Main Article

Influence of Intercanthal Distance Variation in Locating Lacrimal Sac During Endonasal Dacryocystorhinostomy

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ABSTRACT

Introduction

Endoscopic endonasal dacryocystorhinostomy is one of the leading modalities for the treatment of distal lacrimal system obstruction. Knowledge of an accurate position of lacrimal sac in the lateral nasal wall is crucial to perform this surgery and to obtain favorable long-term results. This study is an attempt to define the position of lacrimal sac in the lateral nasal wall in relation to axilla of middle turbinate which is a well-accepted anatomical landmark on the lateral nasal wall to perform endonasal dacryocystorhinostomy; in extension, a variation in the inner intercanthal distance of the subject was correlated with any variation in the distance between the axilla of middle turbinate and lacrimal sac.

Materials and Methods

An observational cross-sectional study was conducted on thirty patients with epiphora. Patients were evaluated with lacrimal syringing and those with distal lacrimal system obstruction were included in the study. Inner intercanthal distance was measured using vernier caliper. All patients underwent endoscopic endonasal dacryocystorhinostomy and intraoperative measurement between the axilla of middle turbinate and midpoint of lacrimal sac in the anteroposterior dimension was recorded.

Results

Females predominantly presented with epiphora. The average anteroposterior distance of lacrimal sac from the axilla of middle turbinate in the lateral nasal wall was found to be 7.06mm with a range of 6mm to 8mm. Intercanthal distance in our study population had a range of 26mm to 38mm with a mean of 31.46mm. Statistically significant correlation could not be established between the inner intercanthal distance and position of lacrimal sac in relation to the axilla of middle turbinate.

Conclusion

The lacrimal sac can be located 6mm to 8mm anterior to the axilla of middle turbinate. However, it does not correlate with varying inner intercanthal distance. The knowledge of accurate position of lacrimal sac in the lateral nasal wall is important to perform an endoscopic endonasal dacryocystorhinostomy and to obtain good long-term results.

Keywords

Epiphora; Endoscopic Endonasal Dacryocystorhinostomy; Lacrimal Sac; Axilla of Middle Turbinate; Intercanthal Distance

Epiphora is a clinical presentation with overflow of tears. Inadequacy of the lacrimal drainage system is one of the common and important causes of epiphora, which can be functional or anatomical. Anatomical obstruction can occur at various levels of lacrimal drainage system from punctum to Hasner's valve. Failure of proximal pumping mechanism or a critical narrowing in the lacrimal drainage system that slows normal lacrimal flow can cause functional obstruction. The incidence of nasolacrimal duct obstruction is estimated to be approximately 10% at 40 years of age increasing to 35-40% at 90 years of age.[1]

Endoscopic endonasal dacryocystorhinostomy is one of the leading modalities for management of distal lacrimal

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system obstruction which can be at the level of lacrimal sac or distal to it. It is a surgical procedure in which lacrimal flow is diverted into the nasal cavity through an artificial opening made at the level of lacrimal sac. The critical element for success of this procedure is creation of widest possible marsupialization of the medial wall of the lacrimal sac.[2]

Failure to complete endoscopic endonasal dacryocystorhinostomy can be attributed to inability to accurately locate the lacrimal sac during the endonasal approach.[3] This can be overcome by properly mapping the lacrimal sac position in relation to a known anatomical landmark such as axilla of middle turbinate, which is the most anterior part of insertion of the middle turbinate to the lateral nasal wall.

Better knowledge of position of lacrimal sac and its variations in lateral nasal wall helps to achieve complete exposure of lacrimal sac during endonasal dacryocystorhinostomy[4] and also avoidance of complications such as fracture nasal bones, intranasal and orbital hemorrhage[5], orbital fat prolapse, damage to extraocular muscles (medial rectus, inferior rectus) and orbital cellulitis.

Many surgeons have contributed to the understanding of the anatomy of lacrimal sac in the lateral nasal wall and our understanding is still evolving. It is our observation that there is continuing difficulty in locating the lacrimal sac in some cases even in the light of current knowledge. An attempt is made in this study, to define variations in the position of lacrimal sac in the lateral nasal wall with respect to anatomical variations external to the nasal cavity. Woo et al[6] observed and established that a thick frontal process of maxilla can be anticipated in presence of a low nasal bridge in Asian population. However, the positional variation of lacrimal sac with respect to changes in intercanthal distance is not defined in the literature available till date.

The objective of our study is to find a correlation between inner intercanthal distance and the position of lacrimal sac in relation to the axilla of middle turbinate, which may help map the accurate position of lacrimal sac.

Materials and Methods

After obtaining approval and clearance from the institutional ethical committee, 30 patients from outpatient and inpatient departments of otorhinolaryngology, fulfilling the inclusion criteria were enrolled for the study. Informed consent was taken for all patients for enrollment into the study. Demographic information and a detailed history were taken with regards to the symptoms of chronic dacryocystitis like excessive watering of eyes, tearing, swelling at the inner canthi of the eye, discharge of pus or mucus through the punctum on application of pressure over the inner canthi. Local examination of eye, local examination of nose including anterior rhinoscopy and endoscopic examination followed by complete otolaryngologic examination including neck. Inner Intercanthal distance was measured using vernier caliper. Inclusion criteria were age above 18years, patients with chronic dacryocystitis presenting with epiphora with regurgitation from opposite punctum on lacrimal syringing i.e. with no canalicular block and patients willing to give informed consent and fit to undergo surgery. Exclusion criteria were patients not willing to give informed consent and not fit to undergo surgery, pregnant and lactating women, patient with epiphora with regurgitation from same punctum on lacrimal syringing i.e. with canalicular block, patients with punctal abnormalities like ectropion or entropion, patients with acute dacryocystitis or lacrimal abscess**,** patients with a large swelling, scar, fistula or deformity around root of nose, malignancy involving lacrimal drainage system, previous history of surgery of lacrimal drainage system, previous nasal surgery on the affected side, patients with history of trauma to face, facial bone fractures.

Intercanthal distance was measured using vernier's calipers. [figure 1] Endonasal dacryocystorhinostomy was performed under local anesthesia / general anesthesia with informed written consent. Nasal cavity was anaesthetized and decongested with 4% lignocaine and adrenaline, ten minutes prior to the procedure. Patient was positioned supine with 30-degree head end elevation. Local infiltration was given to the lateral nasal wall with 2% lignocaine and 1:1,00,000 adrenaline using 26G needle.

Axilla of middle turbinate was identified on endoscopy. In cases where there was a deviated septum restricting the surgical field, a concurrent septoplasty was performed. Incision for dacryocystorhinostomy was placed anterior to middle turbinate starting around 8mm above the axilla of middle turbinate, down to the level just above the insertion of inferior turbinate. Rectangular flap was made with the above defined limits. Mucoperiosteal flap was elevated using Freer's elevator to expose the anterior lacrimal bone and posterior frontal process of maxilla, which were removed with Kerrison's punch or a microdrill to allow maximum exposure of lacrimal sac, to the extent it stood proud on the lateral nasal wall. At this point, before incising the well exposed lacrimal sac, the anteroposterior distance between the axilla of middle turbinate and midpoint of the medial wall of the lacrimal sac was measured and documented [figure 2]. This measurement was done using the straight end of a Freer's elevator which was calibrated in millimeters, which was specially designed for this study. It contained markings in millimeters up to 20mm [figure 3]. Surgery was completed with adequate marsupialization of the sac.

Statistical analysis was performed to correlate the variation of the inner intercanthal distance measurements with the variations in the distance of axilla of middle turbinate and the lacrimal sac measured.

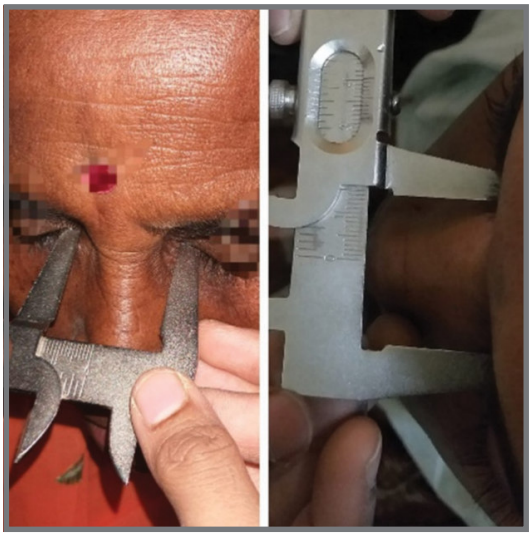

Fig. 1. Measurement of intercanthal distance using Vernier's calipers.

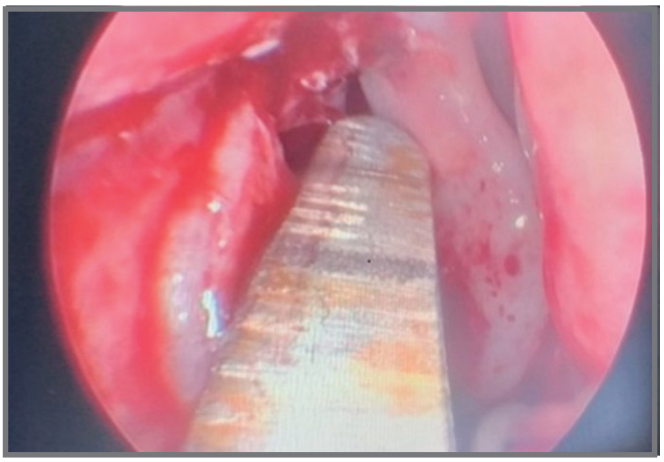

Fig. 2. Intraoperative measurement of distance between axilla of middle turbinate and lacrimal sac.

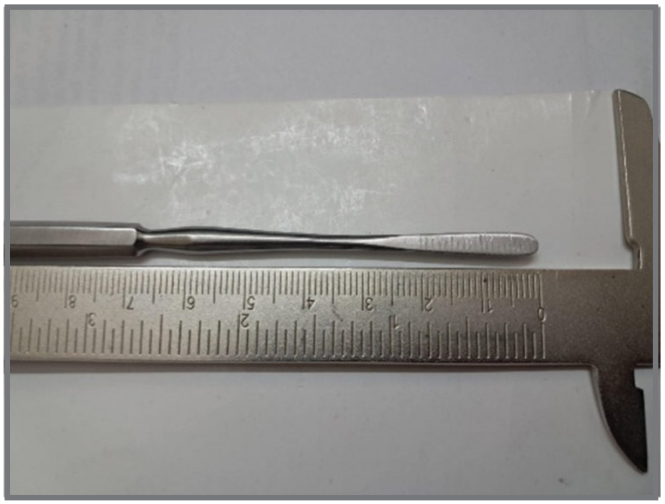

Fig. 3. Calibrations on flat end of Freer's elevator used to measure distance between axilla of middle turbinate and lacrimal sac.

Results

Presentation of epiphora was commonly found in 4th decade and a range of 24 years to 71 years were evaluated in our study. The mean age of presentation was 41 years with standard deviation of 13 years. Out of 30 participants in the study, 19 patients (63%) were females and 11 patients (37%) were males, indicating female predominance in the presentation of epiphora. Ten

percent i.e., three of our patients presented with bilateral epiphora, about 43% of our patients presented with left sided epiphora and 47% of our patients presented with right sided epiphora. Most of our patients presented with watery discharge from eye, but 7 of our patients had mucoid discharge from the eye and resultant associated blurred vision. Four of our patients also had associated nasal obstruction on the affected side and four patients had associated headache. On diagnostic nasal endoscopy, four patients had a deviated septum on the affected side restricting the handling of surgical field who underwent concurrent septoplasty; one patient had a hypertrophied turbinate on the affected side. Another patient had nasal polyp in the middle meatus on the affected side on diagnostic nasal endoscopy, which was managed medically before proceeding to dacryocystorhinostomy and endoscopic sinus surgery.

Intercanthal distance measured in our study was of the range 26mm to 38mm with a mean of 31.46mm and a standard deviation of 3.14. Females had an intercanthal distance of 26mm to 34mm whereas males had a range of 31mm to 38mm. The average intercanthal distance in males and females were 34.09 and 29.94 respectively in our study.

Table I: Distribution of inner intercanthal distance

SEX	RANGE (mm)	MEAN ± SD (mm)
Male (11)	31-38	34.09 ± 2.42
Female (19)	26-34	29.94 ± 2.43
Total (30)	26-38	31.46 ± 3.14

The anteroposterior distance from axilla of middle turbinate (MT) to the lacrimal sac, measured intraoperatively was found to be in the range of 6mm to 8mm in our study with mean measurement of 7.06 mm.

Table II: Distance between axilla of MT and midpoint of sac

SEX	RANGE (MM)	MEAN ± SD (MM)
MALE (11)	6 – 8	7.06 ± 0.784
FEMALE (19)	6 – 8	7.07 ± 0.78
TOTAL (30)	6 – 8	7.06 ± 0.784

A scatter diagram was plotted (Figure 4) with the inner intercanthal distance on abscissa and the distance of the lacrimal sac from the axilla of middle turbinate on ordinate. Chi square test was used for statistical analysis. P value was found greater than 0.05, interpreted to be not significant statistically.

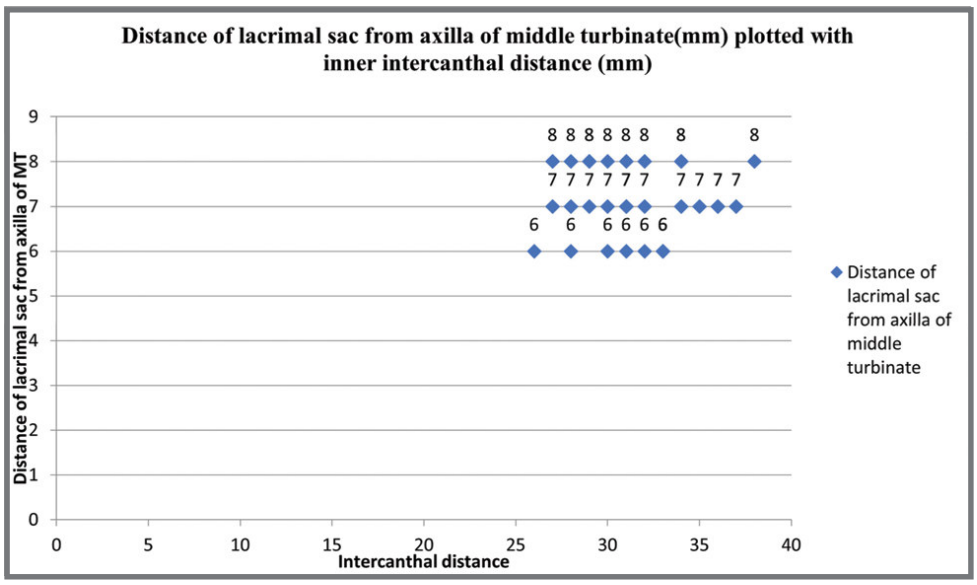

Fig. 4. Scatter diagram representing correlation between distance of midpoint of lacrimal

Discussion

Success of an endoscopic endonasal dacryocystorhinostomy can be attributed to factors such as good visualization of the lacrimal sac, knowledge of anatomical landmarks known to help locating the lacrimal sac endonasally and ability to remove the bone overlying the lacrimal sac to completely expose the sac for marsupialization.[7] Despite advancements in technology and continuing research contributing to the knowledge on anatomical localization of lacrimal sac in the lateral nasal wall, difficulties are still encountered in accurately locating the sac with consequent failure to complete the procedure.

Axilla of middle turbinate is the most anterior and superior insertion of middle turbinate to frontal process of maxilla on the lateral nasal wall and is synonymous to operculum of middle turbinate, anterosuperior attachment of middle turbinate mentioned in various literature. Other intranasal landmarks used to describe the position of lacrimal sac include maxillary line and uncinate process. Maxillary line is a curvilinear eminence or protuberance in the lateral nasal wall extending from the axilla of middle turbinate to the root of inferior turbinate; lacrimal sac is located lateral to the maxillary line.[8] Uncinate process is a thin sickle shaped bone oriented in para-sagittal plane; it attaches to frontal process of maxilla and lacrimal bone anteriorly. The lacrimal sac fossa lies anterior to uncinate process and posterior to the maxillary line. Uncinate process limits the posterior extent of dissection in endonasal DCR and has to be preserved.[9] A collective knowledge of these anatomical structures in the lateral nasal wall and their variations is required for a surgeon to perform endonasal DCR. An additional knowledge of sac position variations with respect to extranasal measurements may help us anticipate different positions of the sac.

Most of the patients in our study were in fourth decade and the mean age of presentation was 41years with standard deviation of 13. The youngest patient was in our study was 24years and the oldest patient was 71years. Nearly two thirds of our study population (19patients) were females and only one third (11patients) were males. The distribution of age in our study is similar to the study by Onerci M et al[10] which has a mean age of presentation as 42years with a standard deviation of 15; the study had 78% of female and 22% male patients. This female predominance of nasolacrimal duct obstruction can be explained by the lower nasolacrimal fossa and the narrower nasolacrimal duct observed in females.[11] Majority of the patients in our study were home makers. There is no predilection in laterality observable in our study.

The inner intercanthal distance measured in our study was of the range 26 mm to 38 mm with a mean of 31.46 mm and standard deviation of 3.14 mm. Females had an intercanthal distance of 26 mm to 34 mm whereas males had a range of 31mm to 38mm. The average inner intercanthal distance in males and females were 34.09 mm and 29.94 mm respectively in our study. Facial anthropometric assessment of inner intercanthal measurement by Agarwal J[12] et al gives the mean inner intercanthal distance to be 32.50 mm in adults above 25 years of age with a range of 30.85 mm to 37.65 mm.

Patients with developmental disabilities, oculofacial trauma, sinonasal tumor presenting before complete development of craniofacial skeletal framework, craniofacial congenital anomalies like cleft lip and palate, history of certain neurological diseases exhibit an abnormally increased inner intercanthal distance, also called telecanthus. The patients in our study did not have history of any such anomalies and none of the patients exhibited an abnormally increased intercanthal distance. The intercanthal distance varies among different racial groups due to potential differences in craniofacial growth patterns. Intercanthal distance increases with increasing age due to growth of cranial bones till the age of 25 years as observed by Agarwal et al.[12] All the patients in our study were above the age of 25 years with completed craniofacial growth. There are no studies in literature which has evaluated a correlation between inner intercanthal distance and position of lacrimal sac in relation to an anatomical landmark in the lateral nasal wall.

The distance between the axilla of middle turbinate and the lacrimal sac was measured intra operatively using

the graduated straight end of Freer's elevator which was specially designed and calibrated for this study. It contained markings in millimeters (mm) up to 15 mm. The anteroposterior distance from axilla of middle turbinate to the midpoint of the exposed lacrimal sac, measured intraoperatively was found to be in the range of 6 mm to 8 mm in our study with mean measurement of 7.06 mm and no significant difference was noted with respect to sex.

Woo KI[6] et al evaluated computed tomography of 152 normal orbits and inferred that the operculum of middle turbinate was attached to lacrimal sac fossa in 93.4% of the subjects with wide positional variation. In a study by Rebeiz E[7] et al, the lacrimal sac was found consistently in relation to the junction of the superioanterior attachment of the middle turbinate with lateral nasal wall intraoperatively and the average width of the lacrimal sac was found to be 1.13 cm. Wormald PJ4[3] et al demonstrated that the mean height of the sac above the middle turbinate was 8.8 mm and below it was 4.1 mm. Orhan M[13] et al demonstrated that the distance between the axilla of middle turbinate and posterior edge of lacrimal sac was 4.06 mm on an average with a range of 0 mm to 9.68 mm; and the distance between the axilla of middle turbinate and anterior edge of lacrimal sac was 3.67 mm on an average with a range of 0 mm to 7.51 mm. In our study, Chi square test was used for statistical evaluation and P value was found greater than 0.05, thus stating the correlation between inner intercanthal distance and the distance between axilla of middle turbinate and lacrimal sac was statistically not significant.

A review on 208 failed DCR[14] revealed that the major reason for failure were errors in the bony osteum size and location. False location of lacrimal sac, sometimes by a protuberance present more anteriorly than usual, leads to more anterior dissection, causing inadequate exposure, was quoted as one of the failures of DCR[10], thus emphasizing the importance of knowledge and ability to identify the sac in relation to constant anatomical landmarks.

Proper selection of patient and a comprehensive knowledge of the lateral nasal wall anatomy with respect to lacrimal sac is an essential prerequisite for a surgeon to perform successful endoscopic endonasal DCR with minimal complications and obtain good long-term results. The lacrimal sac was found to be 6mm to 8mm distant from the axilla of middle turbinate in our study. Results of this study showed no significant correlation between inner intercanthal distance and the position of lacrimal sac from the axilla of middle turbinate.

Conclusion

The anatomical knowledge of the accurate position of lacrimal sac in the lateral nasal wall is very important while performing an endoscopic endonasal DCR and to obtain good long-term results. This study was intended to find out existence of any correlation between inner intercanthal distance and the position of lacrimal sac from the axilla of middle turbinate, which will help us define any change in the location of lacrimal sac in lateral nasal wall when there is an increase or decrease in the inner intercanthal distance. In this study, we did not find a statistical correlation between the inner intercanthal distance and position of lacrimal sac in relation to axilla of middle turbinate.

References

1. Dalgleish R. Idiopathic acquired lacrimal drainage obstruction. Br J Ophthalmol. 1967 Jul;51(7):463
2. Flint PW, Haughey BH, Lund VJ, Niparko JK, Robbins KT, Thomas JR, et al. Cummings Otolaryngology - Head and Neck Surgery E-Book: Head and Neck Surgery, 3-Volume Set. Elsevier Health Sciences; 2014. 4198 p
3. Wormald PJ, Kew J, Van Hasselt A. Intranasal Anatomy of the Nasolacrimal Sac in Endoscopic Dacryocystorhinostomy. Otolaryngol Neck Surg. 2000 Sep 1;123(3):307–10
4. Chan W, Selva D. Ostium Shrinkage after Endoscopic Dacryocystorhinostomy. Ophthalmology. 2013 Aug 1;120(8):1693–6
5. Andrew N, Selva D. Postoperative haemorrhage in powered endoscopic dacryocystorhinostomy. Clin Experiment Ophthalmol. 2014;42(3):262–5
6. Woo KI, Maeng HS, Kim YD. Characteristics of Intranasal

Structures for Endonasal Dacryocystorhinostomy in Asians. Am J Ophthalmol. 2011 Sep 1;152(3):491-498.e1

7. Rebeiz EE, Shapshay SM, Bowlds JH, Pankratov MM. Anatomic guidelines for dacryocystorhinostomy. The Laryngoscope. 1992;102(10):1181–4
8. Chastain JB, Cooper MH, Sindwani R. The Maxillary Line: Anatomic Characterization and Clinical Utility of an Important Surgical Landmark. The Laryngoscope. 2005;115(6):990–2
9. Ooi E. Endoscopic Sinus Surgery: Anatomy, Three-Dimensional Reconstruction, And Surgical Technique, 3rd Edn. P-J Wormald. Thieme, 2012. ISBN 978 1 60406 687 6 pp 304. J Laryngol Otol. 2013 Jan 1;128:S59
10. Metin Önerci MO Oðuz Öðretmenoðlu, Murat Ýrkeç. Long-term Results and Reasons for Failure of Intranasal Endoscopic Dacryocystorhinostomy. Acta Otolaryngol (Stockh). 2000 Jan 1;120(2):319–22
11. Groessl SA, Sires BS, Lemke BN. An anatomical basis for primary acquired nasolacrimal duct obstruction. Arch Ophthalmol Chic Ill 1960. 1997 Jan;115(1):71–4
12. Agrawal J, Yogesh AS, Shukla CK, Banerjee C, Chandrakar AK. Orbitofacial anthropometric assessment of intercanthal and outercanthal distance measurement in Chhattisgarh region. Biomed Res. 2013;24:365–9
13. Orhan M, Saylam CY, Midilli R. Intranasal Localization of the Lacrimal Sac. Arch Otolaryngol Neck Surg. 2009 Aug 17;135(8):764–70
14. Welham RA, Wulc AE. Management of unsuccessful lacrimal surgery. Br J Ophthalmol. 1987 Feb 1;71(2):152–7.