

Morphological and morphometrical study of the nasal opening of nasolacrimal duct in man

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Background: Epiphora constitutes one of the major and very common problems in all age groups. Recent developments in ophthalmology such as balloon dilatation, stent implantation, laser therapy and endoscopy of the lacrimal drainage system raise the need for a detailed anatomical knowledge of this system. It is also important for formulation of principles and techniques in the management of lacrimal problems. The aim of this study was to demonstrate variations in shape, size and location of the opening of the nasolacrimal duct and of the lacrimal fold.

Materials and methods: Twenty sagittal head sections were obtained, the nasal septum was removed and the lateral wall of the nasal cavity was exposed and examined. The opening of the nasolacrimal duct (NLD) was demonstrated and was subjected to anatomical observations for the shape, site, size, opening type and the presence of the lacrimal fold. The different measurements for the distances between the opening of NLD and anterior nasal spine, palate and inferior concha were made.

Results: The examined specimens showed that the opening of the NLD was variable in shape taking the form of sulcus in 70% and fissure in 30% of specimens. The sulcus was either vertical or oblique while the fissure was either vertical, oblique or in the form of anteroposterior one. Regarding the location, the opening of the NLD was located at anterior one third below line of attachment of the inferior concha in nearly half of cases (45%). The lacrimal fold was present in most of examined specimens (70%) and absent in 30%. The fold take 5 different forms.

Conclusions: The knowledge of the morphology and morphometry of the lacrimal drainage system enables the ophthalmologist to plan intervention on the lacrimal drainage system precisely and avoid unnecessary manipulations and also minimizing the risk of injury during intra-nasal surgery. (Folia Morphol 2014; 73, 3: 321–330)

Key words: nasolacrimal duct (NLD) opening, morphology of NLD, morphometry of NLD

INTRODUCTION

Epiphora constitutes one of the major and very common problems in all age groups [1]. Recent developments in ophthalmology, such as balloon dilatation, stent implantation, laser therapy and endoscopy

of the lacrimal drainage system, raise the need for a detailed anatomical knowledge of this system. It is also important for formulation of principles and techniques in the management of lacrimal problems [10, 11].

With the popularity of endoscopic surgery for dacryocystorhinostomy, knowledge of the nasolacrimal duct (NLD) has become essential in spite of the fact that the description regarding the anatomy of the duct is vague in the text books and medical literatures [9].

Functional endoscopic sinus surgery (FESS) of the paranasal sinuses is widely accepted as the main surgical procedure for chronic sinusitis. In FESS, access to the maxillary sinus is usually made from the natural ostium in the middle meatus. However, the surgical production of an inferior meatal window facilitates the treatment and observation of lesions inside the sinus during and after surgery [8]. With these techniques, the only important anatomical features seen in the inferior nasal meatus are the opening of NLD and the lacrimal fold [1, 2].

The opening of the NLD into the nose through an ostium in the inferior nasal meatus is usually partially covered by a mucosal fold called the lacrimal fold [1, 3, 12]. The configuration of this opening varies, but it is located relatively anteriorly in the inferior nasal meatus, approximately 2.5 cm posterior to the nares in adults [3, 12]. A variable valve is reported to be just above this opening [12, 15]. Another application is in NLD obstruction, a relatively common condition in adults and neonates. The dacryoendoscope and a nasal endoscope are extremely useful in investigating the site of NLD obstruction [10, 11]. Narrow opening of NLD may predispose to chronic inflammation of the nasolacrimal drainage system [13]. These data provide valuable anatomical information to the surgeon performing endonasal dacryocystorhinostomy [13].

The aim of this study was to demonstrate variations in shape, size and location of the opening of the NLD and of the lacrimal fold. These quantitative anatomical observations provide a contributory factor to explain the increased prevalence of primary acquired NLD obstruction and to discuss the importance of such knowledge in minimizing the risk of injury during intra-nasal surgery.

MATERIALS AND METHODS

Morphological study

Twenty sagittal head sections were obtained randomly from formalin-fixed dissecting room cadavers (11 right side and 9 left side). Each section was from a different cadaver and the sex was not identified. The specimens were obtained from Anatomy Department, Faculty of

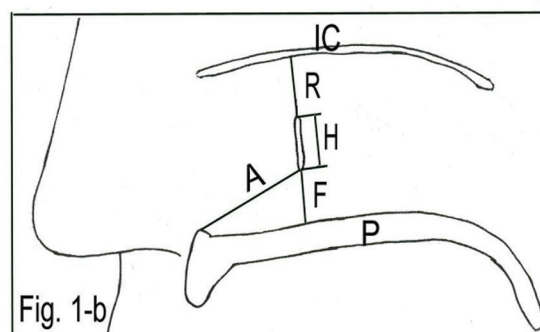
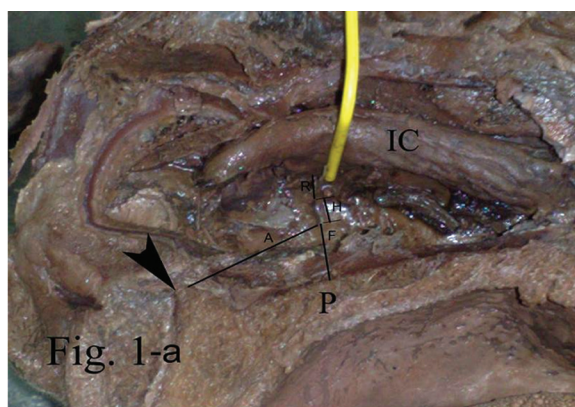


Figure 1. a. Sagittal section of an adult right head showing measurements of different distances applied in the current study: **Distance (R)**: the vertical distance between the attachment line of the inferior concha (IC) to the lateral wall of nasal cavity and the superior point of the opening of nasolacrimal duct (NLD); **Distance (H)**: the vertical length of the opening of the NLD; **Distance (F)**: the distance between the inferior point of the opening of the NLD and the floor of the nasal cavity (P); **Distance (A)**: the distance between the inferior point of the opening of the NLD and the anterior nasal spine (arrow head); **b.** Diagrammatic illustration of Figure 1a.

Medicine, Cairo University, Egypt. The cadavers were of average adult age nearly ranged 30–60 years and showed no evidence of pathology, trauma or apparent abnormality. The specimens were dissected, the nasal septum was removed and the lateral wall of the nasal cavity was exposed and examined. The inferior nasal concha was retracted upward to demonstrate the opening of the NLD. Anatomical observations were made for the shape, site, size, opening types of the NLD and the presence of the lacrimal fold. The distances and diameters were measured with Verner calliper to the nearest 0.1 mm.

Morphometrical study

The following distances were measured according to Orhan et al. [9] and Tatlisumak et al. [13] (Fig. 1): — distance (R) — the vertical distance between the

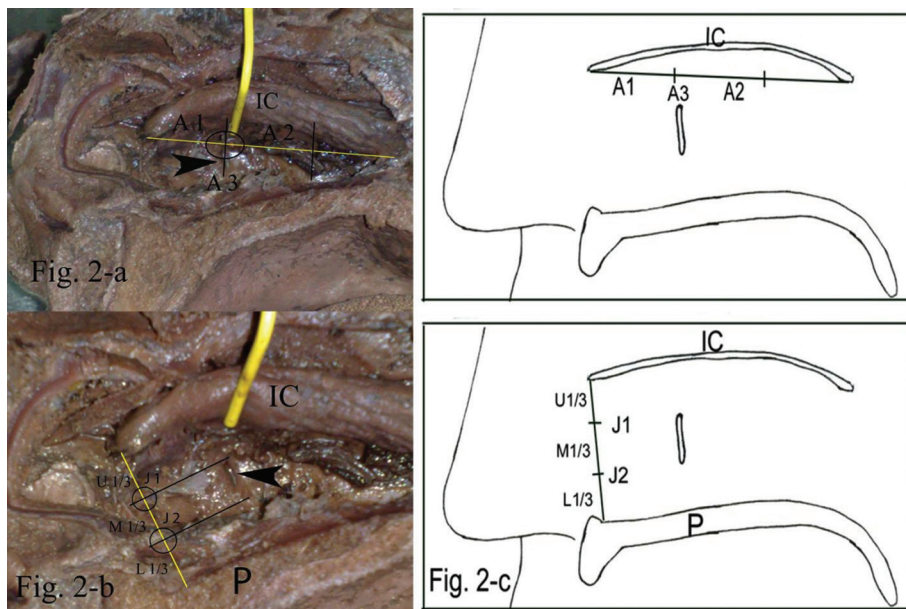


Figure 2. Sagittal section of an adult right head showing the different locations of the opening of nasolacrimal duct (NLD) (arrow head); **a.** In relation to the inferior concha (IC): **Location A1:** the opening is located at the anterior third below line of attachment of the IC; **Location A2:** the opening is located at the middle third below line of attachment of the IC; **Location A3:** the opening of the NLD is located at the junction between anterior and middle third below the line of attachment of the IC; **b.** In relation to the distance between the IC and the floor of the nose (P): **U1/3:** the opening of NLD is located in the upper third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity; **M1/3:** the opening of NLD is located in the middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity; **L1/3:** the opening of NLD is located in the lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity; **J1:** the opening of NLD is located at the junction between upper and middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity; **J2:** the opening of NLD is located at the junction between middle and lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity; **c.** Diagrammatic illustration of Figure 2a and 2b.

- attachment line of the inferior nasal concha to the lateral wall of nasal cavity and the superior point of the opening of NLD;
- distance (H) — the vertical length of the opening of the NLD. If horizontal, the anteroposterior diameter was measured;
- distance (F) — the distance between the inferior point of the opening of the NLD and the floor of the nasal cavity;
- distance (A) — the distance between the inferior point of the opening of the NLD and the anterior nasal spine.

The location of the opening of NLD was investigated according to Orhan et al. [9] and Tatlisumak et al. [13] (Fig. 2):

- A.** Location in relation to the line of attachment of inferior concha:
- location A1 — the opening located at the anterior third below line of attachment of the inferior concha between it and the floor of nasal cavity;

- location A2 — the opening located at the middle third below line of attachment of the inferior concha between it and the floor of nasal cavity;
- location A3 — the opening of the NLD was located at the junction between anterior and middle third below the line of attachment of the inferior concha.

B. Location in relation to the distance between the inferior concha and the floor of the nose:

- U1/3 — the opening of NLD located in the upper third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity;
- M1/3 — the opening of NLD located in the middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity;
- L1/3 — the opening of NLD located in the lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity;

- J1 — the opening of NLD located at the junction between upper and middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity;
- J2 — the opening of NLD located at the junction between middle and lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity. The obtained data were tabulated and subjected for statistical analysis.

RESULTS

Morphologically, the examined specimens showed that the opening of the NLD was variable in shape taking the form of sulcus in 14 out of 20 (70%) specimens and fissure in 6 out of 20 (30%) specimens. The sulcus was either vertical or oblique while the fissure was either vertical, oblique or in the form of anteroposterior one. The different forms of NLD were classified in the current study into following types:

- type I — the NLD was in the form of vertical sulcus in 12 of 20 (60%) specimens, which may be elliptical (Fig. 3), slit (Fig. 4) or hockey stick like (Fig. 5);
- type II — the NLD was in the form of an oblique sulcus in 2 of 20 (10%) specimens (Figs. 6, 7);
- type III — the NLD was in the form of a vertical fissure in 3 of 20 (15%) specimens (Figs. 8–10);
- type IV — the NLD was in the form of an oblique fissure in 2 of 20 (10%) specimens (Figs. 11, 12);
- type V — the NLD was in the form of an anteroposterior fissure in 1 of 20 (5%) specimens (Fig. 13).

The different shapes and sites of the opening of the NLD were illustrated in Figure 14 while the different types of the opening of the NLD in relation to the number of specimen were shown in Figure 15.

Regarding the location of the opening of the NLD the following observations were made:

- A.** Location in relation to the line of attachment of inferior concha:
- the opening of the NLD was located at the anterior one third below line of attachment of the inferior concha (location A1) in 9 out of 20 (45%) specimens (Figs. 4, 6, 7, 10–12);
 - the opening of the NLD was located at the middle one third below line of attachment of the inferior concha (location A2) in 3 out of 20 (15%) specimens (Fig. 8);
 - the opening of the NLD was located at the junction between anterior and middle third below the line



Fig. 3-a

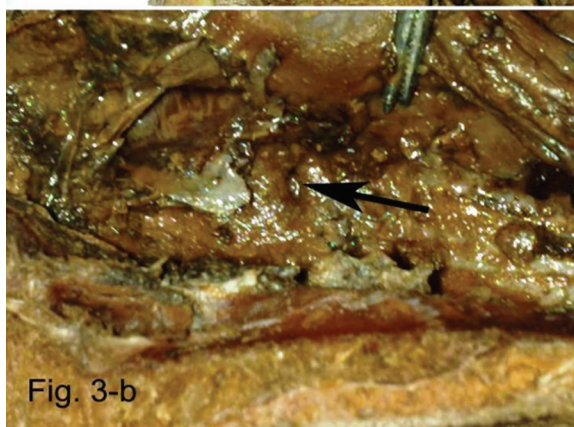


Fig. 3-b

Figure 3 a, b. Sagittal section of adult heads showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of an elliptical vertical sulcus with no mucosal fold. The opening of the NLD is located at the junction between anterior and middle third below the line of attachment of the inferior concha (**location A3**). The opening of NLD is located at the junction between upper and middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity

of attachment of the inferior concha (location A3) in 8 out of 20 (40%) specimens (Figs. 3, 9).

B. Location in relation to the distance between the inferior concha and the floor of the nose:

- U1/3 — the opening of NLD was located in the upper third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity in 7 out of 20 (35%) specimens (Figs. 6, 7, 11, 12). In 4 of them the opening was in the form of vertical sulcus and in the other specimens it was oblique fissure. Five of these specimens had mucosal folds on the superior edge of the opening while in the rest of specimens, the mucosal fold around the opening was absent in one specimen;
- M1/3 — the opening of NLD was located in the middle third of the distance between the at-

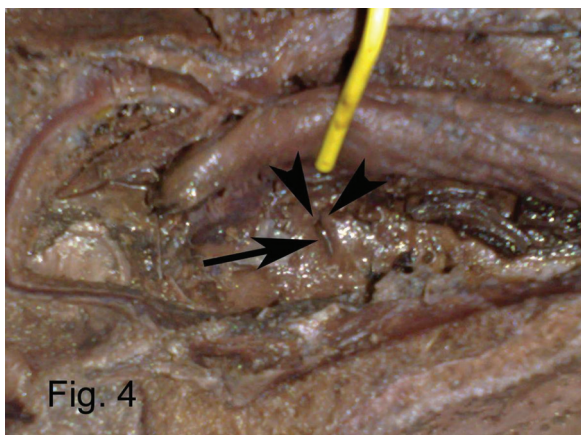


Figure 4. Sagittal section of an adult head showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of slit like vertical sulcus with small rudimentary mucosal folds (arrow heads) projecting anteriorly and posteriorly from the upper end of the duct. The opening of the NLD is located at anterior one third below line of attachment of the inferior concha (**location A1**). The opening of NLD is located in the middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity.

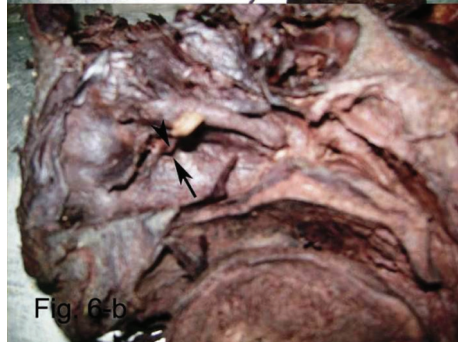
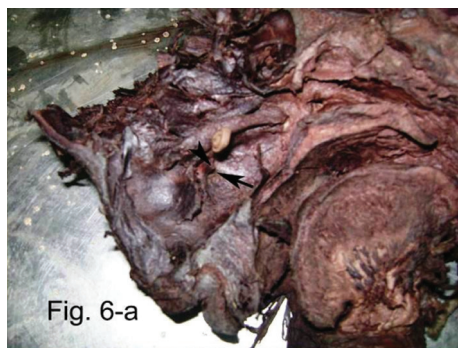


Figure 6 a, b. Sagittal section of adult heads showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of an oblique sulcus with a large mucosal fold on its upper edge (arrow head). The opening of the NLD is located at anterior one third below line of attachment of the inferior concha (**location A1**). The opening of NLD is located in the upper third of the distance between the attachment line of inferior nasal concha (IC) and the floor of nasal cavity.

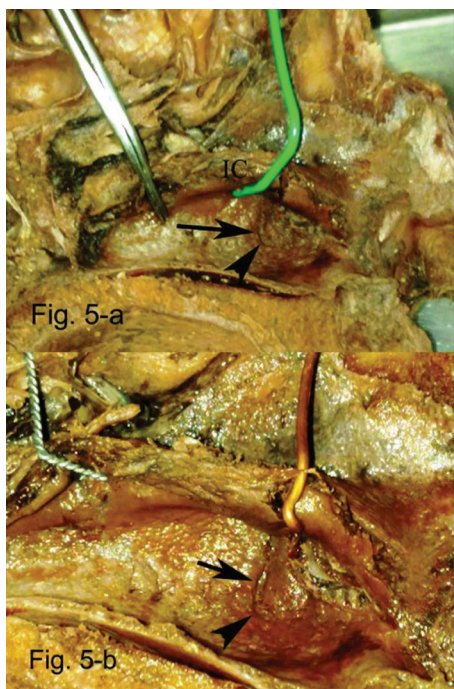


Figure 5 a, b. Sagittal section of adult heads showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of hockey stick like vertical sulcus. Small rudimentary mucosal fold (arrow head) overlapping the lower end of the duct. Note there is no lacrimal valve. The opening of NLD is located at the junction between middle and lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity.

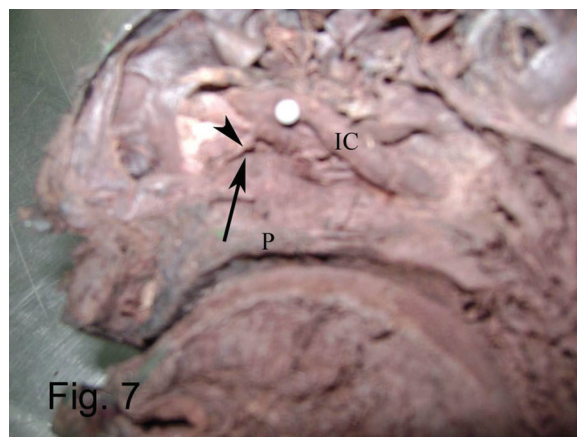


Figure 7. Sagittal section of an adult head showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of an oblique sulcus with a large mucosal fold on its anterosuperior edge (arrow head). Note the inferior concha (IC) and the palate (P). The opening of the NLD is located at anterior one third below line of attachment of the IC (**location A1**). The opening of NLD is located in the upper third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity.

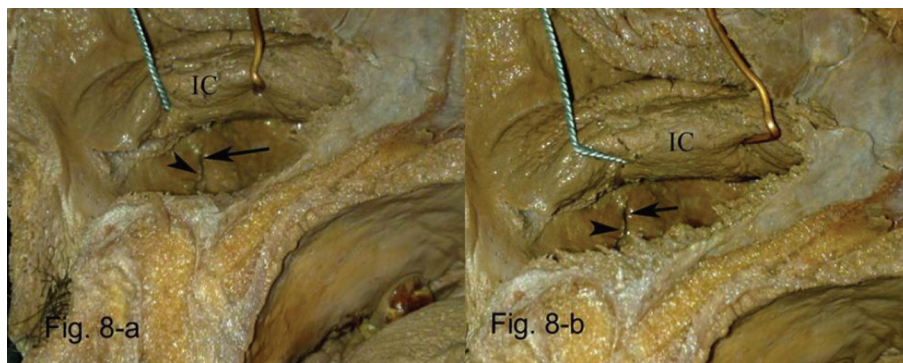


Figure 8 a, b. Sagittal section of adult heads showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of vertical fissure with a large mucosal fold on its anterior edge (arrow head). Note the inferior concha (IC). The opening of the NLD is located at middle one third below line of attachment of the IC (**location A2**). The opening of NLD is located in the lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity.

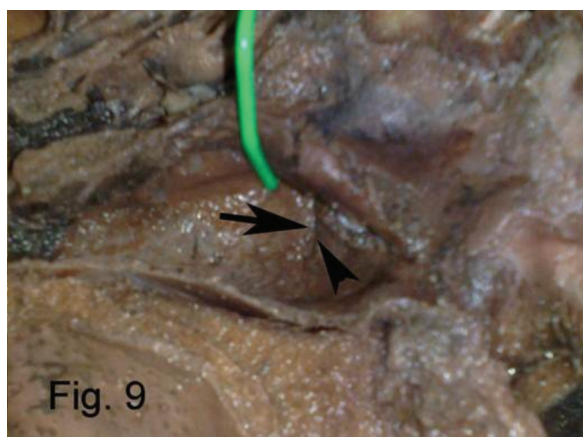


Figure 9. Sagittal section of an adult head showing the opening of the nasolacrimal duct (NLD) (arrow head) in the form of vertical fissure with a large posterior mucosal fold (arrow) completely hiding the opening of the duct. The opening of the NLD is located at the junction between anterior and middle third below the line of attachment of the inferior concha (**location A3**). The opening of NLD is located at the junction between upper and middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity.

attachment line of inferior nasal concha and the floor of nasal cavity in 6 out of 20 (30%) specimens (Figs. 4, 10, 13). In 4 of these specimens, the NLD opened as a vertical fissure, in 2 of them it was an oblique sulcus, and in 2 of them the opening was an oblique fissure.

The lacrimal fold was present on the anterior edge of the opening in 2 specimens, and on anterior and inferior edges in 2 specimens. Two of 6 specimens had no mucosal fold at the opening.

— L1/3 — the opening of NLD was located in the lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal

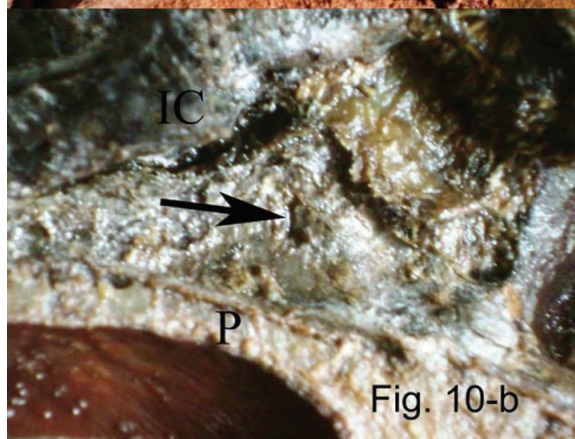
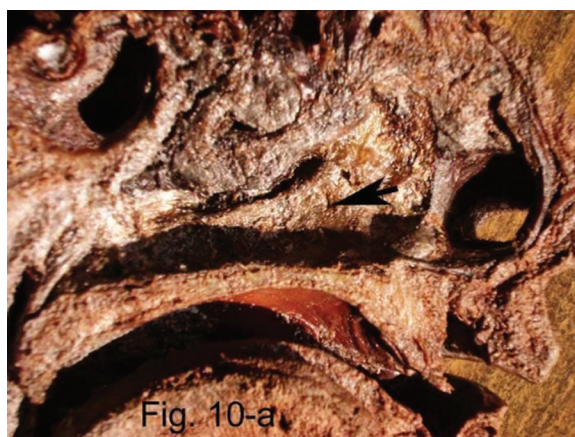


Figure 10 a, b. Sagittal section of adult heads showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of vertical fissure with no mucosal (lacrimal) fold. The opening of the NLD is located at anterior one third below line of attachment of the inferior concha (**location A1**). The opening of nasolacrimal duct is located in the middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity. Note the palate (P).

cavity in 1 case out of 20 (5%) (Fig. 8). In this specimen, the opening was in the form of vertical fissure and had anterior lacrimal fold.

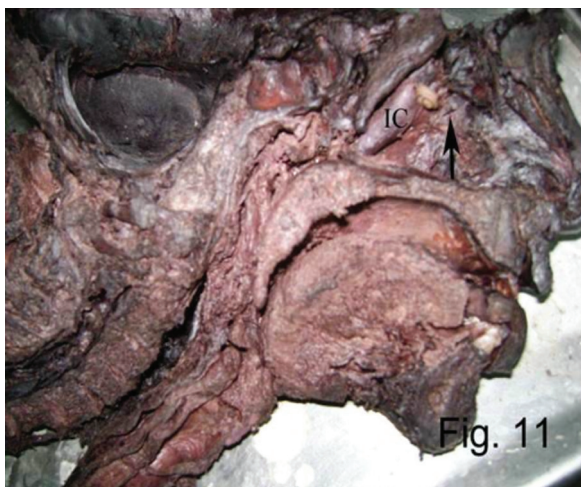


Figure 11. Sagittal section of an adult head showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of an oblique fissure with no (lacrimal) mucosal fold. Note the inferior concha (IC). The opening of the NLD is located at anterior one third below line of attachment of the IC (**location A1**). The opening of NLD is located in the upper third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity.

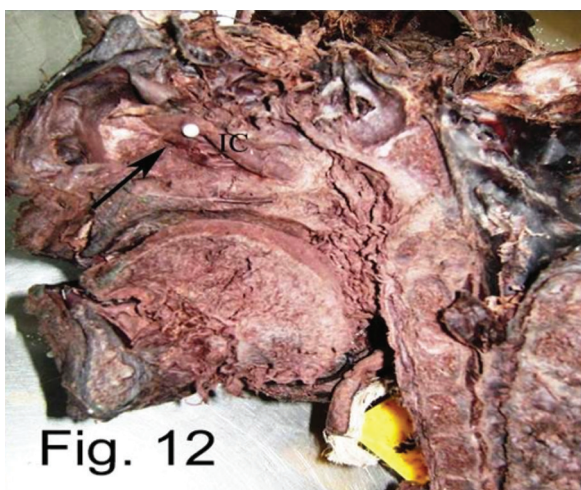


Figure 12. Sagittal section of an adult head showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of an oblique fissure with no mucosal (lacrimal) fold. The opening of the NLD is located at anterior one third below line of attachment of the inferior concha (IC) (**location A1**). The opening of NLD is located in the upper third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity.

— J1 — the opening of NLD was located at the junction between upper and middle third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity in 4 out of 20 (20%) specimens (Figs. 3, 9). The form of the opening was a vertical sulcus in all of them. The

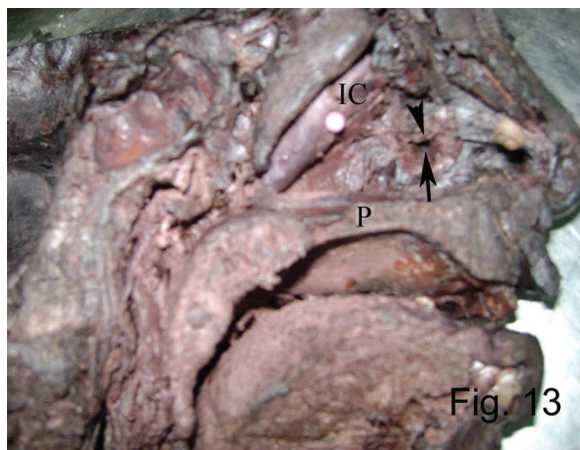


Figure 13. Sagittal section of an adult head showing the opening of the nasolacrimal duct (NLD) (arrow) in the form of an anteroposterior fissure with a mucosal fold on its upper edge (arrow head). The opening of NLD is located in the middle third of the distance between the attachment line of inferior nasal concha (IC) and the floor of nasal cavity (P).

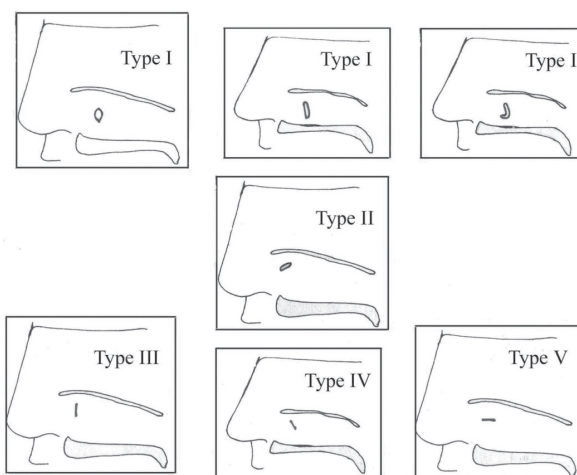


Figure 14. Diagrammatic illustration of different shapes and sites of nasolacrimal duct.

lacrimal fold was on the anterior and posterior edges in 3 specimens and absent in 1 specimen; — J2 — the opening of NLD was located at the junction between middle and lower third of the distance between the attachment line of inferior nasal concha and the floor of nasal cavity 2 out of 20 (10%) specimens (Fig. 5).

The lacrimal fold was present in most of examined specimens (14 out of 20) (70%) and absent in 6 out of 20 (30%) (Figs. 10–12). The fold take 5 different forms:

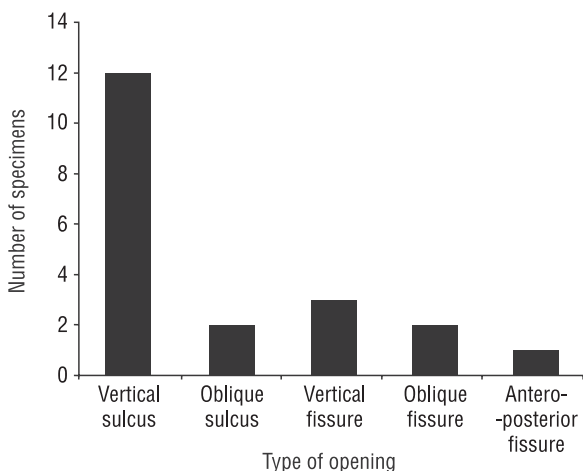


Figure 15. The frequency distribution of the different types of the opening of the nasolacrimal duct among the studied specimens.

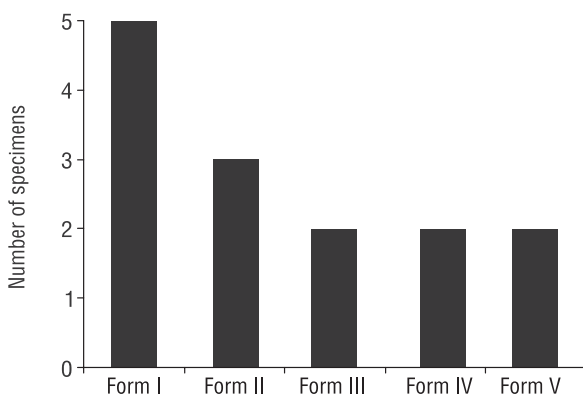


Figure 16. Frequency distribution of the different forms of lacrimal fold.

- form I — the fold was present on the upper edge of the NLD. It was present in 5 out of 20 specimens (25%) (Figs. 3, 6, 7, 13);
- form II — the fold was present on the anterior edge of the NLD. It was present in 3 out of 20 specimens (15%) (Figs. 8, 9). The lacrimal fold was large and overlap the opening almost completely in one of the specimens;

- form III — the fold was present on the anterior and posterior edges of the NLD. It was present in 2 out of 20 specimens (10%) (Fig. 4);
 - form IV — the fold was present on the posterior and inferior edges of the NLD. It was present in 2 out of 20 specimens (10%) (Fig. 5a);
 - form V — the fold was present on the anterior, posterior and inferior edges of the NLD. It was present in 2 out of 20 specimens (10%) (Fig. 5b);
- Regarding the size of the lacrimal fold, it was large in 4 out of 14 (28.5%) specimens (Figs. 7–10). The different forms of the lacrimal fold were summarised in Figure 16.

Morphometrically, the distance between the most anterior point of the opening of the NLD and the anterior nasal spine ranged 21.3–32 mm, with a mean of 25.2 ± 3 mm.

The vertical distance between the attachment line of the inferior nasal concha to the lateral wall of nasal cavity and the opening of the NLD ranged 1–10.2 mm, with a mean of 4.8 ± 2 mm.

The vertical length of the opening of the NLD (height) ranged 0.8–8.0 mm, with a mean of 3.5 ± 1.9 mm.

The distance between the opening of NLD and the floor of the nasal cavity ranged 4.5–20.1 mm, with a mean of 10.3 ± 2.5 mm. All ranges and means of the different measurements were presented in Table 1.

DISCUSSION

Thorough knowledge of gross anatomy is vital for any technique in any surgical field. The anatomy of lacrimal system is important to ophthalmologist for formulations of principal and techniques in the management of lacrimal problems. The use of endoscopes in rhinology has increased the interest of surgeons to expose the nasolacrimal apparatus intranasally for surgical treatment of epiphora as an alternative to external dacryocystorhinostomy [17]. Successful surgical results using this approach depend on a detailed knowledge of intranasal anatomy of the nasolacrimal sac and NLD [21].

Table 1. Showing the range and mean \pm standard deviation (SD) of the different measurements (in mm) of the nasal opening of the nasolacrimal duct (NLD)

Measurement	Range [mm]	Mean \pm SD
Height of NLD (H)	0.8–8.0	3.5 ± 1.9
Distance from upper end of NLD to inferior nasal concha (R)	1.0–10.2	4.8 ± 2.0
Distance from lower end of NLD to the palate (F)	4.5–20.1	10.3 ± 2.5
Distance from the lower end of NLD to the anterior nasal spine (A)	21.3–32.0	25.2 ± 3.0

In the present work the intranasal opening of the NLD was variable in shape taking the form of sulcus in 70% and fissure in 30% of specimens. The sulcus was either vertical or oblique while the fissure was either vertical, oblique or in the form of anteroposterior one. The different forms of NLD were classified into 5 types nearly similar to those of Orhan et al. [9].

On the other hand, the lacrimal fold was present in 70% and absent in 30% of examined specimens in the current study. In specimens with absent lacrimal fold, the NLD takes the shape of slit-like fissure and lies below the anterior part, near the inferior concha in nearly all cases. This can be explained by the fact that due to the absence of the lacrimal fold the site of the opening of NLD becomes higher and is anteriorly protected by the inferior concha.

The shape of opening varied from rounded to slit-like. A papilla-like opening has been mentioned, but this variation was not observed in this study. It has been reported that when the opening was high it tended to be wide, but when it was located lower it was more likely to be slit-like [2, 22]. This relationship was not seen in the present study. Yanagisawa and Yanagisawa [22] observed a double opening of NLD.

The cases with lacrimal fold, most of them take the shape of sulci, are protected by the fold and have different positions from inferior concha.

The knowledge of the morphometry of the lacrimal drainage system enables the ophthalmologist to plan intervention on the lacrimal drainage system precisely and avoid unnecessary manipulations [20].

Regarding the position, a number of landmarks can be utilized to localise the NLD on the lateral nasal wall according to Orhan et al. [9] and Tatlisumak et al. [13]. The importance of landmarks, such as the anterior nasal spine, attachment of the inferior nasal concha and palate, can be used to estimate the position of the NLD at the beginning of endoscopic surgery. The intranasal orifice of the NLD in the current study was 3.5 mm in height, located approximately 25 mm away from the anterior nasal spine, 4.8 mm from the attachment of the inferior nasal concha and 10.3 mm from the palate. The present findings were not agreed with Tatlisumak et al. [13] who found that the intranasal orifice of the NLD was 21.9 mm in height, located approximately 24.6 mm away from the anterior nasal spine, 13.7 mm from the anterior attachment of the inferior nasal concha and 14.3 mm from the palate. However, the current measurements were nearly agreed to those of Orhan et al. [9], where they observed that the intranasal orifice of the NLD was

3.5 mm in height, located approximately 24.5 mm away from the anterior nasal spine, 5 mm from the attachment of the inferior nasal concha and 10.9 mm from the palate.

Yigit et al. [24] stressed on the fact that the exact location of NLD should be known and care should be taken not to violate the NLD during any endoscopic procedures. They also added that the NLD has always been at risk during rhinoplasty operations.

The opening of the NLD was located at variable levels in the inferior nasal meatus in the present study. One of these variations was a high location of the opening just below the attachment of inferior nasal concha as seen in previous studies [16]. The opening was very variable in size from very small apertures in some specimens to large ones in others. In the study of Yanagisawa and Yanagisawa [22], the opening of NLD was described approximately 1.5 cm superior to the nasal floor, though location and size of the opening varied.

Yanagisawa and Yanagisawa [22] reported that the distance between the opening of NLD and anterior nasal spine was 20.5 mm in their subjects. Unlu et al. [14] studied 15 adult cadaver skulls. The distances from the opening of NLD to the anterior nasal spine and the floor of nasal cavity were found to be 23.0 ± 3.3 mm and 13.2 ± 2.7 mm, respectively.

Inferior meatal antrostomy is frequently used in surgery but, when carrying out an intranasal inferior meatal window antrostomy or creating a window transantrally in the inferior meatal wall during the Caldwell-Luc procedure, it is important to locate and prevent damage to the NLD and its opening [8, 18, 22]. In contrast, in FESS, an inferior meatal window can be made safely because of the clear view of the opening of the NLD that is achieved using a 708 or 908 angle endoscope [8].

Weidenbecher et al. [19] stressed on the fact that there is a balance of risks and benefits whereas an inferior meatal window might harm long-term maxillary sinus mucociliary clearance toward the maxillary sinus ostium. On the other hand, dependent drainage through an inferior antrostomy may benefit patients with disturbed mucociliary transport; for example, patients with cystic fibrosis or those who have undergone mucosal stripping during a Caldwell-Luc procedure. The inferior approach has also been shown to be useful in carrying out endoscopic biopsy or in excising inferomedially situated antral lesions or foreign bodies in the maxillary sinus [23].

Kim et al. [4] discussed that a very common problem in ophthalmology is epiphora which may be due to hypersecretion or failure of the lacrimal pump or obstruction of the lacrimal passage. They also explained that the lacrimal

apparatus consisted of secretory (lacrimal gland), distributing (eye lids) and excretory systems (lacrimal puncta, canaliculi, sac and NLD).

Obstruction of the lacrimal drainage apparatus can occur at any level: lacrimal punctum, lacrimal canaliculus, lacrimal sac, NLD, or its opening [10]. Also obstruction can occur at any age but is particularly common in paediatrics. Congenital NLD obstruction is the most common cause of epiphora in new-borns and infants [4, 5, 7]. Congenital obstruction of the lacrimal drainage system is usually caused by a membranous block at the level of the opening of the NLD into the inferior nasal meatus [4, 5]. Sasaki et al. [10] considered that primary NLD obstruction at the lower end of the duct may originate from embryonic malformation of the lacrimal fold, especially large fold. The incidence of this large fold was between 1.75% and 12.5%. The obstruction disappears quickly and spontaneously within 4–6 weeks after birth or by surgical interference [4, 5]. In the present work it was noticed that the lacrimal fold was large in 28.5% of examined specimens. This large fold may interfere with the drainage of the NLD and may be one of the causes of duct obstruction.

The lacrimal fold acts as a flap which prevents air and secretions being blown up the NLD when the intranasal pressure is raised e.g. in blowing the nose or sneezing. The NLD opens into anterior part of the inferior meatus close to the attached border of the inferior concha. It may be wide, patent and circular or the mucus membrane may extend over the opening as a lacrimal fold, thus reducing its size and acting as a flap valve. In few cases the orifice is so small that it is difficult to find. The mucus membrane at the medial side of its opening is raised as the lacrimal fold.

According to Lang [6], the opening into the inferior nasal meatus is present in the neonates, whereas others considered that the duct only breaks through into the nasal cavity later. If the duct does not open to the nasal cavity spontaneously or with massage to the lacrimal sac, a surgical procedure is necessary. In this condition, a detailed anatomic knowledge about the probable location of the opening and its relations with surrounding structures is helpful.

CONCLUSIONS

It can be concluded from the current study that the shape, site, size of the nasal opening of NLD and the exact location in relation to the surrounding structures enables the ophthalmologist and rhinologist to plan intervention on the lacrimal drainage system precisely and avoid unnecessary manipulations and also minimizing the risk of injury at endoscopic intra nasal surgery.

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