to 10, with an average weakness score of 6.6. Prolonged sitting increased symptoms in the affected leg in 24 patients. It was recorded that running at maximum speed and accelerating were symptomatic (pain or weakness) in 31 and 26 patients, respectively. Twenty-six patients also noted aggravated symptoms while forcibly driving the leg forward (eg, kicking, hurdling).

Fifteen patients reported having a history of at least 1 suspected hamstring tear. On average, these patients had 4.8 (range, 1-15) episodes of suspected hamstring tears. Nine of these 15 had also had at least 1 period of significant low back pain. Another 9 patients also reported to have had significant low back pain in the past. This was musculoskeletal back pain without a definitive diagnosis in 11 of 18, and intervertebral disc bulge was diagnosed in 7.

Preoperative Clinical Assessment

On initial clinical examination, 23 patients had tenderness in the proximal hamstring region, and 15 had tenderness over the ischial tuberosity with 2 of those recorded as gluteal region tenderness instead (Table 2). Forty-one cases (87.2%) had recorded strength of resisted hamstring contraction. The strength was recorded as normal, mild, moderate, or severe weakness (MRC power grading of 5, 4.5, 4, and 3.5, respectively) when compared with the nonaffected side. To examine the hamstring strength, the patient is placed in the prone position with the hip extended and the knee at 30° of flexion. The examiner pulls down with one hand behind the heel while the patient resists and attempts to maintain position or flex beyond 30°, and the examiner's other hand is placed on the belly of the hamstring to assess the quality of the muscular contraction. Moderate or severe hamstring weakness was demonstrated in 35, mild weakness in 4, and 2 had normal power. In the same position, the knee is then flexed to 90°, and the examiner attempts to overcome the patient's contraction with the same technique as above.

Hamstring strength at 90° was recorded as normal in 25 cases, mildly weak in 12, and in none was there marked weakness.

Further clinical examination revealed that 12 cases had a mildly positive Lasègue test finding. Fourteen patients had some restriction in straight-leg raising, whereas 22 were considered normal when compared with the asymptomatic side. Six had an increased range of straight-leg raising by 10° to 20°, which was thought to be related to a chronic hamstring tear. Four patients were noted to have a palpable defect in the hamstrings on physical examination, and all were in the group with increased range of straight-leg raising. Only 1 of the 4 with a palpable defect reported a previous hamstring tear.

Imaging and Nerve Conduction Studies

Eighteen patients had an ultrasound examination of the proximal hamstring muscles. This showed no abnormalities in 5 patients. An enthesopathy, with bony irregularities at the ischial tuberosity or fluid at the hamstring origin, was found in 10. In 1 patient, who clinically had a complete hamstring tear, a hematoma was present at the origin of the semitendinosus, and a tear at the origin of the hamstring muscles was found in 2.

Magnetic resonance imaging (MRI) was done in 34 patients and did not show any pathologic abnormalities in 14 patients, including in 4 patients with a normal ultrasound result. Two of the patients in whom an enthesopathy was found on ultrasound examination had a normal MRI finding. Pathological MRI findings were present in 18 patients. Of the 4 with a palpable hamstring defect, 2 had MRI scans that demonstrated a complete avulsion of a major portion of the hamstrings. A partial tear at the hamstrings origin was reported in 3 patients, scarring on the tendon in 5 patients, and increased signal suggestive of an enthesopathy in 10. Signs of sciatic nerve irritation due to thickening or scarring of the tendon were found in 2 patients.

Nerve conduction studies were done in 27 patients. This showed abnormalities with slowing of the F or H wave of the sciatic nerve in 18 of 27 (67%). Seven patients also had a Tc bone scan done, but this was found to be of little value with nonspecific findings.

Conservative Treatment

Before being seen at our sports medicine clinic, conservative treatment consisting of nonsteroidal anti-inflammatory medication (32 patients), cortisone infiltrations (24 patients), physiotherapy (all 44 patients), chiropractic (13 patients), and acupuncture (12 patients) had failed in all. The methods used in physiotherapy were varied and involved multiple modalities, but the details of the exact physiotherapy treatment were not recorded. One patient had a computed tomography–guided block of the sciatic nerve root, without success.

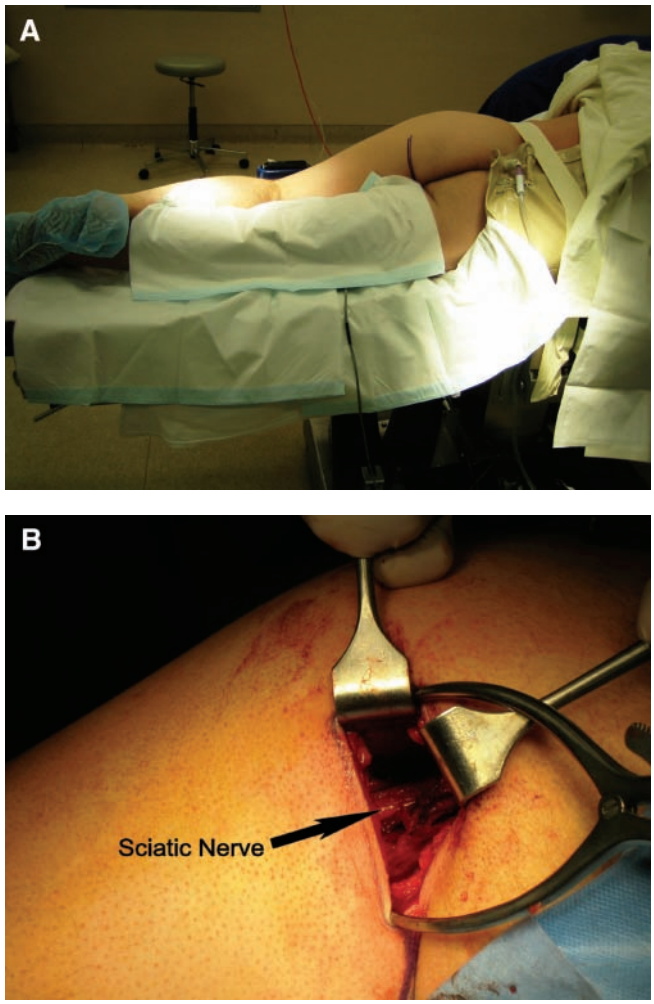

Figure 1. Surgical technique. A, positioning of the patient semiprone on a bean bag with operative side up, gluteal fold incision marked earlier with patient standing. B, intraoperative photograph after proximal hamstring release of the sciatic nerve (arrow).

Surgical Technique

Before surgery, the gluteal fold incision is marked while the patient is standing to improve cosmesis. Under general anesthesia, the patient is placed in a semiprone position, stabilized with a bean bag placed under the patient's pelvis (Figure 1A). An incision is then made in the gluteal fold, extending down to the gluteus maximus. The inferior margin is dissected free, and dissection is continued deep to the muscle toward the ischial tuberosity, which is then exposed. Dissection is continued laterally to expose the sciatic nerve (Figure 1B). Care is taken at this stage to determine if the posterior femoral cutaneous nerve is in the operative field, and if necessary, this is protected from injury. It is usually medial to the sciatic nerve, but at times can be superficial to

it, and needs to be retracted away to protect it. In typical cases, there is thickened fascia between the hamstring tendons, ischial tuberosity, and the sciatic nerve. Any prominent ischial bursal tissue is removed. Dissection is carried out along the lateral border of the proximal hamstrings and along the medial border of the sciatic nerve to free them from each other and divide the intervening scar tissue. Bipolar diathermy is used to control any bleeding. Dissection is continued until the sciatic nerve is completely mobile. Obvious areas of tendinopathy within the proximal tendon are identified, and degenerative areas of the tendon are removed with no attempt made to repair the defects within the tendon. This was necessary in 18 cases, and the tissue was not sent for pathology analysis. The wound is closed in layers with absorbable sutures.

Patients are discharged on the first postoperative day. Crutches are used for comfort. A gentle stretching program is initiated immediately, and active motion is encouraged as tolerated. Most patients can usually start running between 4 and 6 weeks postoperatively.

Follow-up

Clinical follow-up was performed by the senior author in 35 (74.5%) of the cases, initially at 2 weeks postoperatively, then variably after that. Twelve other patients were from interstate, mostly from the Australian Institute of Sport, and were seen locally by appropriate medical personnel with reports to the senior author either orally or in writing.

To assess the final postoperative result, a specifically designed questionnaire was sent out to the patients consisting of 12 questions relating to the postoperative condition. Postoperative subjective pain and weakness were scored on the VAS from 0 to 10, with 0 indicating no pain or weakness and 10 indicating severe pain or marked weakness. Patient satisfaction was also scored on the VAS from 0 to 10, with 0 being completely dissatisfied and 10 being completely satisfied. A paired 1-tailed t test for all patients was performed to analyze changes in preoperative and postoperative pain and weakness. Significance was set at .05. A separate analysis was performed for patients with a positive nerve conduction test result.

RESULTS

Forty-one patients responded to our postoperative follow-up questionnaire, including 3 patients with bilateral surgical interventions, providing us with follow-up data on 44 cases (93.6%). Three patients (6.4%) did not respond, and we were unable to locate them. Average follow-up was 53 months, with a range from 9 to 110 months.

Complications

Minor complications occurred in 9 patients. A superficial wound infection was found in 2, and 9 others reported paresthesia or numbness in the leg. The neurological symptoms resolved spontaneously within 6 weeks in all but 1 patient, in whom mild numbness persisted at the back of the leg in the distribution of the posterior femoral cutaneous nerve.

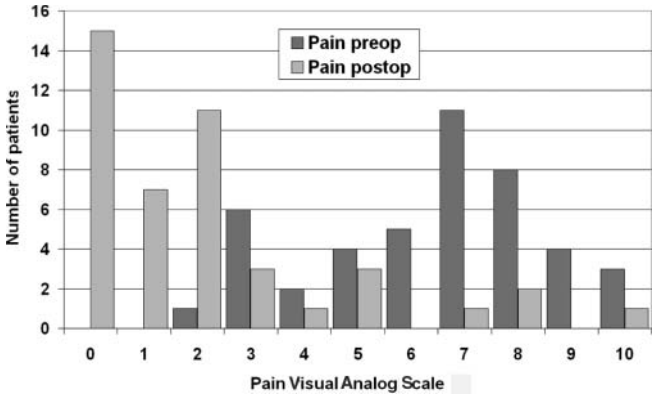

Figure 2. Visual analog scale preoperative versus postoperative pain scores ranging from 0 (no pain) to 10 (severe pain).

Pain

The average VAS score for pain decreased from 6.5 preoperatively to 2.0 (range, 0-10) at follow-up (Figure 2), and there was a significant difference between preoperative and postoperative pain scores ($P < .001$). Two patients (4.5%) had pain scores increase: from 6 to 7 in one and from 7 to 8 in the other. The pain was unchanged in 4 patients (9%) and had decreased in 38 patients (86%). The pain had decreased by 5 or more points in 17 patients (38%).

Strength

At the 2-week clinical review, all 35 patients seen by the senior author reported improved strength, and 25 had normal hamstring strength measurement when compared with the nonoperated side. From the follow-up questionnaire from the 41 patients, the average subjective weakness score decreased from 6.6 preoperatively to 2.8 ($P < .001$). The hamstring muscles felt stronger in 38 patients (86%), unchanged in 3 patients (6.8%), and 3 patients (6.8%) reported increased weakness. Thirteen patients (30%) had a subjective decrease in weakness of 5 points or more (Figure 3).

Sports Activity

Thirty-four patients (77%) had returned to their previous sporting activities (Figure 4A), including 14 of the 15 Australian Rules Football players (93.3%) and 6 of 7 sprinters (85.7%). Continued hamstring region pain and/or weakness prevented 3 patients from returning to their sport, including 2 squash players. The other 7 reported other reasons rather than inability to perform well for not returning to their sport, and most had started a new sport. Twenty-two patients of an initial 32 (68.8%) still competed

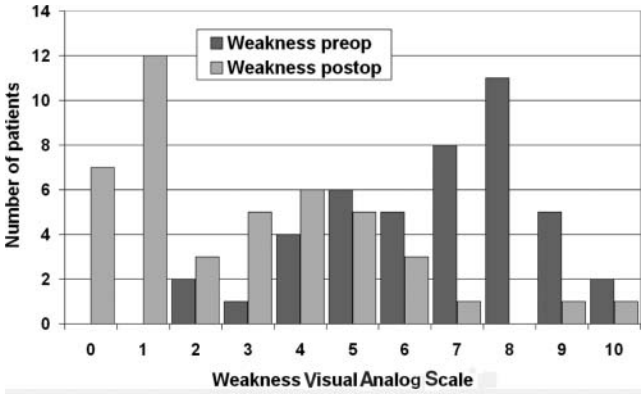

Figure 3. Preoperative versus postoperative weakness scores on the visual analog scale from 0 (no weakness) to 10 (very weak).

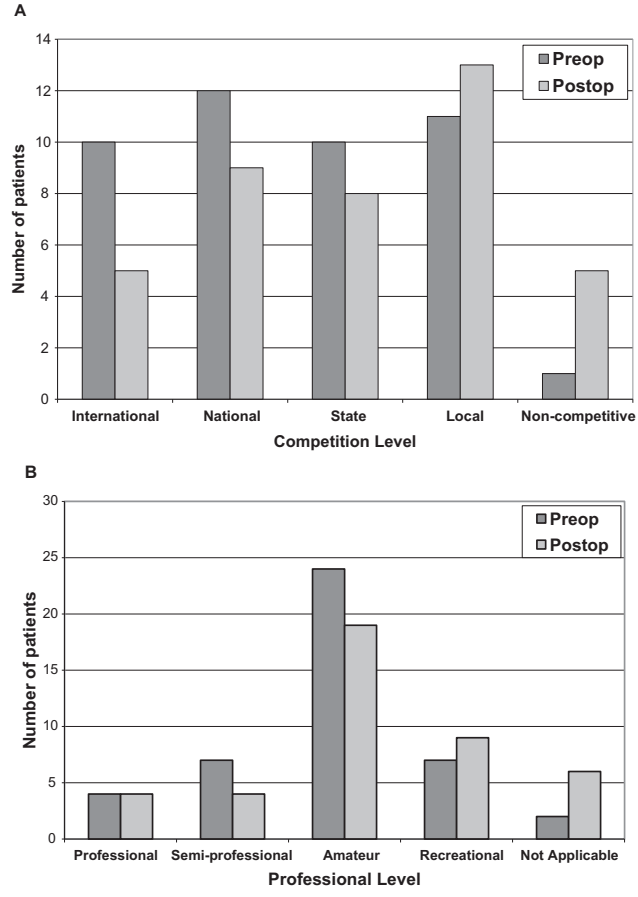

Figure 4. Preoperative and postoperative comparison of athletes with respect to competition level (A) and professional level (B).

at or above state level after surgery (Figure 4A), and 8 of 11 patients (72.7%) returned to competition as a professional or semiprofessional (Figure 4B).

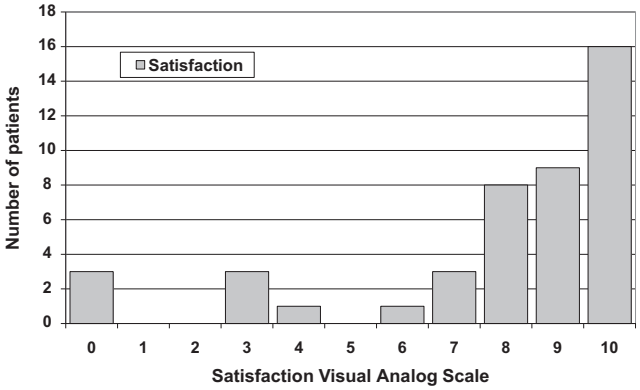

Figure 5. Subjective patient satisfaction on the visual analog scale from 0 (completely dissatisfied) to 10 (completely satisfied).

Satisfaction

The average satisfaction score was 7.8 (Figure 5). Six (14%) were not satisfied with the outcome of the procedure, giving a score between 0 and 3. Five patients (11%) were somewhat satisfied, giving a score between 4 and 7, and 33 patients (75%) were very satisfied, giving a score between 8 and 10. A score of 0 was given by 3 patients (7%), while a perfect score of 10 was given by 16 patients (36%). Three of 4 patients with a palpable hamstring defect were available for follow-up. Two were extremely satisfied with the operation, giving scores of 10 and 8, while the other had a satisfaction score of 0.

Nerve Conduction Studies

Twenty-seven patients had a preoperative nerve conduction test. In the 18 patients with a nerve conduction test indicating impaired sciatic nerve function, pain scores improved from an average 6.1 to 1.7 (range, 0-8), and weakness scores improved from 6.6 to 2.1 (range, 2-10) ($P < .001$). Nine patients had normal nerve conduction study findings, and pain improved from an average of 7.2 to 2.9 (range, 1-9) in this group ($P < .001$), and weakness improved from 5.9 to 3.4 (range, 3-8) ($P = .02$).

DISCUSSION

The study design is a retrospective case series, with no control group, and therefore has a number of inherent limitations. The data concerning the clinical presentation were obtained from the medical record of the patient. Where details were lacking, these were provided from a later questionnaire concerning the preoperative symptoms. These details should represent the effect of the patient's symptoms before surgery and the change in the symptoms after surgery.

Indications for surgery were chronic gluteal region pain consistent with a diagnosis of proximal hamstring syndrome that was refractory to extensive nonoperative management. Patients with proximal hamstring syndrome will typically report pain in the lower buttock region radiating down the posterior thigh to the popliteal fossa. As was shown in our series, the pain can be severe. Weakness of the hamstring muscles is another commonly reported symptom. The patient is usually aware of this weakness, but it may be difficult to detect in well-trained athletes. There is often tenderness in the proximal hamstring region but not over the piriformis or more distal hamstring muscle bellies. Unless there was a complete rupture of the hamstring tendons previously, most patients will have a normal shape of the hamstring muscle belly during contraction. Straight-leg raising is not significantly restricted and, in massive hamstring ruptures, may be even increased. The Lasègue test result is at times slightly positive but never grossly so. Clinically there is no neurological deficit. Marked weakness of the hamstring muscles in the prone patient with the knee flexed to 30° and comparatively normal strength with the knee flexed at 90° was considered to be of great value in the diagnosis of proximal hamstring syndrome. Further validation of this examination technique is needed to become a discriminative diagnostic test. This weakness pattern was found in the majority of patients, but we did not find a clear correlation between this test and clinical outcome after surgery. Two patients with normal strength at preoperative testing had an excellent outcome.

Nerve conduction studies were done in 27 patients. The result was positive in 18 patients and normal in 9. We were unable to show any significant differences between the 2 groups. This suggests either that true sciatic nerve compression, or damage, is not a component of proximal hamstring syndrome or that more than one pathological process can cause the same symptoms. It is also possible that the technique used for nerve conduction studies was inadequate if not performed in a dynamic fashion creating traction on the nerve.

The causes of exercise-associated pain in the hamstring and buttock region are still poorly understood. Only 1 report in the literature discusses the results of treatment of proximal hamstring syndrome,[2] which remains a little-recognized clinical entity.[1] The lack of a firm pathological basis for this condition, and variable investigation findings, makes it difficult to truly know what the surgical exploration and release procedure aims to achieve. Although it is postulated that scarring and fibrosis cause tethering of the sciatic nerve, this has not been proved, and the operation may simply be treating enthesopathy, and scarring, of the proximal hamstring tendons rather than actually releasing the sciatic nerve.

Lack of success of the surgical procedure was defined as the inability of the patients to return to their chosen sport at their preferred level of competition, persistent significant symptoms, complications, and overall dissatisfaction. In our study, 6 (14%) patients were not satisfied with the surgery. One patient had a superficial wound infection, and 1 had a nerve injury. Even more care is now taken not to disturb the posterior femoral cutaneous nerve and to minimize trauma to the sciatic nerve itself. The 6 dissatisfied patients had no improvement in their pain after surgery and had minimal improvement in weakness. The persistent significant pain and weakness in these patients inhibited the return to their chosen sport and level. Combined with the psychological effect on their sporting career due to failure of the surgery, it resulted in 3 very dissatisfied patients. Ultimately, some of the poor results may be due to an incorrect original diagnosis.

Surgical treatment of the proximal hamstring syndrome produced a satisfactory result in most patients. There was significant pain relief (86% of patients) and increased hamstring muscle strength (86% of patients). However there were some failures; therefore patients need to be appropriately counseled before considering this surgical option.

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