Chapter

Percutaneous Radiofrequency Hip Joint Denervation

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Abstract

With an aging population, chronic osteoarthritic hip joint pain is becoming a major issue. Most patients with hip pain can control their pain with conservative measures but with a gradual reduction in their quality of life. When gradually reduced ambulation and pain become recalcitrant, total hip arthroplasty is the next step. For most patients, this is a good way to improve pain control and to recover some quality of life, but for a few this aggressive surgical procedure is not possible. Sometimes co-morbidities make total hip arthroplasties undesirable. At other times, the age of the patients recommends to wait for a while. In these cases, other options have to be explored. Percutaneous partial hip joint sensory denervation has become a notable option as it can provide acceptable rates of pain relief with minimal surgical aggressiveness. There are three modalities to perform it: thermal, cooled and pulsed radiofrequency.

Keywords: chronic hip joint pain, hip osteoarthritis, hip joint denervation, treatment of chronic hip pain, radiofrequency hip joint denervation, interventional pain management, obturator nerve, femoral nerve, radiofrequency ablation, post-total hip arthroplasty pain

1. Introduction

Hip joint osteoarthritis - the most frequent cause of chronic hip pain (CHP) [1, 2] - induces pain, rigidity, muscular atrophy, and walking and sleeping difficulties [3–7]. Its prevalence in people over 45 years old is 9.2% [8]–11% [9] (men 7%–8.7%, women 9.3–10% [1, 8, 10]), reaching 25% by 85 years of age [11]. Not all cases with radiological changes are symptomatic [1, 12]. Other less common causes of CHP are osteonecrosis, rheumatoid arthritis, chronic infectious or post-traumatic arthritis and persistent pain after a total hip arthroplasty (THA) [13, 14].

Conservative measures are the first line of treatment [9, 15, 16]. These include physiotherapy and anti-inflammatory medication [17]. Intraarticular steroid or hyaluronic acid injections are helpful but only on a short term basis [17–20]. THA is indicated when the pain is chronic and the reduced mobility persists despite all conservative measures [21]. This surgical procedure is undertaken in hip joints damaged due to osteoarthritis, rheumatoid or inflammatory arthritis and avascular femoral head osteonecrosis [22–24]. THA is a very common surgical procedure world-wide [25], with more than 500000 cases/year in the USA [22] and 400 cases/year/100000 inhabitants in Sweden [26] (1.4 million THA/year in the whole European Union).

At times, THA is not recommendable due to concomitant severe co-morbidities that increase the risk of severe post-operative complications [27] or because the doctor, the patient or both of them think that it is better to wait before undertaking such a radical surgical procedure. Another reason to delay THA is its failure rate - 5-15% [28–31] - with 7–28% of patients left with post-operative CHP [32–34]. As THA implants have a life expectancy ranging from 10 to 25 years [30, 35–37] many surgeons consider that under 50 years of age it is wiser to delay this surgical procedure as much as possible [38–41]. When THAs are not advisable, hip joint denervation is an option that has been performed for over one hundred years. Continuous refinement in the surgical technique to achieve the denervation of this joint has ameliorated results and reduced complications and side effects.

2. Anatomy of the hip joint capsule nerve supply

The sensory nerve supply for the hip joint is provided by the obturator, femoral and sciatic nerves [42–53] as well as by the lumbar sympathetic plexus [42, 45]. The antero-lateral aspect of this joint is innervated by branches from the femoral nerve, the antero-medial by the accessory obturator and obturator nerves, and the posterior from the sciatic nerve though the *quadratus femoris* nerve branch and the superior gluteal nerve [42, 44, 46, 54–56]. The largest sensory nerve contribution for the hip joint comes from the obturator nerve and the *quadratus femoris* nerve branch [42, 44, 57], while the hip capsule areas with the highest articular nerve coverage are the superior, the anterior and the antero-medial [55, 58].

The articular branches coming from the femoral and obturator nerves can be reached with ease and limited risk of side effects [42, 46, 55, 59], but the hip sensory branches coming from the sciatic nerve are too close to its main trunk to cut them safely [60]. The femoral nerve articular branches pass by close to the periosteum between the inferior iliac spine and the ilio-pubic eminence [44], to lie below the ilio-psoas tendon above the anterior and lateral aspects of the HJ [55, 59]. The obturator nerve's articular branches travel between the pectineus and obturator externus muscles entering the medial joint capsule at the pubo-femoral ligament close by the infero-medial acetabulum in the area known as the "pelvic teardrop" [44, 55, 59]. The accessory obturator nerve can be found at the ilio-pubic eminence just before giving off its hip articular branches [44, 61–63].

Just as the obturator nerve goes out of the obturator canal it divides into two main branches [45]. The anterior branch innervates the adductor *longus*, *pectineus* and *gracillis* muscles and provides sensory branches for the hip joint capsule [46, 55, 59] and runs in the interfascial plane between the pectineus and adductor brevis muscles [64]. The posterior branch innervates the obturator externus, adductor *magnus* and brevis muscles and provides a sensory branch to the knee joint [42, 46, 65].

Referred groin area pain from the hip joint is conveyed by the articular branches of the obturator nerve, while trochanteric area pain comes from the articular branches of the femoral nerve [27, 42, 54]. In a damaged hip joint, the biggest discomfort comes from hip flexion (putting trousers on, climbing stairs) and from hip abduction (genital area hygiene) [66]. The sensation for both movements are mostly covered by the articular branches of the obturator and femoral nerves [42].

3. Historical background hip joint denervation

Selig [67] in 1912 was the first to report obturator nerve trunk intra-pelvic open surgical resection to control chronic osteoarthritic hip joint pain. To alleviate the pain coming from hip extension, other surgeons added the section of the *quadratus femoris* nerve branch [68]. This combined surgical technique was adopted widely [65, 69–71], but gradually abandoned because it induced hip adductor weakness and numbness at the inner thigh [57, 72]. Adding the section of the articular branches of the femoral nerve to the previous combined technique of obturator nerve trunk and quadratus femoris nerve branch resection was reported in 1975, showing improvement in hip pain control [73]. The inconsistent results of all these open surgical procedures were attributed to the wide anatomical variation of the hip joint articular branches [74].

Attempting to avoid the side effects induced by intra-pelvic obturator nerve trunk resection, some researchers attempted local anesthetic agent infiltration at the obturator nerve outside the obturator canal and at the *quadratus femoris* nerve branch and reported that it also provided good short term pain relief [43, 57, 72, 75–82]. This pain improvement lasted usually one to four days [27, 81] but in some exceptional cases up to three months [80, 81]. This extended effect has been attributed to the rupture of the pain vicious cycle [17, 81]. The next supplement was steroids, added to the local anesthetic agent in hip joint infiltration. Steroids are useful short-term [17] but repeated injections can lead to an increase in the infection rate if THA is attempted [83] and to articular cartilage damage [84]. Alcohol injected at the hip joint capsule has been used to treat acute hip fracture pain in people in their nineties [85]. Nowadays, local anesthetic blocks are used exclusively for diagnostic purposes [86].

Moreover, Okada et al. [87] in 1993 introduced the use of thermal radiofrequency to control hip pain. They found it advantageous because it could be applied percutaneously with specially designed cannulas, the size and shape of the lesion could be controlled through the intensity and time of the applied electrical current, and the lesion could be repeated if necessary [88]. Okada et al. lesioned the obturator, femoral and *quadratus femoris* nerves [87]. The obturator nerve trunk was lesioned at its exit from the obturator canal, inducing the same weakness in the hip adductor muscles and sensory loss in the inner aspect of the thigh [87] as with intra-pelvic resection of this nerve.

Hence, over the years several groups of researchers have attempted to improve thermal radiofrequency hip joint partial denervation to maintain pain control effectiveness whilst reducing its side effects [27, 54, 75, 77, 89–93]. Others researchers have also investigated other methods which might yield better results, such as pulsed radiofrequency [94, 95] which avoids damage to the treated nerves because the local temperature does not rise over 42°C [96].

4. Diagnosis, inclusion and exclusion criteria

The clinical diagnosis of chronic osteoarthritis is based on pain in the hip area aggravated by activity (walking, putting trousers on, genital area hygiene, etc.). At times patients find difficult to sleep on the affected side. On clinical examination, there must be pain on hip abduction and flexion. The radiological evaluation of the hip osteoarthritic changes is based on the Kellgren-Lawrence classification [97, 98].

To confirm that the pain is coming from the hip joint and to try to predict the results of a partial hip joint denervation, a diagnostic block of the articular branches is performed [27, 54, 75, 77, 87, 89, 90, 92, 99–102]. Patients are contacted the next day or the following week after the anesthetic block and at least 50% pain improvement is required to proceed with a partial hip joint sensory neurotomy [95, 103], although some researchers request two positive results to diagnostic blocks [103]. These blocks have a good predictive value as there is good correlation between anesthetic block pain relief and the results of articular branch thermal radiofrequency neurotomy [103].

4.1 Inclusion criteria

Moderate to severe CHP for more than 3 months duration with ambulation impairment, unresponsive to conservative treatments [86], radiographic Tönnis grades I and II [40] and refusal of the Orthopedic Surgeons to perform a THA.

4.2 Exclusion criteria

Lumbar radiculopathy, Paget's disease, neurological disorders, hip bony fracture and local infection

4.3 Indications

Hip osteoarthritis [27, 54, 75, 77, 87, 92, 94, 104, 105], rheumatoid arthritis [87], osteonecrosis [87], avascular necrosis [90, 92, 99, 100], chronic infectious coxarthrosis [77, 87], metastasis [54, 92, 101] and persistent pain after THA [27, 87, 90, 102] or after hip dislocation [54, 91].

In most reported series, patients are older than 47 years [75, 77, 87, 89, 90, 92, 94, 104], with only a few cases in the group of 26 to 46 years of age [54].

5. Surgical technique

The first step is to perform an anesthetic block to rule out other causes of buttock/groin pain [82, 100]. This is performed following the technique described by Locher [55]. The patient is placed supine on a radiolucent table and sedated with Propofol (0.5 mg/kg/h). A 22-gauge 80–100 mm long spinal needle can be used. A radiofrequency cannula is preferred (Neurotherm, KC, Cosman® 20G 145mm long needle with a 10 mm un-isolated tip, Burlington, Massachusetts, USA) because it allows electrical stimulation before injecting the local anesthetic agent. Electrical stimulation is performed with a Cosman® Radiofrequency Generator (Burlington, Massachusetts, USA) at 0.4–0.6 V at 50 Hz, 1 msec (sensory testing) and less than 0.9 V at 2 Hz, 1 msec (motor testing). This reduces the chance of anesthetic agent injection close to the main nerve trunks instead of near the articular branches [27, 77, 89–91, 94, 99–102].

The pubic tubercle and femoral vessels must be localized by manual palpation (**Figure 1**) but if the location is not fully clear (e.g. obese patients) ultrasound guidance is advisable [85, 91, 101–103].

For the obturator nerve articular branches, the needle is inserted two centimeters medial to the femoral vessels and two centimeters below the inguinal ligament. The needle is advanced under radiological guidance in the AP projection towards the bottom of the *incisura acetabuli* until the bony "teardrop shape" is reached (outer upper quarter of the junction point between the superior pubic and the ischia-iliac rami, at 2 or 10 o'clock position depending on the side). Bone contact should be felt at the tip of the needle. Electrical stimulation with the above mentioned parameters is performed to rule out proximity to the obturator nerve trunk.

For the femoral nerve articular branches, the needle is inserted 2 cm lateral to the femoral vessels and the needle is advanced again under radiological guidance. The needle's tip is positioned at the antero-lateral margin of the hip joint, below the anterior inferior iliac spine. Again, electrical stimulation with the same parameters is performed.

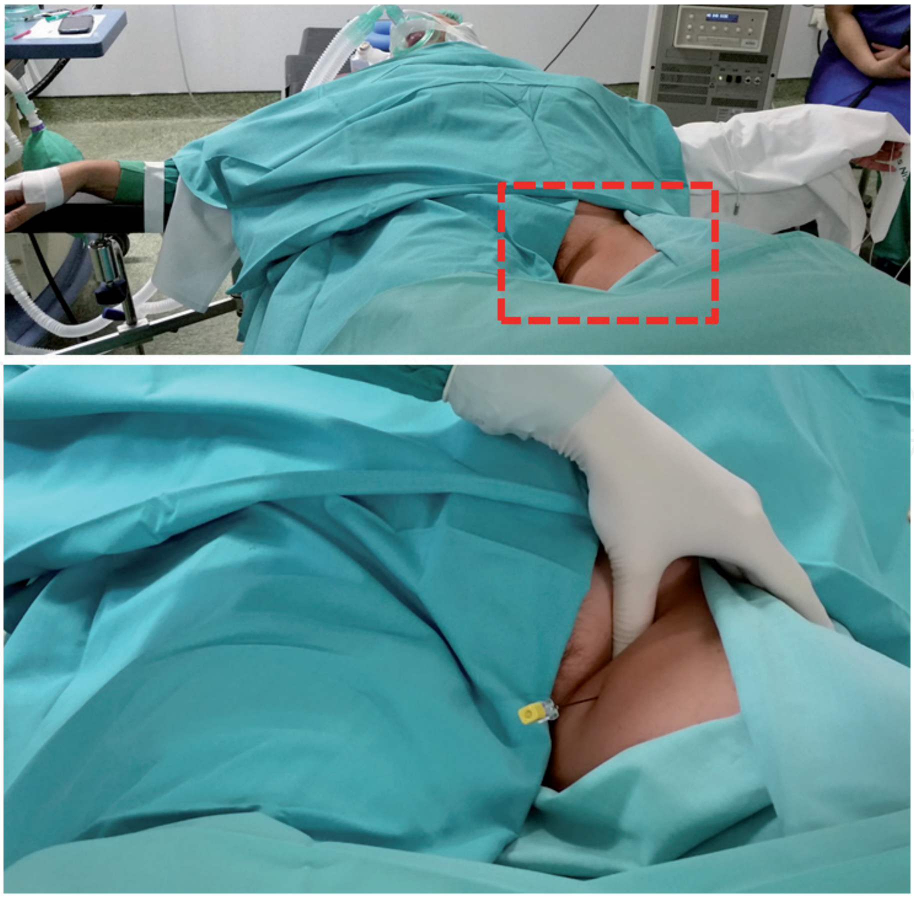

Figure 1.
Local anesthetic block, palpating the femoral vessels.

Needle aspiration must be performed before injecting any local anesthetic agent to prevent accidental intravascular administration. No intra-articular anesthetic agent injection is performed. Once both needles are in place (one for the obturator and one for the femoral nerve articular branches) 1-2 ml of local anesthetic - lidocaine [75, 77, 90, 99, 101], mepivacaine [89], bupivacaine [92, 100, 103] or ropivacaine [95] - are injected through each needle. No more than 1-2 ml of local anesthetic agent must be used to avoid false positives induced by its spread to nearby major nerves (femoral and obturator) or inside the hip joint itself [95, 103]. Some researchers have added steroids (e.g. triamcinolone) to the anesthetic block [101] aiming to prolong the beneficial effects.

Patients are interviewed the following day [86] or the following week [89]. Only those reporting in a VAS scale (Visual Analogue Scale) ≥ 50% pain reduction for the time of action of the local anesthetic agent are considered for percutaneous radiofrequency hip joint neurotomy. It is important to record not only the degree of pain control but also its duration, as the duration of action varies between the different anesthetic agents from two hours for lidocaine [106], two to four hours for mepivacaine [107] and ropivacaine [108] and four to eight hours for bupivacaine [109] – making bupivacaine the preferred anesthetic agent for this type of blocks [92, 100, 102].

Patients showing no improvement with the anesthetic block are referred back to Orthopedic Surgery and to the Physiotherapy Department for further treatments.

5.1 Description of the thermal radiofrequency partial hip joint denervation

The patient is placed supine on a radiolucent table. X-ray, ultrasound or both can be used for guidance during the procedure. A light sedation with propofol is provided.

First, the femoral nerve articular branches are reached with the aid of an 18 gauge, 100 mm length, 10 mm active tip cannula (Halyard, Alpharetta, GA, USA) or a 20G 145mm long needle with a 10 mm un-isolated tip (Neurotherm, KC, Cosman®). The location of skin puncture can be antero-medial (two centimeters lateral to the femoral vessels) [54, 77, 87, 89, 92, 101] or antero-lateral (ten centimeters lateral to the same anatomical structure) [27, 55, 89, 91, 104, 110] (**Figure 2**). Some surgeons are reluctant to use the antero-medial approach as there were three cases of post-operative local hematoma due to femoral artery incidental puncture [27], although other researchers avoid this by using ultrasound guidance [91, 101–103]. Furthermore, Stone and Matchett use ultrasound to navigate the needle in the antero-posterior direction passing between the femoral artery and vein to reach the obturator nerve articular branches [101].

In the lateral approach to the femoral nerve articular branches, the cannula is inserted in the lateral side of the thigh about 10 cm below the anterior iliac spine close to the antero-lateral border of the hip joint. The cannula crosses the *rectus femoris* tendon and the *iliacus* muscle with final position in the area between the ilio-femoral ligament just above the femoral head. This is the place where the articular branches of the femoral nerve travel over the pubic bone before reaching the hip joint [85].

Next, the obturator nerve's articular branches are approached from the thigh medial side, medial to the femoral vessels (**Figure 3**) or from a lateral approach (**Figure 4**). The same type of cannula is used as for the femoral nerve articular branches. The target area is deep to the *pectineus* muscle, adjacent to the pubo-femoral ligament at the junction of the pubic and ischia-iliac rami [59, 85]. As the obturator nerve branches have a big area of distribution [55], the needle tip must be placed as parallel as possible to the ischia-iliac ramus to increase the probability of lesioning all of them [102].

Just as in the anesthetic block performed earlier, electrical stimulation with a Halyard (Alpharetta, GA, USA) or a Cosman® Radiofrequency Generator (Burlington, Massachusetts, USA) should be done at 0.4–0.6 V at 50 Hz, 1 msec

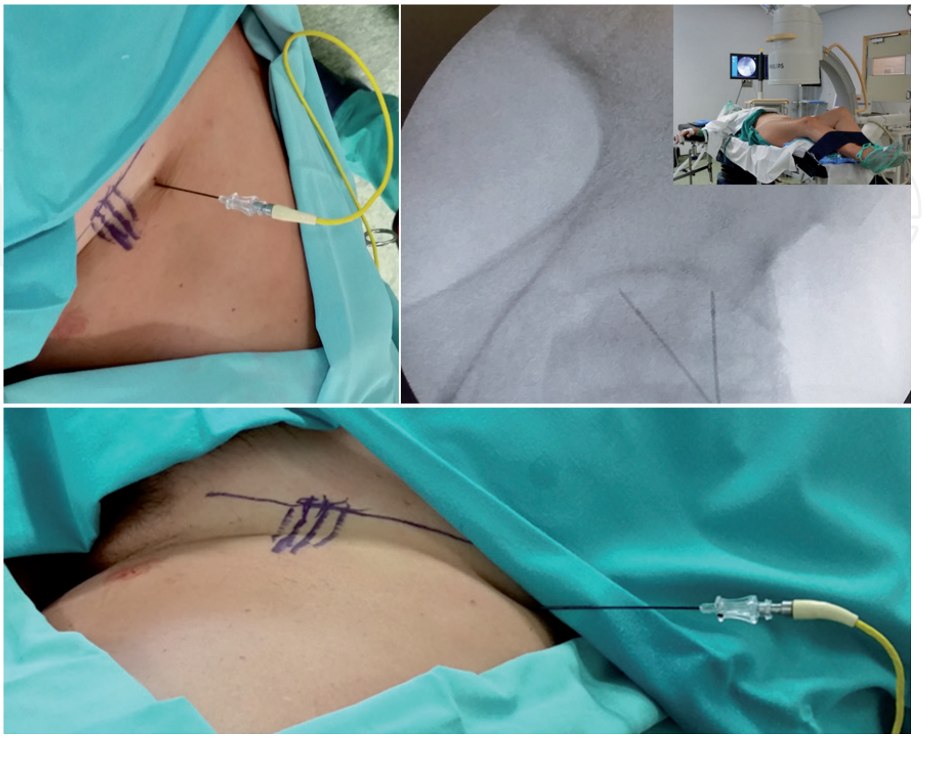

Figure 2.
Monopolar antero-medial versus antero-lateral femora nerve articular branches radiofrequency neurotomy.

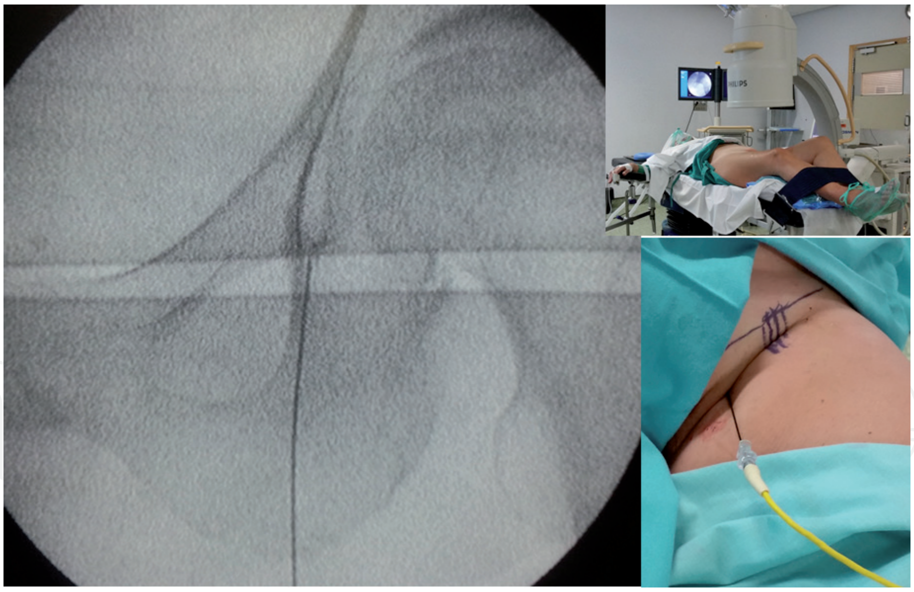

Figure 3.
Monopolar antero-medial obturator nerve articular branches radiofrequency neurotomy.

(sensory testing) and less than 0.9 V at 2 Hz, 1 msec (motor testing) to rule out proximity to the obturator or femoral nerve trunks. This step is essential to avoid sensory anesthesia, neuropathic deafferentation pain or motor nerve damage that could induce weakness of the adductor and/or hip flexor muscles. If any abnormal motor or sensory response is seen, the tip of the cannula has to be repositioned and the electrostimulation repeated. Once in a safe position, two consecutive thermal radiofrequency lesions for each of the femoral and obturator nerve articular branches are made at 90°C for 120 seconds, varying the position of the needle. Patients are continuously monitored for any signs of discomfort. Then, 20 mg of methylprednisolone are injected through the lesioning cannula to reduce local swelling and to prevent a possible neuritis of the lesioned nerves [95]. After the I.V. Propofol effect weans off, patients are discharged home with monitoring.

5.2 Intraoperative guidance

Most clinical studies use only radiological guidance. In the AP X-ray projection, the "teardrop" for the obturator nerve articular branches [27, 54, 89, 91–93, 100, 101, 104] and the antero-inferior iliac spine and the supero-lateral aspect of the acetabular margin for femoral nerve articular branches [27, 54, 91, 92, 100, 104] have been found as reliable landmarks. Adding electrical stimulation [111] or ultrasound guidance [80, 91, 101, 103, 112, 113] to the fluoroscopy increases the accuracy of nerve and great vessel localization, but does not improve the pain relief [27], meaning that they increase the safety of the procedure but do not affect the concluding results [27].

5.3 Nerve targets

Almost all reported studies aim to lesion the articular branches of both femoral and obturator nerves [27, 54, 77, 87, 90–92, 94, 99–101, 100, 104]. The two exceptions are a group of researchers – Akatov and Dreval and Vanaclocha et al. - that only lesioned the obturator nerve articular branches [75, 89] and Kim et al. that applied radiofrequency only to the femoral nerve articular branches in a single case of hip pain after a revision THA. The articular nerves supplying the posterior hip

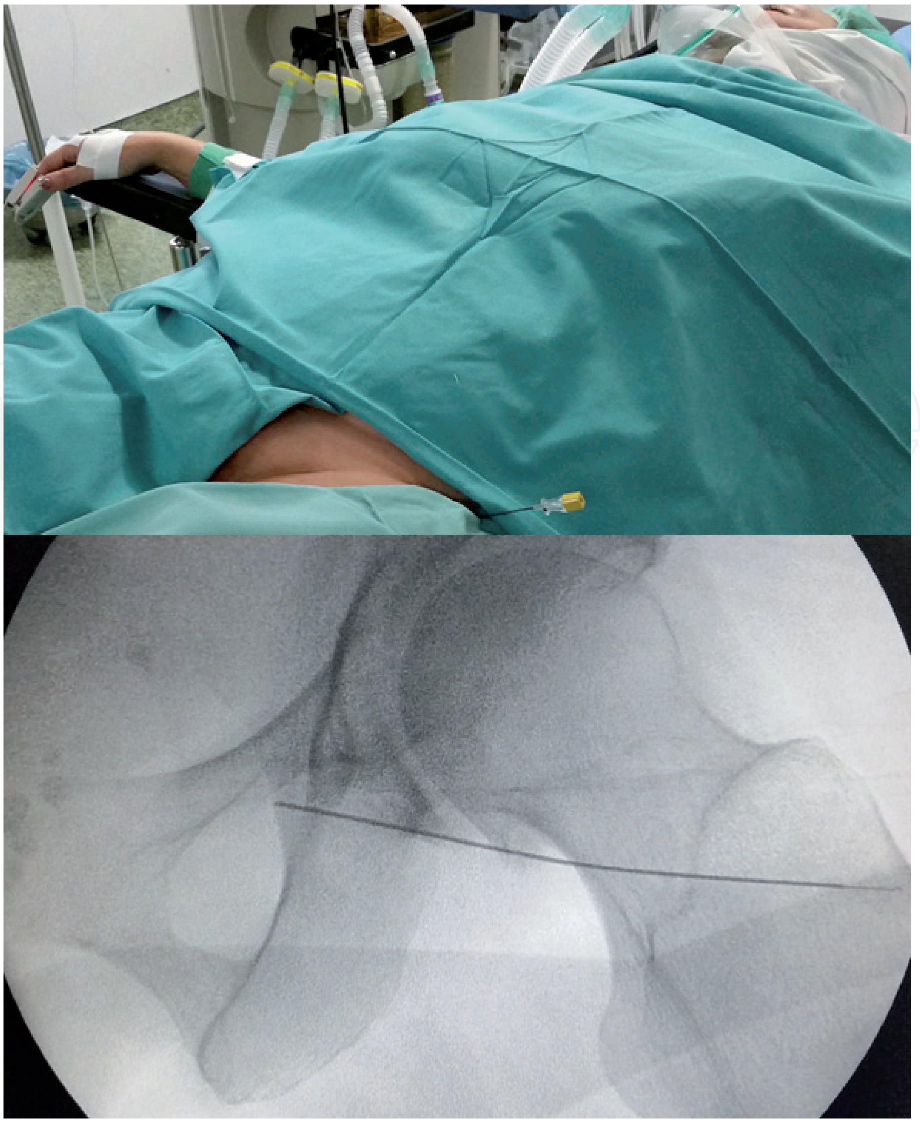

Figure 4.
Monopolar lateral obturator nerve articular branches radiofrequency neurotomy.

joint capsule coming from the superior gluteal and sciatic nerves were lesioned in a single patient, but no details on how the surgical procedure was performed were provided [87].

5.4 Type of radiofrequency: thermal, pulsed or cooled

Thermal radiofrequency with temperatures ≥80°C are the most commonly used [27, 75, 87, 89, 104]. For a maximal effect, the lesioning cannula has to be placed parallel to the nerve branch to be lesioned [114] and as close as possible to it [115]. This is important to remember when inserting the needle, as a completely vertical approach will diminish the damage to the target articular nerve branch [88].

The precise anatomical distribution and number of the articular branches vary widely between individuals and even between sides of the same patient [55]. Thus, a bigger lesion has a bigger chance of lesioning all or at least most of them [103, 116, 117]. This is the reason why some researchers use cooled radiofrequency [102, 103], as it creates lesions much larger than regular thermal radiofrequency [116, 118–120]. Another advantage is that cooled radiofrequency lesions project forwards from the needle tip, so that an articular nerve branch placed perpendicular to the needle can be lesioned [116, 117, 119]. Nevertheless, a lesion too big has also the risk of painful post-operative neuritis as described in a case of cooled radiofrequency [103]. The advantage of cooled radiofrequency is that it allows a single big enough lesion [102, 103] instead of having to repeat the procedure at least twice as in the case of thermal radiofrequency [116–118]. Another possibility is to use bipolar thermal radiofrequency, which we previously explored [89] (**Figures 5** and **6**). This can increase the shape and size of the lesion. Nevertheless, the higher the number of needle passes the higher the chance of incidental femoral vessel puncture with local hematoma formation [103].

Radiofrequency with temperatures over 55°C induces indiscriminate nerve fiber damage due to protein denaturation [121] and possible neuropathic pain [122, 123]. This is the case of both thermal and cooled radiofrequency (60°C) [102]. Thus, some researchers have used pulsed radiofrequency [90, 94, 95] because the temperature does not increase over 42°C and there is no irreversible neural tissue damage [96, 122]. However the effects are not long-lasting, about 3–4 [90] months to a year [94, 95].

5.5 Gauge of the lesioning cannulas

Their size varies among different doctors with 25 [103], 22 [27, 77, 85, 90, 91, 94, 99, 100], 21 [101], 18 [89, 95] or even 17 [110]. Although a bigger diameter increases the size of the final lesion it also increases intraoperative pain and the chance of post-operative local hematoma formation. Contrariwise, too thin cannulas are difficult to navigate inside the muscle bulk to reach a deep location. The choice is probably a compromise for each individual doctor.

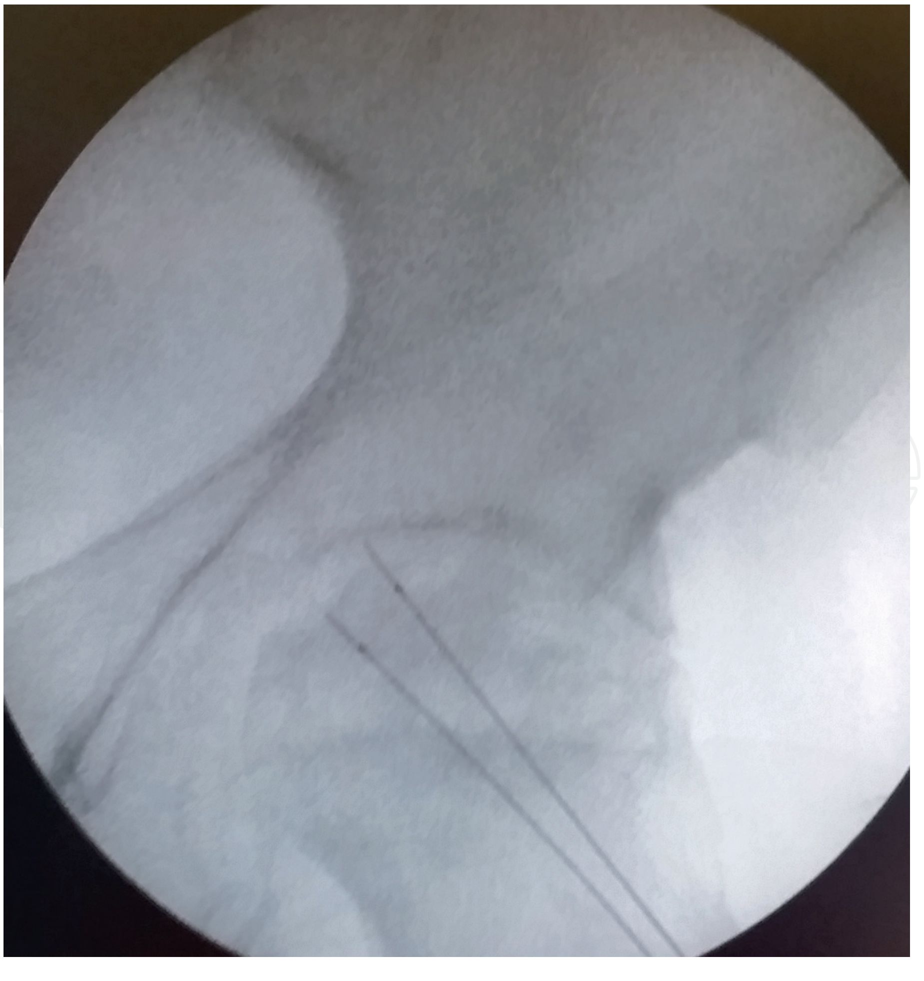

Figure 5.
Bipolar antero-medial obturator nerve articular branches radiofrequency neurotomy.

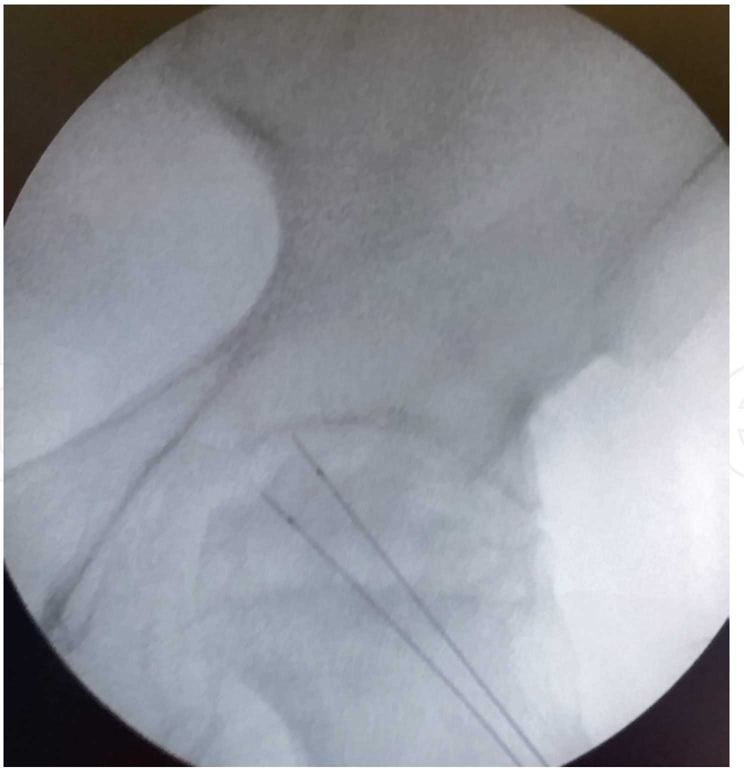

Figure 6.
Bipolar antero-lateral femoral nerve articular branches radiofrequency neurotomy.

5.6 Lesioning cannula tip size

The exposed electrode tip varies from 4mm [77] to 5mm [27, 91] and 10mm [89, 90, 94, 95, 104]. A 10 mm exposed tip is better as the location of the obturator and femoral articular nerve branches has a big anatomical variation between patients and between sides of the same patient [55]. Thus, a bigger lesion has a higher chance of success.

5.7 Temperature of the radiofrequency lesion

In thermal radiofrequency it varies from 60°C [102] to 75–80°C [54, 75, 87, 91, 92, 99, 104] or even 90°C [27, 77, 89, 100]. To allow for the wide anatomical variability it is recommended to increase the temperature over 80°C to induce a lesion of sufficient size that includes all articular branches [88]. In pulsed radiofrequency, the temperature is raised to 42 [94]-45°C [90].

5.8 Time to create the lesion

Duration matters, as lesion size increases 11–20% from 1 to 2 minutes and 20 to 23% from 2 to 3 minutes [88]. The times used have varied from 60 [91] to 80 [101], 90 [27, 27, 54, 92, 99, 100],, 150 [102] and 180 seconds [94]. Again, a larger lesion is advisable provided it does not damage the nearby 120” [75, 77, 87, 90, 104] femoral and obturator nerve trunks. Most groups of researchers report using 90” [27, 27, 54, 92, 99, 100] or 120 seconds [75, 77, 87, 90, 104] per lesion.

5.9 Number of lesions

The majority of researchers only do two lesions (one for the femoral and one for the obturator articular nerve branches) [27, 54, 75, 87, 91, 92, 100, 101]. Only three studies report two adjacent lesions per treated nerve to improve the lesion size to account for the anatomical variability in the number and distribution of the articular branches [89, 99, 104]. This was already recommended by Locher et al. [55] after a cadaveric anatomical study and confirmed recently by Short et al. [44].

6. Results

The open intrapelvic surgical section of the obturator nerve trunk introduced by Selig [67] provided 83% pain relief at six months [71] and 18% at three years [124]. Okada et al. [87] report pain relief in 14 out of 15 patients with no further details. Akatov and Dreval [75] lesioning the obturator nerve trunk at its exit from the obturator canal reported pain relief in 12 out of 13 patients with an increase in the range of hip motion in 9 patients and 80% 'excellent' results at 3 years follow-up. Fukui and Nosaka [77] reported 80% pain relief and improvement in walking at 6 months with gradual return of pain by 2 years without reaching baseline pain levels. Kawaguchi et al. [54] reported 60% pain reduction in 11 out of 14 patients with a failure rate of 22%. Malik et al. [92] reported 30–70% pain reduction with improvement in function in 3 out of 4 patients and decrease in pain medication use in 2 out of 4 patients. Rivera et al. [27] reported 33% pain reduction with ≥50% pain improvement in 8 out of 18 patients, 16% reduction in WOMAC and 34% in Harris Hip Score. Gupta et al. [104] reported 90% pain improvement with return to baseline function and stopping analgesic consumption for 6 months. Kim et al. [102] reported a single case with excellent pain control at two years follow-up.

Moreover, the reduction in analgesic use was demonstrated by some researchers but no details were provided about the reduction in the amount or follow-up [27, 92, 94, 100, 101]. Some researchers have reported that in spite of good post-procedural hip pain control, patients continue taking similar amounts of opioids [103]. This observation can be attributed to the fact that these patients often have other chronic pain conditions, i.e. chronic lumbar, cervical or knee pain [103].

The initial favorable results decline over time [77, 104] but long term data is limited. Vanaclocha et al. [89] in a follow-up ranging from 24 months to 8 yrs. (mean 3.91 ± 1.67SD yrs.) reported a marked improvement in 72 out of 131 patients (69.19%). This is the longest and most detailed study: VAS preop 8.2 ± 0.84SD; postop 2.53 ± 0.76SD 1 month, 2.40 ± 0.78SD 6 months, 3.82 ± 1.27SD 12 months and 5.07 ± 1.61SD 24 months. WOMAC pain 16.10 ± 2.15SD pre-op, post-op 3.72 ± 1.44SD 1 month, 3.56 ± 1.2SD 6 months, 5.1 ± 2.12SD 12 months and 8.36 ± 4.54SD 24 months. NSAID'S consumption, pre-op 2.78 ± 0.41SD; postop 1.67 ± 0.74 1 month, 1.44 ± 0.95 6 months, 1.55 ± 0.86SD 12 months and 1.78 ± 0.74 24 months. Opioid consumption pre-op 20.74 ± 30.23SD, post-op 9.34 ± 17.28 1 month, 8.60 ± 23.23SD 6 months, 6.63 ± 16.59SD 12 months and 12.50 ± 32.83SD 24 months. No changes in the pain control were seen after two years post-thermal radiofrequency obturator and femoral articular nerve branches neurolysis. No complications were reported.

With pulsed radiofrequency, the results are not as good. Initially, there is a ≥ 50–80% [90, 94] pain reduction with improvement in walking and reduction in analgesic medication. However pain recurs by three months and mostly within a year [3, 67, 68], not improving much on thermal radiofrequency results.

6.1 Results on repeating the procedure a second time

It has only been reported by Fukui et al. [77], Gupta et al. [104] and Vanaclocha et al. [89]. Fukui et al. [77] reported a single case with limited pain improvement but no details were provided. Gupta et al. [125] on repeating the procedure a second time found a 20–50% pain improvement, moderate limitations in function and pain medication cessation for 4 months after this second treatment. Vanaclocha et al. [89] reported that the procedure was repeated a second time in 27 out of 131 patients, and in 12 a third time. The duration of pain relief for the second-time thermal radiofrequency obturator and femoral articular nerve branches was 3–4 years (mean 3.2 ± 1.09SD years) and for the third time 2.5–3 years (mean 2.8 ± 0.7SD years). The results of the second and third procedures are evidently worse than for first one, but pain improved in a significant amount of patients.

7. Follow-up

It ranges from 3 months [90–92, 94], 4 months [90], 6 months [27, 77, 99, 100], 11 [54] months, 12 months [87], 2 years [77, 102], 3 years [75] and 8 years [89]. Longer follow-ups provide more data on the real effect of these pain controlling procedures but are limited to a single publication [89].

8. Side effects

Local hematoma formation after percutaneous radiofrequency procedure occurs sometimes when the procedure is done only under radiological guidance. Some researchers have reported three such cases [27] due to femoral vessel puncture. Ever since they changed the needle insertion point from the midline thigh area to a more lateral approach [27]. To minimize this risk, some have recommended the use of ultrasound guidance [103]. Adductor and hip muscle weakness and sensory disturbances were described in the old reports when the procedure involved lesioning the nerve trunks [67, 68, 75, 87] but not since the aim of the treatment is only the articular branches. No major complications have been described except allergy to the local anesthetic agent [27, 54, 73, 92]. Malik et al. [92] in 2003 reported a case that complained post-operatively of numbness in the inner aspect of the thigh. Cortiñas-Saénz et al. [100] reported a case of permanent anesthesia over the hip joint but no details were provided on the nerve distribution.

9. Long term consequences

A major concern is that hip joint denervation might accelerate the progression of hip osteoarthritis or induce a Charcot arthropathy. Obletz in 1949 [125] reported no radiological changes at 20 months follow-up after open partial sensory denervation of the hip, but Kaiser [65] in the same year and with the same surgical technique reported Charcot joint changes in some of his cases. Fernandes et al. [111] showed no radiological deterioration in a 5 to 14 month follow-up after anesthetic block. Only Kang and Bulstrode [126] saw radiological deterioration after repeated hip anesthetic and cortisone blocks, perhaps attributable to the cortisone being injected inside the hip joint. No cases of hip joint degeneration attributable to the technique have been observed with hip radiofrequency - thermal, pulsed or cooled - articular nerve branch neurotomy. In a study with eight years follow-up, Vanaclocha et al. [89] did not see any radiographic changes suggestive of acceleration of natural degenerative progression.

10. Conclusions

Aging population may suffer from significant co-morbidities that may impede hip arthroplasty. Percutaneous radiofrequency denervation of the femoral and obturator sensory branches to the hip offers an alternative for those patients with severe hip pain who are not surgical candidates. The relative simplicity of this technique is worthwhile for these patients, often confined to wheelchairs and with no prospect of surgical relief. They are often pleased even with a partial pain improvement. This procedure had no major complications and could be applied to patients who had a very poor general status. The results are satisfactory in the majority of cases with a good long term control reported for the thermal radiofrequency. With cooled radiofrequency there are no long term follow-up [102, 103] reports and with the pulsed radiofrequency the pain is back in less than a year.

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