Lamina papyracea position in patients with nasal polypi: A computed tomography analysis

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ABSTRACT

Objective: This study aimed to describe the positions of the lamina papyracea (LP) in patients who had nasal polypi, by computed tomography (CT) analysis.

Methods: Paranasal CT scans of patients diagnosed to have nasal polypi were included in the study. CT images were acquired with multiplanar reformates to obtain delicate details in coronal planes for all subjects. Positions of the LP were registered then analyzed in relation to nasal polypi grading.

Results: Forty seven subjects (94 nasal sides) were included in the current study. Grade I lamina detected in 50% or more of all cases. Patients who had larger polypi (polyp grade 3, 4) were associated with significantly more medial LP (grade II) than smaller polypi (polyp grade 0, 1, 2) (P = 0.00386).

Conclusion: The current study improves surgeons’ awareness of LP position in different grades of nasal polypi and highlights that larger polypi are significantly associated with more medial LP than smaller polypi. This may be one of the causes of the higher incidence of complication in larger polypi and can help for safer surgery.

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1. Introduction

Sino nasal polyps are a common clinical condition, affecting up to 4% of the general population. Surgical management of nasal polyps is generally indicated for patients whose symptoms persist despite appropriate maximal medical treatment [1,2].

Endoscopic sinus surgery (ESS) is considered as the mainstay surgical treatment. Although it is a relatively safe procedure, ESS can be associated with both minor and/or major complications [4], particularly orbital complications. The close anatomical relationship between the orbit and the paranasal sinuses places the various ocular structures at risk of injury during ESS [3].

Orbital complications range from minor complications (orbital emphysema, ecchymosis) to diplopia with temporary or permanent blindness [4]. Iatrogenic entry into the orbit from the paranasal sinuses through the lamina papyracea (LP) is the most frequent cause of orbital complications [3]. The use of powered instruments is very common in ESS nowadays, but it adds some dangers if the LP is injured [4].

There is a great anatomic variation of the orbit and paranasal sinuses not only among individuals but also within the same individual between the two sides, and it is important to consider these anatomical variations that may predispose the various ocular structures to be injured during ESS [5]. Such anatomic variations could be detected during careful preoperative CT...
review [6], which is a critical step in the preoperative planning for ESS [7].

Identification of the LP is the key to avoid orbital injury during surgery which is located just superior to the maxillary antrostomy [8,9].

The current study aimed to investigate the LP positions in patients who had nasal polypi by computed tomography (CT) analysis of such patients, to assess whether the position of the LP could be affected by the presence of nasal polyps.

2. Patients and methods

This study was conducted in the Otorhinolaryngology and Radiodiagnosis departments in tertiary University Hospitals, during the period between January 2014 and February 2016. Included subjects were adults who had allergic nasal polypi after proper history taking, clinical and endoscopic nasal examination for diagnosis, and grading of nasal polypi. Informed written consent was signed by all subjects to share in the study after explanation of its purposes and Zagazig University IRB approved the study. Subjects under the age of 16 years, patients who underwent previous sinonasal surgery, maxillary hypoplasia, craniofacial disorders or patients with sinonasal trauma, neoplasms, or invasive fungal sinusitis were excluded from the study.

Grading of nasal polyps was made according to Passali et al. [10]. When no visible polyps were detected, it was grade 0. While a small amount of polypoid disease confined within the middle meatus was graded as grade 1. Multiple polypi occupying the middle meatus were graded as grade 2. Polypi that extended beyond the middle meatus but not totally obstructing was given grade 3. Lastly, polypi completely obstructing the nasal cavity was regarded as grade 4.

CT examinations were performed for all included patients with a 64-slice CT scan (Light speed volume VCT, GE medical system, Milwaukee, WI, USA). The protocol of 64-slice MDCT was performed with a detector width of 0.625 mm, a section width of 1.5 mm and an interval reconstruction of 0.5 mm using 130 kv and 150 mA/s with scan time 1.5 s wide window (Window widths about 1300–2000 and window levels about –80 to –200). Examinations were done with bone window setting of 3000 HU, centered at 300 HU. High resolution algorithm was used for enhancement of the fine bony details.

Films were inspected in a routine standardized fashion to insure that the small details were not missed. Radiological identification and positions classification of the LP was done in all CT slides according to Herzalla et al. classification [11]. In which, the LP position was examined in relation to the middle meatal antrostomy (MMA) line in the relevant coronal image. Maxillary ostium plane was identified in the CT coronal image, then a vertical line drawn from the MMA line identified by the attachment of the inferior turbinate to the lateral nasal wall (medial maxillary wall), Then the distance from the midpoint of the LP to the MMA line (Figs. 1–3).

Type I LP presents within 2 mm on either side of the vertical plane of inferior margin of the planned MMA. Type II LP sets at >2 mm medial to the MMA line. Type III LP lays >2 mm lateral to the MMA line.

Each of the authors evaluated the CT images on separate sessions, on all views; the LP positions were categorized for each patient then the types were registered.

Statistical comparisons were performed using the SPSS statistical software package (version 18.0; SPSS, Inc., Chicago, IL, USA). P value of < 0.05 was considered statistically significant.

3. Results

47 Egyptian subjects (94 sides) were included in the current study. Their ages ranged between 24–58 years with mean age of 35.3 ± 10.4, 15 females (32%) and 32 males (68%).

Fig. 2. coronal CT showed: A: on right side, grade 4 polypi with lamina papyracea (LP) grade I. left side showed polpi grade 3 and LP grade III. B: on right side grade 2 polypi with LP grade I. left side showed polpi grade 2 and LP grade II. C: on right side grade 4 polypi with LP grade II. Left side showed polpy grade 4 and LP grade II.
Grade I lamina was registered in 57 sides; 20 of them (35.1%) had polypi grade 0, 1 or 2 while the other 37 sides (64.9%) had grade 3 or 4 polypi. Grade II lamina (medial lamina) was documented in 17 sides; 5 (29.4%) of them had polypi grade 0, 1 or 2, while the remaining 12 (70.6%) sides had grade 3 or 4 polypi. Grade III lamina (lateral lamina) was documented in 20 sides; 15 of them had polysi grade 0, 1 or 2, while the remaining 5 sides had grade 3 or 4 polypi.

On the other hand, grades 3 and 4 polypi were associated more with Grade II (medial) lamina in 12 sides, and Grade III (lateral) lamina in 5 sides, and Grade I in 37 sides. So grade I LP was detected in 50% or more of all cases.

Patients who had larger polypi (polyp grade 3, 4) were associated with significantly more medial LP (grade II) than smaller polypi (polyp grade 0, 1, 2) (P = 0.00386) (Table 1). On excluding grade I LP, grade II (lateral) LP was significantly found more in patients had smaller polypl (grade 0, 1, 2) while grade II (medial) LP was detected more in patients had larger polypi (grade 0, 1, 2) (P = 0.00555) (Table 1).

Thus larger allergic polypl had significantly nearer LP to the ethmoidal polyps adding more risk of orbital complication during sinuscope removal of such larger polypl.

4. Discussion

Nasal polyposis, inflammatory outgrowths of sinonasal epithelium, affects patients’ quality of life. ESS is one of the most common surgical procedures performed by otolaryngologists [1]. It is reserved for cases associated with severe symptoms, recurrent sinusitis, and for patients not responding to medical therapy [12].

Complications and inefficient surgeries continue to occur despite of the progress in ESS experiences. Because the number of performed ESS is increasing, reported ESS complication also increases particularly orbital complication that varies from insignificant periorbital ecchymosis till orbital hemorrhage [4]. Penetration of LP and accidental entry into the orbit is the most frequent cause of orbital complications [4].

Celis et al. reported that all major complications were documented in patients with grade III polyposis while complications in patients with grade I polyposis were minor and of lower incidence [13]. Therefore larger polypi represent a risk factor during ESS.

Residual ethmoid cells on the LP remain one of the most common findings in revision FESS [14,15–20] in up to 79% [17]. So, efficient clearance of ethmoid air cells on the LP remains challenging.

Anatomical variations have been considered predisposing risk factors for intraoperative injury [7,20]. Therefore, detailed knowledge of the radiological and endoscopic sinonasal anatomy particularly at critical areas such as LP [7,20–25] and in cases of nasal polypl is the key to obtain efficient clearance of ethmoid air cells, and to avoid orbital complication of ESS [20].

Up to our knowledge, the current study is the first study that describes the CT position of the LP in relation to different grades of nasal polypl. In our study, we found that grade I LP accounts for about 60% of all cases, grade II LP accounts for 18% and grade III accounts for 22%. These findings are in accordance with the study of Herzallah et al. [11] regarding grade I LP, but it differs in relation to grade II and III. The small sample size in our study may have partly contributed to this difference.

On the other hand, we found that patients with larger polypl (polyp grade 3, 4) showed significantly more medial LP than smaller polypi (grade 0, 1, 2) indicating that larger allergic polypl does not push the lamina as could be expected, and this finding may explain the incidence of complication reported by Celis et al [13].

Our description of the variable positions of LP in relation to the polypl grade can help surgeons to predict its location during preoperative evaluation, as well as intraoperatively, which should allow safer and more effective surgery.

So large polypl by used classification is not associated with more lateral LP as intuitively expected by mass effect, which

### Table 1

<table>
<thead>
<tr>
<th>Polyp grade</th>
<th>Number</th>
<th>Grade I</th>
<th>Grade II (medial)</th>
<th>Grade III (lateral)</th>
<th>X² =</th>
<th>P =</th>
</tr>
</thead>
<tbody>
<tr>
<td>0, 1, 2</td>
<td>40 sides</td>
<td>20 (50%)</td>
<td>5 (12.5%)</td>
<td>15 (37.5%)</td>
<td>11.114</td>
<td>0.00386 S</td>
</tr>
<tr>
<td>3, 4</td>
<td>54 sides</td>
<td>37 (68.5%)</td>
<td>12 (22.2%)</td>
<td>5/20 (9.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>57</td>
<td>17</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comparison between Grade II (medial) and grade III (lateral) LP between small (grade 0, 1, 2) and larger (grade 0, 1, 2) polypl

\[ X^2 = 7.69 \]

\[ P = 0.00555 S \]

\[ X^2 = \text{Chi square test} \]

\[ S = \text{significance} \]

\[ LP = \text{lamina papyracea} \]
may mean that such large polyp grow more toward nasal cavity than pushing and displacing LP. Or else, it raises a question on the ethmoidal space between LP and MT as a factor affects the size of the nasal part of the polypi. Thus small ethmoidal space in medially positioned LP may contribute in pathogenesis and growth of larger part (grade) of nasal polypi. Moreover, this ensures that ethmoidal polyp is directed by ciliary movement anteriorly to nasal cavity. The total mass of nasal polypi in different grade may be equal with this lateralized LP in grade 3 and 4 polypi. However multi centers studies with larger sample are needed to confirm the findings.

In Herzallah et al. study [11], the authors were concerned with the assessment of the LP in relation to the MMA line in the CT for cases with either normal or pathological finding, and they make the classification and the incidence of the position of the LP regardless the nature of the pathology, especially the grade of the allergic nasal polypi.

On the other hand, in our study we are focusing on the LP position and its incidence in cases with nasal polypi, in order to assess the effect of these polypi on the LP, especially with high grade polypi that need a surgical interference aiming to add a guide in the way of safe and effective surgery.

Attention to the LP location in patients with nasal polyps may help surgeons get a step forward in performing closely related endoscopic work more safely and effectively. We believe that our findings will be very helpful to the otorhinolaryngologist during ESS, as it will give them an idea about the expected location of the LP, especially in cases of advanced nasal polyposis (grade 3 and grade 4), particularly with those that do not have a computer assisted imaging in their centers as it is found in most of the centers in developing countries, which will add to the safety and effectiveness of the outcome of the operation. Also, we are in need to further studies from multi centers with larger samples in order to confirm our findings. We should keep in mind that all of our cases had polypi of allergic origin and we don’t have cases of fungal sinusitis with polyposis, so we do not have an exact idea about the location of the LP in these cases.

Thus, the current work provides a basis for future prospective clinical trials that should focus on the relationship between the position of LP and the polyp grade.

5. Conclusion

The current study improves surgeons’ awareness of LP position in different grades of nasal polypi and highlights that larger polypi are significantly associated with more medial LP than smaller polypi. This may be one of the causes of the higher incidence of complication in larger polypi and can help for safer surgery. Further studies are needed to investigate the impact of LP position knowledge on safety and efficiency of surgery.

Ethical approval

All the procedures performed in current study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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References


