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**SURGICAL ANATOMY OF THE PERINEUM OF THE  
SHE-CAMEL.  
(CAMELUS DROMEDARIUS)  
(With 5 Fig.)**

By

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**التشريح الجراحي للمنطقة العجانیه فی اناث  
الجمال وحیدة السنام**

زین العابدین أنور یاصیر ، جمال رجب

أجريت هذه الدراسة على أنثى عشر جنيناً أنثوياً كامل النمو للجمال وحيدة السنام بالإضافة الى حوضين كاملين لاثنتين من أنثا الجمال البالغة والسليمة ، وذلك لدراسة منبت ومنضم وعلاقات العضلات العجانیه المختلفه ، بالإضافة الى المدد العصبى لها ، مع التركيز على طريقة تثبيت الفرج والمستقيم ، وذلك بغرض تفسير بعض المشاكل التى تتعرض لها هذه المنطقه أثناء توليد تلك الحيوانات والمساهمة فى طريقة علاجها .

وقد تم تقسيم هذه العضلات الى أربعة مجموعات خاصه بالشرح والقناه البوليه التناسليه والحجاب الحوضى والحجاب البولى التناسلى .

وقد أثبتت هذه الدراسة أن الشرح والمستقيم فى اناث الجمال وحيدة السنام يكونا مثبتين مع الفقرات الذيليه من خلال الرباط المعلق للشرح والعضله المستقيمه العصبيه . هذا ويبدو الشرح مثبتاً أيضاً مع الفرج من خلال تصالب العضله العاصره الشرجيه فى الجسم العجانى والتحامها مع الفرج . هذا وقد يفسر هذا التثبيت بأنه دعامة تساعد على تقليل نسبة حدوث سقوط المستقيم وتهتك المنطقه العجانیه فى تلك الحيوانات . هذا وقد لوحظ ان الوجهه البطنيه لدھليز المهبل تكون مثبتة مع كل من القوس الوركى والوتر الارتفاقي ، والذي يفسر على أنه دعامة للقناه التناسليه أثناء الحمل والولاده .

وبعد دراسة الوصف التشريحي للمدد العصبى لتلك المنطقه ، قد تم تحديد الأماكن المناسبه لانسداد العصب القبلى ، والتي تتمثل فى الحفره الوركيه المستقيمه والرباط العجزى الوركى ، بالإضافة الى الجهه البطنيه للدھليز المهبلى وبالتحديد عند منتصف القوس الوركى . وقد لوحظ أن المكان الأخير هو أنسب مكان لانسداد العصب القبلى لكلا الجانبين فى مكان واحد ، والذي يعطى فرصه أيضاً لتخدير الضرع بالإضافة الى الدھليز المهبلى . هذا وقد أسهم انسداد العصب القبلى بدور كبير فى علاج حالات سقوط الرحم التى وردت الينا فى تلك الحيوانات . هذا وقد تمت مناقشة هذه النتائج مع مثيلاتها فى الحيوانات الأخرى .

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## SUMMARY

The present study was conducted on 12 female full grown foetuses of dromedary camels, and two pelvis of adult healthy she-camels. The perineal musculature were organized under four categories, referred to as the anal and urogenital groups as well as the pelvic and urogenital diaphragms. The orientation of the perineal musculature as well as their innervation were thoroughly investigated. The study presented a particular attention on the sort of fixation of the anua with both the caudal vertebrae, through the suspensory ligament, and the vulva through the decussated portion of the *M. sphincter ani externus*. Such a fixation may decrease the possibility of incidence of the rectal prolapse and perineal lacerations. The vestibular fixation, on the other hand, with both the ischial arch and the symphyseal tendon, which may sustain the vestibule against expulsive effort, possessed also a focussed attention in this work. Furthermore, the reasonable sites for blockage of *N. pudendus* were strictly determined. Such a blockage was virtually utilized to obtain a safe surgical manipulation during the treatment of some cases of uterine prolapse in the she-camel.

**Keywords:** Surgical anatomy, perineum, she-camel.

## INTRODUCTION

Interest in the surgical anatomy of the perineum of domestic animals was stimulated by some authors emphasizing the importance of anatomic knowledge in repairing some of the obstetrical problems like perineal hernia (PETTIT, 1962), rectal prolapse (OECHME and PRIER, 1974), dystocia (VANDE PLASSCHE et al., 1984) and rectovestibular laceration (SALEH et al., 1988). In the ewe (McFARLANE, 1963), cow (ELMORE, 1980) and female goat (ARRIA and OTHMAN, 1985 and RAGAB, 1989), the aforementioned problems could be overcome by the blocking of *N. pudendus*. However, the she-camel exhibited many complicated obstetrical problems due to the paucity of fundamental anatomical and surgical principles on its perineum.

Therefore, the present investigation was undertaken to attempt the morphology and innervation of the perineal musculature in the she-camel with a particular attention on the

mode of fixation of the anal and urogenital canals, in addition to the appreciable sites for blockage of *N. pudendus*.

## MATERIAL AND METHODS

### For Anatomical Study:

A total of 12 female full term foetuses of dromedary camels and two pelvis of adult healthy slaughtered she-camel, were obtained. The specimens were carefully dissected either fresh or in a fixed state. The use of 10% glacial acetic acid as well as the magnifying lens during dissection were utilized to persuade the fine ramifications of the nerves. Nomenclature was adopted according to the *N.A.V.* (1983).

### For Anaesthesiological Study:

A) **Experimental study:** Three she-camels were subjected to 8 trials.

Techniques used in the pudendal nerve block:

- 1- Through the ischiorectal fossa, after *HALL and CLARK* (1983) in the bull.
- 2- Through the sacrotuberal ligament, after *RAGAB* (1989) in the buck. In the she-camel, the injection performed about 10 to 12 cm. distal to the 2<sup>nd</sup> caudal vertebra.
- 3- Through insertion of the needle at the mid-point of the ischial arch, ventral to the vaginal vestibule. This vulva was elevated and a suitable needle (10 cm) was inserted beneath the vestibule, exactly within the fascia of the urogenital diaphragm. An injection of 10 to 15 ml of 2% solution procaine Hcl, was performed.

### B) Clinical cases:

Seven she-camels suffered from uterine prolapse (Fig. 5) were presented to the surgical clinic of Faculty of Vet. Med. Beni-Suef and were treated through the blocking of *N. pudendus*. Furthermore, the udder of these animals was subjected to a safe manipulation under the blocking of such a nerve.

## RESULTS

### A- Perineal musculature:

An imaginary line drawn both Tuber ischii, the perineal musculature could conceivably be organized under four categories.

## I- Anal group:

- 1- *M.Sphincter ani externus*: (Fig. 1 and 2/5). It was evidently recognized as a subcutaneous rounded muscular mass encircling the anus and located caudal to the Pars analis of the *M.constrictor vestibuli*. Some fibres were decussated at the perineal body (Fig. 1 and 2/13) to merge with the contralateral ones of the *M.constrictor vulvae*.
- 2- *M.Sphincter and internus*: Represented by an ill-defined band of smooth muscle fibres encircling the anal orifice and being derived from those of the rectum.
- 3- *M.rectococcygeus* (Fig. 1 and 2/1): Appeared triangular in shape emanated from the longitudinal smooth muscle fibres of the terminal rectum and inserted on the ventral aspect of the 4<sup>th</sup> caudal vertebra. Its wide base was interposed between the Pars rectalis of the *M.retractor clitoridis* cranially and the Pars analis of the *M.constrictor vestibuli* caudally.
- 4- *M.retractor clitoridis*: It is convenient to divide this muscle into Pars rectalis and Pars clitoridea (Fig. 2/12). The former originated from the ventral aspect of the 2<sup>nd</sup> caudal vertebra, and proceeded caudoventrally on the lateral rectal wall in front of the origin of the *M.rectococcygeus* and medial to the *M.levator ani*. It continued distally on the ventrolateral wall of the vestibule, constituting the Pars clitoridea which joined its fellow just prior to its termination on the Corpus clitoridis.

The suspensory ligament of the anus (Fig. 1 and 2/4) was represented by a muscular sling, originated from the transverse process of the 3<sup>rd</sup> caudal vertebra on either side of the *M.rectococcygeus* and descend to merge with its fellow below the anus. On the ventrolateral aspect of the latter, it blended with the adjoining portion of the *M.constrictor vestibuli*.

## II- Urogenital group:

- 1- *Miconstrictor vulvae*: (Fig. 1 and 2/6): Appeared as a well developed muscle encircling the vulvar cleft as well as the clitoris. At the dorsal vulvar commissure, it appeared thicker and received fascicles from the decussated fibres of the *M.sphincter ani externus*. At the ventral commissure, on the other hand, some fibres were dispersed within the fascia of the semimembranosus muscle.

- 2- *M. constrictor vestibuli*: It was represented by a well developed muscular sheet strikingly distinguished as an upper Pars analis (Fig. 1 and 2/7) and a lower Pars vestibularis (Fig. 1 and 2/8). The former embraced the dorsolateral wall of the anus being interposed between the suspensory ligament of the anus together with the *M. rectococcygeus*, cranially and the *M. sphincter ani externus* caudally. The latter portion continued distally on the ventrolateral aspect of the vestibule, constituting the Pars vestibularis, which fused with its fellow on the ventral vestibular wall, via a strong fibrous raphe.
- 3- *M. ischiocavernosus* (Fig. 1/10): Represented by a thin muscular band originated from the medial aspect of the Tuber ischii, in close proximity to the *M. ischiourethralis*. It ran medioventrally within the fascia of the urogenital diaphragm to terminate upon the Crus clitoridis. It measured about 5 to 6 cm long and 2 to 2.5 cm wide.

### III- Diaphragma pelvis:

- 1- *M. levator ani* (Fig. 1 and 2/3): It was observed as a relatively thin muscular sheet, exhibiting a tendinous origin from the ischiatic spine as well as the medial aspect of the broad sacrotuberal ligament. It was directed caudodorsally, being interposed between the *M. coccygeus* and the lateral rectal wall. It sinks undertake the anal portion of the *M. constrictor vestibuli* to be inserted within the fibres of the *M. sphincter ani externus*.
- 2- *M. coccygeus* (Fig. 1 and 2/2): It was represented by a thick band of muscle fibres. It originates similar and lateral to the preceding muscle. It preceded caudodorsally to terminate on the transverse processes of the 3<sup>rd</sup> caudal vertebra.

### IV- Diaphragma urogenitale:

- 1- *M. urethralis* (Fig. 2/11): It could be distinguished as Pars urethralis and Pars vestibularis. The former encircled the caudal half of the urethra and continued caudally with the vestibular one. The latter embraced the ventrolateral wall of the vestibule, up to the level of the ischial arch, and originated from the external fascia of the pelvic diaphragm. The entire craniocaudal extent was about 10 to 11 cm long.

2- *M. ischiourethralis* (Fig. 1/9): Is described as a flat muscular band of about 8 to 10 cm long and possessing a tendinous origin from the medial aspect of the Tuber ischii. It ran medioventrally within the fascia of the urogenital diaphragm to join its counterpart at the ventral vestibular wall, about one cm caudal to the external urethral orifice.

3- *M. bulboglandularis*: Was represented by a thin muscular sheet, covering the lateral wall of the vaginal vestibule, in relation to the major vestibular gland. It was related laterally to the Pars vestibularis of the *M. constrictor vestibuli* and Pars clitoridea of the *M. constrictor clitoridis*. In three cases, the muscle appeared to be derived from the contiguous portion of the *M. constrictor vestibuli*.

It is relevant to point out that the ventral vestibular wall was fixed with the mid-point of the ischial arch via a strong fibrous band of about 2 to 2.5 cm long, representing the fascia of the urogenital diaphragm (Fig. 2/14), which was located in front of the *M. constrictor vestibuli*. Caudal to the latter, in addition, the vestibule was strongly anchored to the symphyseal tendon which was designated as the caudal continuation of the suspensory apparatus of the udder.

#### B- Innervation:

1- *N. pudendus*: It resulted substantially from the union of two main roots; the first (Fig. 3/2) originated from the ventral primary branch of the 2<sup>nd</sup> sacral nerve together with *N. ischiaticus*, while the second (Fig. 3/3) from the ventral primary branch of the 3<sup>rd</sup> sacral nerve, accompanied with the Ramus *M. coccygei*, *M. levatoris ani*. The two roots ran caudoventrally, medial to the sacrotuberous ligament and united distal to the 4<sup>th</sup> sacral segment. They formed *N. pudendus* (Fig. 3/4) insinuated itself between the sacrotuberous ligament and the initial portion of the *M. coccygeus*, where it received a relatively long *R. communicans* from *N. ischiaticus* (Fig. 3/6). At the caudal margin of the ischiatic spine, in addition, the *N. pudendus* was reinforced by a *R. communicans* from the Ramus *M. coccygei*, *M. levatoris ani* (Fig. 3/11).

Then after, the *N. pudendus* inclined caudoventrally and medially to persuade within the ischiorectal fossa. At the ischial arch, it splitted into a short *N. dorsalis clitoridis* (Fig. 3/8) and a long *R. mammarius* (Fig. 3/9).

## SURGICAL ANATOMY, PERINEUM & SHE-CAMEL

During its course, the *N.pudendus* released the following tributaries.

- 1- *R.cutaneous proximalis* (Fig. 3/5): It sprang from the parent nerve, exactly distal to the 4<sup>th</sup> sacral segment. It ran caudodorsall to pierce the sacrotuberal ligament and ramified on the skin covering the vertebral heads of the semitendinosus and semimembranosus muscles.
- 2- *N.perinealis profundus* (Fig. 3/7): It was represented by a long slender branch emanated from the *N.pudendus* at the beginning of the lesser ischiatic notch, strictly under the 2<sup>nd</sup> caudal vertebra. It furnished twigs to the urethralis, ischiourethralis and ischiocavernosus muscles in addition to the retractor clitoridis. In two examined cases, such a nerve was represented by 2 to 3 short ones which independently were derived from the *N.pudendus* at the caudal margin of the ischiatic spine.

II- *Ramus M.coccygei, M.levatoris ani* (Fig. 3/10): It was a considerable ramus, departed from the ventral primary branch of the 3<sup>rd</sup> sacral nerve in common with the second root of *N.pudendus*. It proceeded caudoventrally being intervened between the muscles of the pelvic diaphragm where it ramified. It innervated the preceding muscles in addition to the rectococcygeus.

II- *N.rectalis caudalis* (Fig. 3/12): It arose from the ventral primary branch of the 4<sup>th</sup> sacral nerve and coursed caudally with slight ventral inclination between the lateral aspect of the rectum and the muscles of the pelvic diaphragm. Strictly ventral to the 3<sup>rd</sup> caudal vertebra, the *N.rectalis caudalis* released the *N.perinealis superficialis* (Fig. 3/13) and continued caudoventrally along the lateral aspect of the vaginal vestibule where it ramified to innervate the *M.constrictor vulvae* and *M.constrictor vestibuli*, in addition to the skin covering the vulva. The *N.perinealis superficialis* proceeded caudorsally to ramify on the *M.sphincter ani externus* and the Pars analis of *M.constrictor vestibuli*, as well as the skin covering the anus.

From the preceeding anatomical foundations about the perineal musculature and their innervation in the she-camel, the appreciable sites for blockade of *N.pudendus* became explicit. Although the blockade of *N.pudendus* through the ischiorectal fossa and the sacrotuberal ligament exhibited a good result after 10 minutes from injection, in the form of a loss of sensation of the hind quarters, staggering gait and loss of balance. Moreover, the blockade of *N.pudendus* at the

mid-point of the ischial arch, ventral to the vestibule, appeared more easier and efficient because it needed only one site of injection, since the *Nn. pudendi* of both sides bifurcated here. The treatment of some clinical cases of uterine prolapse in the she-camel through the blockade of *N. pudendus* was more easier with no signs of straining or tenesmus after reduction of the prolapsed uterus.

## DISCUSSION

Concerning the origin of both coccygeus and levator ani muscles from the ischiatic spine and the sacrotuberal ligament presented in this study was concurrent with the findings of CAMPBELL (1954) in the mare and BASSETT (1971) and HABEL (1975) in female ruminants. However, BRADLEY (1946) in the horse and BASSETT (1971) in the sow observed a single origin from the sacrotuberal ligament. The present study revealed that the *M. levator ani* was inserted via a single muscular band within the *M. sphincter ani externus*. Meanwhile, in the mare, either three (HABEL, 1953) or two (CAMPBELL, 1954) bands were observed, but in the she-donkey (YADM *et al.*, 1989) five bands have been demonstrated. Similar to the present findings, MAKITA and GOTO (1983) in the pig and YADM *et al.* (1989) in the she-donkey, observed an insertion for the *M. coccygeus* on the transverse process of the 3<sup>rd</sup> caudal vertebra.

The present study agreed with EL-GINDY *et al.* (1983) in the donkey, in the fact that the *M. sphincter ani externus* was represented by a single undivided mass. However, HABEL (1975) in the cow, smuts and BEZUIDENHOUT (1987) in the camel, YADM (1988) in the goat and YADM (1989) in the she-donkey found that the muscle was divided into two portions. CAMPBELL (1954) in the mare and EL-GINDY *et al.* (1983) in the donkey denied the decussation of that muscle in the region of the perineal body, which appeared evident in the present study, the case which simulated the findings of HABEL (1975) in the cow and YADM *et al.* (1989) in the she-donkey. Such a decussation could support the perineal body and therapy decreased the possibility of incidence of perineal laceration in the she-camel during delivery.

The *M. rectococcygeus* as well as the suspensory ligament of the anus which previously recognized by CAMPBELL (1954) in the mare and YADM (1988) in the goat in addition to the present study in the she-camel were not mentioned by SMUTS and BEZUIDENHOUT (1987) in the camel. furthermore, the latter authors in the camel revealed that the pars rectalis of the



*m. retractor clitoridis* of both sides united to form a sling ventral to the rectum, a result which was conflicted with the present findings.

The orientation of the muscles of the urogenital diaphragm was generally simulated to the findings of GETTY (1975) in the mare, HARTMAN (1975) in the goat and YADM *et al.* (1989) in the se-donkey, except for the continuation of the *M. urethralis* with the constrictors of the anus and vestibule, which was not encountered here.

It was established that, the mode of fixation of the vestibule with both the ischial arch and the symphyseal tendon presented in this study, would appeared to sustain the genital tract against the forward pull of the gravid uterus and when everted during parturation against the expulsive effort. Similar findings have been observed by HARTMAN (1975) in the goat.

The present study together with SMUTS and BEZUIDENHOUT (1987) in the camel, observed that the *N. pudendus* was formed by the ventral primary branches of the 2<sup>nd</sup> and 3<sup>rd</sup> sacral nerves.

However, BRADLEY (1946) and GHOSHAL (1975) in the horse decided that it was resulted from the union of the 3<sup>rd</sup> and 4<sup>th</sup> sacral nerves, and YADM (1989) in the donkey, observed its formation from the first and second ones.

HARTMAN (1975) in the female goat, GOSHAL (1975) in the female ruminants and YADM (1989) in the she-donkey observed that the *N. pudendus* detached the *R. cutaneous* distalis which destined to innervate the muscles as well as the cutaneous covering of the anus and vulva. Such a nerve could not be traced by SMUTS and BEZUIDENHOUT (1987) in the camel as well as the present study in the same animal, where these organs were innervated by the *N. rectalis caudalis*.

The origin of the *N. rectalis caudalis* was variable among domestic animals. In the camel, it was derived either from the 3<sup>rd</sup> and 4<sup>th</sup> sacral nerves (MOBRAAK *et al.*, 1980), or from the 4<sup>th</sup> one as observed by the present work. In the same animal, however, SMUTS and BEZUIDENHOUT (1987) considered it as a collateral branch from the *N. pudendus*. Meanwhile, in the mare (HABEL, 1953) and in the donkey (YADM, 1989). The caudal rectal nerve was given from the 3<sup>rd</sup> sacral nerve. The integral ramification of the *N. rectalis caudalis* on the anus and vulva may play an important role in the mechanism of urination and defecation, which was previously mentioned by WILSON and KUSBA (1983) in the cat.

Considering the remarkable difference in the origin of the *N. perinealis superficialis*, the present study in the camel considered it as a collateral branch from the *N. rectalis*

caudalis. However, SMUTS and BEZUIDENHOUT (1987) in the same animal observed it as an independent nerve arose from the 2<sup>nd</sup> and 3<sup>rd</sup> sacral nerves. In the same respect, GHOSHAL (1975) in ruminants considered it as one of the terminal branches of the *N. pudendus*. The preceding authors as well as the present study in the camel found that the *N. perinealis superficialis* was confined to innervate the anus and in ruminants decided it ramifies on the mammary gland.

The present work showed that the pudendal nerve block has been found to be successful by the three techniques (ischio-rectal fossa, sacrotuberal ligament and at the mid-point of the ischial arch, ventral to the vaginal vestibule). The third technique appeared more easier and direct than the others because it needed only one site for injection.

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#### LEGENDS

- Fig. 1 & 2: Diagrammatic representation showing the arrangement of the perineal musculature in the she-camel, caudal and lateral views, respetively:
- 1- M.rectococcygeus. 2- M.coccygeus.
  - 3- M. levator ani. 4- Suspensory ligament of the anus.
  - 5- M.sphincter ani externus 6- M.constrictor vulvae.
  - 7- M.constrictor vestibuli (Pars analis).
  - 8- M.constrictor vestibuli (Pars vestibularis).
  - 9- M.ischiourethralis. 10- M.ischiocavernosus.
  - 11- M.urethralis.
  - 12- Pars clitoridea of of M.retractor clitoridis.
  - 13- Perineal body 14- Fascia of urogenital diaphragm.
  - 15- Rectum. 16- Vesica urinaria.
- Fig. 3: Diagrammatic representation showing the pattern of ramification of the nerves suppling the perineal musculature:
- 1- N.ischiaticus. 2- First root of N.pudendus.
  - 3- Second root of N.pudendus. 4- N.pudendus.
  - 5- R.cutaneous proximalis. 6- R.communicants of (1).
  - 7- N.perinealis profundus. 8- N.dorsalis clitoridis.
  - 9- Ramus mammarius.
  - 10- Ramus m.coccygei, m.levatoris ani.
  - 11- R.communicants of (10). 12- N.rectalis caudalis.
  - 13- N.perinealis superficialis. S<sub>2</sub>,S<sub>3</sub> and S<sub>4</sub>- ventral primary branches of the second, third and fourth sacral nerves.

Fig. 4: A photograph showing the appreciable site for pudendal nerve blockage in the she-camel.

- 1- Through the ischiorectal fossa.
- 2- Through the sacrotuberal ligament.
- 3- In the mid point of the ischial arch ventral to the vaginal vestibule.

Fig. 5: A photograph showing one of the cases of uterine prolapse in the she-camel, that treated via the blockage of N.pudendus.

- 1- Prolapsed uterus (u).
- 2- After treatment.

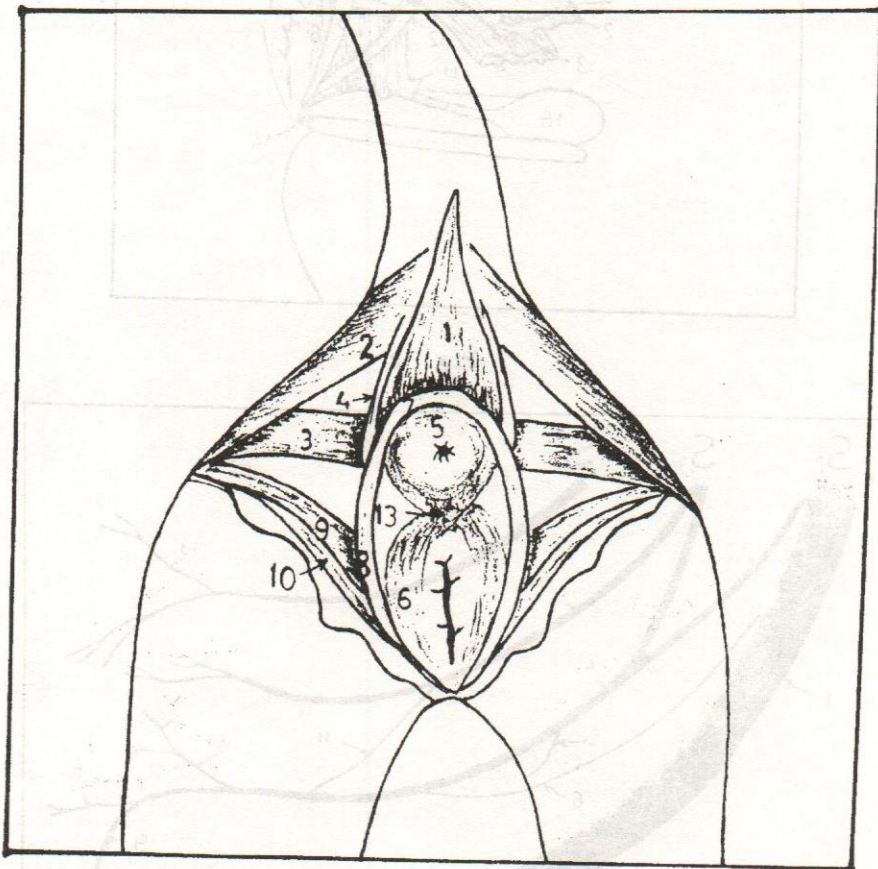


Fig. 1

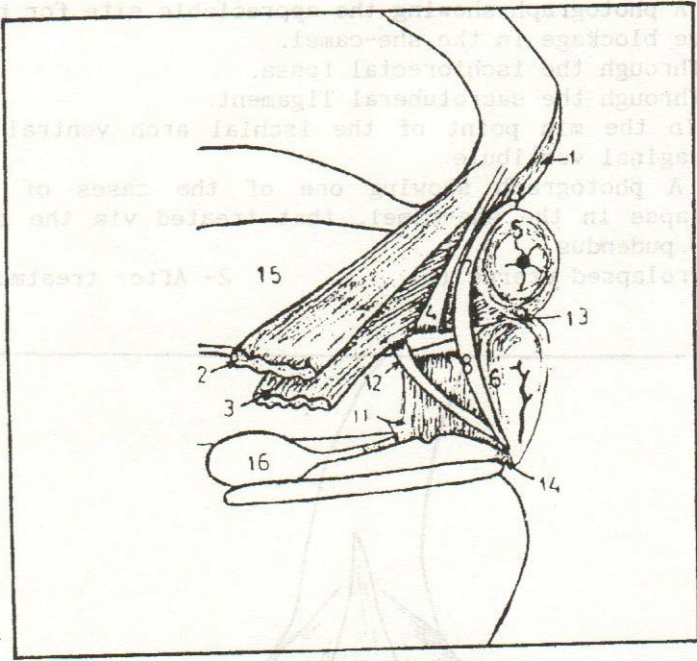


Fig. 2

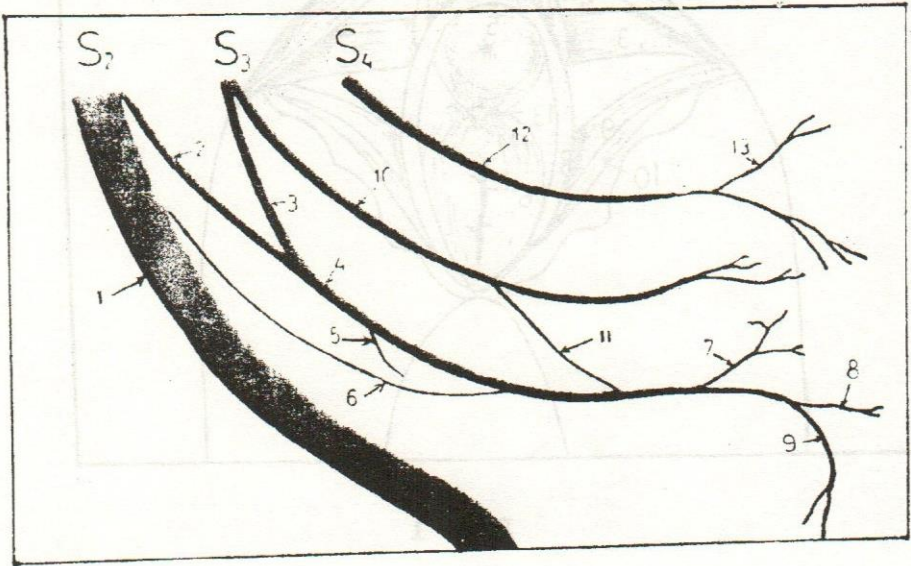


Fig. 3

