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Anatomical and Clinical Evaluation of Tympanic Tegmen and Mastoid Bone with Multidetector Computed Tomography

Evaluación Anatómica y Clínica del Tegmen Timpánico y Hueso Mastoideo con Tomografía Computarizada Multidetector

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SUMMARY: Tegmen level and mastoid bone thickness are important parameters of surgical risk in middle ear and mastoid region surgeries. This retrospective cohort study was conducted to provide a risk classification for the mastoid and middle ear regions. The study population comprised of 300 patients who underwent multidetector computed tomography (MDCT) for various indications. Patients with no pathology that disrupted the structure of the temporal region were included in the study. A risk classification was generated by analyzing the data obtained from mastoid and tympanic tegmen depths and the mastoid bone thickness by MDCT. The mastoid and tympanic tegmen were lower on the right side than on the left. In women, the right-sided mastoid bone thickness and mastoid tegmen were lower, and low-level tympanic and mastoid tegmen on the left and thin right mastoid bones were more common. According to the risk classifications for mastoid and middle ear region surgeries, women demonstrated a higher risk than men. In addition, as the thickness of the mastoid bone increased, the levels of the mastoid and tympanic tegmen increased. The present study provides a proper risk classification that may be helpful for preoperative risk assessment prior to middle ear and mastoid region surgery.

KEY WORDS: Mastoid bone; Middle ear; Radiological anatomy.

INTRODUCTION

The tegmen is a thin bony plate separating the middle ear and mastoid cavities from the dura mater in the middle cranial fossa (Weber, 2005; Makki *et al*., 2011; Luers & Hüttenbrink, 2016). The tegmen plate is the superior limit for certain surgical procedures, and its variable shape makes it a critical point for otolaryngologists and neurosurgeons. It can be subdivided into three parts: the roofing epitympanicum (tegmen tympany), the mastoid antrum (tegmen antri), and the mastoid cavity (mastoid tegmen) (Singh *et al*., 2020). However, in most studies, it is typically evaluated as a single structure.

Tegmen defects may result from congenital skull base defects, chronic otitis media (COM), neoplasms, and fractures, or may present as surgical complications (Egilmez *et al*., 2014; Singh *et al*., 2020). Any damage to the tympanic plate can lead to otorrhea and meningoencephaloceles. Repair of tegmen dehiscence requires complicated treatment because of the need for adequate bone, cartilage, and fascia support, or placement of composite grafts. Such complications may be repaired by transmastoid surgery or a more complicated middle cranial surgical approach (Neely & Kuhn, 1985; Kuhweide & Casselman, 1999; Weber, 2005; Egilmez *et al*., 2014). Whether surgery is undertaken to treat the aforementioned conditions or iatrogenic complications, the essential point to prevent negative outcomes in patients is proper knowledge of the anatomy and preoperative radiological evaluation.

The mastoid bone, which consists of air cells, is connected to the tympanic cavity via the aditus ad antrum. The antrum is the first air cell visible at 21–22 weeks of gestation. Pneumatization is completed by the development of the last air cells in the petrous apex during puberty. Mastoid size is determined by the pneumatization process, which is influenced by heredity and the environment (Cinamon, 2009; Karatag *et al*., 2014). Literature regarding

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the relationship between mastoid size and tegmen level is limited (Piromchai *et al*., 2015).

In the present study, the mastoid and tympanic tegmen were handled separately, as discussed in the relevant literature. In addition, the link between the mastoid size and tegmen level was analyzed. The mastoid size, tympanic and mastoid tegmen levels, and differences related to sex, side, and age are also presented. These structures, which cannot be considered separately in terms of surgical practice, should be evaluated together, and the relationship between them should be clarified. Unlike previous studies done so far, the present study aimed to gather all of these variables and their relationships with each other under the same roof.

MATERIAL AND METHOD

All procedures of the present study were approved by the Ankara Yıldırım Beyazıt University Medical Faculty Clinical Research Ethics Committee (Decision number: 2022/03-22). The study population consisted of 300 patients who underwent multidetector computed tomography (MDCT) imaging for various indications between July and December 2020 at the Ankara City Hospital (Table I).

Patients who had a history of head trauma, neoplasm, or fracture in the temporal bone; previous ear and cranial surgery; COM; and those younger than 18 years were not included in this study. Mastoid tegmen depth, tympanic tegmen depth, and mastoid thickness were measured in the coronal plane. Age-, sex-, and side- related changes were statistically analyzed for each measure.

The mean value of the mastoid bone thickness was 0.73 ± 0.18 mm in the right temporal bone and 0.74 ± 0.18 mm in the left temporal bone. Mastoid bone thickness below the mean values on either sides were classified in the "thin mastoid bone" group and those above it were classified in the "thick mastoid bone" group (Fig. 1a, Table II).

In women, the right tympanic tegmen depth was -0.2 ± 0.14, the right mastoid tegmen depth was -0.43 ± 0.27, the left tympanic tegmen depth was -0.12 ± 0.16, and the left mastoid tegmen depth was -0.38 ± 0.28. In men, the right tympanic tegmen depth was -0.17 ± 0.15, the right mastoid tegmen depth was -0.38 ± 0.25, the left tympanic tegmen depth was -0.13 ± 0.16, and the left mastoid tegmen depth was -0.36 ± 0.24. Values below the average were classified in the 'low' group, whereas those above the average were classified in the 'high' group (Table III). In depth measurements those below the 'C line' were indicated by numerically minus values while those above the 'C line' were expressed as plus. The deeper mastoid tegmen and tympanic tegmen, which have greater absolute numerical values, are also termed low mastoid tegmen and low tympanic tegmen, respectively. Shallower mastoid tegmen and tympanic tegmen with lower absolute numerical values are termed high mastoid tegmen and high tympanic tegmen, respectively, in different sections of this paper (Figs. 1b-d).

The patients were classified into high-, moderate-, low-, and risk-free groups according to the above measurements.

Risk classification for operations performed only in the mastoid bone (Risk 1):
High mastoid tegmen + thick mastoid bone = low risk
High mastoid tegmen + thin mastoid bone = moderate risk
Low mastoid tegmen + thick mastoid bone = moderate risk
Low mastoid tegmen + thin mastoid bone = high risk

Risk classification for operations including the tympanic tegmen (Risk 2):
Thick mastoid bone + high mastoid tegmen + high tympanic tegmen = no risk
Thick mastoid bone + high mastoid tegmen + low tympanic tegmen = low risk
Thick mastoid bone + low mastoid tegmen + high tympanic tegmen = moderate risk
Thick mastoid bone + low mastoid tegmen + low tympanic tegmen = moderate risk
Thin mastoid bone + high mastoid tegmen + high tympanic tegmen = moderate risk
Thin mastoid bone + high mastoid tegmen + low tympanic tegmen = moderate risk
Thin mastoid bone + low mastoid tegmen + high tympanic tegmen = moderate risk
Thin mastoid bone + low mastoid tegmen + low tympanic tegmen = high risk

Statistical Analysis: All statistical analyses were performed using SPSS software (version 25.0, IBM SPSS Statistics 25 software; Armonk, NY, IBM Corp.). Continuous variables mean ± standard deviation, median (min-max) and categorical variables were expressed as numbers and percentages. The distribution of the measurements was examined using the Shapiro–Wilk test. When the parametric test assumptions were met, an independent sample t-test was used to compare independent-sample differences. When parametric test assumptions were not met, the Mann–Whitney U test was used to compare independent sample differences. The dependent t-test was used to analyze the dependent sample differences. Spearman's correlation analysis was used to examine the relationships between numerical variables. The Chi-square test was used to analyze differences between categorical variables. Statistical significance was set at P < 0.05. significant.

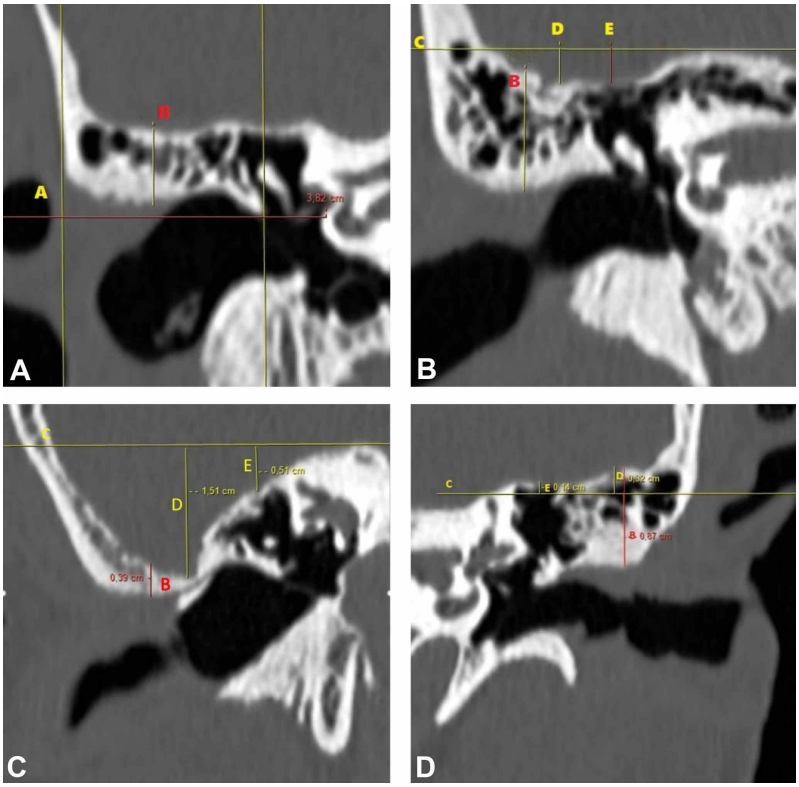

Fig. 1. Coronal MDCT images. (a) Mastoid thickness. (b) Mastoid tegmen and tympanic tegmen depths. (c) Example of measurements. (d) Tympanic tegmen and mastoid tegmen were found above the C line in some individuals. Line A: transverse line between the scutum and lateral end of bony cortex. Line B (mastoid thickness): vertical line between the midpoint of line A and lowermost point of mastoid tegmen. Line C: transverse line at the arcuate eminence level. Line D: mastoid tegmen depth. Line E: tympanic tegmen depth.

RESULTS

Three-hundred individuals were examined, of whom 50 % (n=150) were men and 50 % (n = 150) were women. The overall median age was 44.6 ± 14 (min-max: 18–82) years (Table I).

There was no statistically significant difference in mastoid bone thickness between the right and left measurements. The right mastoid and tympanic tegmen were deeper than the left mastoid and tympanic tegmen (Table II).

There was no significant difference between men and women in terms of age. When clinical measurements were examined, the right mastoid bone thickness values of women were significantly lower than those of men, and the right mastoid tegmen of women were deeper than those of men. Differences in mastoid bone thickness values, which are the differences between the right and left sides, were significantly lower in women than in men (Table III).

When the classification according to sex was examined, the incidence of a thin right mastoid bone was found to be higher in women than in men. It was also observed that women had lower mastoid tegmen on the left side than men. Women had lower tympanic tegmen than men. In addition, it was determined that men were mostly in the low-risk group according to the Risk 1 right classification. In the Risk 1 difference classification, men were mostly in the middle-risk class and women were in the high-risk class. In the Risk 2 classification, a statistically significant difference was found on the right side according to sex. Women were more common in the middle- and high-risk classes than were men (Table IV).

Table I. Demographic information

		N	%
Sex	W	150	50,0
	M	150	50,0
Age	A.M ± S.D.	44,6 ± 14,91	
	Med (min- max)	45 (18- 82)	

A.M ± S.D.: Arithmetic mean ± Standard Deviation; Med (min- max): Median (min-max)

Table II. The comparison of mastoid bone thickness. mastoid tegmen. tympanic tegmen between right and left side.

	Right	Left	*P*-values	Difference
Mastoid bone thickness	0.73 ± 0.18	0.74 ± 0.18	0.258	-0.01 ± 0.14
	0.72 (0.18 to 0.27)	0.75 (0.18 to 0.28)	t=-1.133	-0.02 (0.14 to -0.35)
Mastoid tegmen depth	-0.41 ± 0.26	-0.37 ± 0.26	0.025*	-0.03 ± 0.26
	-0.4 (0.26 to -1.47)	-0.39 (0.26 to -1.24)	t=-2.249	0 (0.26 to -0.9)
Tympanic tegmen depth	-0.18 ± 0.14	-0.13 ± 0.16	0.0001*	-0.05 ± 0.18
	-0.21 (0.14 to -0.61)	-0.17 (0.16 to -0.59)	t=-5.123	0 (0.18 to -0.6)

*p<0.05 statistically significant difference; Descriptive statistics are shown as A.M ± S.D.: Arithmetic mean ± Standard Deviation and Med (min - max): Median (smallest - largest values); t: dependent sample t-test

Table III. Comparison of mastoid bone thickness. mastoid tegmen. tympanic tegmen measurements between men and women

	Women		Men		
	A.M ± S.D.	Med (min - max)	A.O ± S.S.	Med (min - max)	*P*- value
Age	43.41 ± 14.7	44 (18 - 76)	45.8 ± 15.07	46 (19 - 82)	0.165 (t=-1.393)
Right mastoid bone thickness	0.71 ± 0.18	0.7 (0.27 to 1.27)	0.76 ± 0.18	0.75 (0.35 to 1.27)	0.003* (z=-3.009)
Right mastoid tegmen depth	-0.43 ± 0.27	-0.43 (-1.21 to 0.53)	-0.38 ± 0.25	-0.38 (-1.47 to 0.15)	0.033* (z=-2.134)
Right tympanic tegmen depth	-0.2 ± 0.14	-0.22 (-0.61 to 0.1)	-0.17 ± 0.15	-0.21 (-0.49 to 0.27)	0.149 (z=-1.442)
Left mastoid bone thickness	0.73 ± 0.19	0.73 (0.28 to 1.29)	0.75 ± 0.18	0.76 (0.29 to 1.16)	0.288 (t=-1.065)
Left mastoid tegmen depth	-0.38 ± 0.28	-0.4 (-1.22 to 0.57)	-0.36 ± 0.24	-0.36 (-1.24 to 0.15)	0.106 (z=-1.614)
Left tympanic tegmen depth	-0.12 ± 0.16	-0.18 (-0.48 to 0.41)	-0.13 ± 0.16	-0.15 (-0.59 to 0.27)	0.815 (z=-0.234)
Difference mastoid bone thickness	-0.03 ± 0.13	-0.03 (-0.32 to 0.41)	0.01 ± 0.15	-0.01 (-0.35 to 0.45)	0.045* (t=-2.015)
Difference mastoid tegmen depth	-0.05 ± 0.27	-0.04 (-0.79 to 0.61)	-0.02 ± 0.25	0 (-0.9 to 0.57)	0.289 (t=-1.063)
Difference tympanic tegmen depth	-0.07 ± 0.19	-0.04 (-0.6 to 0.45)	-0.03 ± 0.17	0 (-0.57 to 0.46)	0.062 (z=-1.865)

*p<0.05 statistically significant difference; A.O ± S.S.: Arithmetic mean ± Standard Deviation; Med (min - max): Median (smallest - largest values); t: t test in independent groups; z: Mann Whitney U test

There was a statistically significant positive and high-level correlation between the right mastoid bone thickness values and right mastoid tegmen height, as well as a statistically significant positive and moderate correlation between the right mastoid bone thickness and right tympanic tegmen height. In addition, a statistically significant difference was observed. A strong positive correlation was observed between the heights of the right mastoid tegmen and the right tympanic tegmen. Furthermore, there was a statistically significant positive and moderate correlation between left mastoid bone thickness and left mastoid tegmen height; a statistically significant difference was also observed. There were also positive and weak correlations between the left mastoid bone thickness and left tympanic tegmen height. In addition, there was a statistically significant positive and moderate correlation between the left mastoid tegmen height and left tympanic tegmen height (Table V).

DISCUSSION

The mastoid cavity is the diverticulum of the tympanic cavity. Because of their common embryologic origin and close anatomical relationship, both cavities are simultaneously influenced in the case of COM. Inflammation in the tympanic cavity manifests in the mastoid cavity and the Eustachian tube. Tympanic membrane perforation, tympanosclerosis, COM with or without cholesteatoma, and mastoiditis are the most common diseases, some of which require surgical treatment (Weber, 2005; Luers & Hüttenbrink, 2016). Ear surgery may lead serious complications such as facial paralysis tegmen dehiscence, cerebrospinal fluid leak, sigmoid sinus and carotid artery injuries, ossicular disruptions, intracranial infections, pneumocephalus and semicircular canal dehiscence (Neely & Kuhn, 1985; Wormald & Nilssen, 1997; Migirov *et al*., 2004; Bennett *et al*., 2006; Agrawal *et al*., 2007; Mahmutoğlu *et al*., 2013; Luers & Hüttenbrink, 2016; Idris *et al*., 2018; Husain *et al*., 2020). This region presents many pitfalls for surgeons. Otosurgeons are always in a great dilemma regarding the eradication of disease and prevention of complications.

Mastoidectomy is a common surgical option in patients with COM. In some cases, surgeons prefer to leave the posterior canal wall intact and enter the tympanic and mastoid cavities independently (canal wall-up procedure), whereas others open the posterior canal wall without entering the tympanic cavity (canal wall-down procedure) (Goycoolea, 1999; Garap & Dubey, 2001; Yates *et al*., 2002; Aslan *et al*., 2004). The mastoid tegmen, tympanic tegmen levels and mastoid size should be considered in both procedures. Congenital aural atresia (CAA) is another surgical indication, accompanied by smaller mastoids and a lower-level tegmen. Ju *et al*. (2014) indicated that the extent of displacement of the mastoid tegmen is correlated to the severity of CAA. Pneumatization and mastoid bone size have been discussed along with hereditary and environmental theories in the literature. Regardless of

Table IV. The comparison of according to the classification of mastoid bone. mastoid tegmen. tympanic tegmen between men and women.

		Sex		Total	
		Women	Men		p-values
Right mastoid bone thickness	Thin	97 (64.67 %)	71 (47.33 %)	168 (56 %)	0.002* (x^2=9.145)
	Thick	53 (35.33 %)	79 (52.67 %)	132 (44 %)	
Right mastoid tegmen height	Low	81 (54 %)	66 (44 %)	147 (49 %)	0.083 (x^2=3.001)
	High	69 (46 %)	84 (56 %)	153 (51 %)	
Right tympanic tegmen height	Low	99 (66 %)	87 (58 %)	186 (62 %)	0.153 (x^2=2.037)
	High	51 (34 %)	63 (42 %)	114 (38 %)	
Risk 1 for right	Low risk	36 (24 %)	64 (42.67 %)	100 (33.33 %)	0.003* (x^2=11.957)
	Medium risk	50 (33.33 %)	35 (23.33 %)	85 (28.33 %)	
	High risk	64 (42.67 %)	51 (34 %)	115 (38.33 %)	
Risk 2 for right	Risk free	25 (16.7 %)	44 (29.3 %)	69 (23 %)	0.008* (x^2=11.896)
	Low risk	11 (7.33 %)	20 (13.33 %)	31 (10.33 %)	
	Medium risk	56 (37.3 %)	40 (26.7 %)	96 (32 %)	
	High risk	58 (38.67 %)	46 (30.67 %)	104 (34.67 %)	
Left mastoid bone thickness	Thin	77 (51.33 %)	72 (48 %)	149 (49.67 %)	0.564 (x^2=0.333)
	Thick	73 (48.67 %)	78 (52 %)	151 (50.33 %)	
Left mastoid tegmen height	Low	89 (59.33 %)	70 (46.67 %)	159 (53 %)	0.028* (x^2=4.831)
	High	61 (40.67 %)	80 (53.33 %)	141 (47 %)	
Left tympanic tegmen height	Low	85 (56.67 %)	80 (53.33 %)	165 (55 %)	0.562 (x^2=0.337)
	High	65 (43.33 %)	70 (46.67 %)	135 (45 %)	
Risk 1 for left	Low risk	48 (32 %)	54 (36 %)	102 (34 %)	0.085 (x^2=4.935)
	Medium risk	38 (25.33 %)	50 (33.33 %)	88 (29.33 %)	
	High risk	64 (42.67 %)	46 (30.67 %)	110 (36.67 %)	
Risk 2 for left	Risk free	31 (20.7 %)	43 (28.7 %)	74 (24.7 %)	0.136 (x^2=5.547)
	Low risk	17 (11.33 %)	11 (7.33 %)	28 (9.33 %)	
	Medium risk	50 (33.3 %)	57 (38 %)	107 (35.7 %)	
	High risk	52 (34.67 %)	39 (26 %)	91 (30.33%)	
Difference mastoid bone thickness	Thin	82 (54.67 %)	75 (50 %)	157 (52.33 %)	0.418 (x^2=0.655)
	Thick	68 (45.33 %)	75 (50 %)	143 (47.67 %)	
Difference mastoid tegmen height	Low	78 (52 %)	64 (42.67 %)	142 (47.33 %)	0.105 (x^2=2.621)
	High	72 (48 %)	86 (57.33 %)	158 (52.67 %)	
Difference tympanic tegmen height	Low	67 (44.67 %)	49 (32.67 %)	116 (38.67 %)	0.033* (x^2=4.554)
	High	83 (55.33 %)	101 (67.33 %)	184 (61.33 %)	
Risk 1 difference	Low risk	49 (32.67 %)	50 (33.33 %)	99 (33 %)	0.022* (x^2=7.597)
	Medium risk	42 (28 %)	61 (40.67 %)	103 (34.33 %)	
	High risk	59 (39.33 %)	39 (26 %)	98 (32.67 %)	
Risk 2 difference	Risk free	37 (24.7 %)	43 (28.7 %)	80 (26.7 %)	0.07 (x^2=7.074)
	Low risk	12 (8 %)	7 (4.67 %)	19 (6.33 %)	
	Medium risk	65 (43.3 %)	79 (52.7 %)	144 (48 %)	
	High risk	36 (24 %)	21 (14 %)	57 (19%)	

*$p<0.05$ statistically significant difference; χ^2: Chi-square test.

whether the cause is environmental or hereditary, some individuals have insufficient mastoid bone development, and mastoid bone thickness is linked to tegmen location (Karatag *et al.*, 2014). Any study at the tegmen level should not be planned without mastoid size examination. In our opinion, mastoid size and tegmen levels should be evaluated together during the treatment of inflammatory or congenital diseases to prevent surgical complications. In the present study, a statistically significant positive correlation was observed among mastoid thickness, mastoid tegmen, and tympanic tegmen levels. To the best of our knowledge, this is the first study to evaluate the link between mastoid size and tegmen levels (Table III).

Idris *et al*. (2018) examined the height of the tympanic tegmen in patients with sensorineural hearing loss. They measured the distance between the lowest point of lateral semicircular canal and the tympanic tegmen in

Table V. Correlation between mastoid bone thickness. mastoid tegmen height and tympanic tegmen height.

		Right mastoid bone thickness	Right mastoid tegmen height	Right tympanic tegmen height
Right mastoid bone thickness	r	1.000	0.650*	0.449*
	p		0.000	0.000
Right mastoid tegmen height	r		1.000	0.667*
	p			0.000
Right tympanic tegmen height	r			1.000
	p			
		Left mastoid	Left mastoid	Left tympanic
Left mastoid bone thickness	r	1.000	0.510*	0.384*
	p		00.000	0.000
Left mastoid tegmen height	r		1.000	0.598*
	p			0.000
Left tympanic tegmen height	r			1.000
	p			

*p<0.05 statistically significant relationship; r: Spearman correlation coefficient.

both coronal and sagittal planes and proposed a classification system in which tympanic tegmen heights are considered as “low” (type A) and “high” (type B). However, for mastoidectomy or the transmastoid surgical approach, not only the level of the tympanic tegmen but also that of the mastoid tegmen is important (Idris *et al*., 2018). Husain *et al*. (2020) measured the tegmen height in 60 patients with COM using the lateral semicircular canal as the reference point. Based on their results, they concluded that preoperative radiological evaluation is important for preventing dural injury. However, measurements taken at one point are insufficient for proper preoperative risk evaluation of structures such as the tegmen, which has an irregular anatomical structure (Husain *et al*., 2020). In our opinion, the mastoid and tympanic tegmen should be handled separately, but evaluated together for preoperative risk assessment. Studies in the literature are insufficient in terms of preoperative risk analysis because of their small sample sizes and insufficient one-point measurements. The present study, which includes strong statistics, multiple parameters, and a large sample size, is based on the shortcomings of previous literature.

Piromchai *et al*. (2015) studied the relationship between the external and internal features on MDCT images of 112 temporal bones. They evaluated the correlation from the perspective of a surgeon, which they named ‘operating room view’, and from the perspective of a cadaver dissection practitioner, which they named the ‘temporal bone laboratory view’. A strong correlation was observed between the height of the dura and the distance from the inferior external auditory canal to the mastoid tip. They found that a shorter mastoid tip was accompanied by low-lying dura mater. No attributes of sex and side-related differences were encountered in this study. Additionally, only the dura mater overlying the mastoid tegmen was considered (Piromchai *et al*., 2015). In the present study, the right mastoid and tympanic tegmen were found to be lower than the left ones (Tables II and III). It was also observed that female had lower mastoid tegmen on the left side than men, and female had lower tympanic tegmen than male (Table IV).

The Henle’s spine (spina suprameatica) is a variative structure with triangular and crest types. It is absent in 20 % of the specimens in the osteological study of Aslan *et al*. (2004). Karatag˘ *et al*. measured tegmen height from Henle’s spine to the lowest level of the tegmen at one point in their study (Karatag *et al*., 2014). The difficulty in identifying the Henle’s spine on CT images limited the sample size of their study. In addition, because of the slope and irregular tegmen shape, measurements should be performed at more than one point. Numerous studies have measured the tegmen depth. The reference points in radiologic studies should be chosen from well-identified ones in the radiologic scans. The arcuate eminence and scutum were identified as radiological landmarks in the present study (Figs. 1a,b).

We present three new classifications for surgical risk assessment: thick-thin mastoid process, high-low mastoid tegmen, and high-low tympanic tegmen. These parameters were individually evaluated for operations on the mastoid and tympanic tegmen. Moreover, sex- and side-based risk assessments concerning the measurements and operation types were analyzed. Preoperative predictive risk assessment was performed along with the measurements, and the patients were classified into high-, moderate-, low-, and risk-free groups. According to the risk classification made for the surgeries concerning the mastoid and middle ear cavity with the values of mastoid bone thickness, mastoid tegmen level, and tympanic tegmen level values, the highest rate among women was seen in the high-risk group on both sides (42.67 %) for Risk 1 and in the medium-risk group on the right side (37.3 %) for Risk 2. The highest rate among men was seen in the low-risk group on the right side (42.77 %)for Risk 1 and in the medium-risk group on the left side (38 %) for Risk 2. Women were more common in the middle- and high-risk classes than were men (Table IV). This classification, which has not been encountered in previous studies, provides a novel approach to ear surgeries.

CONCLUSION

Preoperative radiological assessment guided by the data presented in this study prevents complications and provides positive patient outcomes. Advanced radiological studies serve as supplementary data for missing information in ear surgery.

SEVER, S. N.; ÇETIN, H.; ÇALISKAN, S. & AKKASOGLU, S. Evaluación anatómica y clínica del tegmen timpánico y hueso mastoideo con tomografía computarizada multidetector. *Int. J. Morphol., 41(3)*:937-943, 2023.

RESUMEN: El nivel del tegmen y el grosor del hueso mastoideo son parámetros importantes del riesgo quirúrgico en las cirugías del oído medio y la región mastoidea. Este estudio de cohorte retrospectivo se llevó a cabo para proporcionar una clasificación del riesgo en las regiones mastoidea y del oído medio. La población de estudio estuvo compuesta por 300 pacientes que se sometieron a una tomografía computarizada multidetector (MDCT) por diversas indicaciones. Se incluyeron en el estudio pacientes sin patología que alterase la estructura de la región temporal. Se generó una clasificación de riesgo analizando los datos obtenidos de las profundidades del tegmen mastoideo y timpánico y el grosor del hueso mastoideo por TCMD. El tegmen mastoideo y timpánico estaban más bajos en el lado derecho que en el izquierdo. En las mujeres, el grosor del hueso mastoideo del lado derecho y el tegmen mastoideo eran más bajos, y eran más frecuente la presencia de tegmen timpánico y mastoideo de bajo nivel en los huesos mastoideos izquierdo y delgados en el lado derecho. Según las clasificaciones de riesgo de las cirugías de la región mastoidea y del oído medio, las mujeres presentaban un mayor riesgo que los hombres. Además, a medida que aumentaba el grosor del hueso mastoides, aumentaban los niveles del tegmen mastoideo y timpánico. El presente estudio proporciona una clasificación de adecuada de riesgo que puede ser útil para la evaluación preoperatoria del riesgo antes de la cirugía del oído medio y la región mastoidea.

PALABRAS CLAVE: Hueso mastoideo; Oído medio; Anatomía radiológica.

REFERENCES

Agrawal, A.; Pratap, A.; Singh, I.; Kumar, A. & Shrestha, S. Cerebellar abscess following mastoidectomy for chronic otitis media. *Pediatr. Neurosurg., 43(4)*:327-9, 2007.

Aslan, A.; Mutlu, C.; Celik, O.; Govsa, F.; Ozgur, T. & Egrilmez, M. Surgical implications of anatomical landmarks on the lateral surface of the mastoid bone. *Surg. Radiol. Anat., 26(4)*:263-7, 2004.

Bennett, M.; Warren, F. & Haynes, D. Indications and technique in mastoidectomy. *Otolaryngol. Clin. North Am., 39(6)*:1095-113, 2006.

Cinamon, U. The growth rate and size of the mastoid air cell system and mastoid bone: a review and reference. *Eur. Arch. Otorhinolaryngol., 266(6)*:781-6, 2009.

Egilmez, O. K.; Hanege, F. M.; Kalcioglu, M. T.; Kaner, T. & Kokten, N. Tegmen tympani defect and brain herniation secondary to mastoid surgery: case presentation. *Case Rep. Otolaryngol., 2014*:756280, 2014.

Garap, J. P. & Dubey, S. P. Canal-down mastoidectomy: experience in 81 cases. *Otol. Neurotol., 22(4)*:451-6, 2001.

Goycoolea, M. V. Mastoid and tympanomastoid procedures in otitis media: classic mastoidectomy (simple, modified, and radical) and current adaptations; open-cavity, closed-cavity, and intact-bridge tympanomastoidectomy. *Otolaryngol. Clin. North Am., 32(3)*:513-23, 1999.

Husain, M.; Khanduri, S.; Faiz, S. M.; Abbas, S. Z.; Yadav, P.; Khan, A. U.; Singh, A. & Khan, M. Role of HRCT temporal bone in pre-operative assessment of tegmen height in chronic otitis media patients. *J. Clin. Imaging Sci., 10*:79, 2020.

Idris, S.; Elkhalidy Y.; Bhargava, R.; Dabr & Ho, A. A new simple radiological classification measuring the height of the tegmen tympani. *Glob. J. Otolaryngol., 16(4)*:82-6, 2018.

Ju, Y. H.; Park, E.; Park, S.; Jung, K.; Lee, K. & Im, G. J. The extent of inferior displacement of the mastoid tegmen is related to the severity of congenital aural atresia. *Acta Otolaryngol., 134(3)*:244-9, 2014.

Karatag, O.; Guclu, O.; Kosar, S. & Derekoy, F. S. Tegmen height: preoperative value of CT on preventing dural complications in chronic otitis media surgery. *Clin. Imaging, 38(3)*:246-8, 2014.

Kuhweide, R. & Casselman, J. W. Spontaneous cerebrospinal fluid otorrhea from a tegmen defect: transmastoid repair with minicraniotomy. *Ann. Otol. Rhinol. Laryngol., 108(7 Pt. 1)*:653-8, 1999.

Luers, J. C. & Hüttenbrink, K. B. Surgical anatomy and pathology of the middle ear. *J. Anat., 228(2)*:338-53, 2016.

Mahmutoglu, A. S.; Celebi, I.; Sahinoglu, S.; Cakmakçi, E. & Sözen, E. Reliability of preoperative multidetector computed tomography scan in patients with chronic otitis media. *J. Craniofac. Surg., 24(4)*:1472-6, 2013.

Makki, F. M.; Amoodi, H. A.; van Wijhe, R. G. & Bance M. Anatomic analysis of the mastoid tegmen: slopes and tegmen shape variances. *Otol. Neurotol., 32(4)*:581-8, 2011.

Migirov, L.; Eyal, A. & Kronenberg, J. Intracranial complications following mastoidectomy. *Pediatr. Neurosurg., 40(5)*:226-9, 2004.

Neely, J. G. & Kuhn, J. R. Diagnosis and treatment of iatrogenic cerebrospinal fluid leak and brain herniation during or following mastoidectomy. *Laryngoscope, 95(11)*:1299-300, 1985.

Piromchai, P.; Wijewickrema, S.; Smeds, H.; Kennedy, G. & O'Leary, S. Correlations of external landmarks with internal structures of the temporal bone. *Otol. Neurotol., 36(8)*:1366-73, 2015.

Singh, A.; Thakur, R.; Kumar, R.; Verma, H. & Irugu, D. V. K. Grading of the position of the mastoid tegmen in human temporal bones - A surgeon's perspective. *J. Int. Adv. Otol., 16(1)*:63-6, 2020.

Weber, P. C. Iatrogenic complications from chronic ear surgery. *Otolaryngol. Clin. North Am., 38(4)*:711-22, 2005.

Wormald, P. J. & Nilssen, E. L. Do the complications of mastoid surgery differ from those of the disease? *Clin. Otolaryngol. Allied Sci., 22(4)*:355-7,1997.

Yates, P. D.; Flood, L. M.; Banerjee, A. & Clifford, K. CT scanning of middle ear cholesteatoma: what does the surgeon want to know? *Br. J. Radiol., 75(898)*:847-52, 2002.

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