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Original Research Article

A Retrospective Study to Review the Anatomy of Nasolacrimal Duct in Relation to the Lateral Nasal Wall: A Cadaveric Study

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Abstract

Aim: The aim of the present study was to review the anatomy of nasolacrimal duct in relation to the lateral nasal wall.

Methods: Thirty sagittal sections of head and neck of formalin fixed adult cadavers present in the Department of Anatomy, Nalanda Medical College, Patna, Bihar, India were selected for the study. Out of thirty, sixteen sections were of left side and fourteen were of right side. The sections with damaged lateral nasal wall were not included in the study. Nasal septum was removed, the orifice of Naso lacrimal duct (NLD) was identified and exposed. The duration of study from March 2023 to February 2024.

Results: In our study the average length of the NLD irrespective of the side was 19.8±1.57mm. The intranasal orifice of the NLD was observed to be located on an average of 24.5±2.6mm from the anterior nasal spine, ranging from 5.5-2. 9mm.The average distance from the nasal roof was found to be 32.2±1.67mm and 16.08±1.71mm from nasal floor. In addition, the average distance from the anterior attachment of inferior nasal concha was found to be 14.82±2.37mm. Posteriorly the NLD has close relationship with the uncinate process and the maxillary sinus ostium. In our study the NLD was an average of 4.08±0.67mm anterior to MSO at the level of the anterior attachment of the MT. On Comparing right and left side The NLD was found to be slightly longer 22.7 in comparison of 22.2 mm on left side. The other distances of NLD from MSO were also found to be larger on left side. The distances of NLD-ANS, NLD NR, NLD -AIT and NLD- NF were also longer on left side.

Conclusion: This study attempts to provide information regarding the position and location of the NLD in relation to the important landmarks in the lateral wall of the nasal cavity. These observations in the lateral wall of the nasal cavity are important during the endoscopic interventions. In our study, average length of the NLD was 19.8mm.

Keywords: Nasolacrimal duct, Maxillary sinus ostium, nasal floor, nasal roof, Anterior attachment of inferior concha

Introduction

The Nasolacrimal duct is the terminal part of the nasolacrimal apparatus or tear apparatus. It is the inferior continuation of lacrimal sac. It courses within the maxilla and lateral nasal wall so it has two parts, The intraosseous part and membranous part. The intraosseous or proximal part enters the lacrimal groove of maxilla and descends within nasolacrimal canal of maxilla. The lower part or distal part, which is called membranous part runs in the nasal mucosa. The membranous terminates below the inferior nasal meatus as a slit like opening [1]. Tears are normally drained into nose through the inferior ostium in to the inferior meatus of the nose. Any pathology causing obstruction of the NLD can lead to the excessive overflowing of the tears over the face, called as epiphora [2] For most of the pathologies of the NLD surgery is usually the treatment of choice which can be attempted, externally or intranasally. The most favored procedure for the surgical treatment of sinonasal pathologies is endoscopic technique because it favors direct revelation, evaluation and management of the intranasal pathologies, in comparison to external cyst rhinotomy for the management of watering eye, which can leave patient with scar mark [3] Nasolacrimal duct (NLD) begins from the lacrimal sac and continues as the bony nasolacrimal duct between the lacrimal bone and maxilla. It drains into nasal cavity at the level of inferior nasal meatus. The NLD is entirely surrounded by the maxilla [4] The obstructions of the NLD are seen frequently, due to its shape. The obstructions can be either congenital

or acquired. In each instance, the etiology and the prognosis is different. [5] There are different options for the management of the obstruction; non-surgical or surgical [6-7] Detailed anatomical knowledge is of great clinical importance for to understand the etiology of the obstruction and the success of treatment techniques. There are numbers of studies that are evaluating the morphometric properties of the NLD [8-10] Nasolacrimal duct obstruction (NLDO) manifesting with epiphora is a common ophthalmic condition. [11] The obstruction can be congenital, most commonly resulting from a persistent membrane at the valve of Hasner; [12] or acquired, which could be classified as primary or secondary. [13] During probing and silicone intubation, the probe may enter the orbit or may lead to false passage formation. However, in patients with an obstruction below the canal entrance, the risk of false passage formation is lower because the obstruction point is surrounded by the bony canal. [14] This signifies the importance of knowing diameter of canal at different points. For nearly a century the gold standard treatment for epiphora and nasolacrimal duct obstruction has been dacryocystorhinostomy (DCR). Success rates of endonasal dacryocystorhinostomy should be measured and compared using strict outcome criteria taking in account both functional and anatomical success and an adequate length of follow-up. [15]

The aim of the present study was to review the anatomy of nasolacrimal duct in relation to the lateral nasal wall. [16]

Materials and methods

Thirty sagittal sections of head and neck of formalin fixed adult cadavers present in the Department of Anatomy, Nalanda Medical College, Patna, Bihar, India were selected for the study. Out of thirty, sixteen sections were of left side and fourteen were of right side. The sections with damaged lateral nasal wall were not included in the study. Nasal septum was removed, the orifice of Naso lacrimal duct (NLD) was identified and exposed. The duration of study from March 2023 to February 2024.

To have a better view, some part of inferior nasal concha was removed. The anterior part of middle nasal concha was also dissected vertically up to its anterior attachment. Then the NLD was dissected and to observe the relationship with the maxillary sinus ostium (MSO), the uncinate process and anterior part of middle turbinate (MT) were resected, sparing a small part of MT for orientation

Dimensions of duct and other following parameters were made using a digital caliper and rounded off to the nearest millimeter. All the measurements were taken thrice and average was taken.

- Length of nasolacrimal duct (NLD Length)
- Nearest distance from the nasolacrimal duct to Maxillary Sinus Ostium. (NLD- MSO)
- Nearest distance from the NLD to the anterior nasal spine. (NLD -ANS)
- Nearest distance of the intranasal orifice of the NLD to the nasal floor (NLD- NF)
- Nearest distance of the intranasal orifice of the NLD to the nasal roof. (NSD -NR)
- Nearest distance of the intranasal orifice of the NLD to the anterior attachment of the Inferior concha. (NSD -AIT)

Results

Table 1: Various parameters of Naso lacrimal duct

SIDE	NLD Length	NLD-MSO	NLD-ANS	NLD-NR	NLD-NF	NLD-AIT
RIGHT	22.2	4.3	29.4	33.9	17.09	12.5
LEFT	19.4	3.9	23.2	31.5	16.5	11.5
LEFT	22.7	4.7	22.3	32.9	16.4	12.4
LEFT	21	4.1	26.1	31.5	19.5	15.4
RIGHT	21.2	3.4	27.6	32.5	16.1	16.6
LEFT	20.2	5.5	24.8	28.8	18.5	17.5
RIGHT	22.2	4.3	26.6	32.7	19.1	14.7
LEFT	18.7	3.9	27.3	28.9	17.8	19.4
LEFT	21.2	4.2	23.8	30.8	17.4	19.6
LEFT	22.4	3.8	26.2	31.8	14.7	16.4
RIGHT	18.4	4.6	22.7	34.3	17.6	16.7
LEFT	17.8	3.2	21.5	32.4	17.2	12.4
LEFT	18.7	4.9	22.4	33.7	15.8	15.5
RIGHT	21.9	5.3	22	32.2	15.6	12.3
LEFT	18.5	4.2	24.4	30.1	16.4	11.7
LEFT	17.8	5.1	28	35.1	15.5	12.6

LEFT	18.5	4.8	30.6	32.6	15.2	11.5
RIGHT	17.5	4.2	28.2	34.2	18	12.1
RIGHT	19.4	3.81	23.8	33.9	16.2	12.7
RIGHT	18.2	4.38	22.4	33.4	13.8	16.8
RIGHT	18.9	3.8	23.6	32.8	15.4	16.6
RIGHT	20.4	3.2	21.6	31.4	12.5	13.4
LEFT	18.6	4.2	23.8	33.4	13.3	14.9
LEFT	17.9	4.3	22.5	30.1	16.7	15.1
RIGHT	20.4	2.9	21.8	31.66	15.4	17.2
LEFT	19.8	3.8	24.7	32.41	12.9	16.3
RIGHT	21.6	2.9	20.8	34.49	14.5	13.4
RIGHT	19.9	4.2	25.6	30.65	15.6	17.1
LEFT	21.2	3.9	27.3	29.99	17.01	17
RIGHT	19.8	2.9	21.9	34.43	14.9	13.4
S. D.	1.57	0.67	2.62	1.67	1.7	2.37
AVERA	19.88	4.08	24.56	32.28	16.08	14.8

In our study the average length of the NLD irrespective of the side was 19.8±1.57mm. The intranasal orifice of the NLD was observed to be located on an average of 24.5±2.6mm from the anterior nasal spine, ranging from 5.5-2. 9mm.The average distance from the nasal roof was found to be 32.2±1.67mm and 16.08±1.71mm from nasal floor. In addition, the average distance from the anterior attachment of inferior nasal concha was found to be 14.82±2.37mm. Posteriorly the NLD has close relationship with the uncinate process and the maxillary sinus ostium. In our study the NLD was an average of 4.08±0.67mm anterior to MSO at the level of the anterior attachment of the MT.

Table 2: Comparison of range between measurements of the NLD from neighbouring structures on right and left side

	Right [14]		**Left [16]**	
	Max	**Min**	**Max**	**Min**
NLD length(mm)	22.2	17.5	22.7	17.8
NLD-MSO (mm)	5.3	2.9	5.5	2.9
NLD-ANS (mm)	29.4	20.8	30.6	21.5
NLD-NR (mm)	34.9	30.6	35.1	28.8
NLD-NF (mm)	19.1	12.5	19.5	12.9
NLD-AIT (mm)	17.2	12.1	19.6	11.5

On Comparing right and left side The NLD was found to be slightly longer 22.7 in comparison of 22.2 mm on left side. The other distances of NLD from MSO were also found to be larger on left side. The distances of NLD-ANS, NLD NR, NLD -AIT and NLD- NF were also longer on left side.

Discussion

The Nasolacrimal duct is the terminal part of the nasolacrimal apparatus or tear apparatus. It is the inferior continuation of lacrimal sac. It courses within the maxilla and lateral nasal wall so it has two parts, the intraosseous part and membranous part. The intraosseous or proximal part enters the lacrimal groove of maxilla and descends within nasolacrimal canal of maxilla. The lower part or distal part, which is called membranous part runs in the nasal mucosa. The membranous terminates below the inferior nasal meatus as a slit like opening.[16] Tears are normally drained into nose through the inferior ostium in to the inferior meatus of the nose. Any pathology causing obstruction of the NLD can lead to the excessive overflowing of the tears over the face, called as epiphora. [17]

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development of nasolacrimal duct in the nasolacrimal apparatus begins at five weeks of gestation. It starts as a linear thickening of ectoderm, present at the junction nasal and maxillary prominences. This Thickening later invades and forms a groove. The thickening in the groove gradually separates and forms a a solid cord. This cord further sinks into the surrounding mesenchyme. Gradually with the development this cord canalizes and forms proximally the lacrimal sac and distally the nasolacrimal duct. [18] This solid nasolacrimal duct extends intranasally to open in the infe- rior meatus under the inferior turbinate. Gradually the inside of the cord breaks down and forms a lumen so this forms a continuous canal from orbit to inferior meatus of lateral nasal wall. This process is generally complete by the time of birth. Tears are formed in the lacrimal gland. They are poured into conjunctival sacs. Most of the tear's fluid evaporates and the remaining fluid is drained into the nose through the NLD. In cases of incomplete canalization of lacrimal duct epiphora or excessive lacrimation occurs because of incomplete drainage of the tears. To expose the nasolacrimal apparatus for dacryocystorhinostomy (DSR) is done by surgeons both externally as well as through the nose. Endoscopic techniques is preferred by the surgeons nowadays in comparison to the external surgery. [19,20]

During cannulation of NLD from above or from inferior opening, length becomes vital in selecting the probe length so as to prevent sur- rounding visceral injury. The uncinate process and ostium of maxillary sinus are chief landmarks to determine the location of the NLD. The uncinate process is related just posterior to the NLD, which is only 4mm anterior to maxillary sinus ostium. These relationships play vital role during endoscopic sinus surgery. During maxillary sinus antrostomy, first of all, uncinate process is removed and then maxillary sinus ostium is enlarged anteriorly with the help of back-biting forceps. When these procedures are attempted, the NLD is at risk of injury due to its close relationship with the uncinate process and maxillary sinus ostium. Therefore, a good knowledge of surgical anatomical relationships plays a vital role to prevent unintended injury during endoscopic sinus surgery. The iatrogenic injury to NLD following endoscopic sinus surgery has been accounted to be 0.3-1.7%. [21-26]

Conclusion

This study attempts to provide information regarding the position and location of the NLD in relation to the important landmarks in the lateral wall of the nasal cavity. These observations in the lateral wall of the nasal cavity are important during the endoscopic interventions. In our study, average length of the NLD was 19.8mm.

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