

Clinical report**Intranasal location of lacrimal sac in Thai cadavers**

Napas Tanamai^a, Teeraporn Ratanaanekchai^a, Sanguansak Thanaviratananich^a, Kowit Chaisiwamongkol^b, Thanarat Chantaumpalee^b

^aDepartment of Otorhinolaryngology, ^bDepartment of Anatomy, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand

Background: Many current literatures have described that the lacrimal sac is located just anterior to the anterior attachment (axilla) of the middle turbinate. However, there was no data on the exact boundary of the sac, especially the distance related with a permanent landmark such as the middle turbinate attachment.

Objective: Determine the intranasal location of the lacrimal sac related to the middle turbinate attachment in Thai fresh cadavers.

Methods: The study was performed in 26 Thai fresh cadavers, donated to Khon Kaen University, Thailand between July 2006 and July 2007. The height and width of the lacrimal sac were recorded, as well as the distances from the upper, lower, anterior and posterior border of the lacrimal sac to the axilla of the middle turbinate were measured.

Results: The mean height and width of 52 lacrimal sacs were 11.2 and 6.2 mm. The mean distances from the upper, lower, anterior, and posterior border of lacrimal sac to the axilla of the middle turbinate were 4.9 mm (95%CI=4.4-5.4), 5.6 mm (95%CI=5.1-6.1), 3 mm (95%CI=2.4-3.6), and 2.9 mm (95%CI=2.3-3.5), respectively. The upper border of all lacrimal sacs were located superior to the axilla of the middle turbinate (95%CI=93.1-100), and posterior border of 44 sacs (85%, 95%CI=72.5-92.0) were located posterior to the axilla. Additionally, the anterior wall did not extend anterior to the anterior attachment of the middle turbinate in 21% of the sac.

Conclusion: This study revealed the more exact intranasal location of lacrimal sacs. This is useful for surgeons to perform adequate endoscopic dacryocystorhinostomy to prevent postoperative lacrimal sump syndrome.

Keywords: Anatomy, lacrimal sac, dacryocystorhinostomy

Lacrimal sac is part of the lacrimal system. It lies in the lacrimal fossa which is bounded anteriorly by the frontal process of the maxillary bone and its anterior lacrimal crest, posteriorly by the posterior lacrimal crest of the lacrimal bone. The length of the sac is 12-15 mm [1, 2]. The content in the lacrimal sac drain into the nasal cavity at inferior meatus via the nasolacrimal duct. If the nasolacrimal duct is obstructed by any causes, dacryocystorhinostomy is the surgical option to relieve the symptom.

This operation has been performed by external approach for a long time, but nowadays endoscopic endonasal approach has been increasingly performed [3]. The advantages of endonasal approach over

external approach are having no facial scar, less bleeding, the ability to correct the other abnormalities in nasal cavity related to nasolacrimal duct obstruction, preserving the orbicularis muscle function, and is not contraindicated in acute dacryocystitis [4-6]. One of the key issues to increase the success of endoscopic endonasal dacryocystorhinostomy is to remove the bone covering the entire medial wall of the sac. Leaving some parts of the medial wall of lacrimal sac may cause recurrent epiphora (lacrimal sump syndrome, prevalence 1.2%) [4, 7, 8].

The knowledge of intranasal location of the lacrimal sac is essential for endoscopic dacryocystorhinostomy. Many literatures have described that all lacrimal sacs are located just anteriorly to the anterior attachment of the middle turbinate [1, 2, 8, 9]. Subsequent studies showed that there was a part of lacrimal sac located above and posterior to anterior attachment of the middle

Correspondence to: Teeraporn Ratanaanekchai, M.D., Department of Otorhinolaryngology, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand.
E-mail: teerapornratana@gmail.com

turbinate. Wormald et al. [10] stated a major portion of the lacrimal sac located above the insertion of anterior end of the middle turbinate, 8.8 mm. Rebiez et al. [9] and Sprekelsen et al. [7] showed that they needed to remove some anterior parts of the middle turbinate for full exposure of the sac. However, there was no data on the distances of the superior and posterior border of the sac related to the middle turbinate attachment and the prevalences of the superior and posterior extensions of the sac related to the anterior attachment of the middle turbinate. The present study was conducted to determine the intranasal location of lacrimal sac in relation to anterior attachment of the middle turbinate and the dimensions, height, and width, in Thai fresh cadavers.

Materials and methods

The intranasal location of lacrimal sacs was studied in Thai fresh cadavers, donated to Khon Kaen University, Thailand. A sample size of 52 sacs was calculated to be able to detect the distance above the axilla of the middle turbinate according to the study by Wormald et al. [10] with a two-sided test with a type 1 error of 5%. Thus, 26 Thai fresh cadavers, donated between July 2006 and July 2007, were included. The age of death was at least 20 years old. Cases that had injury of the lacrimal sac, lateral nasal wall, nasal cavity, or orbit by accident or surgery, were excluded.

The sac was injected with methylene blue via its punctum to outline it. Then, it was dissected freely

from the surrounding tissue (**Fig. 1**), and its height and width were measured. The ala nasi was elevated to enter the nasal cavity. The lacrimal bone was drilled by small burr from external through the nasal cavity at the point of the upper, lower, anterior, and posterior border of the lacrimal sac. The wires were passed along the holes to the nasal cavity (**Fig. 2**). The distances from each wire to the anterior attachment (axilla) of the middle turbinate were measured (**Fig. 3** and **4**). Descriptive statistics was used to analyze the results.

Results

Fifty-two lacrimal sacs of 14 male cadavers (54%) and 12 female cadavers (46%) were studied. Age ranged between 41 and 85 years (mean: 66 years, median: 70 years). The height and width of the sacs were shown in **Table 1**. The mean distances from the upper, lower, anterior, and posterior border of lacrimal sacs to the anterior attachment of the middle turbinate were shown in **Table 2**.

The study revealed that the upper border of all lacrimal sacs were located superior to the anterior attachment of the middle turbinate (95% CI=93.1-100) and posterior border of 44 sacs (85%, 95%CI=72.5-92.0) were located posterior to the axilla. Interestingly, three sacs had the anterior wall located posterior to the anterior attachment of middle turbinate (6%, 95%CI=2.0-15.6) and eight sacs were located at the same level (15%, 95%CI=8.0-27.5).



Fig. 1 Dissected lacrimal sac filled with methylene blue.

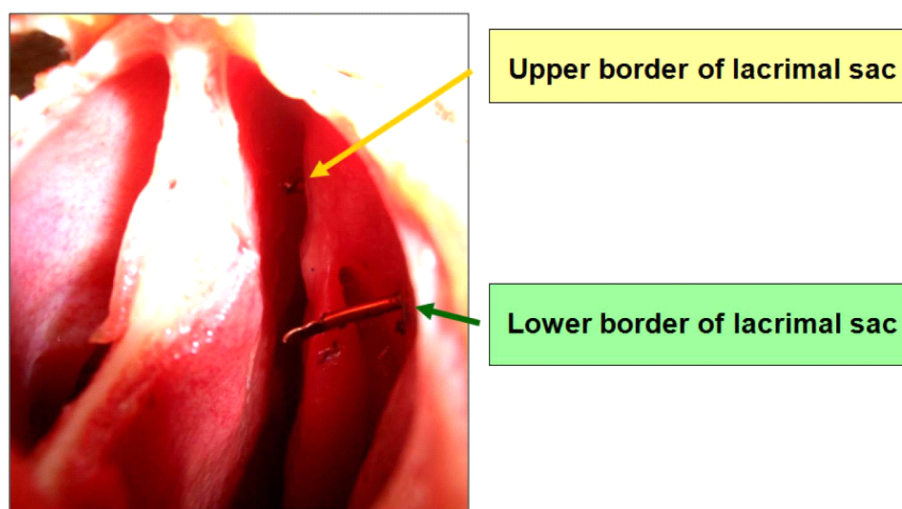


Fig. 2 Wires were passed into the nasal cavities.

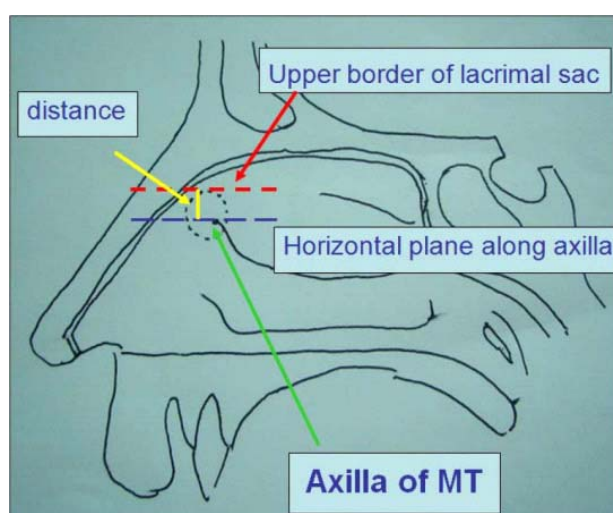


Fig. 3 Technique for measuring the distance from the upper border of lacrimal sac to anterior attachment of the middle turbinate.

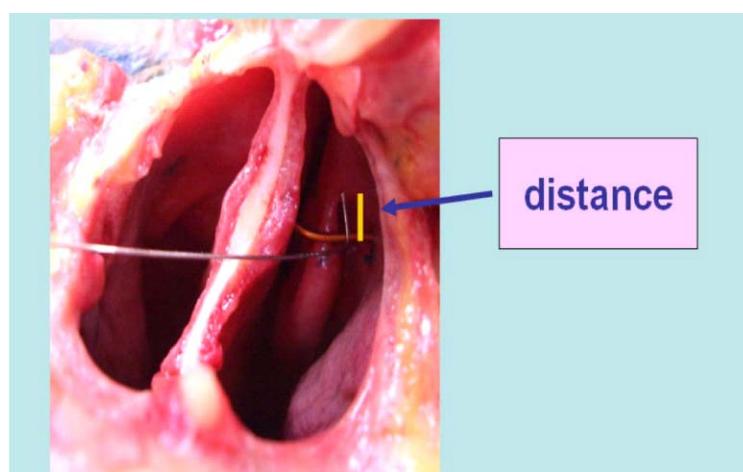


Fig. 4 Distance from the lower border of lacrimal sac to anterior attachment of the middle turbinate.

Table 1. The mean height and width of the lacrimal sacs.

Distances	Height (mm)	Width (mm)
Mean	11.2	6.2
Median	11	6
SD	1.7	1.3

Table 2. The distances between anterior attachment of the middle turbinate and upper, lower, anterior and posterior border of the lacrimal sac.

	Upper border	Lower border	Anterior border	Posterior border
Range (mm)	2 - 9	0 - 8	(-2)* - 7	0 - 9
Mean (mm)	4.9	5.6	3.0	2.9
Standard deviation(SD)	1.8	1.7	2.2	2.3

* Minus value: the anterior border of lacrimal sac located posterior to anterior attachment of middle turbinate.

Discussion

The knowledge of intranasal location of lacrimal sac is most essential for surgeons who perform endoscopic endonasal dacryocystorhinostomy. The previous literatures described that lacrimal sacs were located just anterior to the anterior attachment of middle turbinate [1, 2, 8, 9]. Wormald et al. [10] studied in CT scans, and reported that the major portion of the sac were situated above the attachment of the middle turbinate at a mean of 8.8 mm. Zhang et al. [11] demonstrated that 10 out of 15 cadavers had the sac located above the axilla.

The present study has revealed superior wall of all sacs located superior to the attachment of the middle turbinate. This is the same as the study by Orhan et al. [12]. In addition, this study has showed that the mean vertical diameter of the lacrimal sac was longer than the mean horizontal diameter, 11.2 cm (SD=1.7) vs. 6.2 cm (SD=1.3). This finding was the same as the study by Orhan et al. [12] showing the mean vertical diameter and horizontal diameter of 12.76 cm (SD=2.25) and 7.62 cm (SD=1.46) cm, respectively.

Sprekelsen et al. [7], Rebeiz et al. [9], and Orhan et al. [12] demonstrated that some part of the sac might extend posterior to the axilla of the middle turbinate. The prevalence in our study was 44 sacs (85%) comparing with the study by Orhan, 15 out of the 20 cases.

Interestingly, there were 11 sacs (21%) where the anterior border did not lie anterior to the anterior

attachment of middle turbinate. In the study by Orhan et al. [12], three out of 20 cases the lacrimal sac was situated entirely on the posterior aspect of the axilla of the middle turbinate. Comparing with the Orhan et al. result, it was situated entirely on the anterior aspect of the axilla in two out of 20 cases. This indicates that the sac may be not found by using conventional endoscopic landmarks. Dissection above the middle turbinate or resection of anterior portion of the middle turbinate may be needed for adequate exposure of the lacrimal sac.

Conclusion

The present study demonstrated boundaries of the sac extend superior (100%) and posterior (85%) to the anterior attachment of the middle turbinate. Additionally, there were 21% of sacs where the anterior wall did not extend anterior to the anterior attachment of the middle turbinate. Thus, when endoscopic dacryocystorhinostomy is performed in Thai patients, we should remove the bone covering the sac more than usually described in the literature in order to adequately expose the sac to prevent postoperative lacrimal sump syndrome.

Acknowledgement

We express our thanks to the Invitation Research Granting Committee of the Faculty of Medicine, Khon Kaen University for their funding support. The authors have no conflict of interest to report.

References

1. Anon J, Rontal M, Zinreich S. Orbital-sinus relationships. In: Anon J, Rontal M, Zinreich S, editors. *Anatomy of the paranasal sinuses*. New York:Thieme; 1996. p. 29-34.
2. Metson R. Dacryocystorhinostomy. In: Kennedy D, Bolger W, Zinreich S, editors. *Diseases of the sinuses: diagnosis and management*. Hamilton: BC Decker 1987. p. 317-24.
3. Putterman A, Beyer-Machule C. Lacrimal surgery. In: M.E. Tardy, E.R. Katstenbaure, editors. *Head and neck surgery Vol.1 Face, nose and facial skull, part I*. New York:Thieme; 1995. p. 201-12.
4. Siripoon T. Anatomical relationship of lacrimal fossa and related structures and correlation between bony opening and healed ostium in external DCR. *Bulletin of the Department of Medical Services Thailand*. 2001; 26:378-88.
5. Fayet B, Racy E, Assouline M. Complications of standardized endonasal dacryocystorhinostomy with unciformectomy. *Ophthalmology*. 2004; 111: 837-45.
6. Simon G, Joseph J, Lee S, Schwarcz R, Macann J, Goldberg R. External versus endoscopic dacryocystorhinostomy for acquired nasolacrimal duct obstruction in tertiary referral center. *Ophthalmology*. 2005; 112:1463-8.
7. Sprekelsen M, Barberan M. Endoscopic dacryocystorhinostomy:surgical technique and results. *Laryngoscope*. 1996; 106: 187-9.
8. Metson R, Cosenza M. Dacryocystorhinostomy. In: Levine H, Clemente M, editors. *Sinus surgery: Endoscopic and microscopic approaches*. Stuttgart: Thieme Medical Publishers. 2005. p. 312-5.
9. Rebeiz E, Shapshay S, Bowlds J, Pankratov M. Anatomic guidelines for dacryocystorhinostomy. *Laryngoscope*. 1992; 102:1181-4.
10. Wormald PJ, Kew J, Van Hasselt A. Intranasal anatomy of the nasolacrimal sac in endoscopic dacryocystorhinostomy. *Otolaryngol Head Neck Surg*. 2000; 123:307-10.
11. Zhang SQ, Jia PL, Tang HH. Endonasal anatomy of lacrimal sac and its clinical significance in dacryocystorhinostomy (in Chinese). *Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi*. 2006; 41:506-9.
12. Orhan M, Saylam CY, Midilli R. Intranasal localization of the lacrimal sac. *Arch Otolaryngol Head Neck Surg*. 2009;135:764.