

# The Importance of Anatomical Topography in Nasolacrimal Duct Stenosis

Božo Vojniković<sup>1</sup>, Snježana Bajek<sup>2</sup>, Goran Bajek<sup>3</sup> and Tamara Braut<sup>4</sup>

<sup>1</sup>»Dr. Božo Vojniković« Eye Polyclinic, Antuna Barca 3B, Rijeka, Croatia

<sup>2</sup> Department of Anatomy, School of Medicine, University of Rijeka, Croatia

<sup>3</sup> Clinic of Neurosurgery, University Hospital Centre, Rijeka, Croatia

<sup>4</sup> Clinic of Otorhinolaryngology, University Hospital Centre, Rijeka, Croatia

## ABSTRACT

*In our previous study the inclination of nasolacrimal canal in relation to Frankfurt horizontal plane has been analysed on 71 anatomically prepared human skulls by introducing the probe through canal. The results of that study showed that the alpha angle in the frontal plane was greater than 91° in 27% of cases, i.e. nasolacrimal canals descend diverging in relation to the median plane and both probes are intersected on glabella. In 55% of cases, the alpha angle was less than 89° and probes diverge on glabella, and in 18% of cases the canals were parallel to the median plane. In this study nasolacrimal ducts in patients were visualised with Omnipaque contrast that was injected with probe through the superior lacrimal punctum. Thereafter radiography was performed. These in vivo results confirm our previous results obtained on the skulls. Minimal individual variations of values of the angle were observed. These findings are very important in probing of stenosis of nasolacrimal duct in infants, as the operator would not have to forcefully probe with rigid instrument through gentle infant nasolacrimal duct. Difficult and serious consequences for infants arise when directing the probe »via falsa« and that often happened in practice. The authors therefore suggest when using this old method of probing, that this »surgical« act should be performed with »soft« probe made of nylon or silver that is very pliable and does not lead to nasal or temporal rupture of the canal.*

**Key words:** inclination of nasolacrimal duct, Frankfurt horizontal plane

## Introduction

Stenosis of nasolacrimal apparatus is not harmless and is very frequent in infants, up to 7%.

Detailed knowledge of anatomical structures of nasolacrimal canal (Figure 1) is necessary to perform probing *lege artis*. In our previous study the inclination of nasolacrimal canal in relation to Frankfurt horizontal plane has been analysed on 71 anatomically prepared human skulls by introducing the probe through canal<sup>1</sup>. It is very interesting that there are different data about orientation of nasolacrimal canal in regard to frontal and sagittal plane. So, Sieglbauer<sup>2</sup>, Testut<sup>3</sup>, Waldeyer<sup>4</sup>, Paturet<sup>5</sup>, Šljivić<sup>6</sup>, Alverdes<sup>7</sup>, Hamilton<sup>8</sup>, Borowanski<sup>9</sup>, Told<sup>10</sup>, referred that nasolacrimal canal is directed inferiorly, posteriorly and medially. Other authors, Appleton<sup>11</sup>, Gray<sup>12</sup>, Sobotta<sup>13</sup>, Wolf-Heidegger<sup>14</sup>, Grant<sup>15</sup> are describing the direction of nasolacrimal canal downwards, backwards and laterally. Interestingly, Axenfeld<sup>16</sup> alleged that canal extends paral-

lel to the median plane. Keeping in mind its importance in probing, these very differences in the direction of nasolacrimal canal, led us, in addition to our previous study<sup>1</sup> in which we get quite different results, to examine its direction *in vivo*. Our previous study<sup>1</sup> on 71 skulls, showed the following results:

- a) The alpha angle (lateral angle between horizontal plane and nasolacrimal canal) in frontal plane:
  - 1) in 39 cases (55%) alpha angle was less than 89°, the direction of the nasolacrimal canal downwards and medially, i.e. the divergence of the probes on the glabella;
  - 2) in 13 cases (18%), alpha angle almost equal to right angle (89–91°), the canals were parallel to the median plane;
  - 3) in 19 cases (27%), alpha angle greater than 91°, canals directed downwards and laterally, probes converge or intersect on glabella (Figure 2)

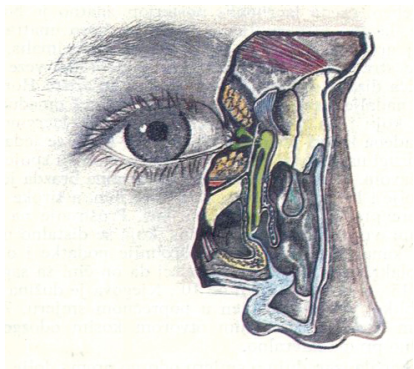


Fig. 1. Schematic presentation of the topographic anatomy of the lacrimal drainage canals.

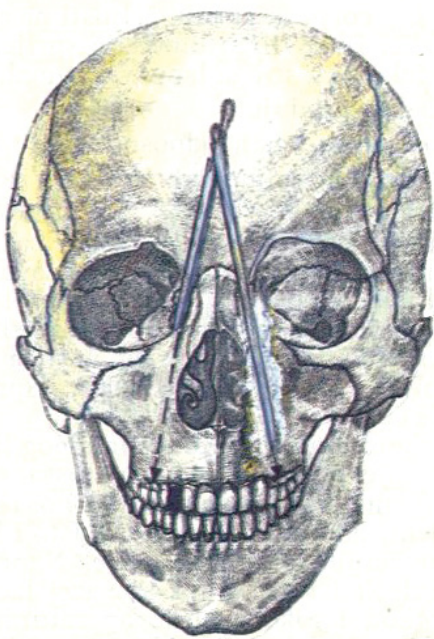


Fig. 2. Rare position of probes after the probing nasolacrimal canal (intersection on glabella).

b) The beta angle (posterior angle between horizontal plane and nasolacrimal canal) in sagittal plane: in all cases beta angle greater than  $90^\circ$ , ranges from  $90$  to  $123^\circ$ , the canal is always directed backwards.

The aim of this study was to examine the inclination of nasolacrimal canal in patients.

### Subjects and Methods

Examination was performed on 30 patients whose age ranged from 10 to 80 years; 14 of them were women. One milliliter of Omnipaque contrast was injected into the nasolacrimal canal, through the superior lacrimal punctum. Thereafter, X-ray examination in two directions

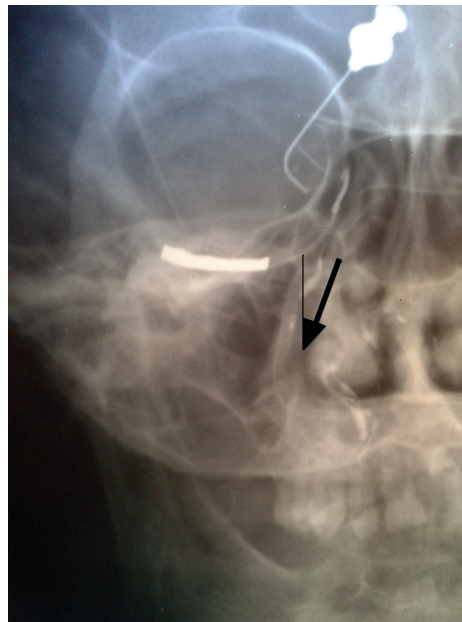


Fig. 3a. Projection in the frontal plane, alpha angle greater than  $91^\circ$ , with imagined intersection of directions of nasolacrimal canals on glabella (24%).

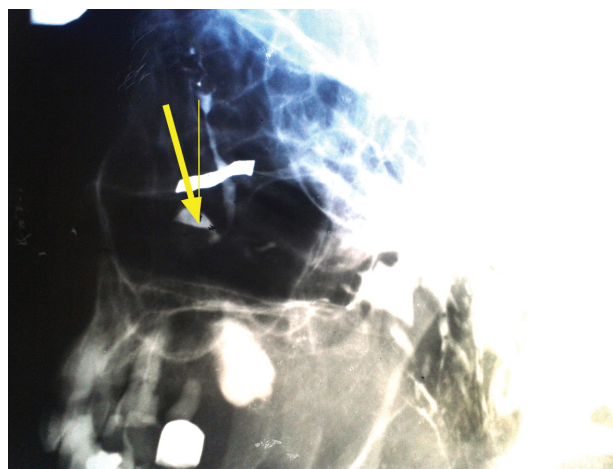


Fig. 3b. Projection in sagittal plane, beta angle greater than  $90^\circ$  ( $90 - 123^\circ$ ), direction of nasolacrimal canals downwards and backwards.

was applied, anteroposterior and laterolateral directions, i.e. projection in frontal and sagittal plane (Figure 3a and b).

### Results and Discussion

a) The alpha angle (lateral angle between horizontal plane and nasolacrimal canal) in frontal plane:  
 1) in 18 cases (61%) alpha angle less than  $89^\circ$ , the direction of the canal downwards and medially, divergence of the probes on glabella.

- 2) in 5 cases (15%) alpha angle almost equal to right angle, 89–91°, the canals were parallel to the median plane
- 3) in 7 cases (24%) alpha angle greater than 91°, canals have a direction downwards and laterally, their imagined continuations intersect on glabella (Figure 2).
- b) The beta angle (posterior angle between horizontal plane and nasolacrimal canal) in sagittal plane: nasolacrimal canals in all cases have the beta angle greater than 90° (ranges from 90 to 123), i.e. the direction is always inferiorly and posteriorly, 90–120°.

It is evident from the above results that the value of the angle and the orientation of nasolacrimal canal in anatomical preparations of the skull do not significantly differ comparing to those in patients. It was ascertained that there were no significant differences between the sexes. As for the ages, it was concluded that there were no differences between children and adults, while for the infant age, because of technical and ethical reasons, comparative groups could not be formed. It can be concluded that the results of aforementioned authors<sup>2–14</sup> are different, whilst our examinations show that all directions of nasolacrimal canal are possible, but with a certain percentage of orientation toward frontal and sagittal plane. Regarding the infants, contrast method could not be applied. Great number of infants (551) was probed and only three complications (*via falsa*) occurred during the initial probing. Comparing to a group of adults, we can conclude that with age exists tendency for alpha angle increasing.

On the basis of results from our previous study regarding the direction of nasolacrimal canal obtained from the anatomically prepared skulls, as well as from examina-

tions on patients in this study, we conclude that the direction of the canal is very variable. Consequently, during the procedure of probing clinicians need to take this into account, and therefore should not force the probe in one direction that they unjustifiably imagine. The consequences of misguided probing can be very serious in the infant age. The probe that goes »*via falsa*« can break a very thin bone of middle nasal meatus or can penetrate through the wall of maxillary sinus (Figure 1). The bones are very soft in the infants and with the hard probe an inexperienced operator can easily and often make one of these mistakes. The probing of nasolacrimal duct should be considered a surgical procedure; no matter what it is usually only a perforation of Hasner's membrane. But sometimes the atresia can extend throughout the whole lacrimal draining system, starting from puncta, through canaliculi, sac and duct. Such a case, as well as some congenital malformations cannot be solved by probing procedure. However, with a little more rigid probe, which in practice should be avoided, it is possible to solve some of those cases. It should be noted that the probing procedure in infants has to be necessarily performed in short-term general anaesthesia and that procedure can last from a few minutes up to twenty minutes. The operator has to be very patient and penetrate through the canal very gently, sensing the slightest obstacle, because adhesions are often also placed above the valve of Hasner membrane. Nowadays there are also minor surgical solutions, suitable also for unsuccessful cases, such as intubation with silicone stent during nasal endoscopy. Finally, nasolacrimal duct stenosis in infants requires serious clinical access and treatment should be classified as a surgical procedure.

## REFERENCES

1. DOBI-BABIĆ R, VOJNIKVIĆ B, STOJANOV D, Chir ophthalmocranio-orofac, 1 (1988) 43. — 2. SIEGELBAUER F, Lehrbuch der Normalen Anatomie des Menschen, 7 anfl (Urban Schwarzenberg, Wien, 1947). — 3. TESTUT L, LATARJET A, Traite d'anatomie Humain, 9-eme (G. Doin et Cie, Paris, 1948). — 4. WALDEYER A, Anatomie des Menschen, II teil (Walter de Gruyter und Co, Berlin, 1950). — 5. PATURET G, Traite d'anatomie Humain, Tome I (Masson et Cie, Paris, 1951). — 6. ŠLJIVIĆ MB, Deskriptivna i topografska anatomija (glava i vrat) (Prosveta, Izdavačko poduzeće Srbija, Beograd, 1946). — 7. ALVERDES K, Grundlagen der Anatomie (Veb Georg Thieme, Leipzig, 1956). — 8. HAMILTON WJ, Textbook of Human Anatomy (Mac Milan and Co LTD, London, 1958). — 9. BOROWANSKY L, Soustavna Anatomie Človeka, I i II dio (Statni Zdravotničke Nakladatelstvi, Praha, 1965). — 10. TOLDS

Anatomischer Atlas-I Band 23 anfl (Urban-Schwarzenberg, Wien, 1957). — 11. APPLETON AB, HAMILTON WJ, TCHAPEROFF JCG, Surface and Radiological Anatomy, 4th Edition (W.Y. Hamilton – G. Simon, Cambridge, 1958). — 12. GRAY H, Anatomy of the Human Body, 26th Edition (Charles Mayo Goss, Philadelphia, 1955). — 13. SOBOTTA J, Atlas der Descriptiven Anatomie des Menschen, I Teil 13 anfl III Teil 12 anfl (Urban-Schwarzenberg, Munschen-Berlin, 1953). — 14. WOLF-HEIDEGGER, Atlas der Systematischen Anatomie des Menschen, vol. II (Basel, 1962). — 15. GRANT B, An Atlas of Anatomy, 4th Edition (The Williams and Wilkins comp, Baltimore, 1956). — 16. AXENFELD TH, HERTEL E, Lehrbuch und Atlas der Augenheilkunde, 8 auf (Gustav-Fisher Verlag, Jena, 1935).

B. Vojniković

Association »Albert Einstein«, Popoviće put 33, 51211 Matulji, Croatia  
e-mail: decv@decv.com

## VAŽNOST ANATOMSKE TOPOGRAFIJE KOD STENOZE NAZOLAKRIMALNOG DUKTUSA

### SAŽETAK

Naša ranija ispitivanja izvršena su na anatomskim preparatima ljudske lubanje, uvodeći sondu u nazolakrimalni kanal, te je prema frakfurtskoj horizontali određen nagib kanala. Rezultati tih istraživanja, na 71 lubanji, pokazuju da je kut alfa u frontalnoj ravnini veći od  $91^\circ$  u 27% slučajeva. Tada se nazolakrimalni kanal spušta divergirajući od medijane ravnine, a obje sonde se konačno križaju na glabeli. U 55% slučajeva kut alfa  $< 89^\circ$ , što znači da sonde divergiraju na glabeli, i u 18% slučajeva kanali su paralelni sa ravninom simetrije. Naša nova ispitivanja rađena su na pacijentima s kontrastom Omnipaque, injicirajući ga u nazolakrimalni kanal kroz gornji punktum, nakon čega je urađen Rtg snimak u antero-posteriornoj projekciji i u latero-lateralnoj. Ovi rezultati uglavnom potvrđuju ranije nalaze na modelu lubanje, sa minimalnim varijacijama. Ovi rezultati su vrlo bitni za kliničku praksu sondiranja nazolakrimalnog kanala, jer upućuju na veliku varijabilnost smjera kanala. U praksi je nažalost često potvrđena greška »*via falsa*« u toku sondiranja, sa mogućom penetracijom nazalno i temporalno, tj. prema srednjem nosnom hodniku ili maksilarnom sinusu. Autori se zalažu za seriozan pristup ovom zahvatu, smatrajući ga kirurškim zahvatom, koji se obavezno mora izvoditi u kratkotrajnoj općoj anesteziji.