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

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Abstract*---Objective:*** This study aimed to describe the variations of the position of lamina papyracea (LP) in patients with allergic nasal polyposis candidate for functional endoscopic sinus surgery (FESS), by computed tomography (CT) analysis. *Méthod:* Paranasal CT scan of patients diagnosed to have allergic nasal polypi were included in this study and positions of lamina papyracea were registered then analyzed in relation to allergic sinonasal polypi grading. *Results:* fifty subjects (100 nasal sides) were included in the current study. Grade of nasal polypi was not necessarily associated with certain grade of lamina payracea. *Conclusion:* This study improves surgeons' awareness of LP position in different grades of allergic sinonasal polypi and highlights that meticulous preoperative reading of every CT is the key to avoid LP injury during FESS.

***Keywords*--**allergic rhinitis, nasal polyps, Endoscopic sinus surgery, Laminal papyracea, Orbital complications.

Introduction

Allergic sinonasal polyps are a common chronic inflammatory disease, affecting large number of the general population causing symptoms affecting the patients' quality of daily life. (1). Functional endoscopic sinus surgery (FESS) has been widely used as the main stay surgical intervention for cases associated with severe symptoms not responding to appropriate maximal medical therapy. (1)

Ocular complications of FESS have been reported for many years owing to the close anatomical relationship between paranasal sinuses and the orbit .Orbital complications range from minor complications like (orbital emphysema, ecchymosis) to diplopia with temporary or permanent blindness (2). Despite technologic advances and improved surgical training, complications and inefficient surgeries can and do still occur. Because the number of performed FESS is increasing, reported FESS complication also increases (3)

Powered instruments are increasingly used in FESS. Although it has certain clear advantage over conventional instrumentations , powered dissection also add some dangers if the lamina papyracea is injured (2). Anatomic variations of the orbit and paranasal sinuses should be considered and carefully detected. These variations are not only detected among individuals but also within the same individual between the two sides, and it is important to consider these variations to avoid injury to oculat structures during endoscopic sinus surgery (4).

Identification of those anatomic variations by careful preoperative CT review is a crucial step in the preoperative planning for FESS (5). Also , identification of the Position of the lamina papyracea and its relation to the maxillary antrostomy is a key to avoid orbital injury during surgery (6). This study aimed to describe the variations of the position of lamina papyracea in patients with allergic nasal polypi candidate for endoscopic sinus surgery by computed tomography analysis.

Patients and Method

This study was conducted in Otorhinolaryngology and Radiodiagnosis departments in El Hussein University Hospital, Al-Azhar University during the period between November 2020 and October 2021.

In this study the total number of patients was 50 (23 females & 27 males). The age ranged from 20 to 57 years. All patients were diagnosed to have allergic nasal polypi at ENT clinic after proper history taking, clinical and endoscopic nasal examination for diagnosis, and grading of nasal polypi and referred to Radiodiagnosis department to perform computed tomography (CT) scanning on the nose and paranasal sinuses, coronal cuts, and bone window.

CT examinations were performed for all included patients with a 64-slice CT scan (GE lightspeed QX/I Quad CT scanner). High resolution algorithm was used for enhancement of the fine bony details.

Technique:

- **Patient position:** Supine
- **Scout:** Perpendicular to the hard palate
- **Tube voltage and tube current:** 125 kV and 80-160 mAs
- **Scan extent:** From the hard palate to above the end of the frontal sinuses
- **Scan direction:** Caudocranial
- **Scan geometry:** Field of view (FOV): 140-160 mm
- **Slice thickness:** 0.625-1.0 mm
- **Reconstruction kernel:** Bone kernel e.g. 4000 HU
- **Multiplanar reconstructions:** Coronal images

This study was approved by ethical committee of Otorhinolaryngology Department, Faculty of Medicine, Al-Azhar University.

Type of study:
A prospective comparative study.

Included subjects:
Adults who have allergic nasal polypi whose symptoms persist despite appropriate maximal medical treatment.

Excluded subjects:

1. Under the age of 16 years.
2. Patients who underwent previous sinonasal surgery.
3. Maxillary hypoplasia and craniofacial disorders.
4. Patients with sinonasal trauma, neoplasms, or invasive or allergic fungal sinusitis.

Methods of data collection:
Grading of nasal polyps was made according to **Passali et al., 2003:**

- **Grade 0:** No visible polyps were detected
- **Grade 1:** Small amount of polypoid disease confined within the middle meatus
- **Grade 2:** Multiple polypi occupying the middle meatus.
- **Grade 3:** Polypi that extended beyond the middle meatus but not totally obstructing nasal cavity.
- **Grade 4:** Polypi completely obstructing the nasal cavity.

CT films were inspected carefully in a routine standardized fashion to insure that the small details were not missed. Radiological identification and positions classification of the lamina papyracea was done in all CT slides according to **Herzallah et al., 2015** classification .

According to this classification 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 was recorded and documented .(Figs. 1-4)

- **Type 1:** LP presents within 2 mm on either side of the vertical plane of inferior margin of the planned MMA.
- **Type 2:** LP sets at >2 mm medial to the MMA line.
- **Type 3:** LP sets at >2 mm lateral to the MMA line. (7)

Evaluation of CT images was done carefully and the LP positions were categorized for each patient then the types were registered.

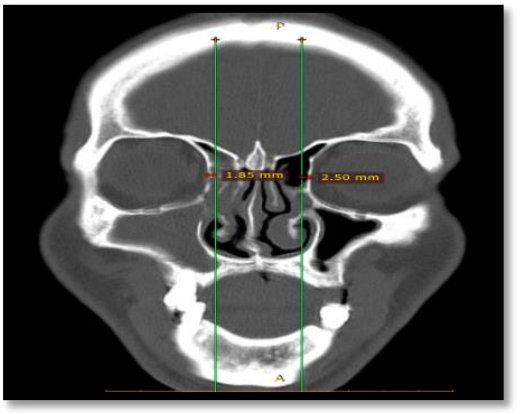

Figure (1): coronal CT showed: on right side grade 2 polypi with lamina papyracea (LP) type 1. on the left side grade 0 polyposis with LP type 3.

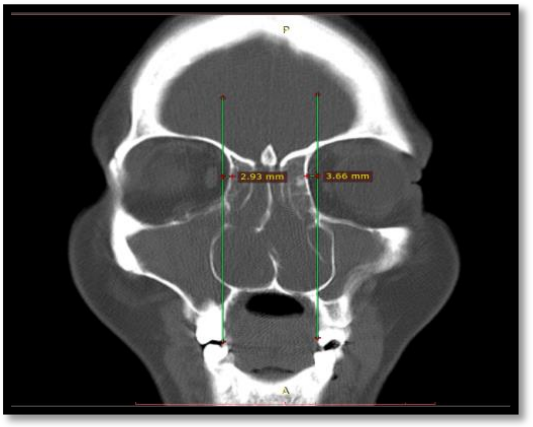

Figure (2): coronal CT showed : on right side grade 4 polyposis and LP type 2 .Left side showed grade 4 polyposis and LP type 2.

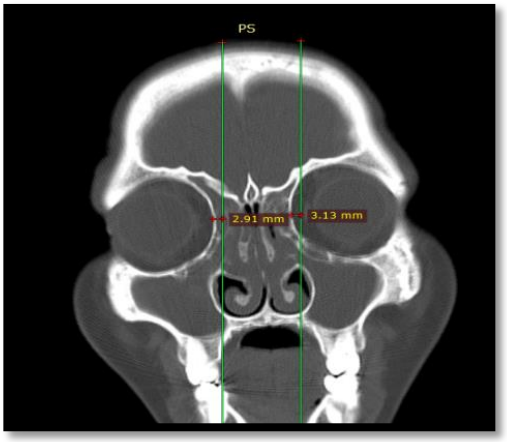

Figure (3): coronal CT showed on the right side grade 3 polyposis and LP type 3. On the left side grade 3 polyposis with LP type 2.

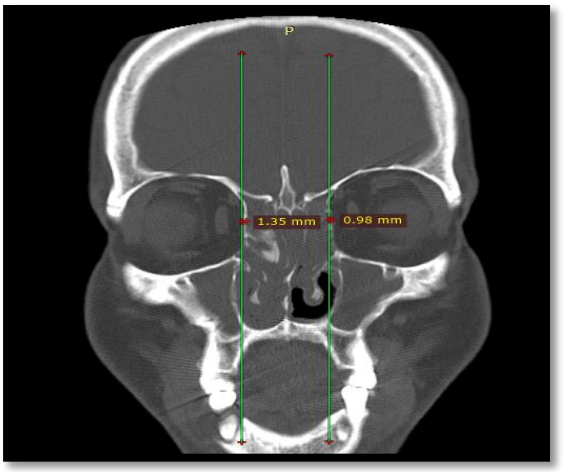

Figure (4): coronal CT showed on the right side grade 4 polyposis and LP type 1 while on the left side showed grade 3 polyposis and LP type 1 .

Results

The results of the present study are demonstrated in the following tables:

Table (1)
Distribution of patients with allergic nasal polypi according to their age "years" (n=50).

Age (years)	Total (n=50)
Range	20-59
Mean±SD	32.36±9.44
Median (IQR)	30 (13)

The mean age of the patients was 32.36±9.44 years (range 20–59 years).

Table (2)
Distribution of patients with allergic nasal polypi according to their sex (n=50).

Sex	No.	%
Female	23	46.0%
Male	27	54.0%
Total	50	100.0%

This table shows that there were 23 (46%) female and 27 (54%) male of sex.

Table (3)
Distribution of patients with allergic nasal polypi according to their nasal polyposis grading (n=50).

Nasal polyposis	No.	%
Grade 0	23	23.0%
Grade 1	6	6.0%
Grade 2	14	14.0%
Grade 3	40	40.0%
Grade 4	17	17.0%
Total	100	100.0%

This table shows that there were Grade 0 (23.0%), Grade 1 (6.0%), Grade 2 (14.0%), Grade 3 (40.0%) and Grade 4 (17.0%) of nasal polyposis.

Table (4)
Distribution of patients with allergic nasal polypi according to lamina papyracea type (Herzallah et al.2015 classification) (n=50).

Herzallah et al. classification	No.	%
Type 1	43	43.0%
Type 2	38	38.0%
Type 3	19	19.0%
Total	100	100.0%

This table shows that there were Type 1 (43.0%), Type 2 (38.0%) and Type 3 (19.0%) of lamina papyracea.

Table (5)
Association between Nasal polyposis grades and lamina papyracea types each degree separately of the study group.

Lamina Papyracea		Nasal polyposis					Total
		Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	
Type 1	No.	10	4	10	14	5	43
	%	43.5 %	66.7 %	71.4 %	35.0 %	29.4 %	43.0%
Type 2	No.	9	2	4	14	9	38
	%	39.1 %	33.3 %	28.6 %	35.0 %	52.9 %	38.0%
Type 3	No.	4	0	0	12	3	19
	%	17.4 %	0.0%	0.0%	30.0 %	17.6 %	19.0%
Total	No.	23	6	14	40	17	100
	%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0 %
Chi-square test	x2	12.598					
	p-value	0.036*					

Using: x2: Chi-square test; *p-value <0.05 S

This table shows statistically significant association between Nasal polyposis grades and lamina papyracea types each degree separately of the study group.

Table (6)
Association between Nasal polyposis [Grade 0,1,2 & Grade 3,4] and Lamina Pyracea types each degree separately of the study group

Herzallla	Nasal polyposis				Total		Chi-square test	
	Grade 0,1,2		Grade 3,4					
	No.	%	No.	%	No.	%	x2	p-value
Type 1	24	55.8 %	19	33.3 %	43	43.0 %	6.807	0.033*
Type 2	15	34.9 %	23	40.4 %	38	38.0 %		
Type 3	4	9.3%	15	26.3 %	19	19.0 %		
Total	43	100.0%	57	100.0 %	100	100.0%		

Using: x2: Chi-square test; *p-value <0.05 S

This table shows statistically significant association between Nasal polyposis [Grade 0,1,2 & Grade 3,4] and lamina papyracea types each degree separately of the study group.

Comparison between Type1, Type 2 and Type 3 LP in relation to degree of nasal polyposis Small (grade 0, 1, 2) versus Larger (grade 3, 4); x2= 0.527; with p-value <0.05

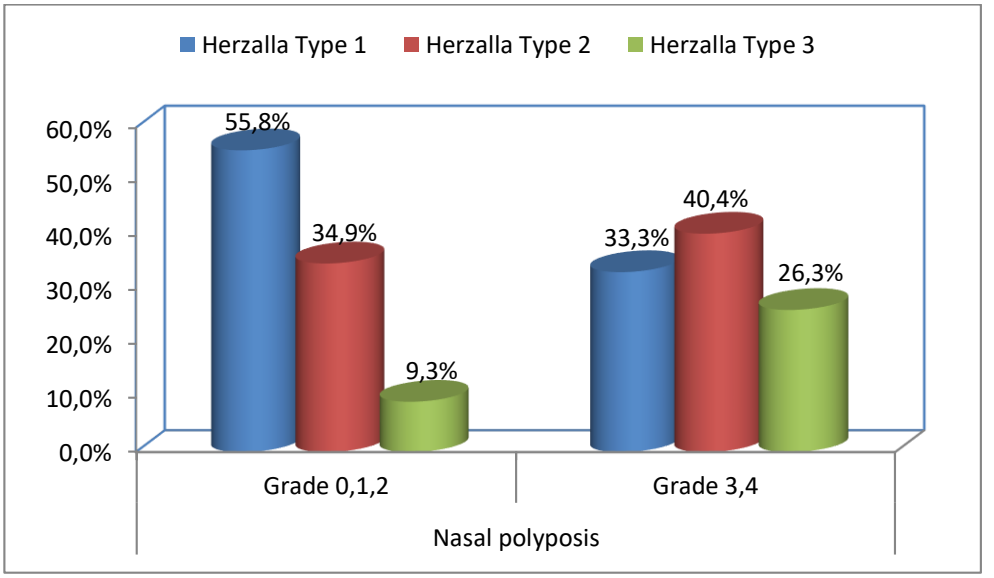

Chart 1: Bar chart Comparison between Type1, Type 2 and Type 3 LP in relation to degree of nasal polyposis Small (grade 0, 1, 2) versus Larger (grade 3, 4)

Discussion

Allergic nasal polyps are benign lesions that arise from the mucosa of the nasal sinuses, most often from the anterior ethmoid complex. They are common chronic inflammatory diseases of the nasal mucosa. These polyps can descend between the middle turbinate and the lateral nasal wall into the nasal cavity causing symptoms affecting the patients' quality of life (8).

Functional endoscopic sinus surgery (FESS) has been widely used in the treatment of cases associated with severe symptoms not responding to medical therapy. It is one of the most common surgical interventions done by otorhinolaryngologists nowadays (9).

With important anatomical structures surrounding paranasal sinuses and their anatomical variations, the likelihood of violating related areas is always present. Orbital complications range from minor complications

(orbital emphysema, ecchymosis) to diplopia with temporary or permanent blindness (2).

Penetration of lamina papyracea and accidental entry into the orbit is the most frequent cause of orbital complications. Injury of the LP commonly occurs in the anterior part during uncinectomy, while performing middle meatal antrostomy (MMA), or during removal of the bulla ethmoidalis (10).

Up to our knowledge, this study is the second study that describes lamina papyracea position in relation to nasal polyposis grading according to computed tomography (CT) analysis. The first study was conducted by **El-anwar et al., 2017.**

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.

In **Herzallah et al., 2015** study, 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.

In present study 50 patients (100 sides); 23 (46%) females and 27 (54%) males were included. The age of them ranged from 20 to 59 years with the mean age of the patients was 32.36±9.44 years.

A study conducted by **El-anwar et al., 2017** on 47 subjects (94 sides). Their ages ranged between 24–58 years with mean age of 35.3 _ 10.4, 15 females (32%) and 32 males (68%).

In present study grade I lamina was registered in 43 sides; 55.8% of them had polypi grade 0, 1 or 2 while the other 44.2% had grade 3 or 4 polypi. Grade II lamina (medial lamina) was documented in 38 sides; 39.4% of them had polypi grade 0, 1 or 2, while the remaining 60.6 % sides had grade 3 or 4 polypi. Grade III lamina (lateral lamina) was documented in 19 sides; 21% of them had polypi grade 0, 1 or 2, while the remaining 79% had grade 3 or 4 polypi.

El-anwar et al., 2017 study they found that grade I lamina was registered in 57 sides; 35.1% had polypi grade 0, 1 or 2 while the other 64.9% had grade 3 or 4 polypi. Grade II lamina (medial lamina) was documented in 17 sides; 29.4% of them had polypi grade 0, 1 or 2, while the remaining 70.6% had grade 3 or 4 polypi. Grade III lamina (lateral lamina) was documented in 20 sides; 75% of them had polypi grade 0, 1 or 2, while the remaining 25% had grade 3 or 4 polypi.

In this study on the other hand, grades 3 and 4 polypi were associated more with Grade II (medial) lamina in 38 sides, and Grade III (lateral)

lamina in 19 sides, and Grade I in 19 sides. Grade 0,1,2 were also associated more with Grade II (medial) lamina in 12 sides, and Grade III (lateral) lamina in 5 sides, and Grade I in 37 sides.

On excluding grade I lamina, subjects of our study who had larger polypi (polyp grade 3, 4) were associated with more medial LP (grade II) than lateral LP Grade III and also those who had smaller polypi (polyp grade 0, 1, 2) were associated with more medial LP (grade II) than lateral LP Grade III .
On accordance with study conducted by **El-anwar et al., 2017** subjects who had 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. Patients who had larger polypi (polyp grade 3, 4) were associated with more medial LP (grade II) than smaller polypi (polyp grade 0, 1, 2). On the other hand grade III (lateral) LP was significantly found more in patients who had smaller ploypi (grade 0, 1, 2) while grade II (medial) LP was detected more in patients had larger polypi (grade 0, 1, 2).

According to our study we found that grade of nasal polypi was not necessarily associated with certain grade of lamina papyracea. The larger the polyposis was not necessarily associated with either more medial LP or more lateral LP as result of pushing LP by mass effect. On the contrary side , the study conducted by **El-anwar et al., 2017** revealed that larger polypi (polyp grade 3, 4) were associated with more medial LP than smaller polypi (grade 0, 1, 2).

Conclusion

Our description of the variable positions of LP in relation to the polyp grade carries a message to otorhinolaryngologists not to relay on predictions regarding LP positions in patients with nasal polyposis undergoing FESS. Preoperative reading of CT in a routine standardized fashion is a must to insure that the small details will not be missed and allows safer and more effective surgery.

Conflict of interest

No conflict of interest

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