

## Anatomical basis of transgluteal pudendal nerve block

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### Abstract

**Background** The pudendal nerve may become entrapped either within the pudendal canal or near the sacrotuberous ligament resulting in a partial conduction block. The goal of the present anatomical study was to assess a new transgluteal injection technique in terms of the precise injection site and the resulting distribution of the injected agent.

**Materials and methods** This study was carried out using eight fresh human cadavers. An epidural needle with a removable wing was inserted and the catheter position visualized using MRI. Through the catheter 10 ml of gadolinium contrast medium was injected into three of the cadavers. A further four cadavers were injected with latex and blue pigment and the pelvi-perineal area of each then separated from the trunk for freezing before being cut into 4–8 mm thick sections with an electric bandsaw. One final cadaver was injected with a mix of gadolinium (5 ml) and latex (5 ml) and both the MRI and anatomical procedures outlined above were performed.

**Results** Using MRI, we clearly imaged both the site of injection, near the trunk of the pudendal nerve, and the gadolinium contrast medium in different pelvic and perineal areas and around the fascia of the obturator internus and levator ani muscle. Concerning the anatomical study, latex was observed mainly around the sacrotuberous ligament, along the obturator internus muscle and in the perineal area in contact with the dividing branches of the pudendal nerve. The mixed injection of latex and gadolinium in the pudendal canal was found with the same localization between MRI and anatomical studies.

**Conclusion** This easily performed technique should provide a new approach for treating perineal neuralgia via pudendal nerve block in the consultation room without the need for computed tomography.

**Keywords** Pudendal nerve · Perineal neuralgia · Entrapment · Regional block

### Introduction

The pudendal nerve follows a long route from its sacral origin to its distal endings (Fig. 1), and is susceptible to damage all along this pathway [3, 6]. Nerve damage is responsible for symptomatic sensitive disorders in the perineal area mostly with invalidating chronic perineal pain [1, 3, 4] either isolated or associated with anal and/or sexual dysfunction [15]. Urinary and fecal incontinence can also result from compression of the pudendal nerve. The nerve may become entrapped either within the pudendal canal [1] or within the more proximal area of the sacrotuberous ligament [12], causing a partial conduction block. A number of therapeutic methods have been proposed in order to treat this condition, including computed tomography-guided nerve blocks under

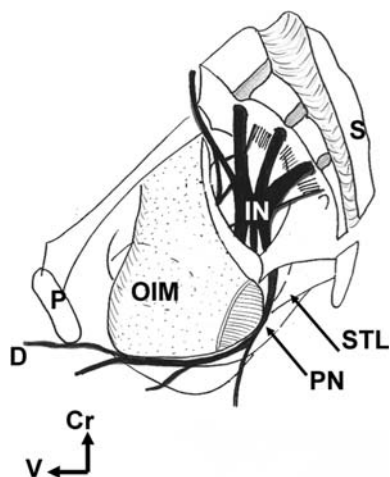
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**Fig. 1** Route of the pudendal nerve. *D* dorsal nerve of the penis or of the clitoris, *IN* ischiatic nerve, *OIM* obturator internus muscle, *P* pubis, *PN* pudendal nerve, *STL* sacro-tuberal ligament, *S* sacrum

nerve stimulation [9, 13] and surgical release of the nerve [9]. In 1976, Pace and Nagle [10] described the technique of local muscular injection for the treatment of piriform syndrome [14]. Using this technique as a basis, we aimed to derive a new method of transgluteal injection of the pudendal nerve, using gluteal anatomic reference points and vaginal or rectal landmarks of the sacral spine, as well as electrostimulation to locate the nervous trunk.

The goal of the present anatomical study was to assess the precise location of the injection site for an easier and more cost-effective approach to pudendal nerve block which can be performed in a consultation room without the need for computer tomography-assisted guidance.

## Materials and methods

### Materials

This study was carried out on eight fresh human cadavers (5 women and 3 men of mean age 71.5, range 47–92 years) a few hours following death in the anatomy laboratory of the faculty of medicine, Nîmes, France between 2005 and 2007. Subjects included had never been operated on in the pelvic region, or undergone procedures relating to the right or left pudendal nerve. An MRI was performed with a 1.5 MR System Magnetom VISION (Siemens, Erlangen, Germany) in our imaging department at Caremeau Hospital, Nîmes. An epidural needle (Tuohy) with a removable wing and large lumen diameter 1.2–1.5-17G L.20 mm (VYGON 95440 ECOUEN France) was used to inject gadolinium contrast medium (Dotarem Guerbet, Aulnay sous Bois France) and/or a mixture of latex 671 (Dupont) with natural pigments (blue oxyd) diluted in pure water (a large

lumen was mandatory because of latex viscosity). An electric bandsaw was used to cut sections (Equipro France).

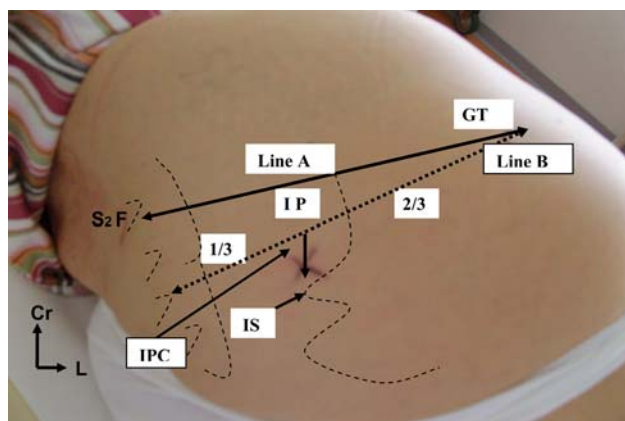
### Methods

Each cadaver was put in the lateral position, with a 90° flexion of the hip to determine the external anatomic landmarks [10]. The second and third sacral foramens, the top of the great trochanter and the lower edge of the piriform muscle were each located by palpation. A horizontal line was drawn between the great trochanter and the second sacral foramen (line A, Fig. 2). The site of injection was localized below the lower edge of the piriform muscle (line B, Fig. 2).

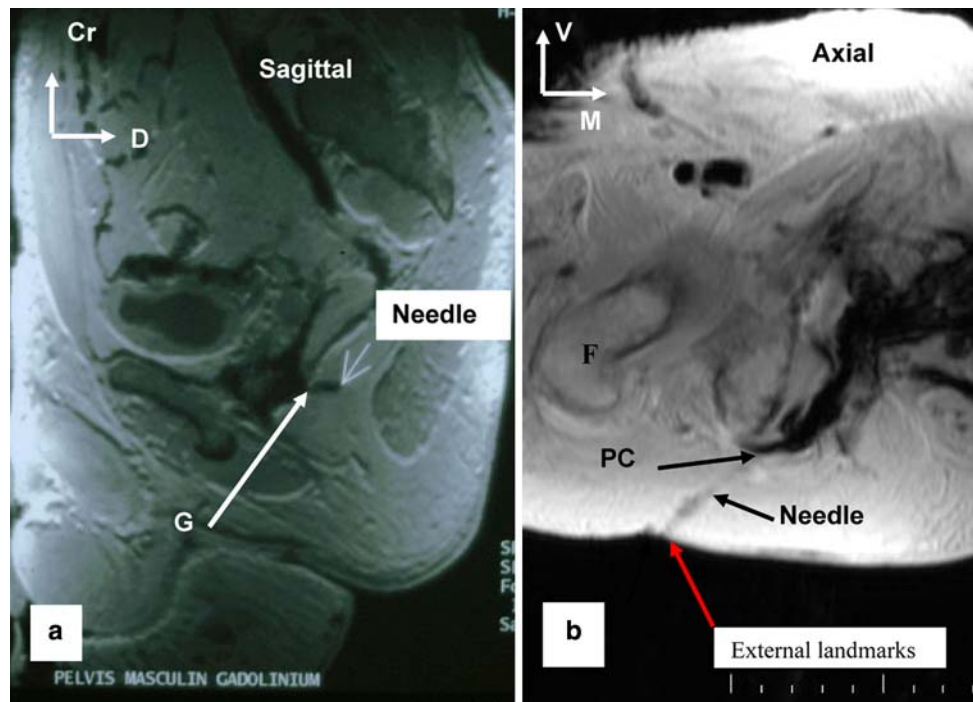
We separated this line into three equal parts. The epidural needle with a removable wing was inserted through the skin at the junction of the medial third and lateral two-thirds of this line at an angle of 45°, and passed medially towards the sacrotuberous ligament until reaching a depth of 85 mm.

Three cadavers (one man and two women) were injected with gadolinium (10 ml) and the wing was then removed. The cadavers were put in the prone position and the catheter position was visualized by coronal and sagittal T1-weighted MRI imaging. Cadavers were imaged in the three planes: sagittal, coronal and axial with T1-weighted gradient-echo sequences (8 mm thick, TE 4.7 ms TR 360 ms SL 8 mm), and 3D Turbo flash spin-echo T1 (TE 4.4 ms TR 11.4 ms) with axial (6 mm), coronal (2 mm), and oblique sagittal reconstructions in the plane of the catheter axis (1.5 mm).

Four cadavers (two men and two women) were injected with a mix of 10 ml of latex 671 (9 ml), H<sub>2</sub>O (1 ml) and blue pigment (1.3 g) through the needle at a fixed rate of 0.1 ml/s. Immediately following the injection, the pelvi-perineal area of the cadavers was separated from the trunk,



**Fig. 2** Site injection: external landmarks, patient in lateral position. *Cr* cranial, *IS* ischial spine, *GT* greater trochanter, *IP* injection, *IPC* infra piriform canal, *L* lateral, *S2F* second sacral foramen



**Fig. 3** RMI external landmarks and needle position. **a** sagittal plane, *Cr* cranial, *D* dorsal, *G* gadolinium **b** axial plane, *G* gadolinium, *M* medial, *PC* pudendal canal, *V* ventral

and frozen at a temperature of  $-18^{\circ}\text{C}$  for 72–76 h. These four specimens (height pelvic perineal areas), were then cut into 4–8 mm thick slices with an electric bandsaw, two specimens in the horizontal, one in the coronal and one in the sagittal plane. Sections were then left to defrost at room temperature before being washed, photographed and observed.

A mix of gadolinium (5 ml), latex (5 ml) and blue pigment (0.7 g) was injected into the last female cadaver. The site of injection was firstly localized using MRI (as with the three cadavers mentioned above) and then both MRI and axial anatomic sections were analyzed as outlined in the two procedures above.

## Results

### MRI

In all three cadavers, the catheter position was visualized in the sagittal (Fig. 3a), coronal and axial plane by T1-weighted MRI (Fig. 3b). The site of injection could also be clearly imaged in all three cadavers, localized near the trunk of the pudendal nerve. In the coronal plane, we saw the gadolinium in different parts of the pelvic and perineal areas (Fig. 4a); in the ventral genitourinary and dorsal recto-anal regions, as well as around the fascia of the obturator internus and levator ani muscles. In the axial plane, we observed the gadolinium near the sacrotuberous liga-

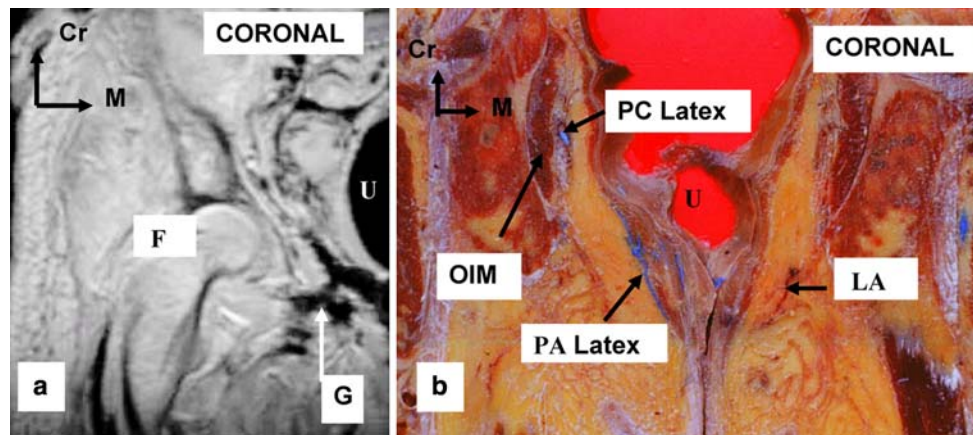
ment, near visceral structures, in the pudendal canal, and around the terminal branches of the pudendal nerve.

### Anatomical study

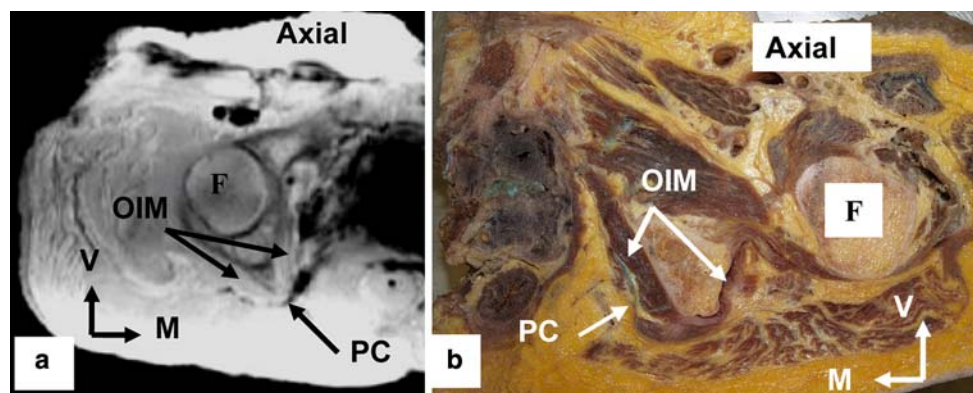
In one of the cadavers, we were unable to obtain satisfactory latex injection; the latex was located uniquely in the gluteal part and in the ischio-rectal fossa. In all three remaining cadavers, the latex was found mainly around the sacrotuberous ligament and along the obturator fascia, and in smaller quantities in the perineal region in contact with the division of the pudendal nerve. In the coronal plane, some latex was found in the ventral genitourinary region and in the dorsal recto-anal region. In all cadavers, a significant amount of latex was found in contact with the pudendal nerve and vessels, in the vicinity of the sacrotuberous ligament. Some latex was observed in the pelvic cavity around the obturator internus muscle, and lower down in contact with perineal viscera (Fig. 4b). Latex was also present along the pelvic fascia and condensations of fascia forming ligaments extending from the cervix to the anterior (pubocervical ligament), lateral (transverse cervical) and posterior (uterosacral ligament) pelvic walls or vesicosacral folds, and around the nerves and vessels.

### MRI and anatomical study in one cadaver

A mix of gadolinium and blue latex was found in the pudendal canal with the same localization between MRI



**Fig. 4** **a** RMI in coronal plane, cadaver injected with gadolinium (10 ml) *F* femur, *G* gadolinium, *U* uterus **b** Anatomical study in coronal plane, cadaver injected with latex (10 ml) *OIM* obturator internus muscle, *LA* levator ani, *PA* perineal area, *PC* pudendal canal, *U* uterus



**Fig. 5** Cadaver injected with gadolinium (5 ml) and latex (5 ml) **a** MRI, in axial plane, **b** Anatomical study, in axial plane, *F* femur, *M* medial, *OIM* obturator internus muscle, *PC* pudendal canal, *V* ventral

(Fig. 5a) and anatomical studies (Fig. 5b). We believe this localization to be identical to that observed following a clinical approach (bupivacaine and/or corticoids) with the same pattern of spreading in perineal and pelvic spaces.

## Discussion

The gadolinium contrast medium spread more easily and widely due to a much lower viscosity than latex. The latex injection and spreading is difficult, remaining unsatisfactory in one of our specimens showing different diffusion patterns perhaps linked to a change in tissue structure. The differences observed in latex spreading between specimens could be the result of differences in spreading and variation in connective tissue. They could also be due to differences in needle placement, particularly in one case in which the needle insertion was difficult.

Nevertheless, in those specimens in which latex was successfully injected, we consistently found it in significant amounts around the pudendal nerve, spreading both

upstream and downstream of the sacrotuberous ligament, a strong supporting ligament implicated in pudendal nerve entrapment syndrome [8, 12], then reaching the terminal branches of the nerve in its perineal part [3]. Some latex was found in contact with the pelvic fascia and condensations of fascia forming ligaments extending from the cervix to the anterior (pubocervical ligament), lateral (transverse cervical), and posterior (uterosacral ligament) pelvic walls or vesicosacral folds. This may explain clinical findings of some patients complaining of urinary bladder or rectum pain associated with pudendal neuralgia [2, 11] that is sometimes, though not always, relieved by nerve block. Pain suppression may occur therefore in patients in whom the product spreads to the hypogastric plexus responsible for the associated visceral pain.

In the cadaver injected with the mix of both gadolinium and colored latex, the decreased viscosity compared to latex alone allowed the product to spread more easily. Indeed, we observed an anatomic distribution similar to that seen with therapeutic agents (bupivacaine and/or corticoids) currently used for diagnostic or therapeutic nerve block [2, 7, 10].

Using various techniques and approaches, published clinical studies have reported complete sedation of pelvic-perineal pain linked to peripheral neurogenic damage of the pudendal nerve in 50–70% of cases. A prospective clinical study will now be necessary to evaluate the efficiency of this new transgluteal approach of pudendal nerve block.

## Conclusion

Pudendal nerve block [13] has been shown to relieve or suppress chronic pelvic-perineal pain in a majority of patients. Here we aimed to derive a new transgluteal method of injection of the pudendal nerve, using gluteal anatomic reference points and vaginal or rectal landmarks of the sacral spine, as well as electrostimulation to locate the nervous trunk.

The present study has demonstrated the feasibility of this new technique and provides useful anatomical landmarks regarding the exact site of injection and the spreading of the product around the pudendal nerve and along its course. These results may contribute to a better understanding of the mechanisms behind pudendal nerve block. This technique does not require concomitant imaging and may therefore represent an advantage over computed tomography-guided nerve blocks [5] for future treatment of perineal neuralgia. Future comparative clinical evaluations are necessary.

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