View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by UnissResearch

Ann. Fac. Medic. Vet. di Parma (Vol. XXVI, 2006) pag. 67 - pag. 78

THE AUTONOMIC AND SENSITIVE INNERVATION OF THE OSTRICH COPULATORY ORGAN

L'INNERVAZIONE AUTONOMA E SENSITIVA DELL'ORGANO COPULATORE DELLO STRUZZO.

Luisa Bo Minelli*, Maddalena Botti*, Angelo Antonio Dessole**,
Giovanni Palmieri**, Franca Acone**

PAROLE CHIAVE:
struzzo, organo copulatore, innervazione autonoma e sensitiva.

KEY WORDS:
ostrich, copulatory organ, autonomic and sensitive innervation.

Riassunto

È stata studiata l'innervazione dell'organo copulatore dello struzzo che è costituita da due componenti: autonoma e sensitiva.

La prima consta di cellule gangliari, isolate e riunite in gruppi, localizzate lungo il decorso di fasci nervosi o nel punto di convergenza di due o più di questi.

La seconda è formata da terminazioni libere e da terminazioni fornite di capsula. Queste ultime mostrano struttura tipica, sono morfologicamente classificabili come corpuscoli di Pacini, paciniformi e corpuscoli genitali e possono trovarsi isolate, riunite a formare infiorescenze ed organizzate in corpuscoli opposito-polari e fibre nervose pecilomorfe.

I corpuscoli di Pacini sono numericamente prevalenti, mentre i paciniformi sono i meno rappresentati.

Summary

The autonomic and sensitive innervation of the ostrich copulatory organ was studied.

The former consisted by isolated and grouped ganglion cells, located along the course of nerve bundles or in the convegence point of two or more of these fascicles.

The latter is represented by free and encapsulated nerve terminations. These last one, morphologically classified as Pacini, Pacini-like and genital corpuscles,

---

*Dept. of Animal Health, University of Parma, Parma, Italy.
Via del Taglio, 8 - 43100 Parma - Tel. 0521/032637 - Fax 0521/032642
e-mail: luisa.bo@unipr.it
**Dept. of Animal Biology, University of Sassari, Sassari, Italy.

showed the typical structure and could be found isolated or assembled to organize flower-sprays, opposite-polar corpuscles or poikilomorphous nerve fibres.

The Pacini corpuscles were numerically prevalent, while the Pacini-like terminations represented the less numerous receptorial type.

Introduction

The copulatory organ of the birds has generally a little development and generally it is not visible because it is located in the ventral part of proctodeum, near to the mucous plica that delimited the cloacal hole.

The observations about the birds proctodeum are not very numerous (1-7) and they concern the female of limited species (duck, turkey, chicken, quail, crow, pigeon, buzzard, goose, ostrich). There are analogous informations about the copulatory organ (1; 4-5; 7).

The aim of the present research was to study, quantitatively, qualitatively and topographically, the nervous autonomic and sensitive somatic components, located in the ostrich copulatory organ.

Materials and methods

The copulatory organ of 3 male, 18 months old, ostriches was taken soon after the slaughtering. These samples were opportunely selected on the basis of their topography with refer to the total organ and on the basis of their depth with refer to the tickness of the wall.

From one subject the samples were processed with the gold chloride method according Ruffini (8).

From another subject, the samples were submitted to aforesaid method but modified by Goglia (9).

From the last subject, the samples were processed with the aforesaid method but modified by Pelagalli and Schiavo (2) and Pelagalli and Cecio (3).

Results

In the studied copulatory organs we constantly found different free and encapsulated sensitive nervous terminations and an autonomic nervous component.

These sensitive and autonomic nervous components were uniformly distributed in the organs of the 3 subjects, but they were differently located in the thickness of the organs. In fact the major concentration was found in the connective tissue of the lamina propria and submucosa. In the muscular coat the nerve trunks, with different diameter, were found near the blood vessels (fig. 1).

The autonomic innervation was much more present in the districts where the vascular component was major concentrated. This autonomic ones was represented by ganglion cells. They had ellipsoidal shape and they were located along the nervous bundles, near their epineural coating or in their perineural connective tissue. The ganglion cells were observed isolated or grouped. They had the minor diameter ranging between 3,6 and 6,7 µm and the major ones ranging between 7,1 and 12,3 µm. The finding of little grouping (5-40 cells), located in the convergence point of two or more nervous bundles, was more frequent than the finding of isolated cells and of grouping more numerous (fig. 2).

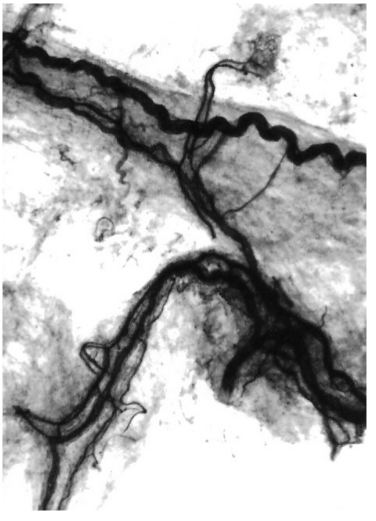

Figure 1:
Ostrich: copulatory organ. Nerve trunks and blood vessels run together. Gold chloride method according to Ruffini. 120x.

Figure 2:
Ostrich: copulatory organ. The arrow indicates a cluster of ganglion cells in the point of convergence of 3 nerve fascicles. Gold chloride method according to Ruffini modified by Goglia. 80x.

The sensitive innervation was represented by the above mentioned free nerve endings and by encapsulated receptors, that were morphologically classified as Pacini (fig. 3, A, B), Pacini-like and genital corpuscles (fig. 4).

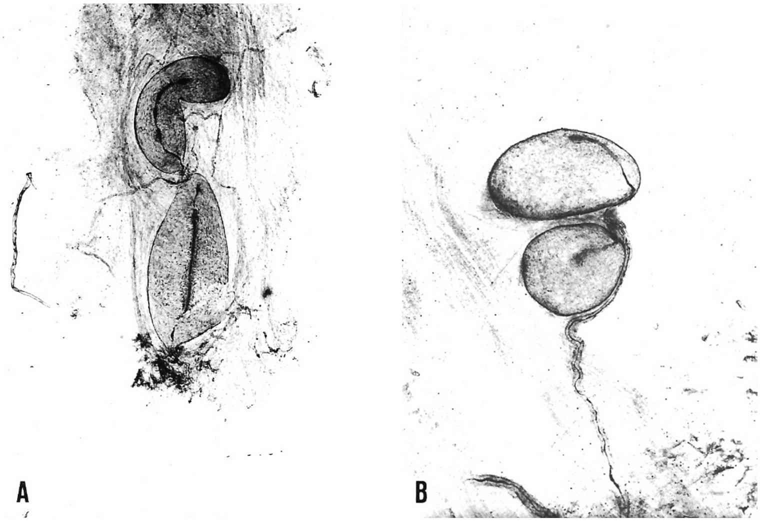

Figure 3 A, B:
Ostrich: copulatory organ. The Pacini corpuscles show different morphology. Gold chloride method according to Ruffini modified by Goglia. 120x.

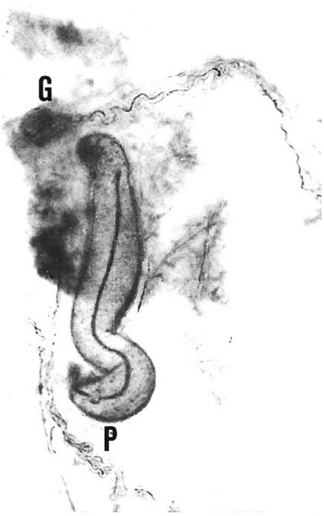

Figure 4:
Ostrich: copulatory organ. Pacini-like (P) and genital (G) corpuscles. In particular the typical structure of Pacinian-like is emphasized. Gold chloride method according to Ruffini modified by Pelagalli, Schiavo and Pelagalli, Cecio.120x.

The free nerve endings originated from the thinner fibres that travelled isolated drawing fine volutes or complicated nets.

The encapsulated receptors were differently sustained by thicker fibres that were distributed in the thickness of the lamina propria and in the submucosa.

The structure of encapsulated corpuscles was typical. In particular, the Pacini and Pacini-like corpuscles were supplied with an expansional axon that was undivided or branched and that had a rectilinear or curved course. This axon was located in the support sole and only rarely it terminated with the typical apical button. In the genital corpuscles, the manner of the expansional axon was different on the basis of the corpuscles shape. In fact, when the genital corpuscle was ellyspoidal, the axon branched off repeatedly and the originated thin branches terminated in a small varicosities. Differently, when the genital corpuscle was spheroidal, the axon terminated undivided to organize a clew with bend more or less dense or it divided and the branches interlaced repeatedly (fig. 5, A, B). The capsule, that had a lamellar organization (fig. 6 B), showed a different thickness. As a rule, the major thickness was observed in the Pacini corpuscles while the minor ones in the genital corpuscles.

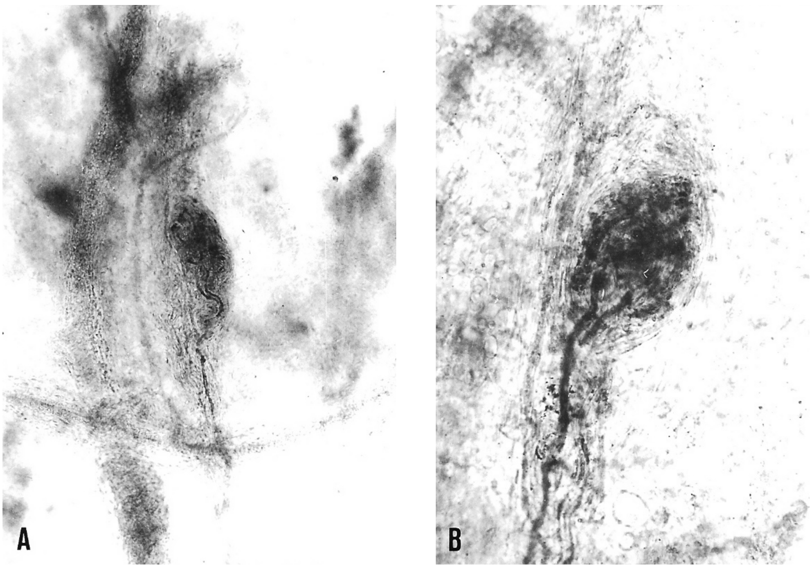

Figure 5 A, B:
Ostrich: copulatory organ. 2 genital corpuscles: ellyspoidal (A), spheroidal (B). Gold chloride method according to Ruffini modified by Goglia. 120x (A); 300x (B).

The more numerous corpuscles were Pacinian, while the less numerous were the Pacinian-like. The different corpuscles could be isolated or grouped into simple (fig. 6, A, B) or complex (fig. 7) flower-sprays, opposite-polar corpuscles (corpuscles were located one after another along the course of nervous fibre that was defined ultraexpansional, fig. 8) and poikilomorphous fibres (a fibre dichotomically divided into two branches that ended in two morphologically different corpuscles, fig. 9).

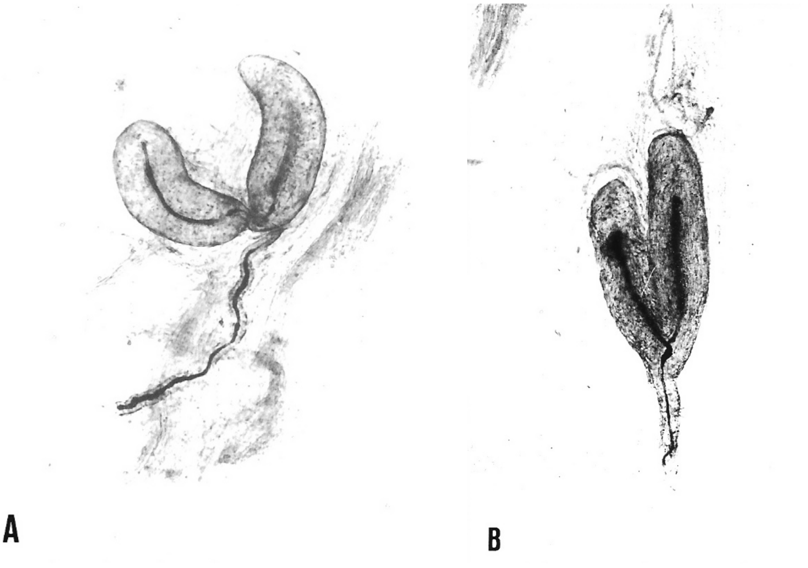

Figure 6 A, B:
Ostrich: copulatory organ. Simple flowers-sprays of Pacini corpuscles. It is possible to see the lamellar structure of the capsules (B). Gold chloride method according to Ruffini modified by Pelagalli, Schiavo and Pelagalli, Cecio.120x.

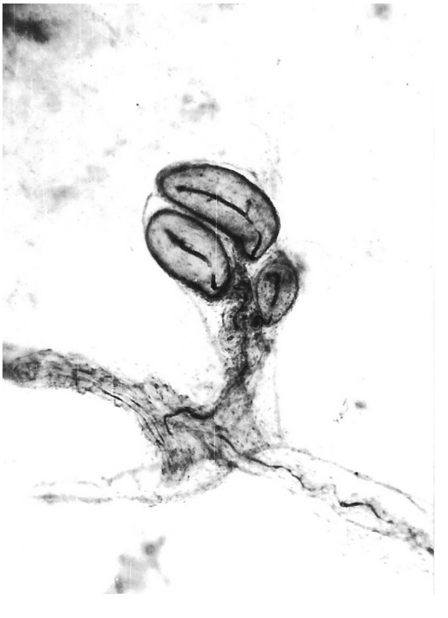

Figure 7:
Ostrich: copulatory organ. Complex flower-sprays of Pacini corpuscles. Gold chloride method according to Ruffini modified by Pelagalli and Schiavo, Pelagalli and Cecio. 80x.

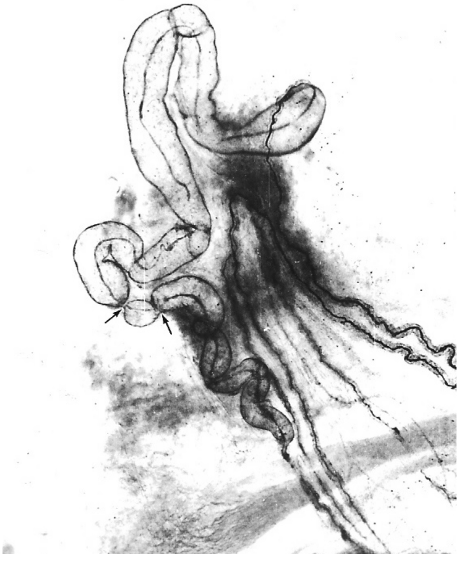

Figure 8:
Ostrich: copulatory organ. Opposite-polar corpuscles. The arrows indicate the boundary marker between 2 Pacini-like and Pacini corpuscles located along the same nervous fibre. Gold chloride method according to Ruffini modified by Pelagalli and Schiavo, Pelagalli and Cecio. 80x.

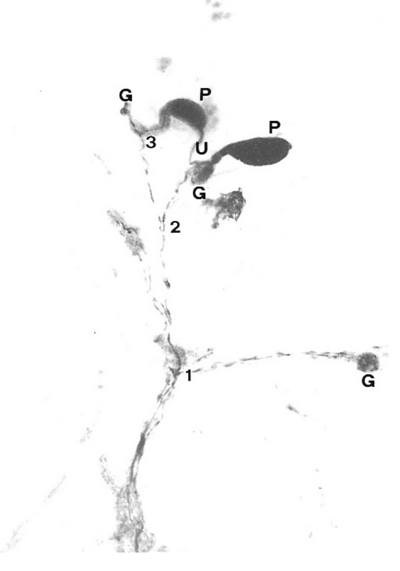

Figure 9:
Ostrich: copulatory organ. The picture shows the co-existence of opposite-polar and poikilomorphous fibres: G, genital corpuscles; P: Pacini corpuscles; U: ultraexpansional fibre. See text for explanation. Gold chloride method according to Ruffini modified by Pelagalli and Schiavo, Pelagalli and Cecio. 65x.

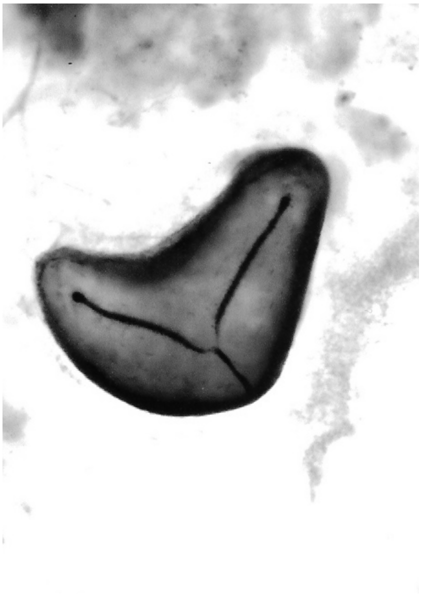

Figure 10:
Ostrich: copulatory organ. Corpuscle with strange shape. Gold chloride method accordin to Ruffini. 120x.

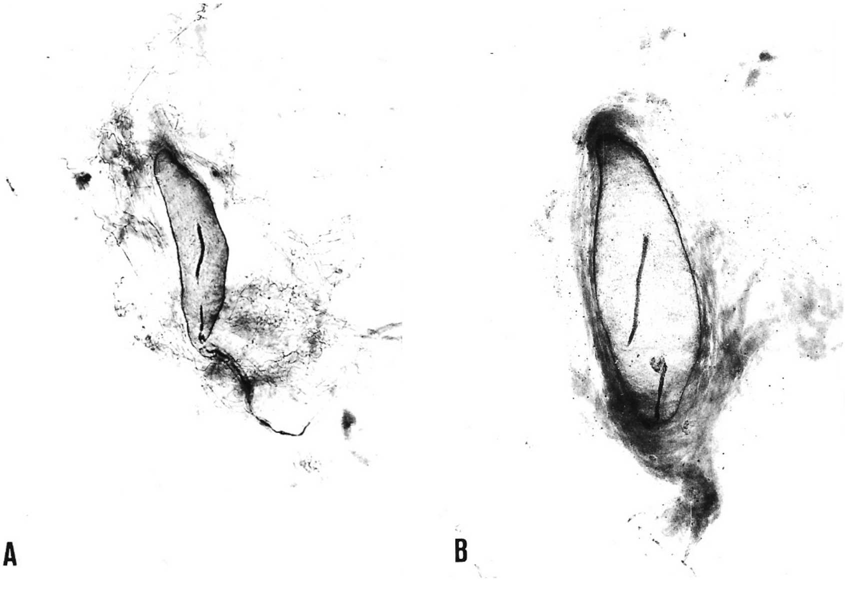

Figure 11 A, B:
Ostrich: copulatory organ. Fragmentation of expansional axon of 2 Pacini corpuscles. Gold chloride method according to Ruffini modified by Pelagalli and Schiavo, Pelagalli and Cecio. 80x (A), 120x (B).

In particular, this last finding documented, for the first time, the existence of a opposite-polar and, contemporaneously, poikilomorphous fibre. This fibre branched off and gave origin to two branches (fig. 9/1). One of these branches, down on the right, gave origin to a genital corpuscle (fig. 9/G), while the other branch, on the left, branched off and the originate branches had a different manner (fig. 9/2). In fact, one branch on high and the right sustained two opposite-polar corpuscles morphologically different: a genital (fig. 9/G) and a Pacinian (fig. 9/P). The other branch, on high and on the left, dicotomically branched off (fig. 9/3) and the originated branches terminated in a little genital corpuscle (fig. 9/G) and in a Pacinian (fig. 9/P). The expansional axon of the Pacinian come out from the opposite pole of the receptor as on ultraexpansional fibre (fig. 9/U) that substained the innervation of the aforesaid genital corpuscle (fig. 9/G).

Finally we observed corpuscles with strange shape (bi-lobate corpuscle, fig. 10) and with fragmentation of expanional axon (fig. 11, A, B). These findings are probably due to deviations of organogenetic processes by exogen or endogen factors.

Discussion

An autonomic and sensitive innervation was always present in the ostrich copulatory organ. These findings were in according with that found in the ostrich by Palmieri et al. (7) and in other species by Pelagalli and Schiavo (2), Pelagalli and Cecio (3), Pelagalli et al. (4). Differently Stefanelli (1) and Esposito et al. (5) have not examined the autonomic nervous component.

However our data on autonomic innervation confirmed the results of our previous observations carried out on the proctodeum of different birds species including the ostrich. This innervation is represented “... of ganglion cells isolated or grouped to form clusters of different sizes [...] These cells, located along the length of nerve bundless and in convergence points of two or more fascicles, are mainly distributed in the superficial layers of the proctodeum wall, close to blood vessels” (6). Also the organization and the distribution of sensitive component were in accordance with that reported by other researchers (1; 4-5; 7) who have found free and encapsulated endings. In particular, the encapsulated endings are classified as Pacini, Pacini-like and genital corpuscles. The aforesaid Authors have constantly found Pacinian and Pacinian-like; besides, we found that the Pacini corpuscles were the most numerous ones and Pacinian-like the less present.

The presence of Pacini corpuscles, with ovoidal shape, confirms the observations carried out on the proctodeum of duck, turkey, goose and ostrich (1; 3-4; 6) but this finding is not characteristic of the duck proctodeum, as instead have sustained Pelagalli and Cecio (3) and Pelagalli et al. (4).

The presence of genital corpuscles has been already documented in the procotodeum of hen, turkey and duck (2-3; 5) and in the copulatory organ of turkey and duck (4-5). Differently these corpuscles are not documented in the procotodeum of some bird species among which ostrich (6), while they are documented in the ostrich copulatory organ. About this apparently contradictory result, Palmieri et al. (6) have hypothesized that “... these corpuscles are exclusively clustered in the copulatory organ of the male and in the correspondent territory of female proctodeum” and the results of present research confirm this hypothesis.

Therefore, we think that further researches will be necessary. In fact the different corpuscles are found in this district (Pacini, Pacini-like, genital, Ruffini, Herbst and Meissner corpuscles) but only Pacinian and Pacinian-like were constantly found. In particular the presence of the Herbst corpuscles, found in the female ostrich proctodeum (6), do not confirmed in the ostrich copulatory organ (7). Therefore the inconstant finding of the different corpuscles can also involved the genital corpuscles.

Finally further researches will be carried out to explain the presence of organogenetic alterations, as an unusual shape of corpuscles or a fragmentation of expansional axon documented in this and other (7; 10-13) studies.

References

1. Stefanelli A. (1935). Le espansioni nervose sensitive nell'organo copulatore di anitra domestica e nel proctodeum di tacchino. Monit. Zool. Ital. 46, 1-7.
2. Pelagalli G. V., Schiavo A. (1958). L'innervazione sensitiva del proctodeo della gallina domestica. Acta Med. Veter. 4, 221-239.
3. Pelagalli G. V., Cecio A. (1959). Ricerche sulla innervazione vegetativa e sensitiva del proctodeo nella femmina del tacchino. Quad. Anat. Prat. 15, 1-27.
4. Pelagalli G. V., Cecio A., Lembo C. (1968). Sulla innervazione sensitiva dell'organo copulatore di Meleagris gallopavo. Boll. Soc. Ital. Biol. Sperim. 44, 1528-1529.
5. Esposito V., Crasto A., Germano G., Varvella F. (1994). Sulle terminazioni nervose dell'organo copulatore e del proctodeo di anatra (Anas plathyrincos). Acta Med. Veter. 40, 205-213.
6. Palmieri G., Sanna M., Bo Minelli L., Botti M., Corriero A., Desantis S., Cappai M. G., Acone F. (2003). Further observations on the sensitive innervation of some bird's proctodeum. Ital. J. Anat. Embryol. 108, 241-254.
7. Palmieri G., Cappai M. G., Costa G., Bo Minelli L., Botti M., Desantis S., Corriero A., Acone F. (2006). Sensitive innervation of the copulatory organ in Struthio camelus: comparison to the corresponding district in female proctodeum. Ital. J. Anat. Embryol. 111, 31-44.
8. Ruffini A. (1897). Observations on sensory nerve endings in voluntary muscles. Brain 20, 368-374.
9. Goglia G. (1965). Sopra una modificazione del metodo aurico di Ruffini per la dimostrazione dei recettori. Quad. Anat. Prat. 18, 40-56.
10. Palmieri G., Panu R., Asole A. (1979). Innervazione sensitiva del legamento sesamoideo prossimale dell'ovino. Quad. Anat. Prat. 35, 229-240.
11. Panu R., Asole A. (1980). Innervazione sensitiva dei cuscinetti digitali, palmari e plantari, del ratto e della cavia. Arch. Ital. Anat. Embriol. 85, 363-366.
12. Palmieri G., Asole A., Panu R., Farina V., Sanna L. (1982). Further observations on the innervation of the proximal sesamoidean ligament of the horse and ox. Arch. Anat. Histol. Embryol. norm. et exp. 65, 121-133.

13 Palmieri G., Acone F., Sanna M., Bo Minelli L., Botti M., Maxia M., Corriero A., De Metrio G. (2002). On the sensitive and vegetative innervation of the ostrich's palate. Ital. J. Anat. Embryol. 107 (suppl. 2), 5-18.