

Original Article	Anatomical Study of the Human Pudendal Nerve and its Application in Clinical Practice <i>Esam M. Eid and Mahmoud E. M. Salem</i> <i>Anatomy Department, Faculty of Medicine, Benha University</i>
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ABSTRACT

Background: The pudendal nerve block is widely used in patients undergoing gynaecologic, obstetric and penile surgery. But in some cases, the pudendal nerve block may fail and be ineffective. This may be due to failure of localization of the pudendal nerve or anatomical variations in its origin, course or branching pattern.

Aim of the work was to study the anatomical variations of the pudendal nerve and the accurate localization of the pudendal nerve in relation to surface landmarks such as the ischial spine.

Materials and Methods: This study was carried out on thirteen dissected human Egyptian pelves, gluteal regions and perineums (11 males and 2 females).

Results: According to our examinations, the roots and trunks of the pudendal nerve could be grouped into four types: In Type I, the pudendal nerve arose from $s_{3\&4}$ in the form of one trunk (19.2%). This trunk divided into inferior rectal nerve, perineal nerve and dorsal nerve of the penis. In Type II, the pudendal nerve arose from $s_{2,3\&4}$ in the form of two trunks (34.6%). The medial trunk continued as the inferior rectal nerve, while the lateral trunk divided into perineal nerve and dorsal nerve of penis. In Type III, the pudendal nerve arose from $s_{2\&3}$ in the form of two trunks (15.5%). The lateral trunk got connected with the sciatic nerve, while the medial trunk divided into the perineal nerve and dorsal nerve of the penis. The inferior rectal nerve arose directly from the 3rd sacral nerve. In Type IV, the pudendal nerve arose from $s_{2\&3}$ in the form of one trunk (30.8%). The origin of the inferior rectal nerve was variable. In 50%, it arose as a branch from the pudendal nerve after passing through the greater sciatic foramen. In 34.6%, the inferior rectal nerve was the continuation of the medial trunk of the pudendal nerve. In 15.4%, it arose directly from S_3 and never joined the pudendal nerve. The dorsal nerve of the penis divided into two branches (medial and lateral) in 81.8% and three branches (medial, lateral and ventral) in 18.2%. The medial branches of both sides communicated with each other to form a plexus behind the corona glandis to supply the glans. The ischial spine was an essential bony landmark for localization of the pudendal nerve. In the gluteal region, the point of the tip of the ischial spine represented the junction between the upper 2/3 and the lower 1/3 of a line extending between the posterior superior iliac spine and the ischial tuberosity. The point of crossing of the pudendal nerve to the sacrospinous ligament lay 1 ± 0.5 cm medial to the point of the tip of the ischial spine. The surface line of the pudendal nerve divided equally the line extending between the base of the coccyx and the ischial tuberosity.

Key Words: Pudendal nerve, anatomical variations, surface landmarks.

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INTRODUCTION

The pudendal nerve is the king of the perineum. It is a branch of the sacral plexus and classically described as being derived from S₂, 3 and 4. It leaves the pelvis via the greater sciatic foramen between the piriformis and coccygeus muscles to enter the gluteal region, then it crosses the sacrospinous ligament, close to the ischial spine where it is accompanied by the internal pudendal ves-

sels. As the pudendal nerve enters the lesser sciatic foramen, it passes through the pudendal canal (Alcock's canal) which lies in the lateral wall of the ischiorectal fossa.

The pudendal nerve gives off the inferior rectal nerve. It soon divides into two terminal branches: The perineal nerve and the dorsal nerve of

penis or clitoris (*Standring et al., 2008; Robert et al., 2009*). The pudendal nerve innervates the external genitalia of both sexes, as well as the erector muscles and the voluntary sphincters of the urinary bladder, rectum and anal canal. It controls erection and the voluntary sphincters. It is also the nerve of the beginning of sexual sensation (*Mellion, 1991; Robert et al., 2009*).

The pudendal nerve can be exposed at certain sites of compression, such as when it is in the clamp between the sacrospinous and sacrotuberous ligaments. It can also be compressed in the pudendal canal, either by the effects of the fal-ciform process of the sacrotuberous ligament or by thickening of the obturator fascia, this case is called the pudendal canal syndrome (*Hough et al., 2003; Bondar et al., 2010*). The pudendal nerve blocks are of value in providing analgesia for the pudendal canal syndrome during labour, repair of episiotomy as well as penile and anal surgery. The approaches of the pudendal nerve block have been described: transvaginal, transrectal, perineal and gluteal approaches (*Mellion, 1991; UZ et al., 2005; Venegas-Ocampo et al., 2010*).

Failure to provide adequate analgesia has been reported up to half of pudendal blocks which are ineffective in one or both sides (*Hough et al., 2003*). This may be due to the anatomical variations of the pudendal nerve or failure of accurate localization of the pudendal nerve in relation to surface bony landmarks. There is lack of literature examining the variations in the pudendal nerve. So, the aim of this work was to study the anatomical variations of the pudendal nerve and its branches. Also, this study described the accurate localization of the pudendal nerve in relation to the surface landmarks particularly the ischial spine, the ischial tuberosity, the posterior superior iliac spine and the base of coccyx.

MATERIALS AND METHODS

Thirteen fresh postmortem human Egyptian cadavers (eleven males and two females) were used in this study. These cadavers were obtained from the postmortem room of the Anatomy Department, Faculty of Medicine, Benha University. The pelvis of each cadaver was sectioned sagittally from the symphysis pubis to the median sacral crest. The posterior wall of the rectum was reflected to expose the roots of the pudendal

nerve, internal pudendal vessels, sciatic nerve, piriformis and coccygeus. The ischial spine was identified by palpation. The number of roots of the pudendal nerve and trunk formation were recorded. The relations of the pudendal nerve to the internal pudendal vessels, the sacrospinous ligament and the tip of the ischial spine were recorded. In the gluteal region, the surface bony landmarks were identified. The Posterior Superior Iliac Spine (PSIS) lay in a skin dimple at the level of 2nd sacral spine. The ischial tuberosity could be palpated and its center was identified by a pin. The coccyx could be palpated in the floor of the natal cleft and identified by its relative mobility. The tip of the ischial spine could be identified on the surface of gluteal region by passing a long needle at the tip of ischial spine from the pelvis and directed backwards to the gluteal region.

The following distances were measured using verger and ruler: the distances between PSIS and the center of ischial tuberosity, between PSIS and ischial spine, between the ischial spine, ischial tuberosity, between the base of coccyx, ischial spine, between the base of coccyx and ischial tuberosity. The surface landmark of the point of crossing of the pudendal nerve to the sacrospinous ligament could be identified and its distance from the tip of the ischial spine was calculated. The gluteus maximus was exposed and sectioned longitudinally near its origin. Then, it was reflected laterally to its insertion. The gluteus medius and minimus, piriformis, two gemelli, tendon of obturator internus and quadratus femoris were identified. The sciatic nerve, the superior and inferior gluteal nerves and vessels were identified. The attachment of the sacrotuberous ligament was identified. It was sectioned at its middle and reflected to see the structures deep to it. The ischio-rectal fossa was dissected.

The pudendal canal was identified in its lateral wall and opened to examine its contents. The inferior rectal nerve was exposed and its distribution was recorded. The perineal nerve and its branches were also recorded. After removal of the penile skin and fascia, antegrade dissection of the dorsal nerve was performed and its branches were recorded. The variations of the pudendal nerve in its roots, trunks, connections and branching patterns were photographed by close up camera under a light source. The previous distances and standard deviations were presented in tables.

RESULTS

This study investigated the anatomy of the pudendal nerve in thirteen dissected human Egyptian pelves, gluteal regions and perineums (13 right and 13 left halves) (11 males and 2 females).

Variations in the roots and trunks of the pudendal nerve:

These variations could be grouped into four types. In type I, the 3rd sacral nerve joined the small part of 4th sacral nerve to form one trunk of the pudendal nerve in 5/26 of specimens (19.2%) (Fig. 1; Tab. 1). In the gluteal region, the trunk of pudendal nerve divided into several branches after passing through the greater sciatic foramen. These branches were (from medial to lateral): The inferior rectal nerve, the two cutaneous, the two muscular branches of perineal nerve and the dorsal nerve of penis. This pattern of branching were seen in 3/5 of specimens of this type (Fig. 2). But in 2/5 of specimens of type I, the inferior rectal nerve arose from the pudendal nerve after passing through the greater sciatic foramen, while the other branches were not seen in the gluteal region (Fig. 3).

In type II, the part of 2nd sacral nerve joined a part of 3rd sacral nerve to form the lateral trunk of pudendal nerve, while the other part of 3rd sacral nerve joined a part of 4th sacral nerve to form the medial trunk of pudendal nerve in 9/26 of specimens (34.6%) (Fig. 4; Tab. 1). The two trunks passed through the greater sciatic foramen between the piriformis and coccygeus muscles. In the gluteal region, the medial trunk of the pudendal nerve continued as the inferior rectal nerve which descended on the surface of the rectum and anal canal. The lateral trunk of the pudendal nerve divided into perineal nerve and dorsal nerve of penis which passed through the ischio-rectal fossa. This pattern of distribution was seen in 8/9 of specimens (Fig. 5). In only one specimen of this type, the medial trunk continued as the pudendal nerve which passed deep to the sacrotuberous ligament to enter the ischio-rectal fossa where it divided into the inferior rectal nerve and the perineal nerve. The lateral trunk got connected partially with the sciatic nerve and gave the dorsal nerve of penis and then joined the medial trunk of the pudendal nerve (Fig. 6).

In Type III, the 2nd sacral nerve joined the 3rd sacral nerve to form one stem which divided into medial and lateral trunks of the pudendal nerve. In this type, the inferior rectal nerve arose directly from the 3rd sacral nerve in 4/26 of specimens (15.4%). The two trunks of the pudendal nerve and inferior rectal nerve passed between coccygeus and piriformis muscles (Fig. 7). In the gluteal region, the lateral trunk got connected with the sciatic nerve, while the medial trunk continued as the pudendal nerve itself. The pudendal nerve and the inferior rectal nerve crossed the back of the sacrospinous ligament, deep to the sacrotuberous ligament (Fig. 8).

In Type IV, the part of 2nd sacral nerve joined a part of 3rd sacral nerve to form one trunk of the pudendal nerve which passed behind the coccygeus muscle in 8/26 of specimens (30.8%) (Fig. 9; Tab. 1). The trunk of the pudendal nerve passed through the pudendal canal. In the ischio-rectal fossa, the branches of the pudendal nerve were: The inferior rectal nerve, muscular and cutaneous branches of perineal nerve and dorsal nerve of the penis (Fig. 10).

Variations in the branches of the pudendal nerve:

- 1. The Inferior Rectal Nerve (IRN):** The origin of IRN was variable. The commonest site of origin was a branch from the trunk of the pudendal nerve after passing through the greater sciatic foramen in 13/26 of specimens (50%) (Figs. 2, 3, 10). The second origin of IRN was a branch from the medial trunk of the pudendal nerve in 9/26 of specimens (34.6%) (Figs. 5, 6). The third origin of IRN was a branch from the 3rd sacral nerve directly and never joined the pudendal nerve in 4/26 of specimens (15.4%) (Figs. 7, 8). The IRN divided into several branches which supplied the puborectalis part of levator ani, the external anal sphincter and the perineal skin. Some branches of IRN got connected with the cutaneous branch of the perineal nerve (Figs. 2, 10).
- 2. The perineal nerve:** It arose from the pudendal nerve in the ischio-rectal fossa in 15/26 of specimens (57.7%) (Figs. 3, 6, 8, 10). In 11/26 of specimens (42.3%), the perineal nerve arose early from the pudendal nerve in the gluteal region

(Figs. 2, 5). In case the pudendal nerve was formed of two trunks, the perineal nerve arose from the lateral trunk, while the IRN arose from the medial trunk (Fig. 5). In case the lateral trunk of pudendal nerve got connected with the sciatic nerve, the perineal nerve arose from the medial trunk of the pudendal nerve (Fig. 6).

- 3. The dorsal nerve of the penis:** It arose from the pudendal nerve in the gluteal region in 12/22 of specimens (54.5%) (Figs. 2, 5, 6). In 10/22 of specimens (45.5%), the dorsal nerve of the penis arose from the pudendal nerve in the ischiorectal fossa (Fig. 10). when the pudendal nerve was formed of two trunks, the dorsal nerve of the penis arose from the lateral trunk (Figs. 5, 6). The dorsal nerve of the penis passed between the two layers of the suspensory ligament to reach the dorsum of the penis. This nerve passed on the surface of the tunica albuginea of the corpus cavernosum beneath the deep fascia of the penis (Buck's Fascia) which was removed during the dissection. In the proximal 1/3 of the shaft of the penis, the dorsal nerve of the penis divided into medial and lateral branches in 9/11 of specimens (81.8%) (Figs. 11, 12). In two specimens (18.2%), the dorsal nerve of the penis divided into three branches which were medial, lateral and ventral branches (Fig. 13). The medial branches of both sides communicated with each other to form a plexus behind the corona glandis to supply the glans penis (Fig. 12).

Surface landmarks for localization of the pudendal nerve:

In the gluteal region, the mean distance between the Posterior Superior Iliac Spine (PSIS) and the ischial tuberosity was about 14.5±1.3 cm. The mean distance between the PSIS and the ischial spine was 9.5±0.8 cm (nearly 2/3 of the total distance). The mean distance between the ischial spine and the ischial tuberosity was about 5.0±0.6 cm (approximately 1/3 of the total distance). So, the point of the surface landmark for the ischial spine lay nearly at the junction of upper 2/3 and lower 1/3 of the line extending between PSIS and the ischial tuberosity. The ischial spine lay at the level of the base of coccyx. The mean distance be-

tween the ischial spine and the base of the coccyx was about 5.1±0.3cm. The mean distance between the ischial tuberosity and the base of the coccyx was about 8.4±0.3cm. The pudendal nerve divided equally the line extending between the base of coccyx and the ischial tuberosity (Fig. 14; Tab. 2).

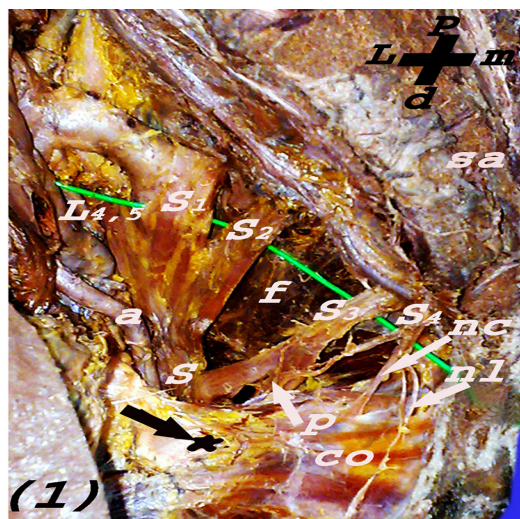


Fig. 1: A photograph of the right side of the male pelvis showing the pudendal nerve (p) formed by fusion of part from S3 and part from S4. The pudendal nerve passes behind the coccygeus (co), while the internal pudendal artery (a) and sciatic nerve (s) pass behind the ischial spine (*). Notice the lumbosacral trunk (L4 & 5), S1, S2, nerve to levator ani (nl), nerve to coccygeus (nc), sacrum (sa) and piriformis (f). Note that proximal (p), distal (d), medial (m) and lateral (l).

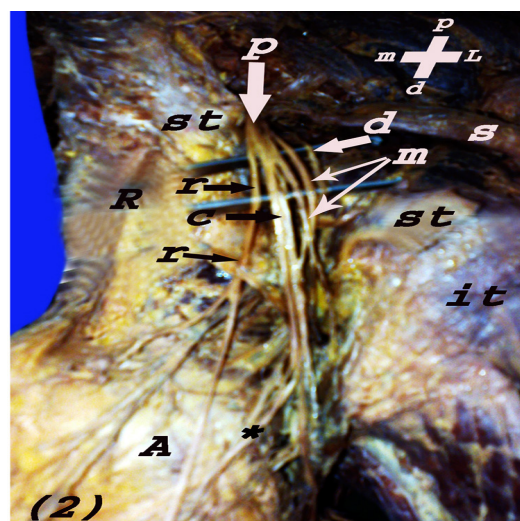


Fig.2: A photograph of the right side of the gluteal region and the ischiorectal fossa showing the early division of the pudendal nerve (p) into branches after passing through the greater sciatic foramen. These branches are inferior rectal nerve (r), two cutaneous branches (c) of perineal nerve, two muscular branches (m) of perineal nerve and dorsal nerve of the penis (d). Notice the connection (*) between the inferior rectal nerve and the cutaneous branch of perineal nerve, sciatic nerve (s), reflected edge of sacrotuberous ligament (st), ischial tuberosity (it), Rectum (R) and Anal canal (A).

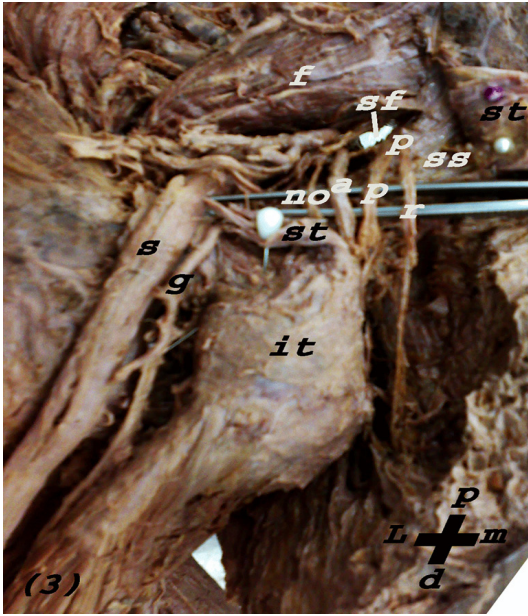


Fig.3: A photograph of the left gluteal region showing the inferior rectal nerve (r) arising from the pudendal nerve (p) immediately after passing through the greater sciatic foramen (sf). Notice the inferior rectal nerve and pudendal nerve crossing the back of the sacrospinous ligament (ss). The internal pudendal artery (a) and nerve to obturator internus (no) crossing the back of ischial spine. Notice the sacrotuberous ligament (st) is incised and reflected. Notice also piriformis (f), sciatic nerve (s), inferior gluteal artery (g) and ischial tuberosity (it).

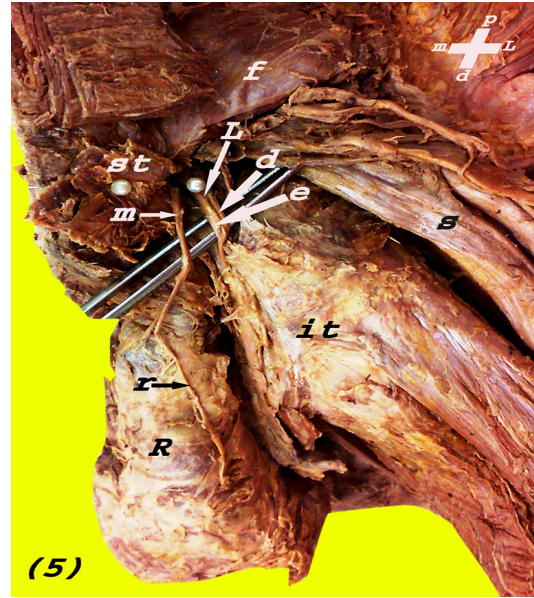


Fig.5: A photograph of the right gluteal region and ischiorectal fossa of the previous specimen showing the medial trunk (m) of the pudendal nerve which continues as inferior rectal nerve (r), while the lateral trunk (L) divides into perineal nerve (e) and dorsal nerve of penis (d). Notice the incised and reflected sacrotuberous ligament (st). Notice also piriformis (f), sciatic nerve (s), ischial tuberosity (it) and rectum (R).

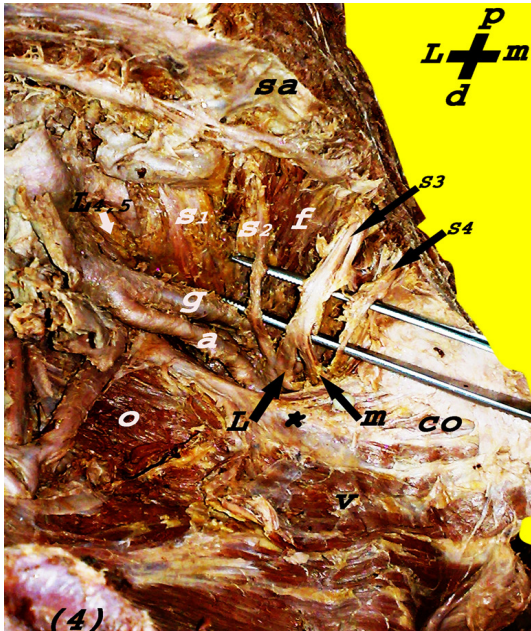


Fig.4: A photograph of the right side of male pelvis showing the part of 2nd sacral nerve (s2) joining the part of the 3rd sacral nerve (s3) to form the Lateral trunk (L) of the pudendal nerve. The part of 3rd sacral nerve joins the part of 4th sacral nerve (s4). Notice lumbosacral trunk (L4 & 5), 1st sacral nerve (S1), obturator internus (o), coccygeus (co), top of ischial spine (*), internal pudendal artery (a), inferior gluteal artery (g), piriformis (f) levator ani (v) and sacrum (sa).

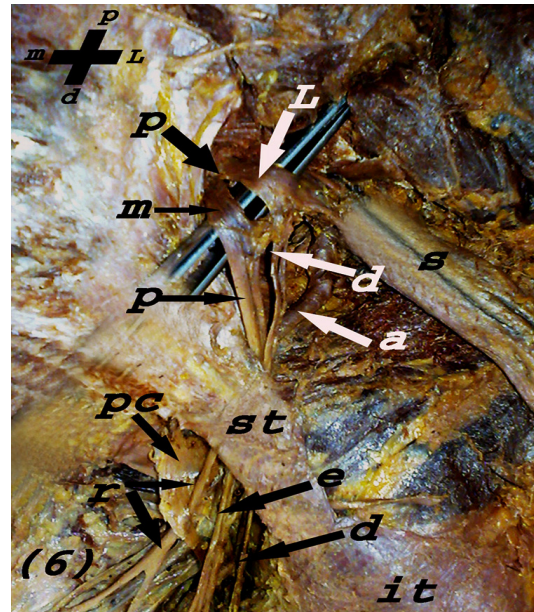


Fig.6: A photograph of the right gluteal region and ischiorectal fossa showing the lateral (L) and medial (m) trunks of the pudendal nerve. The lateral trunk connects with the sciatic nerve (s), gives the dorsal nerve of the penis (d) and rejoins the medial trunk. The medial trunk continues as the pudendal nerve (p). The pudendal nerve, the dorsal nerve and internal pudendal artery (a) descend deep to the sacrotuberous ligament (st). Notice the three nerves seen below this ligament which are the dorsal nerve of penis (d), perineal nerve (e) and inferior rectal nerve (r) which pierces the medial wall of pudendal canal (pc).

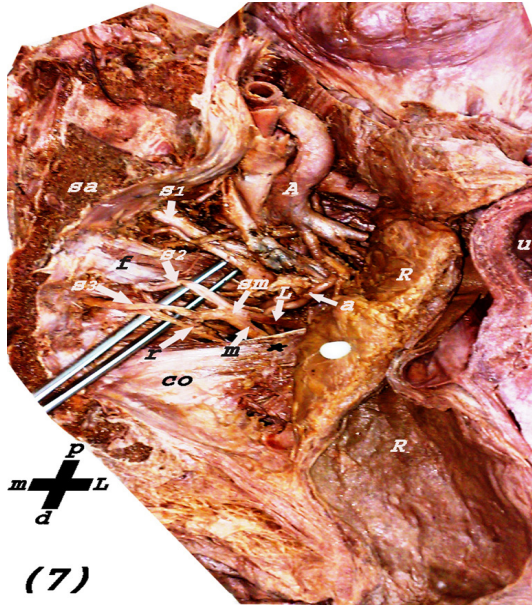


Fig.7: A photograph of the left side of the female pelvis showing the 2nd sacral nerve (s2) joining the 3rd sacral nerve (s3) to form a stem (sm) which divides into the medial (m) and lateral (L) trunks of the pudendal nerve. Notice the inferior rectal nerve (r) arising directly from S3. Notice also the rectum (R), coccygeus (co), ischial spine (*), uterus (u), internal iliac artery (A), internal pudendal artery (a), sacrum (sa), 1st sacral nerve (S1) and piriformis (f).

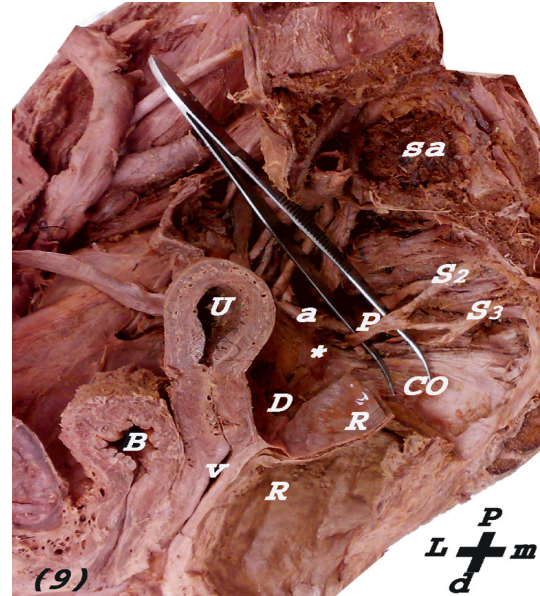


Fig.9: A Photograph of the right side of the female pelvis showing part of 2nd sacral nerve (s2) joining part of 3rd sacral nerve (s3) to form one trunk of pudendal nerve (p) which passes behind the coccygeus (co). Notice the ischial spine (*), rectum (R), Douglas pouch (D), uterus (u), vagina (v), urinary bladder (B), sacrum (sa) and internal pudendal artery (a).

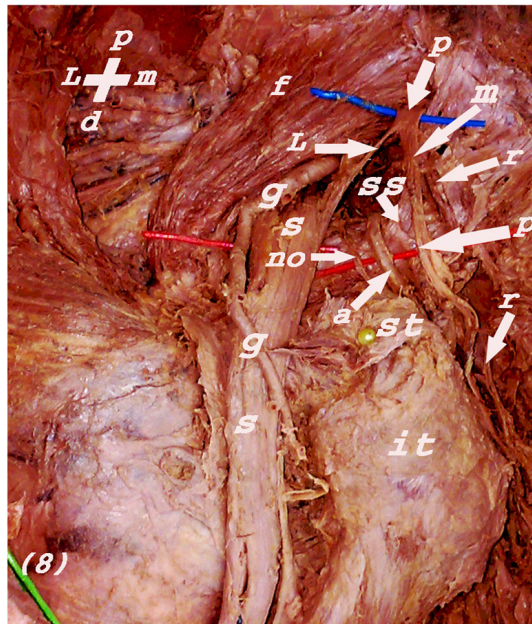


Fig.8: A photograph of the left gluteal region of the previous specimens showing the lateral trunk (L) of the pudendal nerve (p) connecting with the sciatic nerve (S), while the medial trunk (m) continues as the pudendal nerve itself (p). Notice the inferior rectal nerve (r), the pudendal nerve, the internal pudendal artery (a) and the nerve to obturator internus (no) crossing the sacrospinous ligament (ss). Notice also the sacrotuberous ligament (st), ischial tuberosity (it), inferior gluteal artery (g) and piriformis (f).

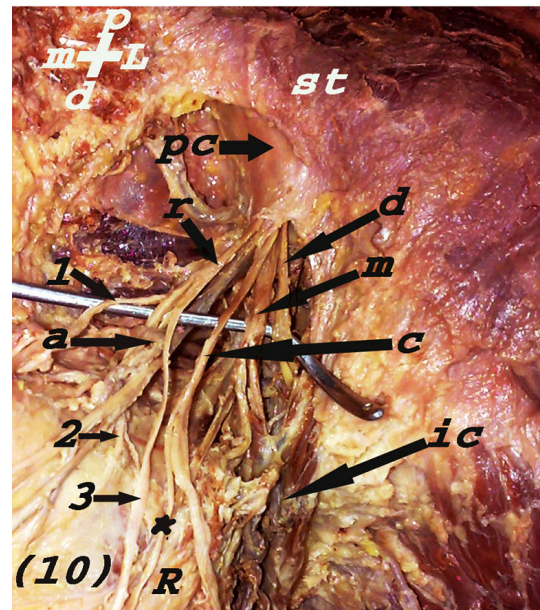


Fig.10: A photograph of the right ischioanal fossa showing the pudendal canal (pc) passing deep to the sacrotuberous ligament (st) and descending in the lateral wall of ischioanal fossa. The pudendal canal is opened to show its contents which are the inferior rectal nerve (r), cutaneous branch of perineal nerve (c), muscular branch of the perineal nerve (m) and dorsal nerve of the penis (d). The inferior rectal nerve divides into branches to the levator ani (1), the anal sphincter (2) and to the anus (3). The branch to anus connects with cutaneous branch of perineal nerve (*). Notice the wall of Rectum (R), ischiocavernosus muscle (ic) and inferior rectal artery (a).

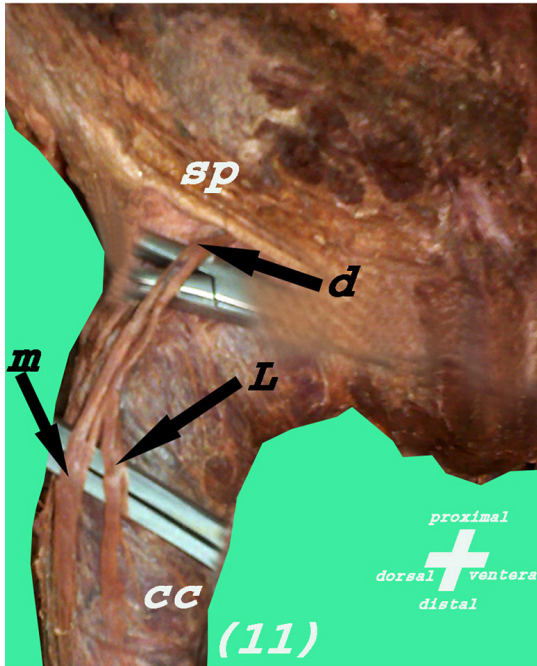


Fig.11: A photograph of the left side of the penis showing the dorsal nerve (d) passing between the layers of the suspensory ligament (sp). In the proximal 1/3 of the shaft of the penis, the dorsal nerve divides into lateral branch (L) and medial branch (m). Notice the corpus cavernosum (cc).

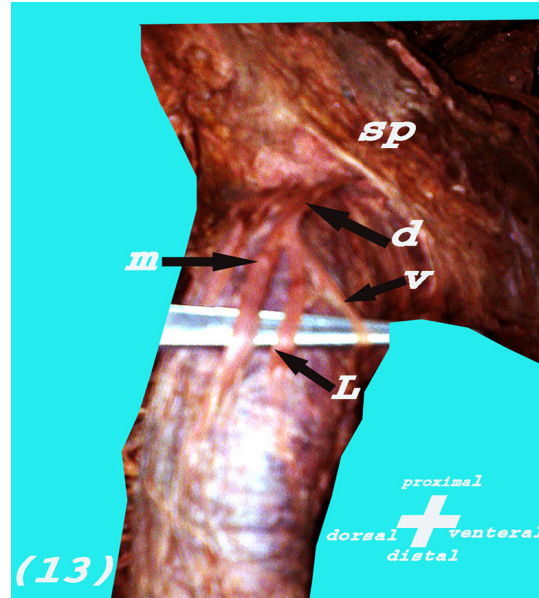


Fig.13: A photograph of the left side of the shaft of the penis showing the dorsal nerve (d) passing between the layers of the suspensory ligament (sp). In the proximal 1/3 of the shaft of the penis, the dorsal nerve divides into medial branch (m) running forward on its dorsum, a Lateral branch (L) running on its lateral side and a ventral branch (v) running on its ventral aspect.

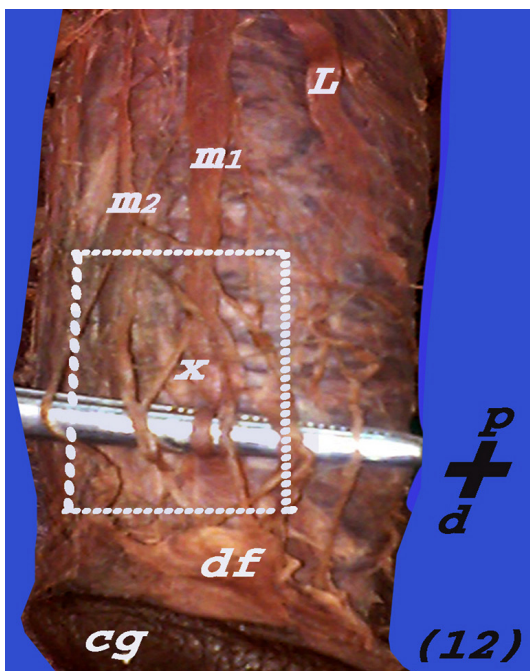


Fig.12: A photograph of the dorsum of the shaft of the penis of the previous specimen showing the medial branch of the left dorsal nerve (m1) communicating with the medial branch of the right dorsal nerve of the penis (m2) to form a plexus (x) behind the corona glandis (cg) which passes through the glans penis. Notice the lateral branch (L) of dorsal nerve of penis and part of the deep fascia of the penis (df).

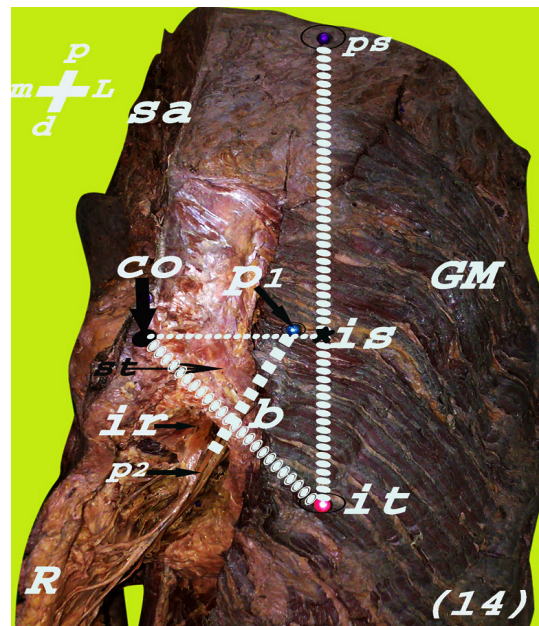


Fig.14: A photograph of the right gluteal region showing the surface landmarks of ischial spine and pudendal nerve. Notice the distance between posterior superior iliac spine (ps) and ischial tuberosity (it), the distance between (ps) and ischial spine (is), the distance between (is) and (it), the distance between (co) and (it). Notice a point of exit of pudendal nerve (p₁) from the greater sciatic foramen, point of transection (b) of pudendal nerve with the line between (co) and (it). Notice also the branches of pudendal nerve (p₂) in the ischioanal fossa (ir), rectum (R), sacrotuberous ligament (st), sacrum (sa) and gluteus maximus (GM).

Table 1: Variations in the pudendal nerve .

Types	Number	Side		Sex		Roots	Trunks	%
		Right	Left	Male	Female	(Sacral)		
I	5	2	3	5	0	S3, 4	1	19.2%
II	9	5	4	8	1	S2, 3 & 4	2	34.6%
III	4	1	3	3	1	S2, 3	2	15.4%
IV	8	5	3	6	2	S2, 3	1	30.8%
	26	13	13	22	4			100%

Table 2: The mean distance between the posterior superior iliac spine (PSIS), ischial tuberosity (IT), Ischial Spine (IS) and base of coccyx (co).

PSIS & IT		PSIS & IS		IS & IT		IS & Co.		IT & Co.	
Mean (cm)	±SD	Mean (cm)	±SD	Mean (cm)	±SD	Mean (cm)	±SD	Mean (cm)	±SD
14.5	±1.3	9.5	±0.8	5.0	±0.6	5.1	±0.3	8.4	±0.3

DISCUSSION

In the present study, the roots and trunks of the pudendal nerve can be grouped into four types: In Type I, the pudendal nerve arose from S3 & 4 in the form of one trunk (19.2%). In Type II, the pudendal nerve arose from S2, 3 & 4 in the form of two trunks (34.6%). In Type III, the pudendal nerve arose from S2 & 3 in the form of one trunk (15.4%). In Type IV, the pudendal nerve arose from S2 & 3 in the form of one trunk (30.8%). So, in 50% of the specimens, the pudendal nerve was one trunk (Type I and IV), while in the other 50% of the specimens, the pudendal nerve was two trunks (Type II and III). The previous studies reported various patterns in trunk formation of the pudendal nerve. *Mahakkanukrauh et al. (2005)* reported that 56.2% of the pudendal nerves were in the form of one trunk, 31.5% were two trunks and 12.3% were three trunks. *Kocabiyik et al. (2008)* reported that the pudendal nerve was defined as a single trunk in 62%, double trunk in 34% and triple trunk in 4%. *Pirro et al. (2009)* reported that the pudendal nerve was a single trunk in 3/4 of cases. *Shafik et al. (1995)* reported that the pudendal nerve was derived from S2, 3 & 4 in 14/20, from S1, 2, 3 & 4 in 5/20 and from S2, 3, 4 & 5 in 1/20.

In the present study, the origin of Inferior Rectal Nerve (IRN) was variable in origin. The commonest site of origin of IRN was from the pudendal nerve after passing through the greater sciatic foramen in 50%. The second common origin of IRN was from the medial trunk of the pudendal nerve in only 34.6%. The third and least origin of IRN arose directly from the Sacral plexus (S3) in 15.4%. These results are nearly similar to the results of *Kocabiyik et al. (2008)* who reported that in case the pudendal nerve was a double trunk, the medial trunk continued as the inferior rectal nerve in 34%. In case the pudendal nerve was a single trunk, the inferior rectal nerve arose proximal to the dorsal nerve of the penis or clitoris in 38%. *Mahakkanukrauh et al. (2005)* reported that in case the pudendal nerve was two trunks, the inferior rectal nerve represented one trunk piercing the sacrospinous ligament in 11% of cases or not piercing the sacrospinous ligament in 9.5%. *Roberts and Williams (2005)* reported that the inferior rectal nerve might have an independent origin from the sacral plexus in 20% of cases and this could represent a problem in the pudendal nerve block.

In the present study, the inferior rectal nerve supplied the under surface of the levator ani, the external anal sphincter and the perianal skin. Some of its branches communicated with the cutaneous branch of perineal nerve. These findings are similar to the results of *Juene-mann et al. (1988)*, *Shafik and Doss (1999)* and *Standring et al. (2008)*.

In the present study, the dorsal nerve of the penis divided into two branches (medial and lateral) in 81.8% and three branches (medial, lateral and ventral) in 18.2%. The medial branches of both sides communicated with each other to form a plexus behind the corona glandis to supply the glans penis. The lateral branch supplied the lateral side of the penis (skin, fascia and corpus cavernosum) and the ventral side of the penis (skin, fascia, corpus spongiosum and urethra). These findings coincide with the results of *Yang and Bradley (1998)*. *Zhang et al. (2009)* reported that the average number of the branches of the dorsal nerve of the penis was 3.55 branches in 38 cases.

In the present study, the ischial spine was important for localization of the pudendal nerve in the gluteal region. The present authors found that the point of tip of ischial spine lay at the junction of upper 2/3 and lower 1/3 of a line extending between the PSIS and the ischial tuberosity. The base of coccyx lay at the same level as the tip of the ischial spine and the distance between them was about 5.10.3cm. The mean distance between the ischial tuberosity and the base of coccyx was about 8.4±0.3cm. Also from this study, it was found that the surface line of the pudendal nerve divided equally the line extending between the base of coccyx and the ischial tuberosity. These results are in agreement with some results of *UZ et al. (2005)* who reported that the distance between the ischial tuberosity and the base of coccyx was 8.62±0.92 cm and the distance between the ischial spine and the ischial tuberosity was 5.23±0.33cm. These landmarks and distances are important during the pudendal nerve block for patients undergoing gynaecologic, obstetric and penile surgery. It may also be used in perineal neuralgia and neurogenic bladder.

Conclusion: It is concluded that the pudendal nerve has many variations in its roots, trunks and branches, especially the inferior rectal nerve

which arises directly from the sacral plexus in 15.4% of cases. This variation explains the failure of the pudendal nerve block in some cases.

REFERENCES

- Bondar, A., Egan, M., Jochum, D., et al. 2010.* Pudendal nerve injury after a sciatic nerve block by the posterior approach. *Anesthesia and Analgesia* 111(2):573-575.
- Hough, D. M., Wittenberg, K. H., Pawlina, W., et al. 2003.* Chronic perineal pain caused by pudendal nerve entrapment: anatomy and CT-guided perineural injection technique. *American Journal of Roentgenology* 181 (2): 561-567.
- Juene-mann, K. P., Lue, T. F., Schmidt, R. A. and Tanagho, E. A. 1988.* Clinical significance of sacral and pudendal nerve anatomy. *The Journal of Urology* 139 (1): 74-80.
- Kocabiyik, N., Tatar, I., Yalcin, B. and Ozan, H. 2008.* The course and branching pattern of pudendal nerve in fetus. *Clinical Anatomy* 21 (7): 691-695.
- Mahakkanukrauh, P., Surin, P. and Vaidhayakarn, P. 2005.* Anatomical study of the pudendal nerve adjacent to the sacrospinous ligament. *Clinical Anatomy (New York)* 18 (3): 200-205.
- Mellion, M. B. 1991.* Common cycling injuries. management and prevention. *Sports Medicine (Auckland, N.Z.)* 11 (1): 52-70.
- Pirro, N., Sielezneff, I., Le Corroller, T., et al. 2009.* Surgical anatomy of the extrapelvic part of the pudendal nerve and its applications for clinical practice. *Surgical and Radiologic Anatomy* 31 (10): 769-773.
- Robert, R., Labat, J. J., Riant, T., et al. 2009.* The pudendal nerve: clinical and therapeutic morphogenesis, anatomy and physiopathology [Le nerf pudendal: Morphogenèse, anatomie, physiopathologie, clinique et thérapeutique]. *Neurochirurgie* 55(4-5):463-469.

Roberts, W. H. and Taylor, W. H. 1973. Inferior rectal nerve variations as it relates to pudendal block. The Anatomical Record 177 (3): 461-463.

Shafik, A. and Doss, S. 1999. Surgical anatomy of the somatic terminal innervation to the anal and urethral sphincters: role in anal and urethral surgery. The Journal of Urology 161 (1): 85-89.

Shafik, A., el Sherif, M., Youssef, A. and Olfat, E. S. 1995. Surgical anatomy of the pudendal nerve and its clinical implications. Clinical Anatomy (New York) 8 (2): 110-115.

Standring, S., et al. 2008. True pelvis, pelvic floor and perineum: in Gray's anatomy. Churchill Livingstone, London, 1083-1098.

Uz, A., Apan, A., Erbil, K. M. and Tekdemir, I. 2005. A new approach for pudendal nerve exposure and its clinical significance. Anat.Sci.Int. 80 (3): 163-166.

Venegas-Ocampo, P. J. J., Castillo-De Lira, H. H., Robles-Scott, M. A., et al. 2010. Effectiveness comparison of transperineal pudendal nerve block as anesthesia method in transrectal ultrasound-guided prostate biopsy. Rev Mex Urol. 70: 164-169.

Yang, C. C. and Bradley, W. E. 1998. Neuroanatomy of the penile portion of the human dorsal nerve of the penis. British Journal of Urology 82 (1): 109-113.

Zhang, H. F., Zhang, C. Y., Li, X. H., et al. 2009. Dorsal penile nerves and primary premature ejaculation. Chinese Medical Journal 122 (24): 3017-3019.

دراسة تشريحية على العصب الفرجي في الإنسان وتطبيقاته في الممارسة الإكلينيكية

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ملخص البحث

إن تخدير العصب الفرجي يستعمل في المريضات اللاتي يخضعن لجراحة أمراض النساء والتوليد وكذلك المرضى الذين يخضعون لجراحة القضيب. ولكن في بعض هذه الحالات قد تفشل عملية تخدير هذا العصب وذلك إما بسبب فشل في تحديد موقع هذا العصب أو بسبب التغيرات التشريحية لهذا العصب في منشأه أو مساره أو تفرعاته. ولهذا كان الغرض من هذا البحث هو دراسة هذه التغيرات التشريحية لهذا العصب وكذلك تحديد دقيق لموقع هذا العصب وعلاقاته السطحية بالشوكة الوركية والحدبة الوركية والشوكة الخلفية العلوية للحرقفة وقاعدة العصعص وكذلك فتحة الشرج.

أجرى هذا البحث على ثلاثة عشر جثة مصرية قد تم تشريح الحوض والإلية والعجان بها (إحدى عشر جثة ذكر وجثتان أنثويتان).

وطبقا لفحوصاتنا التشريحية ، فقد وجد أن جذور وجذوع عصب الفرج تنقسم إلى أربعة أنواع: النوع الأول: نشأ العصب الفرجي من الجذور العجزية الثالثة والرابعة علي شكل جذع واحد بنسبة ١٩,٢% هذا الجذع انقسم إلي ثلاثة أفرع وهي العصب المستقيمي السفلي ، عصب العجان والعصب الظهري للقضيب . النوع الثاني: نشأ العصب الفرجي من الجذور العجزية الثانية والثالثة والرابعة علي شكل جذعين بنسبة ٤٣,٦% هذان الجذعان هما جذع أنسي والذي استمر علي هيئة العصب المستقيمي السفلي بينما الجذع الوحشي انقسم إلي عصب العجان والعصب الظهري للقضيب . النوع الثالث: نشأ العصب الفرجي من الجذور العجزية الثانية والثالثة علي شكل جذعين بنسبة ١٥,٤% الجذع الوحشي اتصل بالعصب الوركى ، بينما الجذع الإنسي انقسم إلي عصب العجان والعصب الظهري للقضيب ، أما العصب المستقيمي السفلي فقد نشأ من الجذر العجزى الثالث مباشرة النوع الرابع: نشأ العصب الفرجي من الجذر العجزى الثاني والثالث علي شكل جذع واحد بنسبة ٨,٣%.

في هذه الدراسة وجد أيضا أن هناك تنوع في منشأ العصب المستقيمي السفلى ففي ٥% من العينات نشأ هذا العصب كفرع من العصب الفرجي بعد مروره من الثقب الوركى العظيم. وأن ٦,٤٣% من العينات نشأ هذا العصب من الجذع الإنسي لعصب الفرج. وأن ١٥,٤% من العينات نشأ هذا العصب مباشرة من الجذر العجزى الثالث ولا يلتحم مع عصب الفرج. ووجد أن العصب الظهري للقضيب قد انقسم إلى فرعين (أنسى ووحشى) في ٨١,٨% من العينات ، وثلاثة أفرع (أنسى، وحشى وبطني) في ١٨,٢% من العينات. ووجد أن الفروع الأنسية على الجانبين تلتحم مع بعضها لتكون ضفيرة عصبية خلف تاج الحشفة لتغذيه الحشفة نفسها. أما الفروع الوحشية فهي تغذى الجلد والأنسجة الليفية والجسم الكهفي والجسم الإسفنجي والإحليل.

من هذه الدراسة وجد أن الشوكة الوركية علامة عظيمة ضرورية في تحديد موقع العصب الفرجي. ففي منطقة الإلية تم تحديد موقع الشوكة الوركية ، حيث تقع عند نقطة التقاء الثلثين العلويين مع الثلث السفلى للخط الواصل بين الشوكة الخلفية العلوية للحرقفة والحدبة الوركية. ووجد أيضا أن نقطة تقاطع العصب الفرجي للرباط العجزى الشوكى كانت مسافة مقدارها $1 \pm 0,0$ سم من قمة الشوكة الوركية ووجد أيضا أن الخط السطحي لمسار العصب الفرجي يقسم الخط الواصل بين قاعدة العصعص والحدبة الوركية إلى نصفين.