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Comparison of the Parasacral Approach and the Posterior Approach, with Single- and Double-Injection Techniques, to Block the Sciatic Nerve

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Background: **The purpose of this study was to compare parasacral and Winnie's single- or double-injection approaches for sciatic nerve block.**

Methods: **One hundred fifty adults scheduled to undergo lower limb surgery were randomized to receive on the sciatic nerve 20 ml ropivacaine, 0.75%: single bolus for parasacral and Winnie's single injection. For Winnie's double injection, the peroneal and tibial nerves received separately 10 ml plus 10 ml. Blocks were performed with the use of nerve stimulator (intensity < 0.5 mA, 1 Hz). For the parasacral method, a line was drawn between the posterior superior iliac spine and the ischial tuberosity; needle entry was at 6 cm inferior to the posterior superior iliac spine.**

Results: **The groups were similar. Time to perform the block was 2 (1–5) min for the parasacral method, with no difference from Winnie's single injection (3 [1–10] min), but was shorter with double injection (5.5 [2–15] min) ($P = 0.0001$). Onset of sensory block was similar in the parasacral (25 [7.5–50] min) and Winnie single-injection groups (25 [5–50] min) but significantly longer in the double-injection group (15 [5–50] min). Success rates for complete block were similar in the parasacral (66%) and Winnie's double-injection groups (68%) after 30 min but higher in the Winnie's single-injection group for tibial sensory and motor block (48%) ($P < 0.017$).**

Conclusion: **Time to perform a parasacral block was short, and the parasacral approach had a high success rate and a short onset time. Therefore, this block might be a useful alternative to Winnie's modification for sciatic nerve block.**

SCIATIC nerve block, associated with an appropriate femoral nerve block, has been described as the peripheral nerve block of choice for operations performed below the knee.[1] Among the blocking procedures of the sciatic nerve recently reported (posterior, anterior, lateral),[2–4] posterior approach is probably the most often performed. Using Labat's classic posterior approach or its modification by Winnie,[5] double injection provides a higher success rate than the single-injection technique.[2] Moreover, the double-injection technique (*vs.* single injection) for Winnie's approach provides a greater success rate and more rapid onset time. However, compared to single injection, double injection may increase both patient discomfort and incidence of neurologic complications.[6]

Several recent articles have focused on a new posterior approach: the parasacral approach, considered a unilateral sacral plexus block.[7–9] This approach, which uses a single injection, has a high success rate, even in the hands of a novice. Its overall success for surgical anesthesia is 97%,[9] and this technique has been associated with excellent patient satisfaction. Moreover, this block seems to be easy to perform and to teach.

The aim of this study was to compare the onset and success rate of the sciatic nerve block using the parasacral approach to those of Winnie's single- and double-injection modification approaches.

Materials and Methods

Patients

After approval by the institutional ethics committee (Gaston Doumergue Hospital, University Hospital of Nîmes, Nîmes, France) and written informed consent from each patient were obtained, patients scheduled to undergo lower limb surgery under combined femoral–sciatic block were prospectively and randomly enrolled into three parallel groups. The planned enrolment was 150 patients. Exclusion criteria were patient refusal, age less than 18 yr, weight less than 50 kg, American Society of Anesthesiologists (ASA) physical status greater than III, anticoagulant treatment, allergy to local anesthetics, neurologic or neuromuscular disease, severe liver or renal insufficiency, women of childbearing age, and patients unlikely to be fully cooperative during the study (such as those with neurologic or psychiatric disorders). Patients were randomized (using a random number generator) preoperatively, just before surgery, using sealed envelopes, to receive one of the three sciatic blocks: parasacral block, Winnie's block with one injection, or Winnie's block with double injection.

Procedures

Oral premedication (1 h before surgery) was standardized with hydroxyzine (100 mg). In the preanesthesia room, patients were monitored (pulse oximetry, heart

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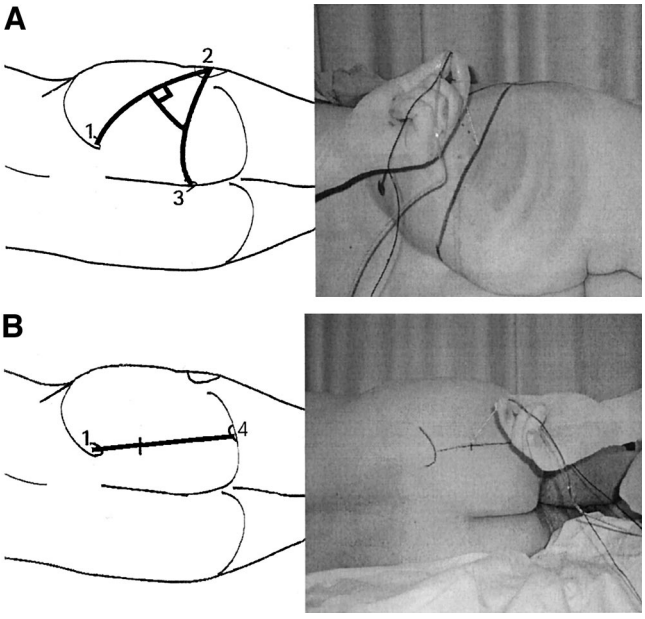

Fig. 1. (*A*) Winnie's modification approach. (*B*) Parasacral approach. *1* = Posterior superior iliac spine; *2* = greater trochanter; *3* = 1 cm below the sacral hiatus; *4* = ischial tuberosity.

rate, noninvasive blood pressure), and venous access was secured. Additional doses of alfentanil (intravenously, 3–5 μg/kg) were administered as necessary while the block was administered to avoid discomfort. For all patients, combined sciatic–femoral nerve blocks (7.5 mg/ml ropivacaine, 20 ml + 20 ml) were performed before surgery. In all groups, the sciatic nerve blocks were performed after a paravascular three-in-one femoral nerve block.

The posterior parasacral approach was described by Mansour.[8] The patient was positioned laterally with the side to be operated on upward. The posterior superior iliac spine and the ischial tuberosity were identified and marked. A line was drawn between the midpoints of the posterior superior iliac spine and the ischial tuberosity. A mark at 6 cm inferior to the posterior superior iliac spine was made on the line (fig. 1). The insulated needle was inserted at this point and advanced in a sagittal plane. If bone was contacted, the needle was removed and reinserted 1–2 cm caudally along the line.

The posterior approach used was the modification of Labat's classic approach by Winnie[5] (fig. 1). Patients were placed in the same position, and lines were drawn from the greater trochanter to the posterior superior iliac spine and to a point approximately 1 cm below the sacral hiatus. A perpendicular line was then drawn from the midpoint of the superior border, and the needle was placed where this line and the inferior border intersected.

All blocks were performed using a 100-mm insulated needle (Stimuplex®; B Braun, Melsungen, Germany) connected to a nerve stimulator (Stimuplex® HNS 11; B Braun). The stimulating current was set initially between 2.0 and 2.5 mA (frequency, 1 Hz; time, 100 μs). When a motor response (dorsiflexion of the foot for common peroneal nerve or plantar flexion for tibial nerve) was elicited because of the sciatic nerve stimulation, the intensity of the stimulation was gradually decreased to 0.5 mA. The needle was considered to be close enough to the nerve when the stimulating current was 0.5 mA or less. For the parasacral and Winnie's single-injection groups, the localization of the nerve was considered successful when either component of the sciatic nerve (tibial or peroneal) was identified. At this point, the parasacral and Winnie's single-injection groups received 20 ml ropivacaine, 7.5 mg/ml. For Winnie's double-injection group, the two components of the sciatic nerve (tibial and peroneal) were identified and received 10 ml ropivacaine, 7.5 mg/ml, on each component. After confirmation of correct needle placement for the tibial nerve by plantar flexion, the needle was directed laterally to locate the common peroneal nerve. Conversely, the needle was directed medially after the common peroneal nerve was stimulated (dorsiflexion) to locate the tibial nerve.

Efficacy Measurements and Variables

Demographic data such as sex, age, ASA status, weight, height, and type of surgery were recorded. The time required to perform the block was defined as the time elapsed from the beginning of the procedure (insertion of the needle through the skin) to the end of injection of local anesthetic. Time 0 was defined as the time corresponding to the end of the local anesthetic solution injection.

Sensory and motor block were assessed every 5 min for a 50-min period by an anesthesiologist who was unaware of the technique used. The sensory block was assessed using a cold test in the peripheral sensory distribution of the sciatic nerve: posterior cutaneous nerve (posterior femoral cutaneous area), tibial nerve (plantar side of the foot), peroneal common nerve (lateral cutaneous side of the calf), superficial peroneal nerve (dorsal aspect of the foot). Sensory block was determined using a rating scale whereby 0 = normal sensation, 1 = blunted sensation, and 2 = absence of sensation (anesthesia).

Motor block was tested: plantar flexion of foot (tibial nerve), dorsiflexion of foot (peroneal nerve). The rating scale for motor block was as follows: 0 = normal contraction, 1 = reduced contraction (paresis), and 2 = no contraction (paralysis). Complete motor or sensory block was considered when responses in all nerve distributions had a score of 2. If the sensory block was not 2 in at least one of the sciatic areas, at the end of the 50-min assessment period, the sciatic block was considered incomplete. Onset time of sensory block and motor block was defined as the interval between time 0 and a complete block. Total block time was defined as the time elapsed from the beginning of the procedure (in-

Table 1. Demographic Data and Surgical Procedures

	Winnie's Injection		
	Single	Double	Parasacral
No. of patients	50	50	50
Age (yr)	45 (19–76)	48 (22–69)	51 (22–84)
Height (cm)	170 (152–181)	170 (155–185)	165 (150–183)
Weight (kg)	75 (56–93)	70 (54–87)	70 (54–90)
Sex (M/F)	35/15	38/12	32/18
ASA (1/2/3)	38/11/1	44/4/2	34/13/3
Limb			
Right	27	25	26
Left	23	25	24
Surgical procedures			
Knee	25	21	27
Below-knee	11	8	9
Ankle	11	17	8
Foot	3	4	6

Values are number and median (5th–95th percentiles); no difference was observed between groups.

sertion of the needle through the skin) to a complete block.

Pain at the surgical incision or as a result of a pneumatic tourniquet being applied to the femoral area was noted. Then, the technique was converted into general anesthesia when necessary.

Statistical Analysis

Statistical analysis was conduced using SAS (release 8.0; SAS Institute, Cary, NC). The primary end point was the rate of success of blockade (complete sensory and motor block). Based on previous studies, it was hypothesized that the rate of success of blockade was 80% for Winnie's single injection and that the rate was similar for parasacral (97%) and Winnie's double injection. To demonstrate a difference of 17% between groups, three multitest comparisons were performed; the calculated number of patients required was 145, with $\beta = 80\%$ and $\alpha = 0.017$ (adjustment).

Quantitative variables were compared by Kruskall-Wallis multigroup test followed by the Bonferroni *t* test for pairwise intergroup comparisons. The *P* value for three comparisons was 0.017 after the Bonferroni adjustment. Qualitative variables were compared by Fisher exact test where the *P* value was 0.05. Epitable (epi-info 6.04; CDC, Atlanta, GA) was used to compare cumulative success rates between groups (interval times).

Results

Between June 2000 and April 2001, 150 patients were included. Demographic data and surgical procedure are listed in table 1. The three groups were similar with respect to demographic variables. The type of surgery was similar in the three groups.

The sciatic nerve was identified in all patients. In the Winnie's double-injection group, peroneal and tibial nerve stimulations were performed in 47 patients. In three cases, the tibial nerve was identified and injected, but the peroneal nerve was not identified. The peroneal nerve was elicited in 16 patients in the Winnie's single-injection group and 10 in the parasacral group, whereas the tibial nerve was elicited in 34 patients in the Winnie's single-injection group and 40 in the parasacral group ($P > 0.05$). Intensity of current stimulation was similar, with no difference between groups.

Times to perform the blocks are listed in table 2. In the Winnie's double-injection group, the three patients with only one nerve identified were excluded for this analysis. Winnie's double injection increased the time to

Table 2. Time to Perform Block and Onset Times (min)

	Winnie's Injection		
	Single	Double	Parasacral
Time to perform block	3 (1–10)	5.5 (2–15)*†	2 (1–5)
Posterior cutaneous nerve	10 (5–38)	10 (5–30)	15 (5–30)
Tibial nerve			
Sensory block	15 (5–40)	10 (5–39)*	15 (5–40)
Motor block	20 (5–50)	12.5 (5–40)*	20 (10–50)
Total onset times	20 (5–45)	12.5 (5–40)*	25 (10–50)
Common peroneal nerve			
Sensory block	15 (5–30)	15 (5–30)*	15 (5–40)
Motor block	20 (5–40)	15 (5–30)	15 (5–50)
Superficial peroneal nerve			
Sensory block	10 (5–40)	10 (5–25)*†	15 (5–30)
Motor block	20 (5–40)	12.5 (5–40)*†	20 (5–40)
Total onset time of peroneal nerve (common and superficial)	17.5 (5–40)	15 (5–40)*	20 (5–50)
Total onset time (tibial and peroneal)	25 (5–50)	15 (5–50)*†	25 (7.5–50)
Total block time	25 (10–50)	20 (5–50)	25 (10–50)

Total onset time was defined as the time to obtain a total sensory and motor block after injection (tibial, peroneal, posterior cutaneous). Total block time was defined as the time elapsed from the beginning of the procedure (insertion of the needle through the skin) to a complete sciatic sensory and motor block. Values (in min) are medians (5th–95th percentiles).

* $P < 0.017$ *vs.* parasacral approach. † $P < 0.017$ *vs.* Winnie's single injection.

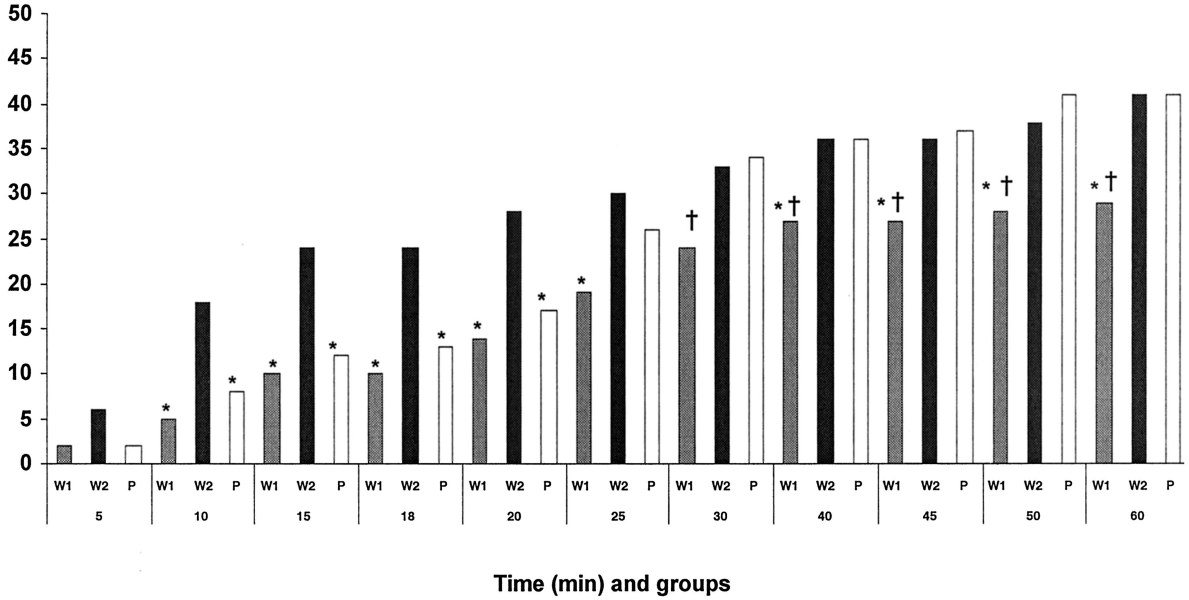

Fig. 2. Cumulative success rate with interval times, specifically, the total number of patients who received a complete sensory and motor block after injection. Time 0 was defined as the time corresponding to the end of the local anesthetic solution injection (50 patients per group). *P* = parasacral approach; *W1* = Winnie's modification of the posterior sciatic nerve block with single injection; *W2* = Winnie's modification of the posterior sciatic nerve block with double injection. **P* < 0.01 *vs.* Winnie's double injection. †*P* < 0.01 *vs.* parasacral injection.

perform the block compared to Winnie's single injection ($P = 0.001$) and the parasacral method ($P = 0.0001$).

The onset times for sensory and motor block are listed in table 2. No differences were observed between the parasacral and Winnie's single-injection groups for the onsets of sensory block ($P > 0.017$), but the onsets of sensory and motor block were significantly faster after the Winnie's double-injection method compared to the parasacral method ($P < 0.017$). However, when onset time and time to perform the block were added (total block time), no differences were observed between groups ($P = 0.64$).

Figure 2 reveals the success rate of the three groups with time intervals. The number of successful blocks (*i.e.*, complete blocks) was greater in the Winnie's double-injection group compared with the Winnie's single-injection group ($P = 0.08$) at any time interval (except between 30 and 40 min). No differences were observed between the parasacral and Winnie's double-injection groups at the time intervals tested from 30 to 60 min (fig. 2). The number of successful (complete sensory or motor) blocks for the different components are presented in figure 3.

Pain with pneumatic tourniquet was noted in 7 patients (14%) in the Winnie's single-injection group *versus* 2 patients (4%) in the Winnie's double-injection group and 1 patient (2%) in the parasacral group ($P = 0.03$). General anesthesia was required (pain during surgery) for 7, 3, and 2 patients in the Winnie's single-injection, Winnie's double-injection, and parasacral groups, respectively (no statistical difference).

Discussion

In this prospective study, three strategies for posterior sciatic nerve block were compared. Winnie's single injection and parasacral block were performed faster than Winnie's double injection. However, Winnie's single injection produced a higher number of incomplete blocks compared with the other groups. The parasacral and Winnie's double-injection methods produced similar success rates for sensory and motor block of the different components of the sciatic nerve. Time to perform the block was faster in the parasacral group than in the Winnie's double-injection group (2.0 *vs.* 5.5 min), whereas onset time was faster in the Winnie's double-injection group (15 *vs.* 25 min). Overall, the total block times (time to perform block + onset time) were similar between the parasacral and Winnie's double-injection groups.

Division of Sciatic Nerve and Clinical Implication

In this study, the parasacral approach using single injection produced similar success rates compared with Winnie's approach with double injection. However, it has been clearly demonstrated that the multiple-injection technique for sciatic nerve block offers a greater success rate.[2] Double injection produced greater success rates not only for Labat's or Winnie's approach[2] but also for the popliteal approach,[10,11] because division of sciatic nerve into its tibial and common peroneal components can occur at any point between the sacral plexus and the lower third. However, the parasacral approach

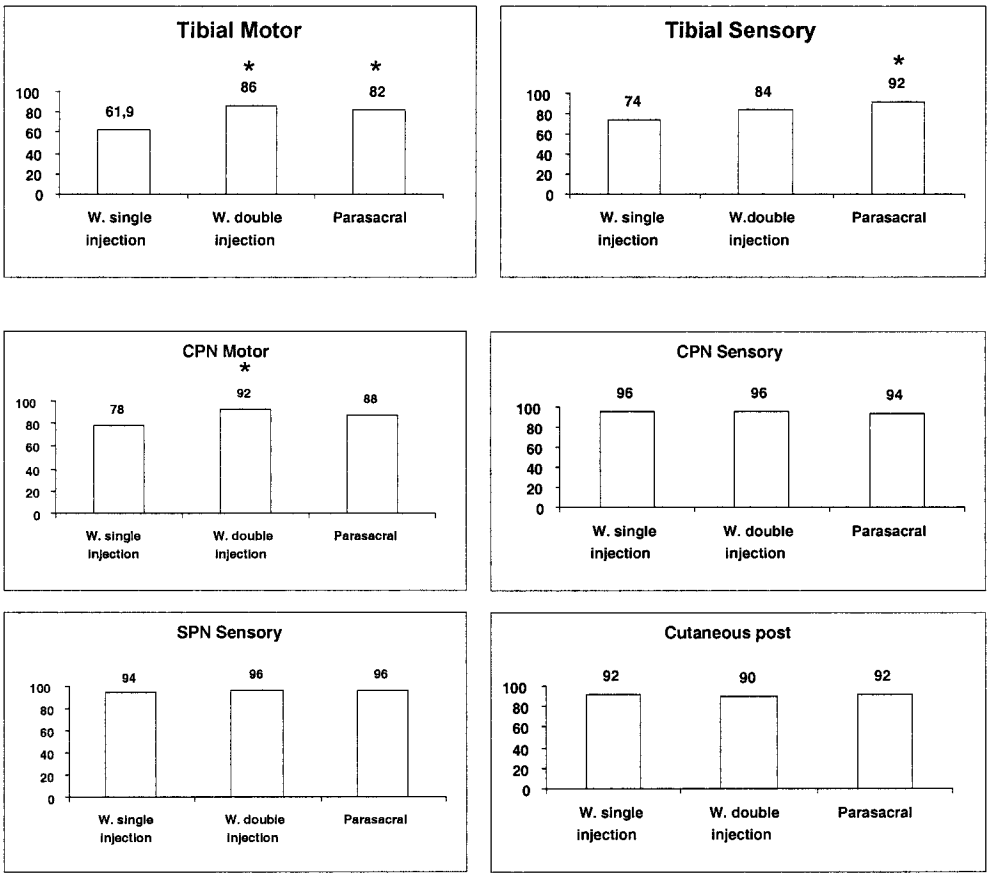

Fig. 3. Success of sensory and motor blocks (50 patients per group). *CPN* = common peroneal nerve; *Cutaneous post* = posterior cutaneous nerve; *Parasacral* = parasacral approach; *SPN* = superficial peroneal nerve; *W. double injection* = Winnie's modification of the posterior sciatic nerve block with double injection; *W. single injection* = Winnie's modification of the posterior sciatic nerve block with single injection. Values are percentages of complete sensory and motor block after 60 min. *$P < 0.017$ *vs.* Winnie's single injection.

attempts to place the local anesthetic near the proximity of the sacral plexus and sciatic division. For this reason, the procedure could also be termed "unilateral sacral plexus blockade" and could explain the high success rate for this block. Also, we found no difference in success rate when either tibial or peroneal nerve was injected in the parasacral group. These results suggest that the two compartments of sciatic nerve may be considered to be close enough at this point. Moreover, using the same volume and intensity of stimulation, the parasacral approach produced a higher success rate with single injection compared to Winnie's single approach, especially for the cutaneous posterior block, which had a very proximal division. This point reinforced the interest in the parasacral approach, because branches of the sacral plexus, which accompany the sciatic nerve through the foramen, may cross the surgical area. Some of these branches contribute to the supply of the hip joint and to the innervation of the gluteal muscles. Bailey *et al.*[2] showed that double injection results in a more rapid onset time and an increased success rate compared with single injection. The current study produced similar findings and demonstrated that, when single injection was injected, the parasacral approach produced similar success compared to double injection and thus may be an interesting alternative to multiple injection.[2]

Morris *et al.*[9] demonstrated that the parasacral approach may offer a reliable method of producing obturator nerve anesthesia. In 28 of 30 patients, the parasacral approach produced obturator nerve block. Does the parasacral approach reduce the inability of the femoral three-in-one block to achieve conduction block of the obturator nerve?[12] A recent study clearly demonstrates the contrary.[13] This point should be investigated.

This study demonstrated that parasacral block was at least as successful as Winnie's block with separate injections for the tibial and peroneal nerves. Recently, several articles have focused on subgluteal or popliteal approaches. The subgluteal or popliteal approaches to the parasacral approach were not compared in this study because a tourniquet was placed in the upper extremity of the thigh and because the aim of the study was only to compare proximal approaches. A large study may be of interest to compare transgluteal, subgluteal, or popliteal approaches, because few comparative data are available.

Volume and Local Anesthetics

Volume of injection may influence the results for the Winnie's approach groups (single or double injection). Increasing volume produced a higher success rate for this approach, especially when the two components were divised.[14] Our results for those two approaches are in agreement with those of Bailey *et al.*[2] Increasing volume (25 or 30 ml in the Winnie's single-injection group) may improve the success rate for Winnie's single injection. Moreover, no study has clearly defined the optimal volume for the posterior approach, and volumes used in the literature have ranged from 15 to 30 ml. The volume of local anesthetic for the parasacral approach varied from 15 to 30 ml.[9] We also found that 20 ml was effective for the parasacral approach. The feasibility of using a smaller volume and a lower concentration needs to be investigated.

Concentration and solution of local anesthetics may influence the success rate and onset times. In this study, we used 7.5 mg/ml ropivacaine. Our results are similar to studies in which ropivacaine was injected at concentrations between 0.5 and 0.75%.[15] The choice of high-concentration ropivacaine may facilitate diffusion of local anesthetic molecules and so be most effective when given as a single injection. However, this study demonstrated significant differences in success rate between the parasacral and Winnie's single-injection groups when single high-concentration ropivacaine was injected. Thus, when single injection is chosen, especially with lower concentrations of analgesic agent, the parasacral approach may improve the success rate compared to Winnie's single injection.

Safety and Technical Procedure

Several authors have demonstrated that the parasacral technique was easy to perform (simple landmarks) with few attempts needed (3.6 ± 2.6).[8,9] Our study confirmed these results (100% successful localization of the nerve). Moreover, our study demonstrated that time to perform the parasacral technique was very short (2 [1–5] min). Also, few studies analyzed patient discomfort during block performance, and its relation with time to perform block or number of attempts.[16] In a multicenter observational trial, Fanelli *et al.*[6] demonstrated that patients receiving sciatic–femoral nerve block (multiple injection) complained of more discomfort and had a poorer acceptance than patients receiving brachial plexus block (single injection). The parasacral technique, requiring one injection and a short time to perform, may improve the ratio of success to patient discomfort.

Although not documented for parasacral block,[17] some concerns have been expressed about the risk of penetrating pelvic structures with the needle (rectum, internal iliac vessel perforation). This theoretical complication was not observed in this study, but the limited number of patients (50) in the parasacral group cannot confirm this view. Nevertheless, we outlined that the contact of the superior edge of the sciatic nerve may be used as a landmark of depth for introducing the needle (skin–bone distance plus 2.5 cm) because pelvic organs may theoretically be threatened by this block.

This study demonstrated that the parasacral approach (single injection) may be an interesting alternative to Winnie's approach when performing a posterior sciatic nerve block.

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