Original Article

Exposure of the sciatic nerve in the gluteal region without sectioning the gluteus maximus: Analysis of a series of 18 cases

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Abstract

Background: Dissecting through the gluteus maximus muscle by splitting its fibers, instead of complete sectioning of the muscle, is faster, involves less damage to tissues, and diminishes recovery time. The objective of the current paper is to present a clinical series of sciatic nerve lesions where the nerve was sufficiently exposed via the transgluteal approach.

Methods: We retrospectively selected 18 traumatic sciatic nerve lesions within the buttock, operated upon from January 2005 to December 2009, with a minimum follow-up of 2 years. In all patients, a transgluteal approach was employed to explore and reconstruct the nerve.

Results: Ten males and eight females, with a mean age of 39.7 years, were studied. The etiology of the nerve lesion was previous hip surgery ($n = 7$), stab wound ($n = 4$), gunshot wound ($n = 3$), injection ($n = 3$), and hip dislocation ($n = 1$). In 15 (83.3%) cases, a motor deficit was present; in 12 (66.6%) cases neuropathic pain and in 12 (66.6%) cases sensory alterations were present. In all cases, the transgluteal approach was adequate to expose the injury and treat it by neurolysis alone (10 cases), neurolysis and neurorrhaphy (4 cases), and reconstruction with grafts (4 cases; three of these paired with neurolysis). The mean pre- and postoperative grades for the tibial nerve (LSUHSC scale) were 1.6 and 3.6, respectively; meanwhile, for the peroneal division, preoperative grade was 1.2 and postoperative grade was 2.4.

Conclusions: The transgluteal approach adequately exposes sciatic nerve injuries of traumatic origin in the buttock and allows for adequate nerve reconstruction without sectioning the gluteus maximus muscle.

Key Words: Buttock, gluteus maximus, nerve repair, sciatic nerve injury, transgluteal approach

INTRODUCTION

Contrary to the numerous advances and techniques recently added to the peripheral nerve surgeon's armamentarium, the approaches used to access injured nerves have not undergone profound changes. In fact, most of the incisions used today were used in the 1920s.[1,2,4,5,23,24,26] The case of the sciatic nerve in the buttock is paradigmatic: it is widely accepted in the literature that sectioning the gluteus maximus muscle

at its insertion to the greater trochanter (leaving a cuff for reattachment at closure) and subsequent reflection of the muscle medially is necessary to achieve adequate access.[7-10,13,16,19,20,25] In this way, gluteal nerves and vessels are preserved; unfortunately, however, sectioning the largest and strongest muscle in the human body – the gluteus maximus – usually is associated with a substantial fibrous reaction, significant adverse cosmetic effects, and prolonged postoperative recovery.

At present, scant literature describes surgical procedures for the management of proximal traumatic lesions or tumors of the sciatic nerve by which sectioning of the gluteus maximus muscle is avoided. Omer[14] and, more recently, Patil and Friedman[15] have sparked interest in the transgluteal approach as a means by which to widely expose the sciatic nerve, splitting gluteus maximus fibers without sectioning the entire muscle. In a recent communication, we presented our results employing this approach in 20 cadaveric dissections, obtaining a mean sciatic nerve exposure of 115.4 ± 17.9 mm, ranging from a maximum of 185 mm to a minimum of 79 mm. In all dissections, we were able to perform microsurgical reconstruction with sural nerve grafts under the microscope.[21] Another less invasive option for accessing the sciatic nerve without muscle disruption is the so-called "subgluteal approach" by which muscle fibers are reclined superiorly, instead of being split [Figure 1]. However, this last approach is better indicated for distal injuries as reliable access to the proximal portion of the sciatic nerve is not guaranteed.

The current paper analyzes a series of 18 patients with sciatic nerve injuries, for which the transgluteal approach was employed to expose the nerve, thereby assessing the feasibility of using this approach to access the sciatic nerve for repair.

MATERIALS AND METHODS

Over the period from January 2005 to December 2009, 71 lesions of the sciatic nerve, including acute trauma and tumors, were operated upon within the Department of Neurosurgery at the University of Buenos Aires School of Medicine. For this study, we selected only those 18 lesions located within the buttocks, all of traumatic origin, for which the transgluteal approach was employed. Preoperatively, all patients were submitted to meticulous anamnesis and clinical examination, with electromyography (EMG) and magnetic resonance imaging (MRI) used as complementary studies in all cases. In the scenario of a closed injury, a period of 3–4 months of clinical surveillance and rehabilitation is indicated. We deemed the absence of motor or sensory improvement after this time as an indication for surgical exploration of the nerve. Open or penetrating stab
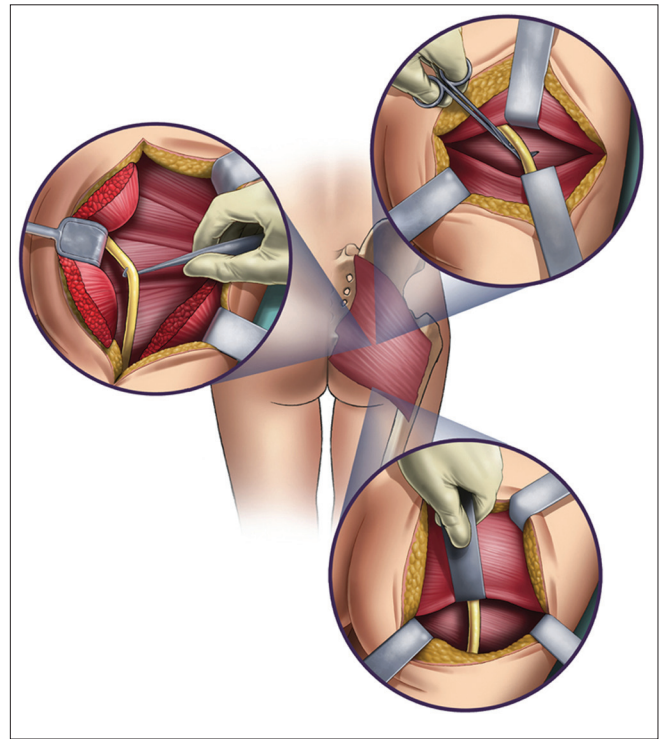
Figure 1: This figure shows the available approaches for accessing the sciatic nerve within the buttock: (center) relationship of the gluteus maximus muscle to the sacrum and femur; (top) transgluteal approach, splitting muscle fibers; (left) classical approach involving sectioning of the gluteus maximus muscle; (bottom) subgluteal approach, reclining the muscle fibers superiorly

wounds were operated upon earlier, 2 or 3 weeks after the primary trauma. Postoperative evaluation was done employing the LSUHSC scale designed specifically for sciatic nerve lesions[9] [Tables 1 and 2].

Surgical technique

Each patient was placed in a ventral decubitus position, with their hips and knees flexed slightly using pillows. A drape was positioned such that the incision could be lengthened if insufficient nerve exposure was noted. A curvilinear incision was created, beginning 4–5 cm lateral to the intergluteal line, at the mid-portion of the gluteal region, and extending toward the trochanter [Figure 2]. The skin, subcutaneous fat, and gluteal fascia were divided, and wide exposure of the gluteus maximus muscle was achieved by subfascial dissection. Then, transverse dissection and splitting of the muscle fibers were performed. The sciatic nerve was readily identified, immediately deep to the gluteus maximus muscle. Once the nerve was isolated, the maximum length of exposure was obtained by splitting gluteus fibers.

Intraoperative notes were prepared and photographs taken, with special care taken to determine the extent and adequacy of exposure. Once the injury was conveniently exposed, it was treated by neurolysis, end-to-end neurorrhaphy, or reconstruction with grafts, as

Table 1: The LSUHSC grading system for buttock or tight-level tibial division lesions

Grade	Criteria
0	No gastrocnemius–soleus function; no inversion; no toe flexion; little or no sensation on the plantar surface of the foot
1	Trace gastrocnemius, but no other tibially innervated muscle function; trace to poor plantar sensation
2	Gastrocnemius contracts vs. gravity only; plantar surface sensation usually ≤grade 2
3	Gastrocnemius–soleus contracts vs. gravity and some force; trace or better inversion; plantar sensation ≤grade 3
4	Gastrocnemius contracts vs. moderate resistance; inversion ≥grade 3; either a trace or no toe flexion; sensation ≥grade 4
5	Gastrocnemius has full function; inversion ≥grade 4; toe flexion present; plantar sensation ≥grade 4

Table 2: The LSUHSC grading system for buttock or tight-level peroneal division lesions

Grade	Criteria
0	No or little function in short head of biceps; no peroneally innervated muscle function; no AT, EHD, or ED function
1	Short head of the biceps contracts; no distal peroneally innervated muscle function
2	Short head of the biceps contracts; peroneally innervated muscles contract vs. gravity or better; no trace of AT; no other distal motor function
3	Short head of the biceps contracts; peroneally innervated muscles ≥grade 3; AT contracts vs. gravity, but function of EHD and ED for toes usually absent
4	Short head of the biceps and peroneally innervated muscles contract, as does AT, which is ≥grade 3; EHD and ED may have trace function
5	Short head of the biceps and peroneally innervated muscles contract, as does AT, which is ≥grade 4; EHD and ED contract, at least vs. gravity

AT: Anterior tibialis muscle, ED: Extensor digitorum, EHD: Extensor hallucis longus

Figure 2: The skin incision used in the present series

indicated with the aid of nerve action potentials (NAPs) when lesions in continuity were founded. Patients were followed up for a minimum of 2 years.

RESULTS

The present series is composed of 18 patients (10 males and 8 females) of age ranging from 4 to 79 years (averaging 39.7 years of age). Table 3 summarizes the clinical cases. All patients had a sciatic nerve lesion within the buttock, and in all cases, the etiology was traumatic, including iatrogenic injury during hip surgery (7 cases, 38.9%), stab wounds (4 cases, 22.2%), gunshot wounds (3 cases, 16.7%), iatrogenic injury during an intramuscular injection (3 cases, 16.7%; in all 3 cases; the injected drug was an antibiotic), and direct trauma to the nerve during an acetabular fracture associated with posterior hip dislocation in a single case (5.6%).

In 15 cases (83.3%), a motor deficit was present, in 12 cases (66.6%) neuropathic pain was reported, and in 12 cases (66.6%) anesthesia or other sensory alterations were described by the patient. The vast majority of cases presented with at least two of these three problems, and 7 (38.9%) patients presented with all the three. Only 3 (16.6%) patients reported pain as their only symptom.

In all cases, the transgluteal approach was noted to be adequate to fully expose the injury and treat it. Treatment was by neurolysis alone in 10 cases (55.5% of cases), by combined neurolysis and neurorrhaphy in 4 (22.2%) cases, and by reconstruction with grafts in 4 (22.2% cases; with neurolysis also performed in 3 of the 4 cases). The mean preoperative division grade for the tibial nerve using the LSUHSC scale was 1.6; postoperatively, this increased to 3.6. Meanwhile, for the peroneal division, the preoperative and postoperative grades were 1.2 and 2.4, respectively. Figures 3 and 4 represent two cases included in this series.

For each reconstructive technique, when neurolysis was the only treatment, the mean result with the LSUHSC grading system was 2.4 before and 4 after surgery (range 0–4/2–4) for tibial division and 1.5 preoperative and 2.5 postoperative (range 0–4/0–5) for peroneal division. For neurorrhaphy, the results were 0.5/3.25 (range 0–2/2–4) for tibial division and 1/1.25 (range 0–4/0–5) for peroneal division; when grafts were employed, the results were 0.5/2.75 (range 0–2/2–4) and 0.25/1.25 (range 0–1/0–3), respectively [Table 4].

One mild postoperative hematoma in the gluteal region was observed (case #5); it was treated conservatively and spontaneous reabsorption was observed after 2 weeks.

DISCUSSION

A widely accepted principle in peripheral nerve surgery

Table 3: Complete series of 18 cases of sciatic nerve injuries at the buttock operated upon using the transgluteal approach

Case No.	Side	Sex	Age (years)	Etiology	Employed reconstructive technique	Tibial division pre/post	Peroneal division pre/post	Effect of surgery (on pain)
1	R	F	34	I	NL	4/5	0/2	M
2	L	F	62	HA	NL	3/4	0/1	M
3	L	M	19	SW	NL + EEN	0/4	0/3	-
4	L	F	24	GSW	NL	4/5	4/5	D
5	R	F	49	HA	NL + EEN	0/3	0/2	M
6	L	M	54	GSW	NL	4/5	¾	D
7	R	M	22	SW	NL	4/5	4/5	D
8	L	F	71	HA	NL + EEN	0/2	0/0	M
9	R	M	44	HA	NL	0/3	0/1	N
10	R	M	58	HA	NL	1/3	½	-
11	L	M	4	I	NL	3/5	2/4	-
12	L	M	18	F	NL + NG	0/3	0/1	-
13	R	F	31	SW	NL + EEN	2/4	4/5	D
14	R	F	79	HA	NL	1/3	1/1	N
15	L	M	21	SW	NG	0/2	0/0	-
16	R	F	68	HA	NL + NG	0/2	0/1	-
17	L	M	23	I	NL	2/4	2/4	N
18	R	M	34	GSW	NL + NG	2/4	1/3	D

R: Right: L: Left, F: Female, GSW: Gun shoot wound, SW: Stab wound, HA: Hip arthroplasty, I: Injection wound, M: Male, NL: Neurolysis, EEN: End-to-end neurorrhaphy, NG: Neurorrhaphy with grafts, M: Pain ameliorated, D: Pain disappeared, N: No substantial change in pain perception
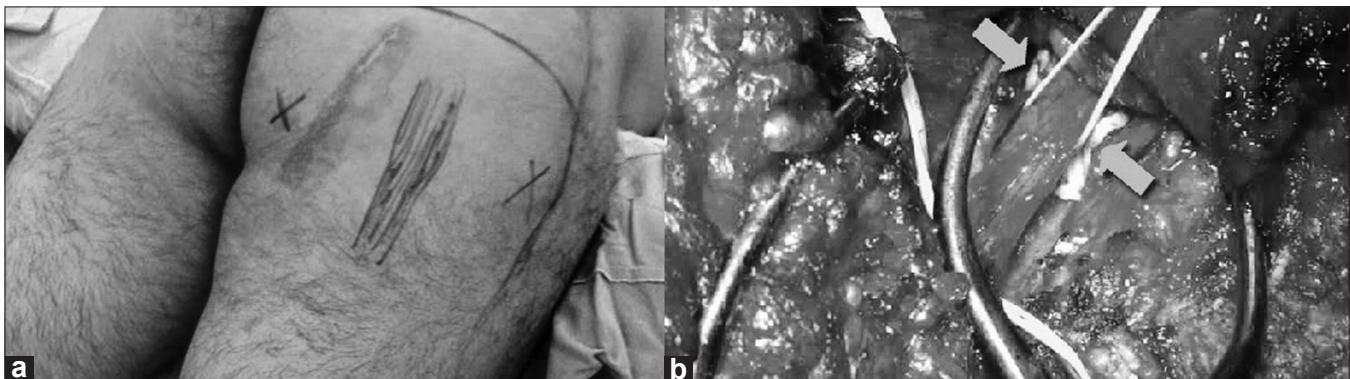
Figure 3: Case #9 – Sciatic nerve injury after hip arthroplasty. (a) The skin incision for the transgluteal approach is in a continuous line. The cross on the left shows the ischium and the one on the right shows the trochanter. Between them, the skin projection of the sciatic nerve is seen. (b) The sciatic nerve was freed from all attachments. The arrows identify acrylic material from the hip arthroplasty, which was damaging the nerve
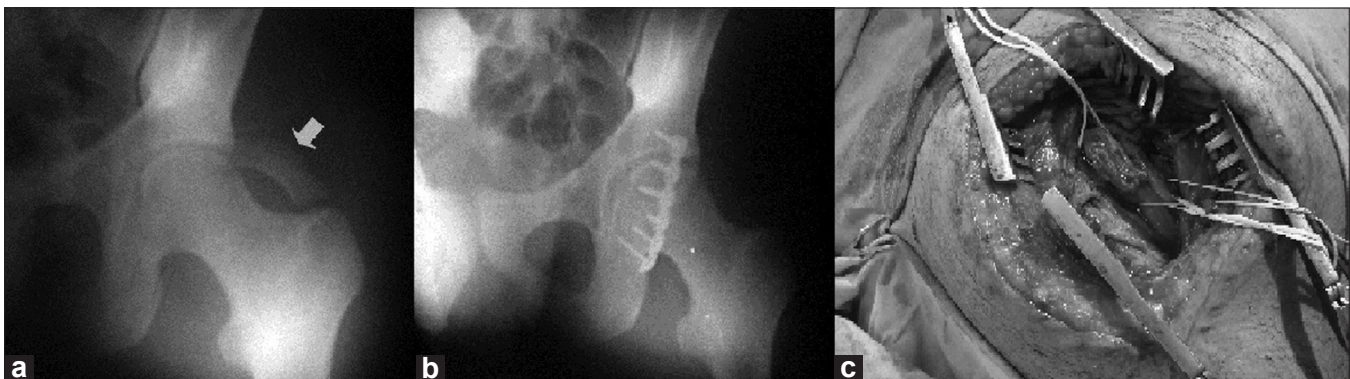
Figure 4: Case #12. (a) Fracture of the left acetabulum after a motorcycle accident; posterior displacement of a fragment was observed by plain radiography. (b) Postoperative plain X-film after open reduction and fixation. During surgery, injury to the sciatic nerve was observed. (c) 3 weeks after bone repair, the nerve was approached via a transgluteal approach and nerve repair using grafts was performed for both divisions of the nerve

is that injured nerves should be exposed broadly. As mentioned previously, the classic approach for sciatic nerve lesions within the buttock entails sectioning the gluteus maximus muscle, and some degree of morbidity is expected. The long incision and complete sectioning of the strongest muscle in the human body typically is associated with a more prolonged postoperative recovery time, including relative immobilization for several weeks to prevent muscular dehiscence. During this period, the patient must limit certain routine daily activities like walking or standing. When wound dehiscence occurs, reparative surgery is required for muscular reattachment, resulting in an even longer immobilization period.[14] Another negative sequela of gluteus maximus sectioning is the resultant cosmetic defect. As the gluteus maximus is superficially situated, its contour affects the external appearance of the whole region. In fact, plastic surgeons always avoid sectioning this muscle during procedures designed to modify gluteal region shape (i.e. gluteoplasty).[17]

Adequate exposure of the proximal portion of the sciatic nerve is guaranteed with the transgluteal approach. Even though this has been accomplished for compressive lesions using much smaller skin incisions elsewhere,[3,6,18,22] in traumatic injuries, as in our series, wider exposure is needed.

The inferior gluteal nerve innervates the gluteus maximus muscle, entering into its deep surface 5 cm from the greater trochanter, and at the lower part of the muscle. Thus, the transgluteal approach does not impair the inferior gluteal nerve, though care should be exercised at the lower segment of the incision to preserve the nerve.[12]

In our series, preoperative symptoms varied from patient to patient, consistent with other publications.[9,10,11,12] Sciatic nerve lesions are associated not only with motor deficits – predominantly of the peroneal division – but also with pain and anesthesia. Lack of protective sensation in the sole of the foot predisposes the patient to the formation of ulcers, osteomyelitis and, potentially, amputation. The results of nerve reconstruction are better for the tibial than the peroneal division, as mentioned elsewhere in the literature.[9,10,11,27] The results of the present series compare adequately with other series published before employing the classical section of the gluteus maximus muscle [Table 5].

A careful preoperative evaluation will determine the best approach in each case. In the scenario of an injury to the sciatic nerve that is more extensive than previously expected, the transgluteal approach may be inadequate on its own, such that further distal exposition is necessary. In this case, the skin incision must be continued distally [Figure 5] and the surgeon must either completely section the muscle or perform the nerve repair beneath the muscle without sectioning it.

One pitfall we have observed employing the transgluteal approach to repair the sciatic nerve is that the surgical field is somewhat deeper and narrower than when complete sectioning of the gluteus maximus muscle is

Figure 5: Skin incision for the transgluteal approach. The dotted line depicts the suggested incision when further distal access is needed

Table 4: Mean results of each reconstructive technique employed in this series using the LSUHSC grading system

Technique	Tibial nerve pre/post	Peroneal nerve pre/post
Neurolysis (as only treatment)	2.4/4 (range 0–4/2–4)	1.5/2.5 (range 0–4/0–5)
Neurorrhaphy	0.5/3.25 (range 0–2/2–4)	1/2.5 (range 0–4/0–5)
Grafts	0.5/2.75 (range 0–2/2–4)	0.25/1.25 (range 0–1/0–3)

Table 5: Results of previously reported series of sciatic nerve repair at the buttock with classical approach compared with the present series employing transgluteal approach[a]

Technique	n	Neurolysis: % ≥ grade 3 (tibial)	Neurorrhaphy: % ≥ grade 3 (tibial)	Grafts: % ≥ grade 3 (tibial)	Neurolysis: % ≥ grade 3 (peroneal)	Neurorrhaphy: % ≥ grade 3 (tibial)	Grafts: % ≥ grade 3 (tibial)
Kim *et al.*[9]	175	87	73	62	71	30	24
Yeremeyeva *et al.*[27]	79	82	75	57	62	33	20
This series	18	100	75	50	57	50	25

[a]The first two series have some patients in common

performed. At the extremes of nerve exposure, some work is done near to and partially under gluteus maximus fibers. For this same reason, both the exposed extremes of the nerve cannot be visualized simultaneously and the assistant must move from one end to the other during the procedure. As demonstrated previously in a cadaveric study,[20] and posteriorly in the present series, this limitation does not interfere with graft reconstruction using microsurgical techniques.

Patil *et al.*[15] employed a skin incision that followed the lateral border of the buttock to treat sciatic nerve lesions via a transgluteal approach. The incision used in the present series, perpendicular to the spine, has at least two advantages: (1) it produces a more favorable cosmetic result and can be hidden easily under clothes and (2) it can be extended distally, as in the cited paper, if further sciatic nerve exposure is needed.

CONCLUSIONS

The transgluteal approach adequately exposes sciatic nerve injuries of traumatic origin in the buttock and allows for reconstruction of the nerve without sectioning the gluteus maximus muscle.

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REFERENCES

1. Brooks D. Founders of hand surgery. Sir Herbert Seddon. J Hand Surg Br 1991;16:223-4.
2. Browne K. A History of Neurological Surgery. In: Walker A, editor. Surgery of the Peripheral Nerves. 1st ed. NY: Hafner; 1951.
3. Filler AG, Haynes J, Jordan SE, Prager J, Villablanca JP, Farahani K, *et al.* Sciatica of nondisc origin and piriformis syndrome: Diagnosis by magnetic resonance neurography and interventional magnetic resonance imaging with outcome study of resulting treatment. J Neurosurg Spine 2005;2:99-115.
4. Gelberman RH, editor. Operative Nerve Repair and Reconstruction. 1st ed. NY: Lippincott; 1991.
5. Huber G. Operative treatment of peripheral nerves after severance, more particularly after loss of substance. J Lab Clin Med 1916;2:837.
6. Indrekvam K, Sudmann E. Piriformis muscle syndrome in 19 patients treated by tenotomy--A 1- to 16-year follow-up study. Int Orthop 2002;26:101-3.
7. Kempe L. Técnicas neuroquirúrgicas. 1st ed. Barcelona: Editorial Científico Médica; 1972. p. 216-7.
8. Kim D, Midha R, Murovic JA, Spinner R, editors. Kline and Hudson´s Nerve Injuries: Operative Results for Major Nerve Injuries. Entrapments and Tumors. 2nd ed. Philadelphia: WB Sounders; 2007.
9. Kim D, Murovic JA, Tiel R, Kline DG. Management and outcomes in 353 surgically treated sciatic nerve lesions. J Neurosurg 2004;101:8-17.
10. Kline DG, Kim D, Midha R. Management and results of sciatic nerve injuries: A 24-year experience. J Neurosurg 1998;89:13-23.
11. Kretschmer T, Antoniadis G, Braun V, Rath SA, Richter HP. Evaluation of iatrogenic lesions in 722 surgically treated cases of peripheral nerve trauma. J Neurosurg 2001;94:905-12.
12. Ling ZX, Kumar VP. The course of the inferior gluteal nerve in the posterior approach to the hip. J Bone Joint Surg Br 2006;88:1580-3.
13. Maniker A. Operative Exposures in Peripheral Nerve Surgery. 1st ed. NY: Thieme; 2004.
14. Omer, GE Spinner M. Management of Peripheral Nerve Problems. 1st ed. Philadelphia: WB Saunders; 1980.
15. Patil PG, Friedman AH. Surgical exposure of the sciatic nerve in the gluteal region: Anatomic and historical comparison of two approaches. Neurosurgery 2005;56 ONS Suppl 1:165-71.
16. Reckling FW, Reckling JB, Mohn MP. Orthopaedic Anatomy and Surgical Approaches. 1st ed. St. Louis: Mosby Year Book; 1990.
17. Robles JM, Tagliapietra JC, Grandi MA. Gluteoplastia de aumento: Implante submuscular. Cir Plast Ibero Latinoam 1984;10:123-9.
18. Rodrigue T, Hardy RW. Diagnosis and treatment of piriformis syndrome. Neurosurg Clin N Am 2001;12:311-9.
19. Samardzic M, Rasulic L, Vuckovic C. Missile injuries to the sciatic nerve. Injury 1999;30:15-20.
20. Siqueira MG, Martins RS. Anatomia Cirúrgica das Vias de Acesso aos Nervos Periféricos. 1st ed. Rio de Janeiro: Di Livros Editora; 2006.
21. Socolovsky M, Garategui L, Campero A, Conesa H, Basso A. Exposure of the sciatic nerve in the gluteal región without sectioning the gluteus maximus: An anatomical and microsurgical study. Acta Neurochir (Wien) 2010;108:233-40.
22. Spinner RJ, Tiel RL. Sciatic nerve compression and piriformis syndrome. In: Midha R, Zager EL, editors. Surgery of peripheral nerves: A case based approach. 1st ed. NY: Thieme; 2008.
23. Stookey B. Surgical and mechanical treatment of peripheral nerves. 1st ed. Philadelphia: WB Saunders Co.; 1922.
24. Sunderland S. The history of nerve repair. In: Sunderland S, editor. Nerve injuries and their repair. 1st ed. Edimburg: Churchill Livingstone; 1991.
25. Whitmore RG, Bhowmick D, Zager EL. Sciatic nerve injury and repair. In: Midha R, Zager EL, editors. Surgery of peripheral nerves: A case based approach. 1st ed. NY: Thieme; 2008.
26. Woodhall B, Bebe G. Peripheral nerve regeneration: A follow-up study of 3656 World War II injuries. Washington DC: US Government Printing Office; 1956.
27. Yeremeyeva E, Kline DG, Kim DH. Iatrogenic sciatic nerve injuries at buttock and tight levels: The Louisiana State University experience review. Neurosurgery 2009;65 Suppl:A63-66.