

Exit point of the external nasal nerve- cadaveric study

Bijo Elsy¹, Mansour A. Alghamdi^{1,2}, Lina E.S. Osman¹

¹ Department of Anatomy, College of Medicine, King Khalid University, Abha, 62529, Saudi Arabia

² Genomics and Personalized Medicine Unit, College of Medicine, King Khalid University, Abha, 62529, Saudi Arabia

SUMMARY

This study aims to confirm how the external nasal nerve exits from the internal surface of the nasal bone to the dorsum of the nose and to determine the exact point of nerve emergence by macroscopic examination. Twenty external nasal nerves of both sexes from the elderly and adult age groups were dissected. The exit point of the external nasal nerve, the width of the nasocartilaginous joint, and the inferior border of the nasal bone from the midline to the nasomaxillary suture were measured. The nerve was classified according to its branching pattern. In this study, in the elderly group, the external nasal nerve enters the dorsum of the nose through the pyriform ligament and exits laterally to the nasocartilaginous joint. But in the adult age group the external nasal nerve exits between the nasal bone and the upper nasal cartilage. We observed mainly three types of nerve but did not find any subtypes or variations in the branching pattern. Among this main classification of nerves, more cases (70%) of type I were observed. However, based on our study, we concluded that the external nasal nerve enters the dorsum of the nose either between the nasal bone and the upper nasal cartilage, or it passes through the pyriform ligament and exits lateral to the nasocartilaginous joint. In rhinoplasty, knowledge

about the course, exit point, branching pattern, and variations of the external nasal nerve is unavoidable.

Key words: External nasal nerve – Nasocartilaginous joint – Nasomaxillary suture – Pyriform ligament

INTRODUCTION

The external nasal nerve is the terminal branch of the anterior ethmoidal nerve; it exits at the inferior margin of the nasal bone (Standring, 2016). The course, exit point, and branching pattern of the external nasal nerve are important in rhinoplasty. The nasal tip's numbness after rhinoplasty is mainly due to damage to the external nasal nerve. There is an obvious difference in the anatomical structure of the external nasal nerve between Caucasians and Asians (Chen and Carr, 2022).

The pyriform ligament is a fascial support between the bones of the pyriform aperture and the adjacent cartilages (Rohrich et al., 2008). It has various other names, such as the lateral sesamoid complex ligament, the lateral crural complex, and the nasal hinge. Hamilton (Hamilton, 2021) reported that the lateral crus of the alar cartilage and accessory cartilages are connected to the frontal process of the maxilla through the pyriform ligament.

Corresponding author:

Bijo Elsy. College of Medicine, Department of Anatomy, King Khalid University, Abha, Saudi Arabia. Phone: 00966533600396. E-mail: bi-jobaby22@yahoo.com

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Kim and Jeong (2023) reported that the pyriform ligament is condensed along the pyriform aperture. The pyriform aperture ligament, or vertical pyriform ligament, attaches between the soft tissue envelope and the border of the pyriform aperture (Saban et al., 2008; Hamilton, 2021).

The fracture of the nasal bone is the most common injury in the facial skeleton, as are any injuries on the dorsum of the nose that affect the external nasal nerve. Many authors (Han et al., 2004; Chen and Carr, 2022) have reported that there are variations in the course, exit point and branching pattern of the external nasal nerve.

Based on the reported findings, our aim is to determine the width of the nasocartilaginous joint, the width of the inferior border of the nasal bone, the exit point of the external nasal nerve, how it exits, and its branching pattern.

MATERIALS AND METHODS

Twenty external nasal nerves of both sexes, 14 male and 6 female, were dissected. Among the 20 specimens, 12 were elderly, and 8 were adult age groups. In neither the elderly nor the adult age groups the exact age is unknown. We examined the pyriform aperture ligament, the pyriform ligament with adjoining parts of the bones and cartilages, and the point of emergence of the external nasal nerve. The images were recorded through photography. We measured the distance from midline to the exit point of the external nasal nerve, along the inferior border of the nasal bone. We also measured the width of the nasocartilaginous joint and the inferior border of the nasal bone from the midline to the nasomaxillary suture. We finally classified the nerve according to its branching pattern. Statistical data analysis was carried out in MS Excel 2019.

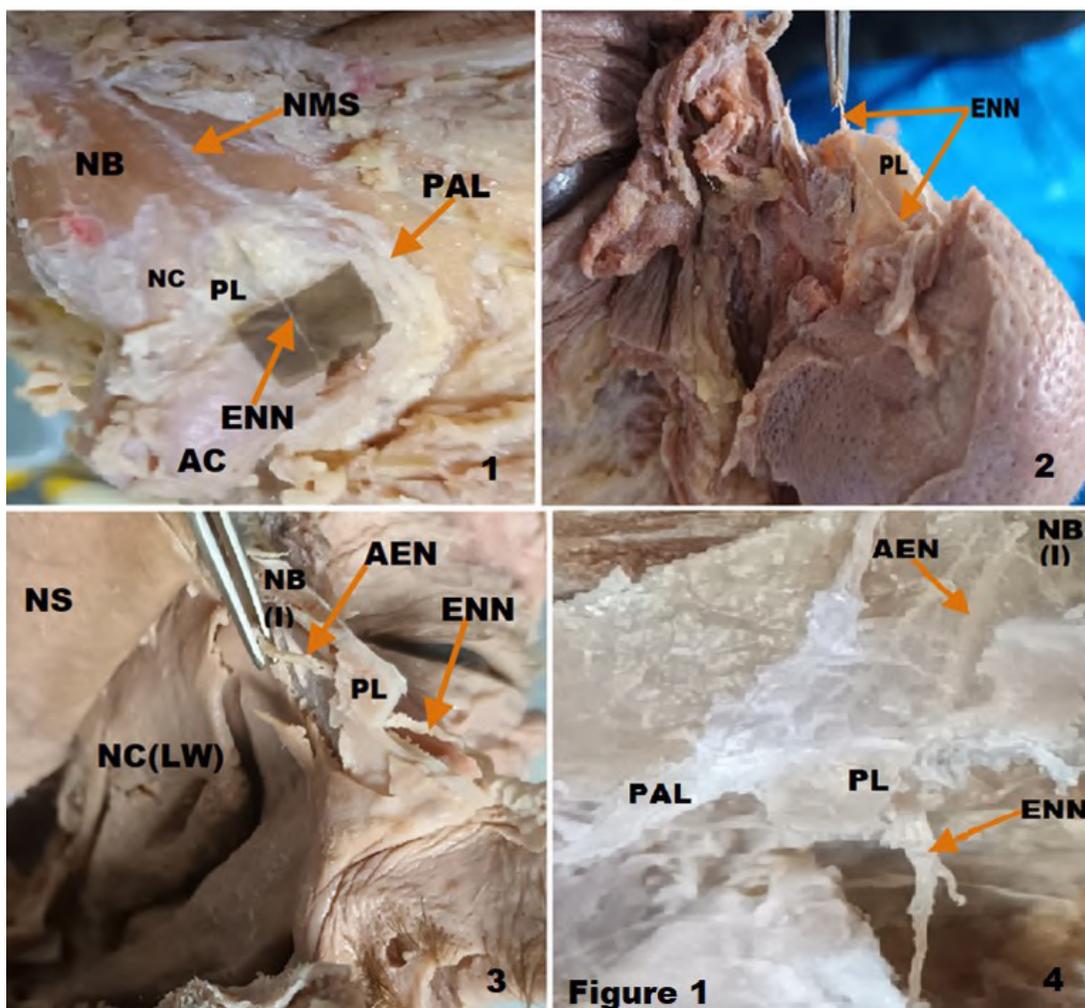
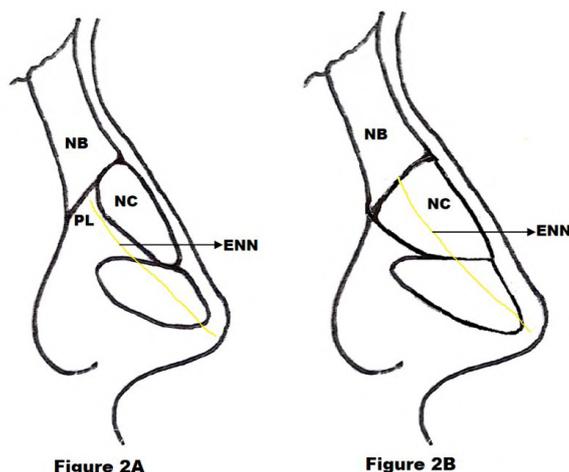


Fig. 1.- Representative images (1, 2, 3 and 4) of the elderly group showing the external nasal nerve (ENN) passing through the pyriform ligament (PL). NB: Nasal bone, NB (I): Nasal bone internal surface, NC: Upper nasal cartilage, PAL: Pyriform aperture ligament, AC: Alar cartilage, AEN: Anterior ethmoidal nerve, NS: Nasal septum, NC (LW): Nasal cavity lateral wall.



Figs. 2.- Drawing illustrating the exit of the external nasal nerve (ENN). **A:** Nerve exit through pyriform ligament (PL) in the elderly group. **B:** Nerve exit between nasal bone (NB) and the upper nasal cartilage (NC) in the adult age group.

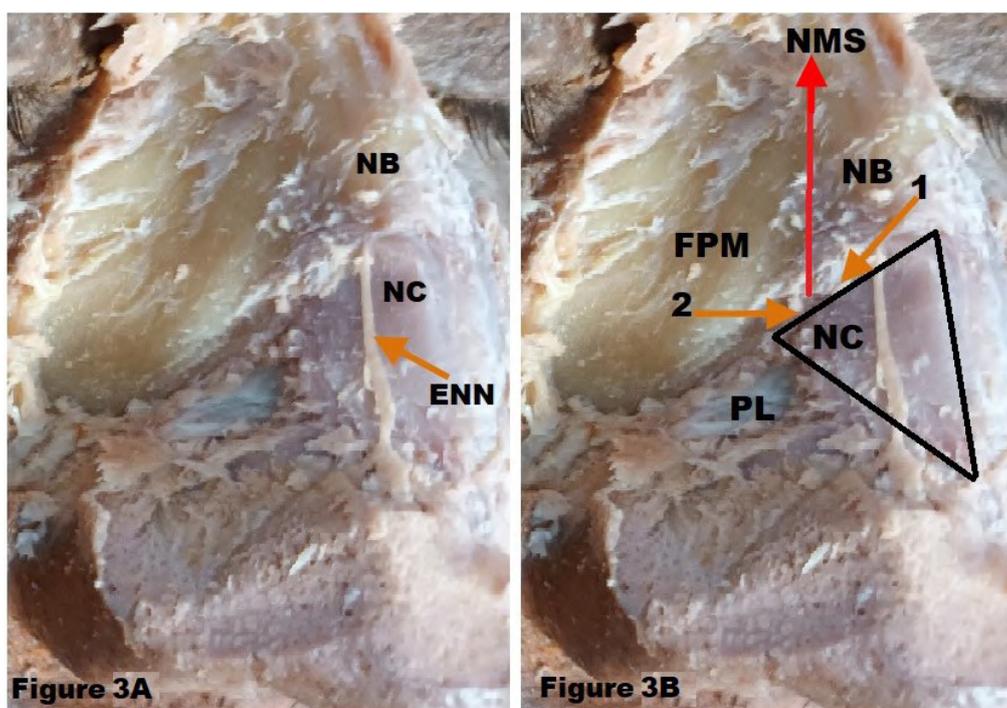
This study was conducted in the Anatomy Department of King Khalid University, Abha, Saudi Arabia, and approved by the Research Ethics Committee (ECM #2023-2118) of King Khalid University.

RESULTS

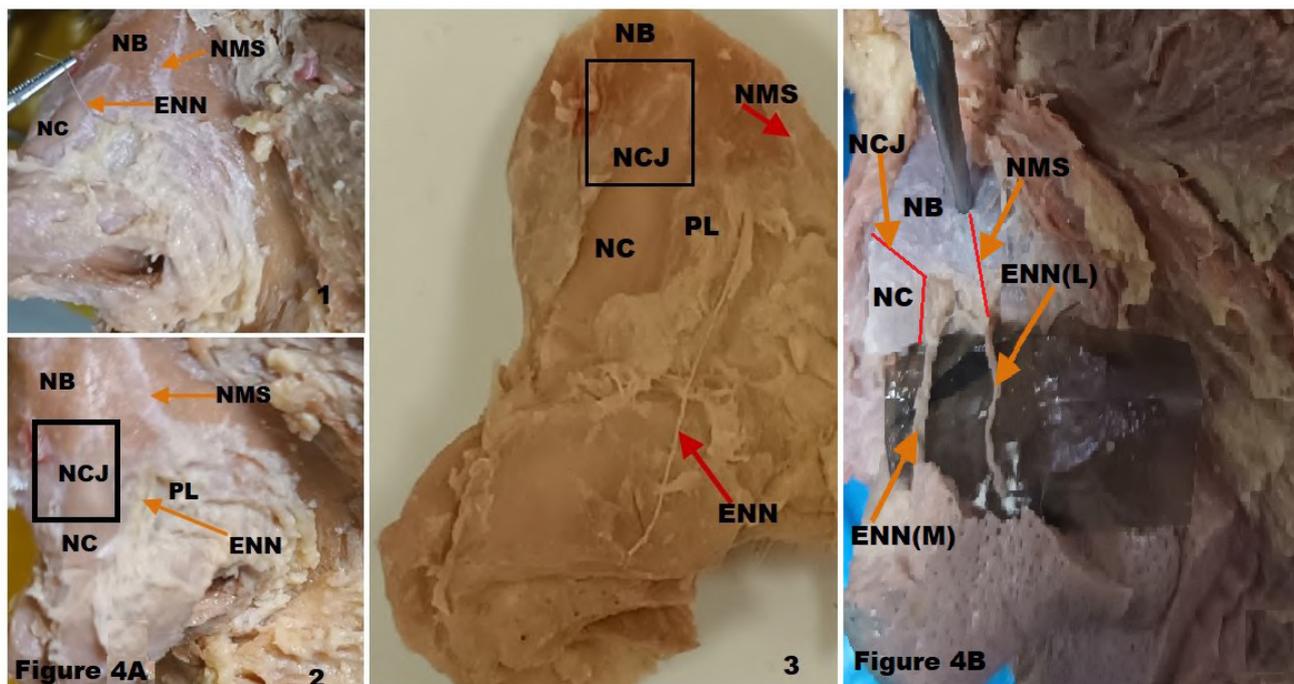
In this cadaveric study, in both sexes of the elderly group, the external nasal nerve exits through the pyriform ligament before entering the dorsum of

the nose (Figs. 1 and 2A). But in both sexes of the adult age group, the external nasal nerve exits between the nasal bone and the upper nasal cartilage (Figs. 2B, 3A and 3B). In all specimens, the nerve exits at the same level on its right and left sides.

In the elderly group, the nerve exit point lies lateral to the nasocartilaginous joint (Fig. 4A). The distance from midline to the exit point of the external nasal nerve, the medial main branch of the type-III nerve, along the inferior border of the na-



Figs. 3A and 3B.- Representative images of the adult age group showing the external nasal nerve (ENN) passing between the nasal bone (NB) and the upper nasal cartilage (NC). Pyriform ligament (PL), NMS: Nasomaxillary suture, FPM: Frontal process of maxilla, 1: Nasal part of nasocartilaginous joint, 2: Maxillary part of nasocartilaginous joint.



Figs. 4A and 4B.- Representative images of the elderly group showing the exit of the external nasal nerve (ENN) lateral to the nasocartilaginous joint (NCJ) through pyriform ligament (PL), Nasal bone (NB), Upper nasal cartilage (NC), NMS: Nasomaxillary suture. ENN (M): Medial main branch of external nasal nerve, ENN (L): Lateral main branch of external nasal nerve.

sal bone ranged from 7.5 to 9.5 mm (mean, 8.36 ± 0.80 mm). The type-III branching pattern was observed in two specimens. Its lateral main branch exits at the level of the nasomaxillary suture, which is 11 mm away from the midline (Fig. 4B).

In the adult age group, the nerve exits between the nasal bone and the upper nasal cartilage. Its exit point lies 5.5 to 6.5 mm (mean, 6 ± 0.5 mm) away from the midline.

The width of the nasocartilaginous joint varies from 6 to 8 mm (mean, 7 ± 0.79 mm) in the elderly group (Fig. 4A). In the adult age group, the nasocartilaginous joint's width varies from 11 to 12 mm (mean, 11.5 ± 0.5 mm) (Fig. 3B). The width of the inferior border of the nasal bone from the midline to the nasomaxillary suture varies in the adult age group from 10.5 to 11.5 mm (mean, 11 ± 0.5 mm), but in the elderly group, it varies from 9.5 to 11 mm (mean, 10.25 ± 0.64 mm).

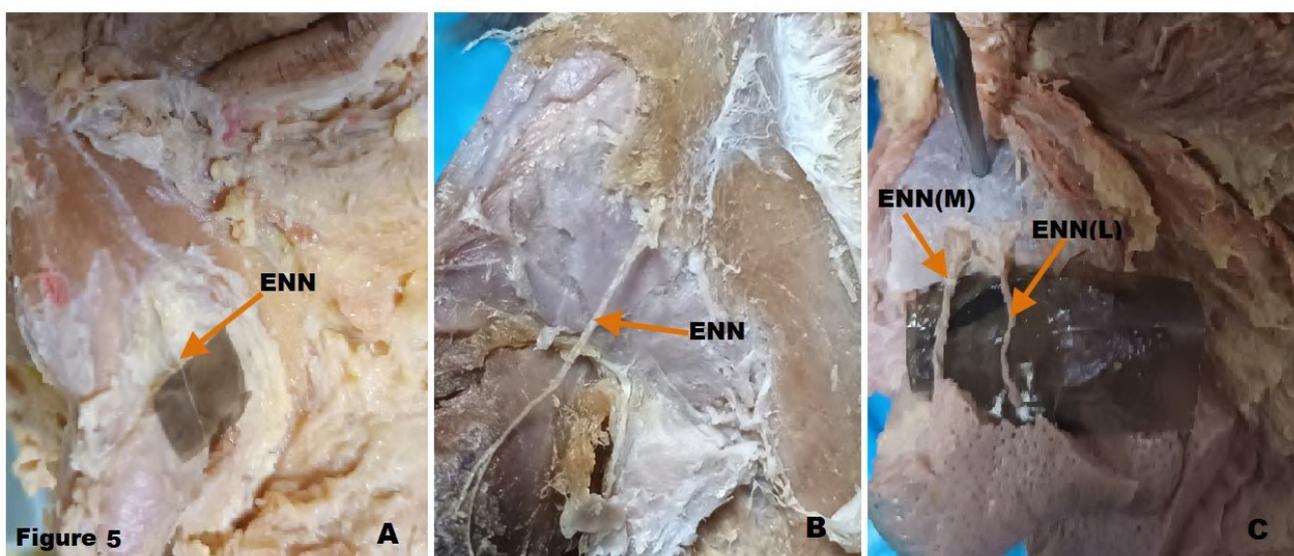


Fig. 5.- Representative images of the classification of the external nasal nerve (ENN). **A:** Type I. **B:** Type II. **C:** Type III. ENN (M): Medial main branch of external nasal nerve, ENN (L): Lateral main branch of external nasal nerve.

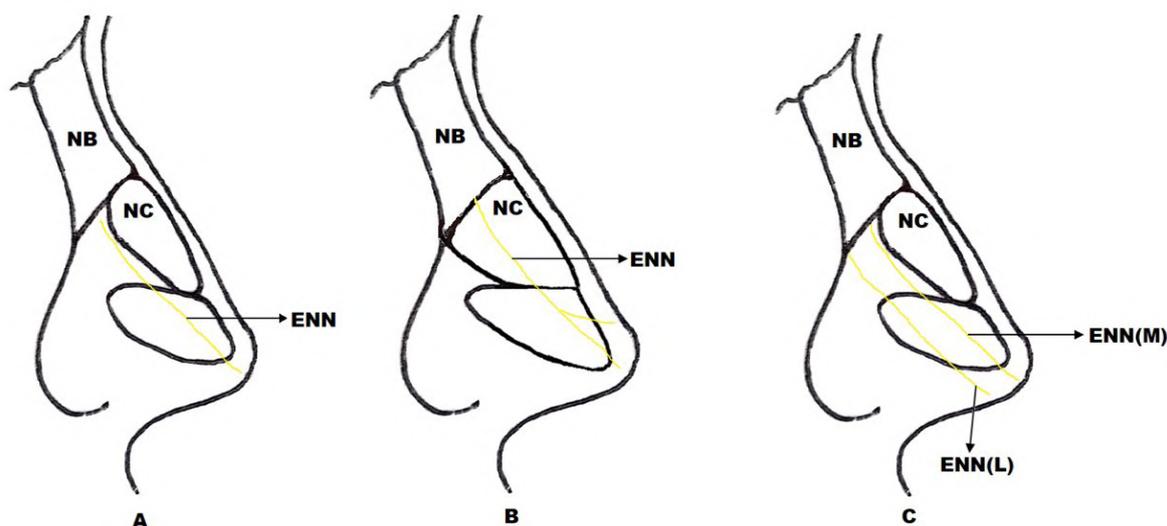


Figure 6

Fig. 6.- Drawing illustrating the classification of the external nasal nerve. **A:** Type I. **B:** Type II. **C:** Type III. Nasal bone (NB), Upper nasal cartilage (NC), ENN (M): Medial main branch of external nasal nerve, ENN (L): Lateral main branch of external nasal nerve.

In the adult age group, the superior margin of the upper nasal cartilage is attached to the frontal process of the maxilla at 0.5 to 1 mm (Fig. 3B).

Based on the branching pattern, we found mainly three types of nerve classification. Among these, type I was observed in 14 of 20 nerves (70%), type II was seen in 4 of 20 (20%), and type III was observed in 2 of 20 (10%) (Figs. 5 and 6). We have not seen any other variations or subtypes.

DISCUSSION

The anterior ethmoidal nerve runs in a groove on the internal surface of the nasal bone, and its terminal sensory branch is the external nasal nerve that innervates the nasal tip (Standring, 2016; Kim and Jeong, 2023). The absence of an external nasal nerve may result in a lack of sensation at the tip of the nose (Bergman et al. 2006). The external nasal nerve anastomoses with the terminal branch of the facial nerve. Knowledge of such neural anastomoses is important in facial reconstructive surgery (Diamond et al., 2011; Shoja et al., 2014).

Most available and recent studies (Chen and Carr, 2022; Standring, 2016) report that the external nasal nerve exits between the nasal bone and the upper nasal cartilage. The same findings were observed in the adult age group of our study.

The exit point of the nerve lies between 5.5 and 6.5 mm (mean, 6 ± 0.5 mm) away from the midline. Whereas in the elderly group, the nerve exits through the pyriform ligament. Its exit point lies lateral to the nasocartilaginous joint and between 7.5 and 9.5 mm (mean, 8.36 ± 0.80 mm) away from midline. In the elderly group, type-III branching patterns were observed. Its lateral main branch exits at the level of the nasomaxillary suture, which is 11 mm from the midline. Chen and Carr (2022) reported that the nerve exit point ranged from 5.08 to 11.94 mm (mean, 8.31 ± 1.85 mm). Another study (Han et al., 2004) observed that the exit point of the external nasal nerve lies lateral to the nasal midline from 6.5 to 8.5 mm (mean, 7.3 ± 0.6 mm).

In the elderly group of this study, the pyriform ligament is connected to the nasal bone, the frontal process of the maxilla, and the upper nasal cartilage (lateral nasal cartilage). The pyriform ligament is a vestigial ligamentous sheet that connects the periosteum of the bony pyriform aperture and the perichondrium of the adjacent cartilage (Daniel and Palhazi, 2018). Our finding in the elderly group is that the external nasal nerve passes through the pyriform ligament. With age, changes occur in the nasal bone and upper nasal cartilage. Thus, the exit point of the external nasal nerve can change (Chen and Carr, 2022). On the

nose, the age-related changes are not uniform. With age, only cartilage moves, and both bone and cartilage become weak (Shastri et al., 2021).

The superior margin of the triangular upper nasal cartilage is attached to the nasal bone and the frontal process of the maxilla. The width, thickness, and length of the nasal bones vary (Standring, 2016). The inferior border of the nasal bone is attached to the superior margin of the upper nasal cartilage to form a tight synchondrosis (Kenyon, 2013). We observed tight synchondrosis only in the elderly group, but it is not seen in the adult age group. In the elderly group, the width of the nasocartilaginous joint ranges from 6 to 8 mm (mean, 7 ± 0.79 mm), and the pyriform ligament is attached to the remaining part of the inferior border of the nasal bone and the frontal process of the maxilla. In the adult age group, the nasocartilaginous joint's width ranges from 11 to 12 mm (mean, 11.5 ± 0.5 mm). The width of the inferior border of the nasal bone from the midline to the nasomaxillary suture ranges from 9.5 to 11 mm (mean, 10.25 ± 0.64 mm) in the elderly group. Whereas in the adult age group, it ranges from 10.5 to 11.5 mm (mean, 11 ± 0.5 mm), but from 0.5 to 1 mm, the superior margin of the cartilage is attached to the frontal process of the maxilla. Kenyon (Kenyon, 2013) reported that the upper nasal cartilage is attached to the nasal bone at a level of 6 to 8 mm.

The present study agrees with previously reported classification and branching patterns (Chen and Carr, 2022; Han et al., 2004). Among 20 nerves, 70% of type I (14 nerves), 20% of type II (4 nerves), and 10% of type III (2 nerves) were observed, but we have not seen any other variations or subtypes.

CONCLUSION

Based on our study, we concluded that in the elderly group the external nasal nerve passes through the pyriform ligament and exits lateral to the nasocartilaginous joint. But in the adult age group the external nasal nerve exits between the nasal bone and the upper nasal cartilage. All available data indicate that the external nasal nerve exits between the nasal bone and the nasal cartilage.

Anatomical knowledge of the external nasal nerve is necessary to avoid nerve injury in rhinoplasty. A clear understanding of the anatomical structure of the nasal bones and cartilages and their changes with age is helpful in surgical procedures.

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REFERENCES

- BERGMAN RA, AFIFI AK, MIYAUCHI R (2006) Illustrated Encyclopaedia of Human Anatomic Variation. Available at: <http://www.anatomyatlases.org/AnatomicVariants/AnatomyHP.shtml> (accessed 17 November 2015).
- CHEN Y, CARR CB (2022) Anatomical comparative study of the external nasal nerve in caucasian and asian: application for minimizing nerve damage in rhinoplasty. *Aesth Plast Surg*, 46: 852-861.
- DANIEL RK, PALHAZI P (2018) The nasal ligaments and tip support in rhinoplasty: an anatomical study. *Aesth Surg J*, 38(4): 357-368.
- DIAMOND M, WARTMANN CT, TUBBS RS, SHOJA MM, COHEN-GADOL AA, LOUKAS M (2011) Peripheral facial nerve communications and their clinical implications. *Clin Anat* 24: 10-18.
- HAMILTON GS (2021) Rhinoplasty as an adjunct to facial rejuvenation. *Facial Plast Surg*, 37: 211-217.
- HAN SK, SHIN YW, KIM WK (2004) Anatomy of the external nasal nerve. *Plast Reconstr Surg*, 114: 1055-1059.
- KENYON G (2013) Nasal anatomy and analysis. *Int J Otorhinolaryngol Clin*, 5(1): 34-42.
- KIM TK, JEONG JY (2023) Surgical anatomy for Asian rhinoplasty. *Arch Craniofac Surg*, 20(3): 147-157.
- ROHRICH RJ, HOXWORTH RE, THORNTON JF, PESSA JE (2008) The pyriform ligament. *Plast Reconstr Surg*, 121(1): 277-281.
- SABAN Y, ANDRETTO AMODEO C, HAMMOU JC, POLSELLI R (2008) An anatomical study of the nasal superficial musculoaponeurotic system: surgical applications in rhinoplasty. *Arch Facial PlastSurg*, 10: 109-115.
- SHASTRI D, TANDON P, SINGH A (2021) Nasal changes in different age groups. *Natl J Maxillofac Surg*, 12(3): 367-371.
- SHOJA MM, OYESIKU NM, GRIESSENAUER CJ, RADCLIFF V, LOUKAS M, CHERN JJ, BENNINGER B, ROZZELLE CJ, SHOKOUHI G, TUBBS RS (2014) Anastomoses between lower cranial and upper cervical nerves: A comprehensive review with potential significance during skull base and neck operations, Part I: Trigeminal, facial, and vestibulocochlear nerves. *Clin Anat*, 27: 118-130.
- STANDRING S (2016) The Anatomical Basis of Clinical Practice. *Gray's Anatomy*, 41st ed. Elsevier Ltd, pp 557-676.