Piriformis Syndrome and Endoscopic Sciatic Neurolysis

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Abstract: Piriformis syndrome is the compression or the irritation of the sciatic nerve by the adjacent piriformis muscle in the buttock leading to symptoms that include buttock pain, leg pain, and altered neurology in the sciatic nerve distribution. Epidemiological figures of the prevalence are unknown, but are estimated to be about 12.2% to 27%. There is no consensus on the diagnostic criteria. Advancement in magnetic resonance imaging allows us to observe unilateral hyperintensity and bowing of the sciatic nerve. The pathophysiology of the disease includes single blunt trauma, overuse causing piriformis hypertrophy, and long-term microtrauma causing scarring. Treatments include physiotherapy, steroid injections, and surgery. Minimally invasive techniques are emerging with the hope that with less postoperative scar tissue formation, there will be less recurrence of the disease. In this chapter, senior author describes his technique for endoscopic sciatic neurolysis.

Key Words: piriformis, piriformis syndrome, deep gluteal syndrome, buttock pain, sciatica, sciatic neurolysis, endoscopic

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THE PROBLEM

Piriformis syndrome (PS) can be defined as the compression or the irritation of the sciatic nerve by the adjacent piriformis muscle in the buttock. This compression of the sciatic nerve leads to symptoms that include buttock and leg pain, with altered neurology in the sciatic nerve distribution and sitting intolerance. The definition implicitly labels the piriformis muscle as the cause of the patient's symptoms. However, the contribution of the piriformis muscle in many patients is far from clear. This implication of the piriformis muscle as the chief cause of the patients' symptoms has come about due to the intimate relationship of the piriformis muscle to the sciatic nerve, as described by Beaton and Anson.[1] Deep gluteal syndrome (DGS) is a more recent term that encompasses any cause of retrotrochanteric pain emanating from irritation, tethering, or compression of the sciatic nerve as it passes from the greater sciatic notch to the thigh. Causes of this include fibrous band formation, hypertrophy of the piriformis muscle, gemelli-obturator internus syndrome, quadratus femoris and ischiofemoral pathology, hamstrings pathology, and gluteal disorders, the most common being gluteal contracture. PS is a cause of DGS, but is a pathologic entity in itself and will be the focus of this chapter.

Exact epidemiological figures on the prevalence of PS are unknown, but are estimated to be about 12.2% to 27%.[2] There is no consensus on the diagnostic criteria or even the existence of this syndrome.[2–8] First described by Yeoman[9] in 1928, his remark still remains a point of view held by some hip specialists: "insufficient attention has been paid to the role of the piriformis in the causation of sciatica." Despite advances in imaging and our ability to perform therapeutic interventions, this syndrome remains poorly defined.[2–8,10–13] The reason it remains controversial is in itself complicated. After Yeoman published his paper, Mixter and Barr[14] produced their landmark paper that first described the rupture of an intervertebral disk as being a leading cause of radicular-type pain. This led to the sidelining of other causes of radicular-type pain including PS.[5] The characteristics of PS have been refined over the years, first by Freiberg,[15] then Robinson,[16] who was the first to use the term "piriformis syndrome."[5] Despite the refinements, it is only with the major advancement in our clinical understanding of the hip and the pelvis in the past decade and the advent of imaging including magnetic resonance imaging (MRI) and computed tomography (CT) that we have been able to look for objective signs of this syndrome and thus begin to establish its existence.

The pathophysiology is uncertain, with a number of authors linking a hypertrophied piriformis causing the local irritation. Filler and colleagues proposed muscle spasms being another cause, their "piriformis amplifier theory" being a possible explanation.[2–4,6–8,10,13,17–21] Single-episode blunt trauma and repetitive use causing hypertrophy of the piriformis muscle seem to be the 2 most popular explanations for the piriformis causing irritation of the sciatic nerve.[2,3,5,6,8,13,20,21] Scarring from repetitive microtrauma has also been described in the literature as a cause of PS, as in competitive cyclists who spend lengthy periods on a bicycle seat causing microtrauma, or the classic example of having your wallet in the back pocket. In these examples the trauma is insignificant enough to cause a problem in the short term, but the body's adaptation to the microtrauma (ie, scarring of the piriformis muscle and the adjacent tissues) is enough, in the long term, to begin to affect the sciatic nerve.[17] A relatively new idea is the formation of fibrous bands (with or without a vascular component), which is an emerging explanation for PS.[17,21] The sciatic nerve requires up to 28 mm of excursion to accommodate normal hip motion.[17,21] It is possible that tethering by the fibrous band causes abnormal tension stress in the nerve, resulting in radicular-type pain.[17] Anatomic variations have also been implicated, with the most common being an abnormal path of the nerve through piriformis as described by Beaton and Anson, or a vascular leash comprising branches of the superior gluteal artery, possibly resulting in the restriction of the sciatic nerve.[17] A common observation by senior author is scarring and medial tethering of the sciatic nerve to or near the ischial tuberosity, offering a plausible explanation for the ubiquitous sitting intolerance.[17] This observation seems to be shared by Martin et al in their paper detailing their treatment of DGS.[17] However, despite the uncertainties, what remains well recognized is a

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subset of patients who experience buttock pain, sitting intolerance, and neurological symptoms, which can severely impact their quality of life often for many years. These people may benefit from prompt diagnosis and effective treatments for a cluster of symptoms and signs that fall within the umbrella of PS/DGS.

CLINICAL EXAMINATION

The first step is to take a thorough history. A previous heavy fall on the buttock with swelling and bruising in the past, a repetitive activity such as competitive cycling, prolonged sitting, and previous hip surgery are all relevant.[2–7,13,20,22,23] Patients often complain of buttock pain with sitting (problems with watching a movie or a car trip), pain with exercise (running and cycling), burning pain, usually extending half way down the thigh, but occasionally to the foot, and less commonly numbness and tingling down the back of the leg.[20,21] The patient will often sit through the interview perched on the asymptomatic buttock.[20,21] A gynecologic history is important for female patients as intrapelvic conditions such as endometriosis can result in scarring, tethering, and restriction of the lumbosacral plexus within the pelvis. Symptoms fluctuating with the menstrual cycle can be a key finding.

Unfortunately, no single test is diagnostic for PS; instead, a collection of symptoms and clinical suspicion will lead to the diagnosis. Patients are often referred to the clinic with the provisional diagnosis of sciatica or buttock pain. The physician must differentiate whether this is discogenic or nondiscogenic, intraspinal or extraspinal, pelvic or extrapelvic, which can be difficult even for an experienced hip specialist. A lumbar spine MRI is often performed before being referred to a clinic to exclude patients in whom a disk pathology is the more likely cause.[2,4,6,17,22–25]

Lumbar spine, hip pathology, and knee pathology should be ruled out in the examination. Nerve-root compression, posteroinferior hip arthrosis, pincer femoro-acetabular impingement, and sacroiliac joint pathology all need to be considered. A straight-leg raise is performed, and in case of discogenic disease, it will normally yield a positive result.[20,21] In PS, this test is normally negative, and therefore, discogenic-type symptoms with a negative straight-leg test should arouse the suspicion of the possibility of PS.[20,21] There have been a number of tests described by various authors that attempt to elicit the compression of the sciatic nerve by the piriformis muscle. Firstly, palpation of the nerve at the sciatic notch has been described by a number of authors.[2,5,20–22] In the authors' experience, this is a useful test, and a modification made to improve it has been to palpate from the sciatic notch and follow the nerve course down to the level of the lesser trochanter, a positive test being where palpation reproduces the pain troubling the patient. The validity of the Lasegue test (a positive straight-leg raise) has been questioned. Both Freiberg and Robinson included it in their cardinal signs for diagnosing PS.[2,5,20] Recently, the literature is finding the straight-leg raise to be usually negative in patients with PS, and this is true in the authors' experience. Pace signs such as pain and weakness on abduction and external rotation of the hip in the lateral position in the literature has been shown to be useful. A modification used by the author is to perform the test in a prolonged manner (over 45 to 60 s). The active piriformis and seated piriformis stretch tests have been shown to have a higher sensitivity and specificity than the other tests that can be performed, especially when their results are used in combination.[21] Martin et al[21] have specified that in the workup of DGS, the physical examination should include the Lasegue test, the Pace test, and the Seated Piriformis Stretch test. Freiberg test (revisited hip abduction in the seated position) is also useful. Because of the conflicting results, most hip specialists including the author do not use conduction tests and instead use history, physical examination, and CT-guided lidocaine/steroid injections as part of their workup of a patient with regard to PS. This involves a CT-guided injection of dilute bupivacaine, saline, and 40 mg triamcinolone adjacent to the sciatic nerve at the piriformis muscle. The patient is given a pain chart to fill out over the next 2 weeks. A positive test involves either reduction in symptoms on injection day (bupivacaine) and/or over the next 2 weeks (triamcinolone effect).

IMAGING MODALITIES

The interest in PS has only increased with our increasing ability to image the body. Unlike many other orthopedic issues, imaging the sciatic nerve presents several problems as there is no definitive bony landmark that can be used to locate the sciatic nerve, and unfortunately, unlike other peripheral neuropathies (carpal tunnel/cubital tunnel, etc.), the sciatic nerve is deep and surrounded by an intricate array of muscles, tendons, and blood vessels. Ultrasound is a more challenging investigation to find the nerve accurately because of its depth and often the large amount of subcutaneous fat normally found in this area of the body. MRI is emerging to be the main investigation of choice for PS.

The main signs to look for when diagnosing PS are as follows:

- Unilateral hyperintensity on a fat STIR sequence of MRI of the sciatic nerve that extends down the tract of the nerve: this indicates edema and therefore likely irritation of the nerve.[7]
- Bowing of the sciatic nerve on the medial side of the piriformis indicates that the sciatic nerve is being compressed and therefore its circular shape is being affected by the local compression of the piriformis muscle on the nerve.[7]

There is a body of evidence of people describing the "magic angle," a term more often associated with thoracic outlet syndrome and used to describe a false-positive increase in the signal of the sciatic nerve. Although there may be certain cases where this is true, the magic angle is now being used by some critics to discredit the increase in signal in patients with piriformis-type symptoms.[3,7]

MRI has become a useful tool in the workup of PS. Inflammation around the nerve, scar tissue adjacent to the nerve, anatomic variations in the path of the nerve, and unexpected space-occupying lesions compressing the nerve can all be identified.[7]

Magnetic Resonance Neurography (MRN)

The use of MRN to evaluate the physical state and anatomic relationship, the size, and the shape of a nerve is a developing and promising field. The idea of this is to be able to evaluate the physical nature of the sciatic nerve and piriformis muscle to determine whether PS is the diagnosis in this person's case. MRN is now increasingly used in the assessment of pain-like syndromes including piriformis and thoracic outlet syndrome.[7]

TREATMENTS

With increasing interest in the diagnosis and the management of PS, a number of treatments have been tried with varying results.

One of the most used treatments is specific piriformis stretching. This is reported as having mixed results. The main problem with this treatment is the fact that it requires intensive physiotherapy sessions performed by an experienced physiotherapist. It also requires a patient who is motivated and willing to accept the slow progress of recovery; studies show that 79% of the patients can have a 50% improvement in their symptoms.[6]

The next step in escalating the nonoperative management of PS is the use of either MRI or CT for the injection of the local anesthetic and steroids into the piriformis muscle to treat the symptoms while assisting with the diagnosis.[4,6,7,11,22,26] Electromyography was used at 1 stage in the attempt to locate the piriformis muscle during injections of the piriformis muscle. However, this has not been shown to be effective in locating the piriformis muscle accurately and is problematic in some patients, as electromyography can be very painful in patients with PS, lessening its usefulness.[7] Both MRI and CT have been shown to guide the injection. CT is quicker and cheaper, but exposes the patient to radiation in the genital area, which is not advisable for patients who are normally still of fertile age.[7] The literature reports vary in reporting this as a successful treatment. It can give most patients short-term to mid-term symptomatic relief. However, 20% or less of the patients with PS are treated (avoid surgery) with local injections alone.[5–7] The benefit in performing the injection, however, is the fact that a positive response to either the local anesthetic or the dilute steroid can be diagnostic for PS, thus not only relieving the troubling symptoms but also aiding in the diagnostic workup of patients considering surgery.

In the event of a patient not responding to conservative treatment, a surgical option is considered. The surgical criteria used by senior author for sciatic neurolysis include the following 6 criteria with 1 and 4 being mandatory and the patient requiring to fill in 5 of the 6 criteria:

(1) Retrotrochanteric pain, sciatica-like leg pain, numbness, paresthesia.
(2) Sitting intolerance.
(3) Buttock pain on resisted external rotation of the hip at 90-degree flexion and full internal rotation.
(4) Normal lumbar spine MRI.
(5) Positive response to CT-guided injection of dilute naropin and 40 mg triamcinolone (either immediate with the local anesthetic or delayed with cortisone).
(6) Greater than 6 months' symptoms and failure of conservative measures.

The main objective of surgery is to debride tissue around the sciatic nerve (especially if excessive scar tissue is present) and to release the sciatic nerve from any areas of entrapment from the greater sciatic notch to below the lesser trochanter. Fractional lengthening of the piriformis tendon is also performed routinely at its lateral insertion on the greater trochanter. It is accepted that there is no randomized controlled trial to guide the surgeon as to whether or not this is necessary. Fractional lengthening results in a 25% to 50% reduction in the muscle volume on MRI scan 12 months later, but no discernable loss of external rotation power on testing has been observed.

Although the objective remains the same, the method of accomplishing this has changed and evolved with the increasing mastery in endoscopy. Dezawa and colleagues, in the early 1990s, described an endoscopic approach for sciatic neurolysis through a keyhole incision in the posterior buttock. Dezawa et al[13] also performed this operation under a local anesthetic with very large amounts of local anesthetic being used to facilitate this. The rationale behind evolving to endoscopic surgery was to decrease the amount of bleeding and scarring resulting from open surgery. Martin et al[17] also released a paper detailing the use of endoscopy for debriding the sciatic nerve, in which he has obtained very promising results with endoscopic treatment. The results include 83 patients having no postoperative sitting pain, all patients stating that they could go back to work, and 100% of the patients stating that they would undergo this surgery again, which are all very promising results for patients who on average suffer from this condition for too many years.[21] The senior author has also developed a technique to decompress the sciatic nerve. Reports about endoscopically releasing the sciatic nerve currently show mixed results, with more data required to show whether or not endoscopically debriding the nerve is a technique superior to open release.[6,8,13] The rationale for endoscopic release includes the superior view of the anatomy in an experienced arthroscopists hands, increasing the surgical safety. Another reason was the senior author's experience of a 30% rate of recurrence of symptoms 6 to 18 months postoperatively after open sciatic neurolysis. This is thought to be due to the formation of scar tissue and consequent limitation of nerve excursion secondary to the open procedure. The senior author is performing endoscopic sciatic neurolysis as a revision procedure for patients who have undergone open surgery at other surgical centers followed by recurrence. The main finding is a large amount of scar tissue from the previous operation, tethering and entrapping the sciatic nerve. Well-described complications after arthroscopic surgery around the hip include fluid extravasation into the surrounding tissues including the retroperitoneum, and thermal damage from radiofrequency wand use. Pump pressures can be kept at 30 to 40 mm Hg to minimize fluid escape. The Arthrocare 50-degree wand also has a thermal alarm that can be set to a safe level. Traction complications are not seen as it is not required. More specific complications include damage to the sciatic nerve. However, the adjacent small nerves, the posterior cutaneous nerve of the thigh, the nerve to the obturator internus, and the inferior gluteal nerve are damaged more easily. Bleeding from the small branches from the superior gluteal artery can also result in postoperative hematoma formation.

THE SURGICAL TECHNIQUE

The patient is placed in the lateral decubitus position. General anesthesia without paralysis is used.[13] The traction bolster of the McCarthy hip traction device (Innomed Inc., Savannah, GA) is utilized. If hip arthroscopy is indicated, this is undertaken before sciatic neurolysis (Fig. 1). The leg is taken out of traction and placed on a custom U-shaped bolster, allowing free flexion and extension of the hip (Fig. 1). The traction boot is also removed to allow visualization of any foot movement as a result of sciatic nerve stimulation (Fig. 1).

The femur is marked; the posterosuperior portal is positioned 1 cm superior to the tip of the greater trochanter and 1 to 2 cm posterior to the posterior edge of the greater

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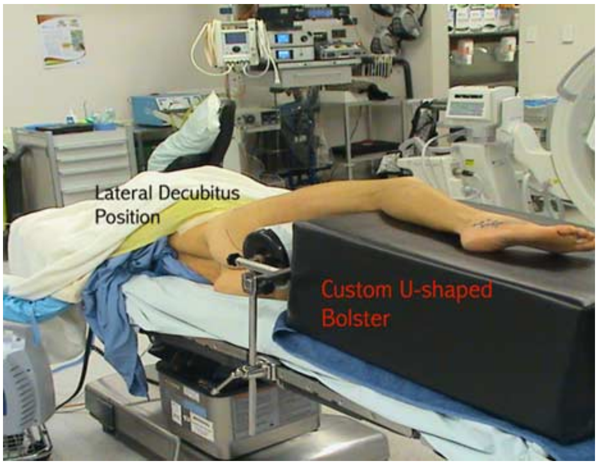

FIGURE 1. The patient is placed in the lateral decubitus position. General anesthesia without paralysis is used. The traction bolster of the McCarthy hip traction device (Innomed Inc.) is utilized. If hip arthroscopy is indicated, this is undertaken before sciatic neurolysis. The leg is taken out of traction and placed on a custom U-shaped bolster, allowing free flexion and extension of the hip. The traction boot is also removed to allow visualization of any foot movement as a result of sciatic nerve stimulation.

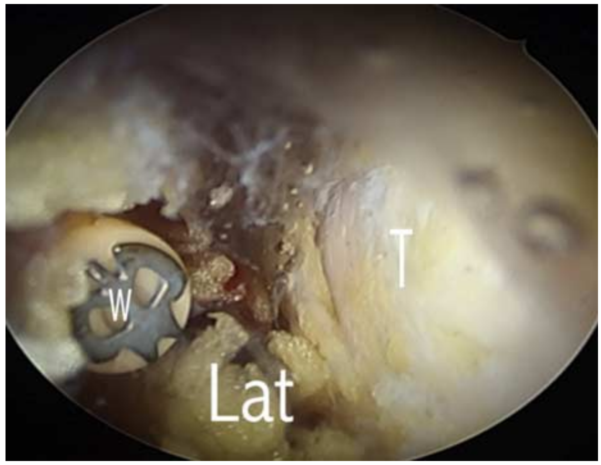

FIGURE 3. The starting view: the white of the trochanter (T) is seen on the right, with a clear view of the wand (W). The surgeon can now find the piriformis tendon with x-ray guidance and gentle internal rotation of the hip. The retrotrochanteric space is characterized by loose areolar tissue (Lat) and fat; if muscle is all the surgeon can see, they are still within the gluteal bulk. Removal of the scope and blunt dissection further anterior with artery forceps is required.

trochanter (Fig. 2). The posteroinferior portal is positioned 6 to 7 cm distally, allowing easy triangulation between the scope and the instruments (Fig. 2). To ensure easy access to the retrotrochanteric space, spinal needles inserted through the marked portals should strike the femur at a 30- to 40-degree angle to the vertical plane. A lesser angle results in an awkward vertical position of the scope and the instruments. Standard adhesive drapes are used with a large pocket for collecting the arthroscopic fluid. The image intensifier C-arm is a helpful tool due to the lack of simple anatomic landmarks. Two straight artery forceps are used for blunt dissection through the gluteus maximus into the retrotrochanteric space. The image intensifier combined with surgical "feel" or "jousting" can confirm triangulation posterior and medial to the greater trochanter. A 30-degree scope with a blunt trochar is introduced in the distal portal, aiming for the back of the greater trochanter. A fluid pump (Arthrex Inc., Naples, FL) is set at 40 mm Hg. The retrotrochanteric space is characterized by loose areolar tissue and fat (Fig. 3). If muscle is encountered, instruments are too posterior or lateral and the gluteus maximus has not been fully traversed. A further anterior and medial positioning is required, along with a few degrees of internal rotation of the femur. The Arthrocare 50-degree radiofrequency wand (Arthrocare Corporation, Austin, TX) has proven to be an ideal starting instrument as it minimizes bleeding. It is important to identify the characteristic white color of the posterior edge of the trochanter to confirm orientation (Fig. 2). Dissection medially combined with further internal rotation of the limb by an assistant will lead to the piriformis tendon. Once found, it can be released

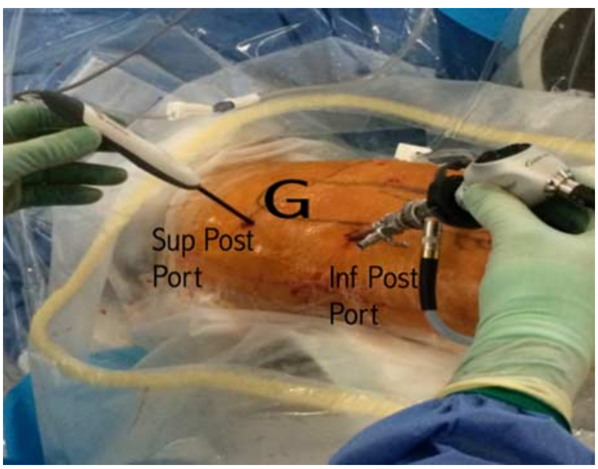

FIGURE 2. The femur is marked; the posterosuperior portal (Sup Post) is positioned 1 cm superior to the tip of the greater trochanter (G) and 1 to 2 cm posterior to the posterior edge of the greater trochanter (the portal to the left). The posteroinferior (Inf Post) portal is positioned 6 to 7 cm distally (the portal on the right), allowing easy triangulation.

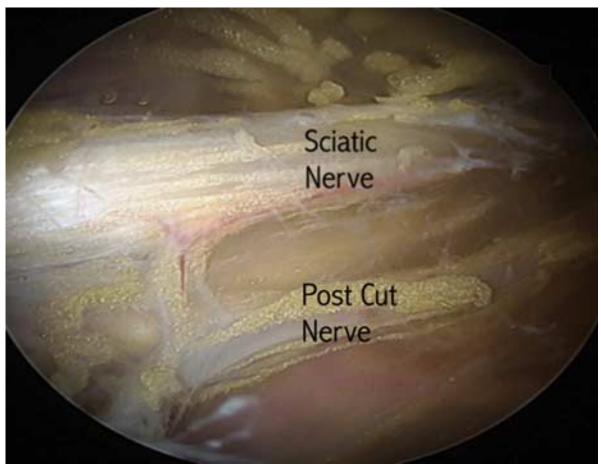

FIGURE 4. The posterior cutaneous nerve of the thigh is seen posterior to the sciatic nerve.

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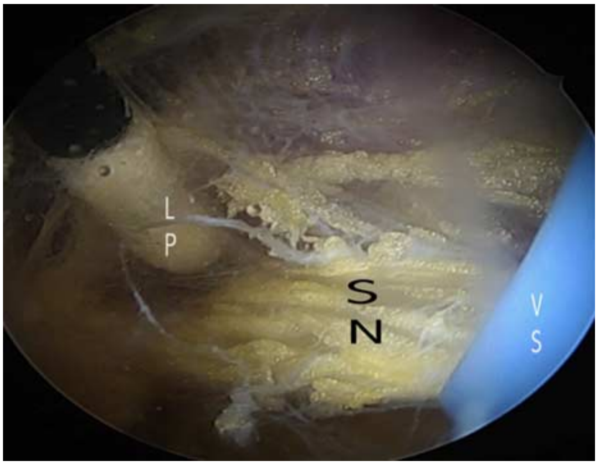

FIGURE 5. The peanut (LP) is used to dissect tight fibrous bands around the sciatic nerve (SN) at the greater sciatic notch to make way for the Blue vascular sling (VS).

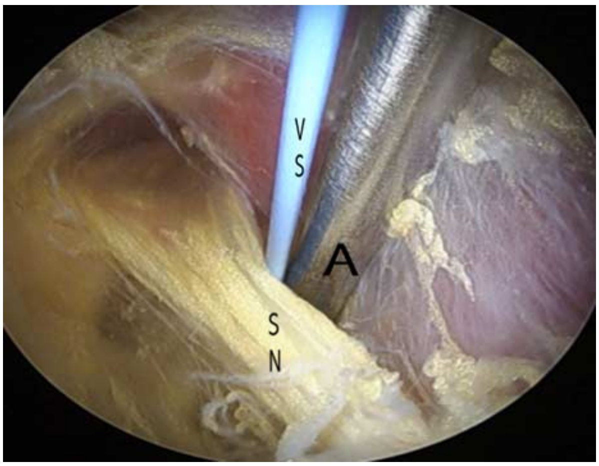

FIGURE 6. The blue vascular sling (VS) is passed anterior to the nerve with the Arthrex suture holder (A).

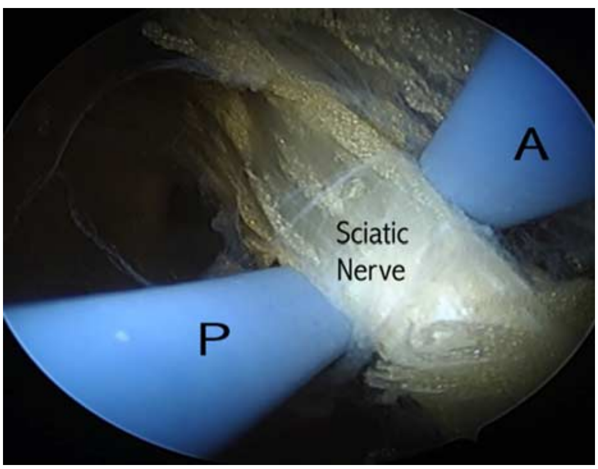

FIGURE 7. The sciatic nerve (SN) is now controlled by the vascular sling: the anterior (A) and the posterior (P) parts of the sling have been labeled.

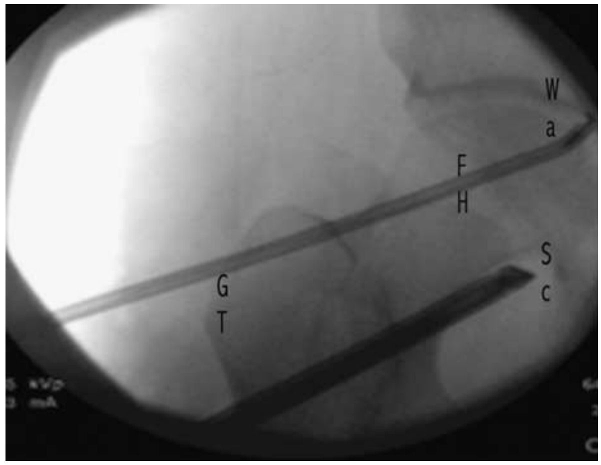

FIGURE 8. The proximal (and distal) extent of the dissection is checked easily with x-ray. FH indicates femoral head; GT, greater trochanter; SC, arthroscope; Wa, arthroscopic wand.

using the radiofrequency wand, resulting in a 10-mm (range, 5 to 20 mm) retraction.

The 50-degree wand is useful to follow the obturator internus muscle medially until the outline of the sciatic nerve is seen. This wand will result in muscle activation, and the foot twitches within 20 mm of the nerve. Once twitches are seen, the wand is exchanged for the sabre electrode (Arthrocare Corporation). X-ray should confirm that the wand is directly posterior to the middle of the femoral head. The sabre allows safe dissection as the scar tissue over the nerve can be hooked, pulled away from the nerve, and then cut. It is important to note that the nerve to the obturator internus and the posterior cutaneous nerve of the thigh are immediately medial to the sciatic nerve (Fig. 4). To release the tissue on the medial side of the sciatic nerve (inferior in the lateral position), the laparoscopic peanut is useful (Fig. 5). A "candy floss" technique is safe. Twist the areolar tissue around the peanut by spinning the instrument and then pull gently, teasing the tissue away (Fig. 5). Only use the shaver (facing away from the nerve) for loose fronds of areolar tissue as otherwise bleeding can be difficult to deal with close to the nerve. The laparoscopic peanut is also a safe instrument for working in and around the greater sciatic notch. Once 3 to 4 cm of the nerve is free, as it exits the greater sciatic notch, a blue vascular sling is passed around

TABLE 1. The Surgical Criteria Used to Identify the Patients in Whom Endoscopic Sciatic Neurolysis Will Most Likely Prove Most Beneficial

Surgical criteria for endoscopic sciatic neurolysis
Retrotrochanteric pain, sciatic-like leg pain, numbness, paresthesia
Sitting intolerance
Buttock pain on resisted external rotation of the hip at 90-degree flexion and full internal rotation
Normal lumbar spine MRI
Positive response to CT-guided injection of dilute naropin and 40 mg triamcinolone (either immediate with the local anesthetic or delayed with cortisone)
Greater than 6 mo symptoms and failure of conservative measures

TABLE 2. Some of the Points Believed by the Senior Author to be Crucial in Ensuring the Success of the Operation and the Pitfalls Encountered

Tips
- The procedure is suitable for an experienced arthroscopist
- Cadaver laboratory experience is valuable
- The posterior aspect of the greater trochanter is an excellent initial landmark
- The anesthetist should NOT use a paralyzing agent
- If proximal hamstring tethering is encountered, a third more distal portal can be used to extend the surgical range

Pitfalls
- Large branches of the inferior gluteal artery can bleed after cautery. Use a laparoscopic vascular clip if concerned
- Bleeding is difficult to overcome with fluid pressure. Care is required
- The inferior gluteal nerve, the posterior cutaneous nerve of the thigh, and the nerve to the obturator internus are small, fragile, and nearby. Knowledge of the anatomy is important, and radiofrequency is best avoided immediately medial to the sciatic nerve and within the greater sciatic notch

the nerve (Fig. 6). Placed in the tip of a blunt grasper, the sling is pushed anterior and medial to the nerve and retrieved posterior and medial (below) to the nerve (Fig. 7). This allows gentle lateral traction and simplifies medial dissection. The nerve is followed into the greater sciatic notch. One has to be aware that the inferior gluteal nerve hooks around the inferior border of the piriformis here. It is safer to dissect in the notch with the peanut. Branches of the inferior gluteal artery are often encountered. Should these restrict sciatic nerve movement, they can be clipped with a 5-mm laparoscopic vascular staple. Once the proximal part of the release is completed, portals are switched to continue distally. The ischial tuberosity is palpated easily with instruments medially (Fig. 8). The sciatic nerve is often tethered medially to the ischial tuberosity and can be freed safely with the sabre electrode. Often the electrode does not require activation and can be used here as a simple mechanical hook. Further distally, the hamstring tendons are visualized. An x-ray confirms that the dissection has been performed at least as far as the distal edge of the lesser trochanter. The goal is to slide the vascular sling up and down the nerve all the way from the greater sciatic notch to the lesser tuberosity. Blood vessels supplying the nerve, which do not restrict movement, are left intact.

The final step is to place a spinal needle at a safe distance from the nerve, remove the arthroscopic fluid with vacuum, thus collapsing the view, and inject 40 mg triamcinolone (Tables 1–4).

TABLE 3. Advantages of the Endoscopic Approach Focus on the Ability to Gain Better Visualization of the Anatomy and of the Working Space While Reducing Potential Complications and Morbidity

Advantages of Endoscopic Surgery	Disadvantages of Endoscopic Surgery
Reduced surgical morbidity	Requires a high level of arthroscopic proficiency
Easily performed at the same time as hip arthroscopy	Bleeding more difficult to control in the large potential space
Reduced bleeding/scarring/potential for recurrence	Landmarks more challenging than intra-articular surgery
Excellent visualization of the anatomy	Any postoperative bleeding is in a confined space and can create a pressure effect on the sciatic nerve
Visualization from within the greater sciatic notch all the way to well below the hamstring origin is possible	

Being able to perform the surgery at the same time as hip arthroscopy is very helpful. Disadvantages include the need to be experienced in not only hip arthroscopy but also in this technique itself. The enclosed space with the gluteus maximus intact makes it more important to control bleeding; vascular clips must be used for larger vessels and a "redivac" drain must be considered.

DISCUSSION

With recent rapid advances in hip arthroscopy, clinicians have developed a deeper understanding of PS. The classic mechanism of injury is a heavy fall on the buttocks, but it is also seen secondary to repetitive activities such as competitive sports. The senior author has noted an incidence of patients with intra-articular hip pathology (femoro-acetabular impingement, traumatic chondrolabral injury) who manifest burning nerve-like pain down the leg as far as the sole of the foot with or without altered sensation, marked sitting intolerance, and retrotrochanteric tenderness. In these patients, treating the hip pathology alone has not resolved the buttock pain and/or the neurogenic pain. Endoscopic sciatic neurolysis allows both areas to be addressed with minimal extra morbidity and 1 extra portal. Published results from endoscopic surgery have been encouraging.[8] Procedures similar to this one have been described with mixed results. The senior author noted, in his own practice, an estimated 30% recurrence of symptoms after open surgery, which was a significant driver to refine a safe endoscopic technique. To accommodate hip movement, a sciatic nerve excursion of up to 28 mm has been measured.[17] Any anatomic variant, vascular or connective

TABLE 4. Key Points to Ensure Success of the Operation

Pearls
- Ensure the patient is not paralyzed
- Perform intra-articular arthroscopic work before sciatic neurolysis, if necessary
- Triangulate the instruments with the help of the image intensifier
- Switch from the Arthrocare wand to the sabre when approaching the nerve
- The laparoscopic peanut is useful for dissection of the areolar tissue from the nerve
- A vascular sling helps to control the nerve after preliminary dissection
- Dissect until the nerve is free from the sciatic notch to the lesser trochanter
- Inject triamcinolone at the end of the case after the placement of the needle under direct vision

tissue leash, or posttraumatic scarring has the potential to limit the required excursion and trigger "sciatica-like" pain, sitting intolerance, and retrotrochanteric tenderness. A risk of open surgery is damage to the sciatic nerve or its branches. Arthroscopic sciatic neurolysis allows excellent visualization and the ability to protect local nerves. The use of the radiofrequency wand minimizes bleeding and thus the potential for recurrent scarring and tethering of the nerve. Structures at risk include the sciatic nerve itself, but more importantly the smaller nerves nearby (inferior gluteal nerve, posterior cutaneous nerve, nerve to obturator internus). Larger branches of the inferior gluteal artery are clipped more safely with a laparoscopic vascular staple as bleeding can continue even with extensive cautery. With increasing interest in this procedure, a step-by-step technical description with tips may prove useful for other hip arthroscopists. Orientation is more difficult than intra-articular arthroscopy. The procedure is suitable for an experienced arthroscopist with the recommendation of prior cadaver work and/or observing a surgeon performing the technique currently.

REFERENCES

1. Beaton L, Anson B. The Sciatic nerve and the piriformis muscle their interrelation and possible cause of coccygodynia. *J Boint Joint Surg Am*. 1938;20:686–688.
2. Hopayian K, Song F, Riera R, et al. The clinical features of the piriformis syndrome: a systematic review. *Eur Spine J*. 2010;19:2095–2109.
3. Lewis Am, Layzer R, Engstrom JW, et al. Magnetic resonance neurography in extraspinal sciatica. *Arch Neurol*. 2006;63: 1469–1472.
4. Filler AG, Haynes J, Jordan SE, 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.
5. Thomas Byrd JW. Piriformis syndrome. *Oper Tech Sports Med*. 2005;2:71–79.
6. Fishman LM, Dombi GW, Michaelsen C, et al. Piriformis syndrome: diagnosis, treatment, and outcome—a 10-year study. *Arch Phys Med Rehabil*. 2002;83:295–301.
7. Filler AG. Piriformis and related entrapment syndromes: diagnosis and management. *Neurosurg Clin N Am*. 2008;19: 609–622.
8. Martin HD, Atem M, Palmer IJ. Endoscopic sciatic nerve decompression: operative technique. *Oper Tech Sports Med*. 2012;20:325–333.
9. Yeoman W. The relation of arthritis of the sacroiliac joint to sciatica. *Lancet*. 1928;ii:1119–1122.
10. Broadhurst NA, Simmons N, Bond MJ. Piriformis syndrome: correlation of muscle morphology symptoms and signs. *Arch Phys Rehabil*. 2004;85:2036–2039.
11. Petchprapa CN, Rosenbery ZS, Sconfenza LM, et al. MR imaging of entrapment neuropathies of the lower extremity. *Radiographics*. 2010;30:983–1000.
12. Tiel RL. Piriformis and related entrapment syndromes: myth & fallacy. *Neurosurg Clin N Am*. 2008;19:623–627.
13. Dezawa A, Kusano S, Miki H. Arthroscopic release of the piriformis muscle under local anesthesia for piriformis syndrome legends. *Arthroscopy*. 2003;13:554–557.
14. Mixter WJ, Barr JB. Rupture of intervertebral disc with involvement of the spinal canal. *N Engl J Med*. 1934;211: 110–115.
15. Freiberg Albert H. Sciatic Pain and Its Relief by Operation on Muscle and Fascia. *Arch Surg*. 1937;34:337.
16. Robinson DR. Pyriformis syndrome in relation to sciatic pain. *Am J Surg*. 1947;73:355–358.
17. Hernando MF, Cerezal L, Perez-Carro L, et al. Deep gluteal syndrome: anatomy, imaging and management of sciatic nerve entrapments in the subgluteal space. *Skeletal Radiol*. 2015;44:919–934. Doi: 10.1007/s00256-015-2124-6.
18. Young IJ, Van Reit PP, Bell SN. Surgical release for proximal hamstring syndrome. *Am J Sports Med*. 2008;36: 2372–2378.
19. Toussaint CP, Perry EC III, Pisansky MT, et al. What's new in the diagnosis and treatment of peripheral nerve entrapment neuropathies. *Neurol Clin*. 2010;28:989–1004.
20. Plante M, Wallace R, Busconi BD. Clinical diagnosis of hip pain. *Clin Sports Med*. 2011;30:225–238.
21. Martin HD, Shears SA, Smathers AM, et al. The endoscopic treatment of sciatic nerve entrapment/deep gluteal syndrome. *Arthroscopy*. 2011;27:172–181.
22. Kulcu DG, Naderi S. Differential diagnosis of intraspinal and extraspinal non-discogenic sciatica. *J Clin Neurosci*. 2008;15: 1246–1252.
23. Malviya A, Stafford GH, Villar RN. Hip arthroscopy for treatment of peri-articular disorders. *J Bone Joint Surg*. 2012. Available at: http://www.boneandjoint.org.uk/content/focus/hip-arthroscopy-treatment-peri-articular-disorders.
24. Coppieters MW, Alshami AM, Babri AS, et al. Strain and excursion of the sciatic, tibial, and plantar nerves during a modified straight leg raising test. *J Orthop Res*. 2006;24: 1883–1889.
25. McCarthy JC, Lee J. History of hip arthroscopy: challenges and opportunities. *Clin Sports Med*. 2011;30:217–224ß.
26. Spinner RJ, Thomas NM, Kline DG. Failure of surgical decompression for a presumed case of piriformis syndrome. *J Neurosurg*. 2011;94:652–665.

