



Nasolacrimal Duct Orifice: A Cadaveric Study in Relation to Important Anatomical Landmarks

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Abstract

The nasolacrimal apparatus is intimately associated with the lateral nasal wall and may be approached using an endoscopic technique. This study was undertaken to describe in detail the gross anatomy of the nasolacrimal duct orifice in relation to various landmarks of the lateral nasal wall to improve the safety and efficiency of endoscopic surgical procedures. The study was conducted on 25 sagittal sections of adult cadavers in the Department of Anatomy, Kasturba Medical College, Manipal. The parameters measured were the distance from nasolacrimal duct orifice (NO) to the anterior end of middle concha (MC), distance from NO to the anterior nasal spine (ANS), distance from NO to the nasal floor (NF), distance from NO to anterior end of the inferior concha (AIC), and distance from NO to posterior end of the inferior concha (PIC). The shape of the NO was also observed and classified as oval, round and slit. The distance from NO to ANS was 2.73 ± 0.26 cm, the distance from NO to NF was 1.19 ± 0.34 cm, the distance between NO to MC, NO to AIC and PIC were 2.55 ± 0.28 cm, 1.85 ± 0.3 cm and 3.4 ± 0.36 cm respectively. We also observed 3 types of shapes of NO, majority were slit like followed by oval and round. Knowledge of the anatomy of the nasolacrimal apparatus is essential for the surgeon during the performance of endonasal cystorhinostomies and maxillary osteotomies.

Key Words: Nasolacrimal duct orifice, anterior nasal spine, middle concha, inferior concha

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Introduction

Injury to the lacrimal system has been reported with facial trauma, craniofacial surgery, nasal osteotomies during rhinoplasty and nasal anastomies [1, 2]. The lacrimal drainage system (LDS) can be accidentally traumatized in view of its location on the lateral wall of the nasal cavity. This might occur during the treatment of maxillofacial trauma, rhinoplasty, orbital decompression, surgery of the nasal and paranasal sinus tumours, as well as conventional or endoscopic sinus surgery [3, 4].

The endoscopic technique is currently the most favored procedure for surgical treatment of sinonasal pathologies. This technique allows direct visualization, evaluation, and treatment of intranasal abnormalities [5]. The nasolacrimal apparatus is intimately associated with the lateral nasal wall and may be readily approached using an endoscopic technique, which minimizes the functional interference with the physiological action of the lacrimal apparatus [6]. Defining the position of the nasolacrimal sac and duct during this surgical procedure is important. Studies defining the nasolacrimal apparatus in cadavers and in healthy people using computed tomography have been reported in the literature [7-9]

The success and safety of intranasal endoscopic surgery primarily depend on the surgeon's knowledge of intranasal anatomy, especially that of the lateral nasal wall. Although there have been a number of reports on the surgical anatomy of the nasolacrimal duct (NLD) in relation to the lateral nasal wall, these involve either drawings or computed tomography (CT) scans [10,11].

However, anatomic studies using cadavers for the evaluation of the morphological features and morphometric measurements of the nasolacrimal apparatus are few. Cadaveric study is an invaluable approach by which surgeons can increase their knowledge and understanding of the topographic anatomy of the area [12].

Hence this study was undertaken to describe in detail the gross anatomy of the nasolacrimal duct orifice (NO) in relation to the lateral nasal wall and to measure the distances of surgically important landmarks from relevant structures to improve the safety and efficiency of endoscopic surgical procedures performed in this area.

Materials and Methods

The study was conducted on 25 sagittal sections of adult cadavers (13 left and 12 right) in the Department of Anatomy, Kasturba Medical college, Manipal. At first the NO in the inferior nasal meatus was identified reflecting the inferior concha. To obtain a better exposure, the inferior nasal concha was incised at the junction of anterior one third and posterior two thirds.

The following parameters were measured using a digital caliper in centimeter and are depicted in Figure 1.

- Distance from NO to the anterior end of middle concha (MC)
- Distance from NO to the anterior nasal spine (ANS)
- Distance from NO to the nasal floor (NF)
- Distance from NO to the anterior end of the Inferior concha (AIC)
- Distance from NO to the posterior end of the Inferior concha (PIC)

The shape of the NO was also observed and was classified as oval, round and slit shaped. Appropriate statistical tests were applied using SPSS version 16.

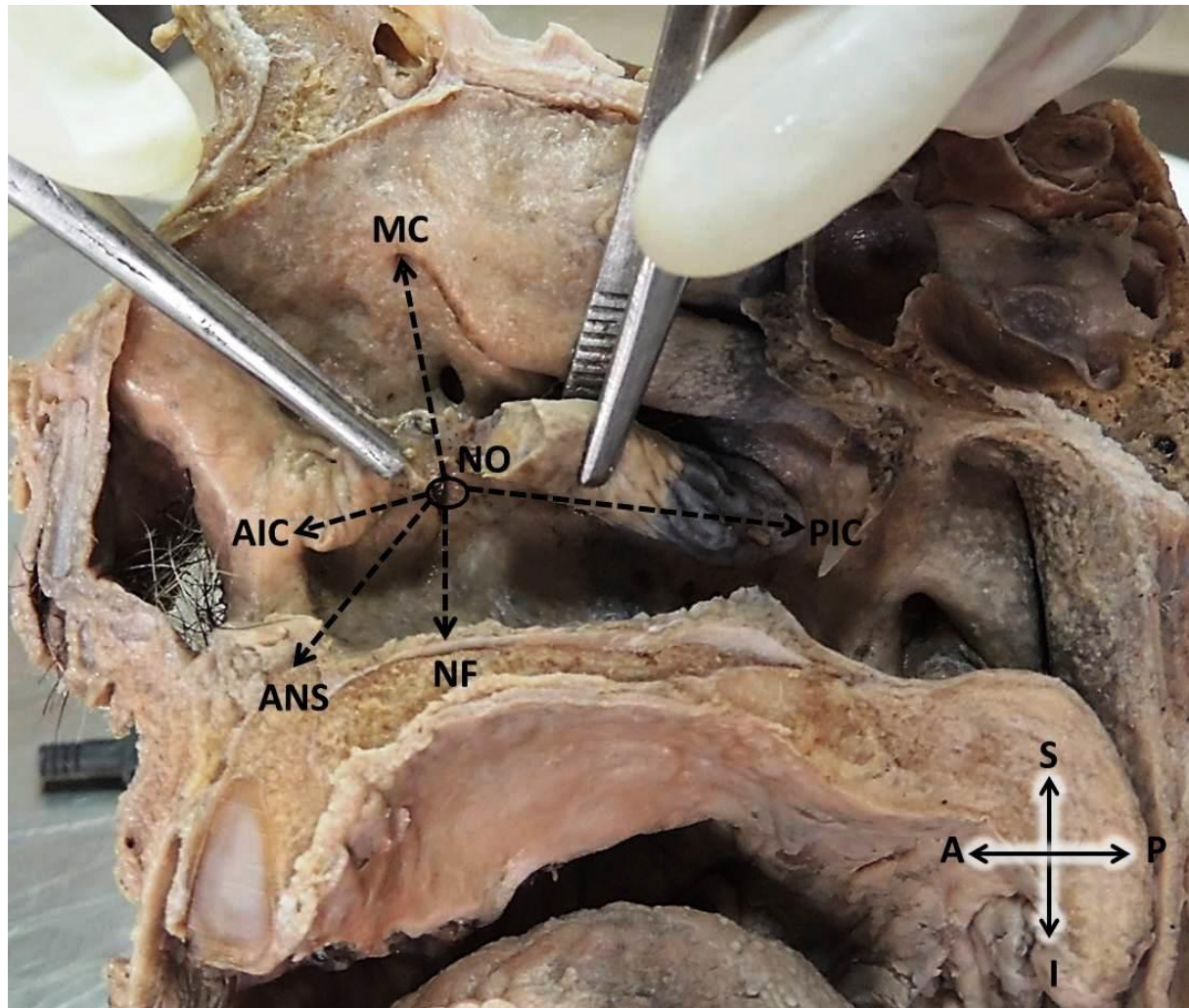


Figure 1. Sagittal section of nasal cavity showing anatomical landmarks used and distances measured

NO- nasolacrimal duct orifice, ANS- anterior nasal spine, NF- floor of the nasal cavity, AIC- anterior end of inferior concha, PIC- posterior end of inferior concha, MC- anterior end of middle concha

Results

The study used 25 sagittal sections of adult head and neck specimens. The mean and standard deviations of the parameters measured were calculated and are shown in Table 1. Student t test was used to compare the means of right and left sides (Table 2) which did not show any statistical significance.

The commonest shape of the NO was slit which was found in 76% of cases followed by oval (20%) and round (4%). Figure 2 shows the different shapes of the NO observed. In majority

of specimens the NO was observed in the anterior one third of the inferior meatus (N=22) while in 3 cases it was found in the middle one third of the inferior meatus.

Table 1. Descriptive statistics of parameters measured

Parameters measured	Right (cm) (N=13)	Left (cm) (N=12)
NO- ANS	2.73±0.26	2.4±0.48
NO- NF	1.19±0.34	1.32±0.31
NO- AIC	1.85±0.3	1.9±0.34
NO- PIC	3.4±0.36	3.1±0.42
NO- MC	2.55±0.28	2.55±0.39

NO- nasolacrimal duct orifice, ANS- anterior nasal spine, NF- floor of the nasal cavity, AIC- anterior end of inferior concha, PIC- posterior end of inferior concha, MC- anterior end of middle concha

Table 2. Student t-test for the comparison of means of both the sides

Parameters measured	P value
NO- ANS	0.06
NO- NF	0.46
NO- AIC	0.7
NO- PIC	0.07
NO- MC	0.8

NO- nasolacrimal duct orifice, ANS- anterior nasal spine, NF- floor of the nasal cavity, AIC- anterior end of inferior concha, PIC- posterior end of inferior concha, MC- anterior end of middle concha

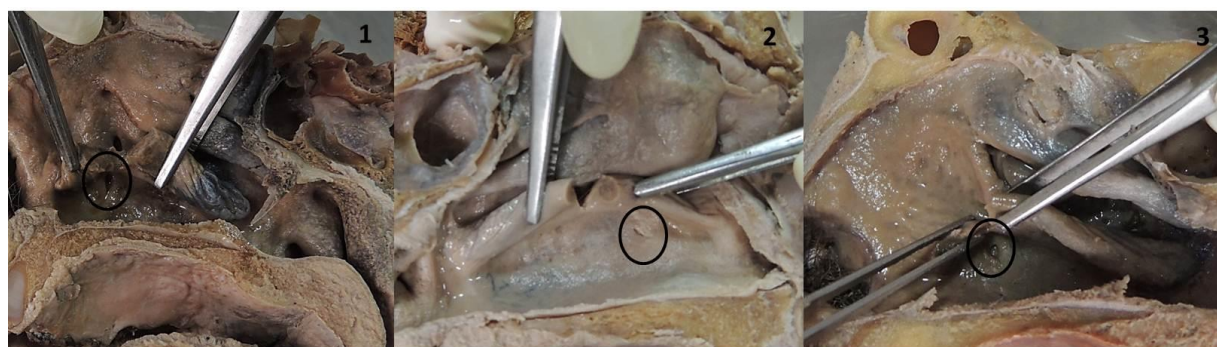


Figure 2. Shapes of nasolacrimal duct orifice

- 1- Oval
- 2- Oblique slit
- 3- Round

Discussion

The LDS can be damaged during the antrostomies performed in the surgical treatment of chronic sinusitis. The Hasner's valve at the orifice of the NLD at the inferior meatus can be traumatized during inferior meatal antrostomy [3, 4].

In our study we observed the distance from NO to ANS was 2.73 ± 0.26 cm and the distance from NO to NF was 1.19 ± 0.34 cm. Whereas study conducted by Halis et al [13], the distance from NO to ANS was 23.0 ± 3.3 mm, NO to NF was 13.2 ± 2.7 mm. Similar study conducted by Ertugrul et al [14] the intranasal orifice of the NLD was observed to be located an average of 25 mm from the ANS and was 13.7 ± 3.15 mm away from the NF. Study conducted by Yong-Ho Kim et al [15] also got a similar value like 22.8 ± 4.8 mm from the ANS and 10.7 ± 2.7 mm above the floor of the nasal cavity.

In our study the distance between the NO to the anterior end of middle concha, to the anterior and posterior end of inferior conchae were 2.55 ± 0.28 cm, 1.85 ± 0.3 cm and 3.4 ± 0.36 cm respectively. Similar study done by Ertugrul et al [14], the distance from the anterior end of the inferior nasal concha was 14.3 ± 2.05 mm. Study conducted by Halis et al [13], the distance was 21.4 ± 3.5 mm from the middle nasal concha and 5.2 ± 1.9 mm from the anterior end of the inferior nasal concha.

We also observed 3 types of NO, majority were slit like (76%), followed by oval (20%), then round (4%) respectively. Similar study done by Ertugrul et al. observed five pin-point (33.3%), four triangular (26.6%) and six slit-like (40%) orifices [14]. Pin-point and slit-like openings indicate that even a very small diameter of the NO is sufficient for its patency. This observation is in agreement with the study of Lindberg et al. (1982), who found that even a very small (1.8 mm) ostium resulted in excellent functional outcome after an external operation [16]. Knowledge of the intranasal anatomy of the nasolacrimal apparatus is essential for the surgeon during the performance of endonasal endoscopic cystorhinostomies and maxillary osteotomies.

Conclusion

The present anatomical study highlights the surgical anatomy of NO in relation to the important anatomical landmarks which will be essential during the endoscopic surgical procedures involving the nasolacrimal duct.

Conflict of interests

The authors report no conflict of interest in this work.

References

1. Demas PN, Sotereanos GC. Incidence of nasolacrimal injury and turbinectomy--associated atrophic rhinitis with Le Fort I osteotomies. *J Craniomaxillofac Surg.* 1989;17(3):116-8.
2. Lauritzen C, Lilja J. Nasolacrimal obstruction in craniofacial surgery. *Scand J Plast Reconstr Surg.* 1985;19(3):269-72.
3. Serdahl CL, Berris CE, Chole RA. Nasolacrimal duct obstruction after endoscopic sinus surgery. *Arch Ophthalmol.* 1990;108(3):391-2.
4. Bolger WE, Parsons DS, Mair EA, Kuhn FA. Lacrimal drainage system injury in functional endoscopic sinus surgery. Incidence, analysis, and prevention. *Arch Otolaryngol Head Neck Surg.* 1992;118(11):1179-84.
5. Tatlisumak E, Aslan A, Cömert A, Ozlugedik S, Acar HI, Tekdemir I. Surgical anatomy of the nasolacrimal duct on the lateral nasal wall as revealed by serial dissections. *Anat Sci Int.* 2010;85(1):8-12.
6. Unlu HH, Goktan C, Aslan A, Tarhan S. Injury to the lacrimal apparatus after endoscopic sinus surgery: surgical implications from active transport dacryocystography. *Otolaryngol Head Neck Surg.* 2001;124(3):308-12.
7. Asaumi R, Sato I, Miwa Y, Imura K, Sunohara M, Kawai T, Yosue T. Understanding the formation of maxillary sinus in Japanese human foetuses using cone beam CT. *Surg Radiol Anat.* 2010;32(8):745-51.
8. McCormick A, Sloan B. The diameter of the nasolacrimal canal measured by computed tomography: gender and racial differences. *Clin Experiment Ophthalmol.* 2009;37(4):357-61.
9. Moscato EE, Kelly JP, Weiss A. Developmental anatomy of the nasolacrimal duct: implications for congenital obstruction. *Ophthalmology.* 2010;117(12):2430-4.
10. McDonogh M, Meiring JH. Endoscopic transnasal dacryocystorhinostomy. *J Laryngol Otol.* 1989;103(6):585-7.
11. Kurihashi K, Imada M, Yamashita A. Anatomical analysis of the human lacrimal drainage pathway under an operating microscope. *Int Ophthalmol.* 1991;15(6):411-6.

12. Lucente FE, Schoenfeld PS. Calibrated approach to endoscopic sinus surgery. *Ann Otol Rhinol Laryngol.* 1990;99(1):1-4.
13. Unlü HH, Gövsa F, Mutlu C, Yüçetürk AV, Senyilmaz Y. Anatomical guidelines for intranasal surgery of the lacrimal drainage system. *Rhinology.* 1997;35(1):11-5.
14. Tatlisumak E, Aslan A, Cömert A, Ozlugedik S, Acar HI, Tekdemir I Surgical anatomy of the nasolacrimal duct on the lateral nasal wall as revealed by serial dissections. *Anat Sci Int.* 2010;85(1):8-12.
15. Kim YH, Park MG, Kim GC, Park BS, Kwak HH. Topography of the nasolacrimal duct on the lateral nasal wall in Koreans. *Surg Radiol Anat.* 2012;34(3):249-55.
16. Linberg JV, Anderson RL, Bumsted RM, Barreras R. Study of intranasal ostium external dacryocystorhinostomy. *Arch Ophthalmol.* 1982;100(11):1758-62.