

INTRANASAL ANATOMY OF NASOLACRIMAL SAC IN ADULT HUMAN CADAVER

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ABSTRACT

Obstructive epiphora is a common problem especially among adult and elderly. Dacryocystorhinostomy (DCR) is the treatment of choice for the obstruction. Anatomical variations of the lacrimal sac make DCR localization,difficult to have reproducibility endonasally. **Objective:** To establish the accurate intranasal anatomical landmarks for easier localization of the lacrimal sac through the lateral nasal wall during endoscopic DCR (EDCR). **Setting:**Anatomy and Otorhinolaryngolog departments,Zagazig University. **Patients and methods:** Ten adult cadaver sagittal head sections were evaluated. During dissections, the maxillary line, , axilla of middle turbinate, and lacrimal sac(LS) were exposed.The relations between the sac especially its inferior border and axilla of middle turbinate, maxillary line and its (M) point were studied.**Results:**The mean height of LS was 11.2mm, whereas the mean width was 4.5mm.The right and left sides did not show any significant statistical difference.The upper border of the LS was situated above the axilla in all cases. The anterior border of LS was anterior to the axilla in 70% ,while the posterior border of the sac was posterior to the axilla in 80% of cases.The study evaluated the localization of LS to the maxillary line, which is of clinical importance in intranasal osteotomy during DCR.The lower border of LS was at same level of (M) point in 60%,while it was higher than this level in 30%, and below it in 10%. **Conclusion:** Localization of the inferior part of LS is valid in 60% of cases and very difficult and hazardous in 40%.. The accuracy of localization of the LS can be increased by using intrasac fiberoptic transillumination using halogen light or laser beam.

INTRODUCTION

The nasolacrimal duct stenosis causes constant epiphora. DCR is the surgical procedure of choice for the treatment of these conditions and it is based on creating a permanent communication between the LS and the nasal cavity by means of a bony window. DCR can be carried out externally , or endonasal (1). EDCR enables improved visualization, does not pose any risk of creating a lesion in the medial palpebral ligament and orbicularis oculi, does not require an external incision and thus presents a cosmetic advantage, prevents angular vein damage, spares the pumping function of the nasolacrimal system, and promotes faster healing(2). Nonetheless, EDCR still hazardous because of there is no specific anatomical landmark of the inferior part of the LS where the stoma should be created. There are significant anatomical variations in the middle meatus regarding its conventional reference points (axilla of middle concha, uncinat process, ethmoidal bulla, the

maxillary line and the midpoint of the maxillary line(M point) and of these with the lacrimal pathway, making it difficult to have a reproducible technique to approach the lacrimal pathway through the lateral nasal wall based solely on anatomical parameters(3)

The maxillary line is protrusion that lies as a curved line from the axilla of the middle turbinate to the inferior turbinate.This line is corresponded intranasally to the junction of the uncinat and maxilla and extranasally to the suture line between the lacrimal bone and maxilla within the lacrimal fossa. This suture was approximately half way between the anterior and posterior crests. Axially, the plane of the M point corresponded to the superior margin of the maxillary sinus ostium posteriorly (average 10 mm) and was just inferior to the lacrimal sac-duct junction anteriorly (4) .Due to the possibility that such inconsistent anatomical landmarks, cadaver studies are still an invaluable approach by which

surgeons can increase their knowledge and understanding of the anatomy of the area (5).

The aim of this study is to detect specific intranasal anatomical landmarks for easier localization of LS during EDCR so as to increase success rate and decrease complications. To achieve this goal cadaveric head dissection will be done with special emphasis on medial wall of the lacrimal fossa and its relation to the lateral nasal wall.

MATERIALS AND METHODS

The study was conducted in the Anatomy department, faculty of medicine, Zagazig university between April 2010 and March 2011 on 10 half-heads of adult human cadavers (two female, 8 male), of which six were the left side and four were the right side.

Each skull was examined endoscopically (0,30 degree) regarding the structure of the lateral nasal wall (axilla of middle turbinate, M point of maxillary line) in relation to the lacrimal sac. The sac was injected with methylene blue via its punctum to outline it (figure1), then external dissection included removal of skin, subcutaneous tissues, muscles covering the sac, then it was dissected freely from the surrounding tissues. The lacrimal bone was drilled by small burr from the external through the nasal cavity at the point of upper, lower, anterior, posterior borders of the lacrimal sac, then thin wires were passed along the holes to the nasal cavity (figure2), followed by examination of the lateral nasal wall. The skull was mid sagittally bisected using a saw with removal of the nasal septum using sharp scissor (figure3). During the dissection the maxillary line was determined by retraction of the middle turbinate superiorly (figure4). The mucosa and periosteum in front of the uncinat process were elevated and the lacrimal bone was exposed (figure5). The LS was dissected by removal of the lacrimal bone and the

relation of these structures to the lateral nasal wall landmarks were observed.

The height and width of the lacrimal sac, as well as the distance from the upper, lower, anterior and posterior border of LS to the axilla of the middle turbinate were recorded. Also, the relation between the (M) point and both the axilla and the inferior border of the LS was determined (figure 6).

RESULTS

The average length of LS was between 6-18 mm and width was between 4-6 mm, there was no significant difference between mean value of right and left sided (Table1).

The relations among anatomical structures were evaluated. The mean distances from the LS borders to the axilla were studied (Table2). The upper border of the LS was located superior to the axilla of the middle turbinate in all cases (100%), while the lower border was located at about 5.6 mm below the axilla in 6 cadaver (60%), about 4mm below the axilla in 2 cadaver (20%), about 8mm below the axilla in one cadaver (10%), and at the same level of the axilla in one cadaver (10%) –(Table3).

The anterior border of the LS was anterior to the axilla in 7 cadaver (70%), while it was at the same level of the axilla in 2 cadaver (20%), and it was behind the axilla in one cadaver (10%) –(Table 3). The posterior border of 8 sacs was located posterior to the axilla (80%), and at the same level in 2 cadaver (20%) –(Table 3).

In this study, the mean distance between (M) point of the maxillary line and axilla was about 6mm. Regarding the relation of the inferior part of the LS to the (M), cadaveric dissection revealed that the lower part of LS was at the same level of (M) point in 6 cadaver (60%), while was higher than the (M) point in 3 cadaver (30%), and below it in 1 cadaver (10%) –(Table 4). The maxillary line was corresponded with the lacrimal sac in 8 of 10 cadaver and it was totally anterior to the sac in 2 of 10 cases (figure7).

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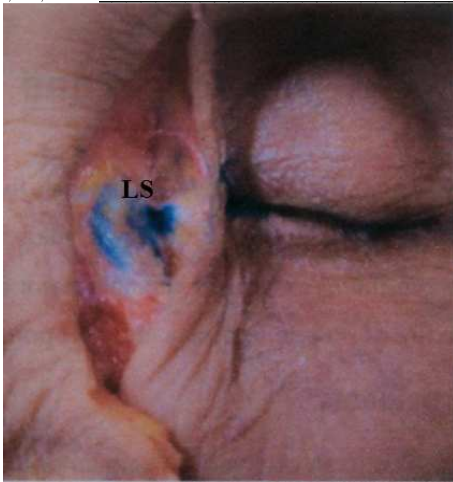


Figure 1. Dissected LS filled with methylene blue

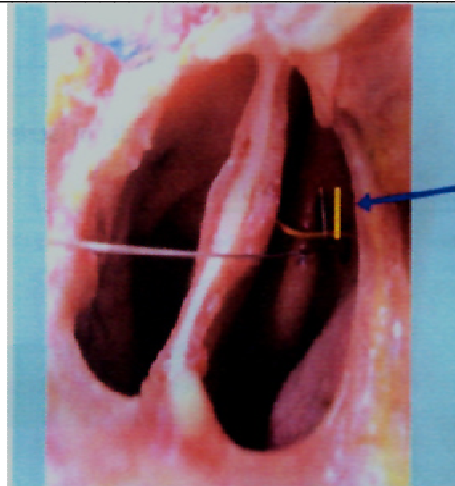


Figure 2. Wire passing through the lower border of LS and the distance from it to the axilla is measured

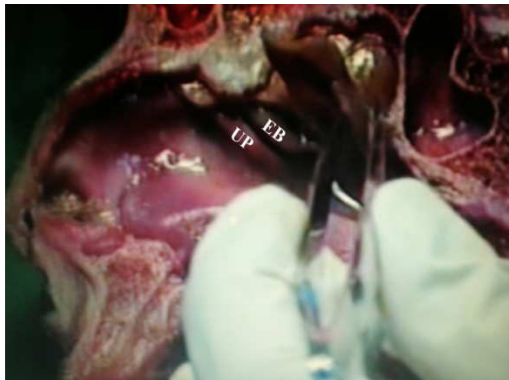


Figure 3. Anatomy of the lateral wall of nasal cavity after elevation of middle turbinate. UP (uncinate process), EB (ethmoidal bulla)

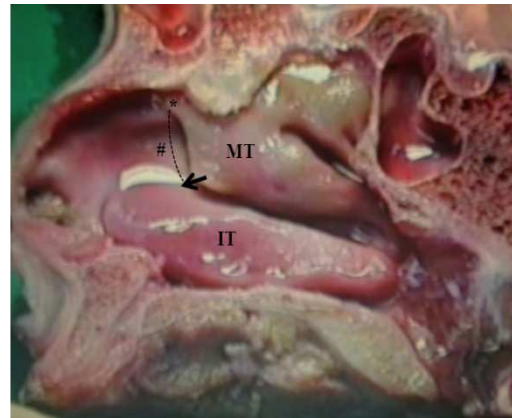


Figure 4. the maxillary line extended from the axilla (*) to the root of inferior turbinate (←). M point of maxillary line.



Figure 5, The mucosa at LS and NLD was elevated to expose the lacrimal bone(*).

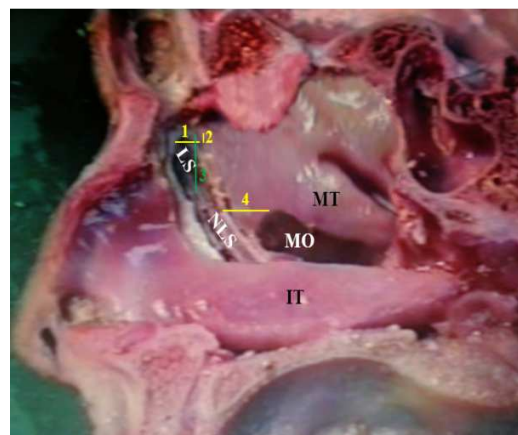


Figure 6. The distances between the axilla and the upper border of LS (1), between axilla and anterior border (2), and between axilla lower border of LS (3). The line (4) extend from upper border of maxillary ostium (MO) to the junction between LS and NLD (M point).

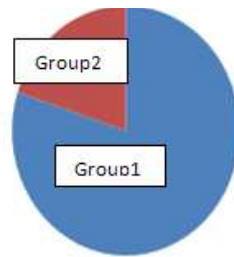


Figure7 : The relation between LS and maxillary line. group1 The line was corresponded with LS (80%). group 2 the line was totally anterior to the LS(20%).

TABLE (1) : The height and width of LS .

DISTANCES	HEIGHT(mm)	WIDTH(mm)
Mean	11.2	4.5
Median	11	4
SD	3.1	0.85

TABLE (2) The mean distances from the upper ,lower,posterior and anterior borders of LS to the axilla.* Minus value means that the anterior border located posterior to the axilla.

	Upper border	Lower border	Anterior border	Posterior border
Rang (mm)	2-9	0-8	(-2)*-(7)	0-6
Mean (mm)	4.9	5.6	3.0	2.9
SD	1.8	1.7	2.2	2.3

Table 3: Relation between LS borders and axilla * means significant value.

Relation of LS to axilla	Number	Percentage	Probability
Upper border of LS	10	100%	
1-superior to axilla			
Posterior border of LS			
1-posterior to axilla	8*	80%	0.007*
2-At same level	2	20%	
Anterior border of LS			
1-Anterior to axilla	7*	70%	0.009*
2-At same level	2	20%	
3-Posterior to axilla	1	10%	
Lower border of LS			
1-Below axilla by 5.6mm	6*	60%	0.028*
2- Below axilla by 4mm	2	20%	
3- Below axilla by 8mm			
4-At same level of axilla	1	10%	
	1	10%	

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Table 4 : Distance between inferior border of LS and both axilla and M point.

Relation of inferior border of LS&(M) point	Distance of inferior border of LS&axilla	Number of cadaver	Total number	Percentage
Above M point	0 mm	1	3	30%
Above M point	4mm	2		
At same level	5.6mm	6	6	60%
Below M point	8mm	1	1	10%
Mean±SD	4.96±2.05		P = 0.057	
Rang	0-8			

DISCUSSION

The anatomy of the LS is important to ophthalmologist and otorhinolaryngologist for formulation of the principles and techniques in the management of lacrimal problems. A very common problem is watering from the eye (epiphora) due to hypersecretion , failure of the lacrimal pump or obstruction of the lacrimal passage. The obstruction of the lacrimal passage is the most common cause of epiphora. With the popularity of endoscopic surgery for DCR , knowledge of the lacrimal system anatomy has become essential .Many factors are responsible for the failure of the endonasal DCR approach: the dimension of the bony ostium, localization of this part, and the size of the lacrimal sac, which may differ from patient to patient(6). Welham and Wulc(7) revealed that the size of the ostium and its localization were responsible for most of DCR failures. To obtain the best result, current studies suggest the necessity of opening the ostium as wide as possible in surgical procedures. The surface anatomy of the lacrimal sac in the nasal cavity is also an important factor.

Relevant landmarks are required to better localization of the lacrimal sac on the lateral wall. The maxillary line and axilla of the middle turbinate are the most frequently used anatomical landmarks . When one takes the anatomical variations into consideration, the performance of a mucosal incision and osteotomy in a safer

area is essential for more reliable and functional results(8).

In this study, the relationship of the maxillary line to the lacrimal sac after the removal of the bony structure was observed: the maxillary line overlapped the lacrimal sac at a ratio of 8:10. In 2 cases, LS was situated entirely posterior to the maxillary line. In gree , *Orhan et al.* (9) stated that , the rate of reaching the lacrimal sac is 90% through an incision performed anterior to the maxillary line, whereas, in 10% of cases in which the lacrimal sac wall is not visible, the conducting of mucosal elevation and osteotomy more posteriorly is sufficient to reveal the lacrimal sac wall.

Most authors defined the axilla of the middle turbinate as the upper border of the LS(10-11).This study revealed that the upper border of LS was located superior to the axilla in all cadaver (100%) inspite of in most anatomical drawings and definitions, 0% to 20% of the lacrimal sac is found to be situated superior to the axilla of the middle turbinate(12). In agree with our results,*Orhan et al.*(9) concluded that the lacrimal sac is located superior to the axilla of the middle turbinate and it may be the most reliable landmark in the localization of the LS and the most appropriate mucosal incision is that which is placed 8 to 9 mm anterior to, and reaches 8 to 9 mm superior to the axilla of the middle turbinate.

The anterior border of the LS was anterior to the axilla in 70% of the cadaver

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while the posterior border was located posterior to the axilla in 80% of the cadaver, these results agree with the results of Pearlman et al.(13) who stated that in most cases the LS lies anterior to axilla.

Also as regard the relation between lower part of LS and M point of maxillary line which was proposed by Chastain et al.(4) as a sure sign of the lower point of the sac. Our study revealed that this relation was true only in six cadavers (60%), while it was higher than M point in 30% and below this point in 10% of the cadavers.

The results of this study stated that the superior border of LS in all cadavers was located superior to the axilla of the middle turbinate and so the axilla may be considered as a reliable landmark for intranasal localization of the LS, but the problem was that the anterior and posterior borders of LS had no fixed relation to the axilla. The M point does not landmark the inferior border of LS in 40% of the cadaver, and this explains the difficulty that faces surgeons in localizing the inferior part of LS during EDCR in good percentage of the cases.

CONCLUSION

Topographic localization of the lacrimal sac should be presumed with the help of landmarks, the axilla of the middle turbinate is a reliable landmark. The accuracy of localization of the LS can be increased by using intrasac fiberoptic transillumination using halogen light or laser beam.

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الدراسة التشريحية للكيس الدمعي داخل الانف في الجثث البشرية

تفرز الغدد الدمعية الدموع لغسيل العين وسلامتها ثم تتجمع في الحويصلة الدمعية ومنها الى الانف عن طريق القناة الدمعية. تتسد القنوات الدمعية ما بين الحويصلة الدمعية والانف مما ينتج عنه كثرة الدموع. يتم علاج هذه المشكلة عن طريق عملية تجرى من خارج الانف يتم فيها توصيل الحويصلة الدمعية بالانف بدون المرور بالقناة الدمعية، وتجرى العملية الان من داخل الانف باستخدام المنظار الانفي للتغلب على عيوب العملية من خارج الانف. تهدف هذه الدراسة الى تحديد علامات تشريحية داخل الانف تسهل الوصول للكيس الدمعي من داخل الانف مما يؤدي الى زيادة معدلات نجاح العملية ويقلل من المضاعفات. اجريت الدراسة التشريحية على عشرة جثث ، وقد اظهرت الدراسة ان الحد الاعلى للحويصلة الدمعية يقع اعلى التصاق الجزء الامامي من غضروف الانف الاوسط في كل الجثث (100%) ، اما الحدود الامامية ، الخلفية، السفلية للحويصلة الدمعية وايضا علاقتها بمنتصف الخط الوجني فهي مختلفة النسبة من جثة لآخرى. اثبتت الدراسة انه يمكن الاعتماد على منطقة التصاق الجزء الامامي من غضروف الانف الاوسط كعلامة تشريحية ثابتة مع مد الشق الجراحي مسافة [سنتيمتر اعلى منه المنطقة ، كما يمكن زيادة نسب النجاح باستخدام الاضاءة من داخل الكيس الدمعي.