The Laryngoscope

Morphometric and Anthropometric Analysis of Killian's Triangle

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Objectives/Hypothesis: To determine the prevalence and the morphometric characteristics of Killian's triangle and to examine their relationship with the anthropometric features of the person.

Study Design: Prospective.

Methods: The hypopharyngeal wall was examined on 47 human cadavers. After a standardized method of dissection, the muscular structures of the hypopharyngeal wall were demonstrated and the existence or absence of Killian's triangle was determined. The triangle was examined in regard to its morphometric characteristics. In addition, anthropometric examinations of the whole body and of the head and neck regions on these cadavers were done, and the results were compared with the features of Killian's dehiscence.

Results: A triangle of Killian was present on 60% (9/15) of the males and on 34% (11/32) of the females. The mean height for the males was 7 mm and for the females 4 mm, and the width was on average 16 mm and 12 mm, respectively. The dimensions of the triangle were correlated significantly with the dimensions of the body and with the length and the descensus of the larynx.

Conclusions: The frequency and the dimensions of Killian's triangle appear to be greater in males than in females. Furthermore, the morphometric characteristics of the dehiscence show a correlation with the anthropometric features of the person. These findings can be an explanation for the higher incidence of Zenker's diverticulum with men and for the geographical differences of the diverticulum's frequency.

Key Words: Killian's triangle, Killian's dehiscence, Zenker's diverticulum, inferior pharyngeal constrictor muscle, cricopharyngeal muscle, anatomy.

Level of Evidence: 2c.

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INTRODUCTION

The point of origin of the pharyngoesophageal or Zenker's diverticulum is a triangular weak spot on the dorsal wall of the hypopharynx, known as Killian's dehiscence or Killian's triangle. The name of the dehiscence derives from the German physician Gustav Killian (1860–1921), who identified the exact site of formation of the pharyngoesophageal pouch in the year 1908.[1] Despite a further century of research on the pathophysiology of Zenker's diverticulum, the area of the dehiscence still remains more or less unknown, not only anatomically but also in regard to its specific role on the development of the diverticulum. The triangular area of muscular weakness (*locus minoris resistentiae*) is formed between the oblique and the transversal-orientated muscle fibers of the inferior pharyngeal constrictor muscle (IPC) (Fig. 1). These two kinds of fibers are described as the oblique and the fundiform part of the cricopharyngeal part of the inferior pharyngeal constrictor muscle, respectively. The transverse band is called cricopharyngeal muscle (CPM) in the clinical and surgical routine.[1–3] The nomenclature of the different portions of the IPC is so controversial that other authors describe Killian's triangle as being located between the thyropharyngeal and the cricopharyngeal part of the IPC,[4,5] or even between two independent muscles, namely the IPC and the CPM.[6–9] In addition to the specific structure of the muscular layer, the consistency of the connective tissue also contributes to the mechanical weakness of the dorsal hypopharyngeal wall. It is reported that at this level of the pharynx the solid pharyngobasilar fascia is being replaced by loose connective tissue.[2]

Zenker's diverticulum consists of a protrusion of pharyngeal mucosa and submucosa through the musculature layer of the hypopharyngeal wall. Thus, it is considered a false diverticulum of the pulsion type. The hypopharyngeal pouch herniates more often to the left, and is rarely seen in the right side of the neck.[1,8–11]

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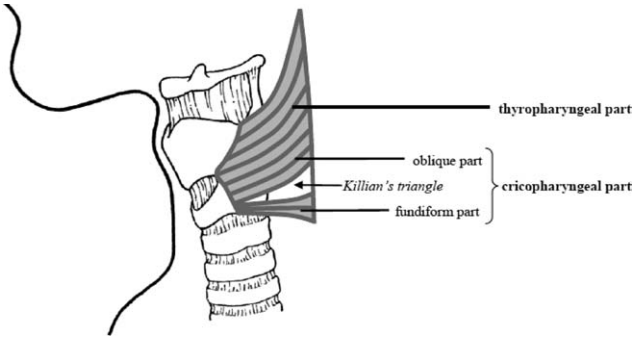

Fig. 1. Parts of the inferior pharyngeal constrictor muscle (IPC) (lateral view). Killian's triangle lies between the oblique and the fundiform part of the cricopharyngeal part of the IPC (white area).

Regarding the etiology and the pathophysiology of the hypopharyngeal pouch, various theories have been published. The most accepted theory concerns an inadequate opening of the upper esophageal sphincter due to reduced compliance of the CPM.[6,10] Such a process results in a high-intrabolus pressure during deglutition and potentially to the development of a pulsion diverticulum. Among other pathologies, Zenker's diverticulum has been associated with the presence of extraesophageal reflux. This relationship is believed to be due to induction of structural and functional changes of the CPM through the gastric acid fluid.[10,11] van Overbeek, after examining and treating a large series of patients with Zenker's diverticulum, suggests that individual anatomical variations could be the critical factor for the development of a hypopharyngeal pouch. Patients with longer necks might have a larger triangle of Killian than would persons with a short neck. This could be due to the longer descensus of the larynx and could predispose for the development of Zenker's diverticulum. Such an assumption could be the explanation for differences in the incidence of Zenker's diverticulum in terms of gender and origin. The male/female ratio in series of patients with Zenker's diverticulum is at least 1.5 to 1. Furthermore, this kind of diverticulum is seen more often in Northern Europe, the United States, Canada, and Australia, but it is very rare in Japan and Indonesia.[8,9]

The aim of our study was to investigate the prevalence and the morphology of Killian's triangle and subsequently to examine a possible relationship with the anthropometric characteristics of the person.

MATERIALS AND METHODS

A total of 47 human cadavers from the supply of the Department of Anatomy of the University of Cologne were examined (32 females, 15 males; mean age, 82 years [61–99 years]). The cadavers were fixed with a 90% ethanol and 10% formalin solution. In each cadaver two series of measurements were performed. First anthropometric measurements on the intact cadaver were made, and then morphometric measurements of the constrictor pharyngis muscle and Killian's triangle were made.

Anthropometric Measurements

On the whole body, the distances between the following landmarks were measured: crown of the skull, heel, upper edge of the pubic symphysis, jugular incisure, and apex of the greater trochanter of the femur. In the head and neck region we measured the longitudinal axis interspace between the jugular incisure, the apex of the mastoid process, the inferior edge of the hyoid bone, the inferior edge of the cricoid cartilage, the superior thyroid incisure, and the frontal distances between the two mastoid processes and the two mandibular angles.

Morphometric Analysis

Observing the dorsal pharyngeal wall and the pharyngoesophageal transition from the posterior side, the following measurements and surveys were carried out: the length of the whole constrictor pharyngis muscle, the existence or absence of the triangle of Killian and its height and breadth and transversal orientation on the pharyngeal wall, the form of the cricopharyngeal muscle in regard to the rest of the muscular pharyngeal wall, and the craniocaudal height of this muscle. To achieve accurate measurements, all of the cadavers were dissected with the same method. The dissection of the structures of the pharyngoesophageal transition was performed under a binocular loupe.

The length of the whole constrictor pharyngis muscle was measured from the pharyngeal tubercle of the basilar part of the occipital bone to the caudal edge of the CPM along the midline.

The existence of Killian's triangle was investigated after determining its borders. Considering their exact anatomical characteristics, the oblique and the transversal muscle fibers of the cricopharyngeal part of the IPC were carefully determined, and the topographic relationship between them was defined. Either they overlaid each other, or they formed a continuous muscle layer (absence of a dehiscence), or a gap remained between the two muscle parts (existence of a dehiscence).

In the case of the existence of Killian's triangle, the dorsal pharyngeal wall was spread in a plane surface and the triangle's height was measured between the caudal end of the raphe pharyngis and the cranial edge of the cricopharyngeal muscle along the longitudinal axis. The breadth of the triangle was measured along its basis, that is, along the upper edge of the CPM. Furthermore, the topographic localization of Killian's triangle in regard to the whole dorsal wall of the hypopharynx was estimated, namely, if the main surface of the triangle laid predominantly in the middle or was displaced on one side. In the case of a local dislocation of the muscle fibers due to dilated submucosal blood vessels or protrusion of the mucosa and submucosa in the area of Killian's dehiscence, the muscle parts were restored to their original position to avoid errors on the muscle position because of secondary events.

The observation of the muscular wall of the cricopharyngeal transition allowed us to recognize the variability of the form of the CPM. It was examined if the muscle was exhibiting a smooth continuity with the rest of the pharyngeal wall and, consequently, a flat surface on the frontal plane, or if the CPM formed a recess or constriction on the muscular wall resulting in a protrusion in the pharyngeal lumen. Furthermore, after defining the upper and lower borders of the CPM muscle, the height of the muscle on the craniocaudal axis along the middle line was measured.

The statistical analysis was carried out using the SPSS 15.0 software for Windows (SPSS Inc., Chicago, IL). Data are presented as mean $\pm$ standard deviation. Because of the small number of samples ($N = 47$), nonparametric statistical tests were used.

RESULTS

Anthropometric Measurements

The anthropometric distances on the whole body were on average greater in males than in females

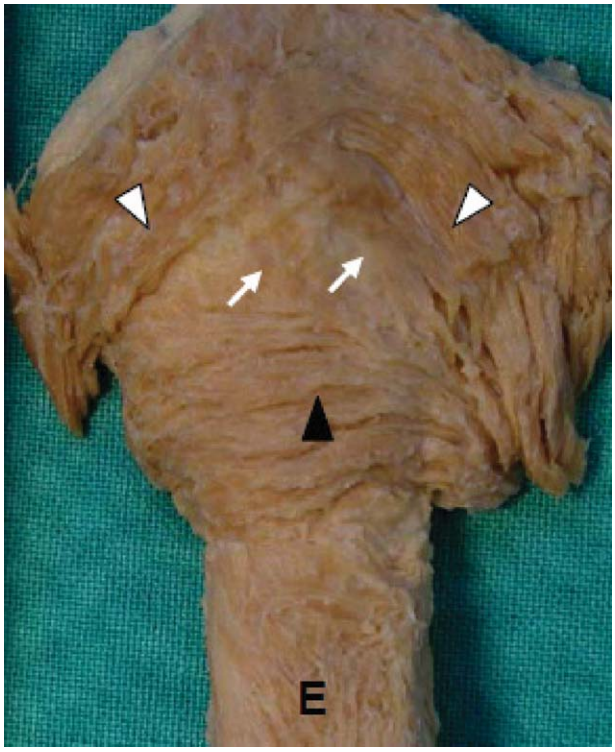

Fig. 2. Killian's triangle on the dorsal wall of the hypopharynx (dorsal view, male, 67 years old). The triangle is formed between the oblique- (white arrow heads) and the transversal-(black arrow head) orientated muscle fibers of the inferior pharyngeal constrictor muscle. The white arrows show the scanty irregular muscle fibers within Killian's triangle. E = esophagus. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

(Mann-Whitney U test, $P < .001$). In the head and neck region, the distances between the jugular incisure and cricoid cartilage on the one hand, and thyroid cartilage on the other hand, showed no difference between the two genders (Mann-Whitney U test, $P > .05$). The other measured distances in the head and neck area are, on average, significantly longer in males (Mann-Whitney U test, jugular incisure to hyoid bone, $P < .05$; the remaining measurements, $P < .001$).

Morphometric Analysis

After the demonstration of the fundiform and the oblique parts of the cricopharyngeal part of the IPC, a few muscle fibers on the dorsal wall of the hypopharynx remained that could not be classified as part of these muscle groups. The origin or the insertion of these fibers coincided with neither those of the fundiform nor of the oblique parts, and only a fraction of them belonged with one or the other part. Furthermore, in the majority of cases they were relatively thin, and they crossed either each other or the oblique and transversal fibers in places other than the pharyngeal raphe. They showed an irregular course and could not be regarded as true oblique or fundiform fibers, but rather as branches or divergences of them (Fig. 2).

The average vertical length of the constrictor pharyngis muscle was 12.4 ± 1.2 cm. Men had a significantly longer constrictor pharyngis muscle (13.7 ± 0.6 cm) than women (11.8 ± 0.9 cm; Mann-Whitney U test, $P < .001$).

Twenty of the 47 examined specimens (42.6%) were found to exhibit Killian's dehiscence (Fig. 2), whereas on the other 27 specimens no gap between the oblique and the fundiform fibers was noted (Fig. 3). The incidence of Killian's triangle for men was much greater (nine of 15 or 60%) than for women (11 of 32 or 34.4%). The statistical analysis in regard to the anthropologic measurements on the whole body and the head and neck region showed no statistical differences between triangle-positive and triangle-negative subjects (Mann-Whitney U test, $P > .05$), although the triangle-positive subjects had, on average, longer anthropometric characteristics than the negative ones (except the distance between the cricoid and thyroid cartilages). The most pronounced difference was the whole body height (distance from the crown of the skull to heel), that is, the cadavers with a triangle of Killian were on average 4.6 cm higher than the others (Mann-Whitney U test, $P = .079$). In a similar way, the length of the neck measured with the distance between the jugular incisure and the mastoid process was on average 0.6 cm longer in the cadavers with dehiscence (Mann-Whitney U test, $P = .076$). In regard to the other anthropologic measurements, the differences between the specimens with and without a dehiscence were less noticeable.

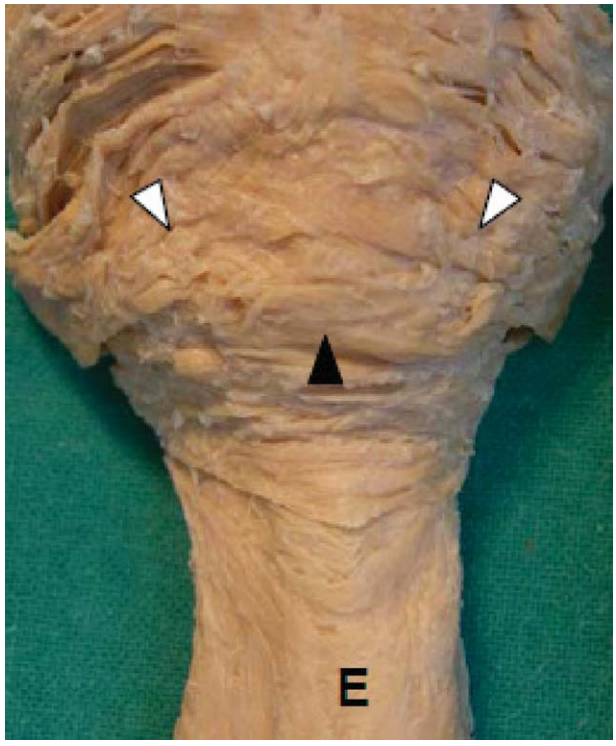

Fig. 3. Example of a specimen without a triangle of Killian (dorsal view, female, 98 years old). The oblique- (white arrow heads) and the transversal-(black arrow head) orientated muscle fibers of the inferior pharyngeal constrictor muscle overlay each other. The scanty irregular muscle fibers have been removed. E = esophagus. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

TABLE I.
Morphometric Characteristics of Killian's Triangle.

Killian's Triangle	Males	Females
Existence	9/15 (60%)	11/32 (34%)
Height, mm	7 ± 4	4 ± 2
Width, mm	16 ± 4	12 ± 3

The height and width of the dehiscence are represented as mean ± standard deviation.

The average height of the 20 triangles of Killian found in this study was 6 ± 3 mm with a maximum value of 12 mm. The male triangle was on average higher (7 ± 4 mm with a maximum value of 12 mm) than the female one (4 ± 2 mm, maximum value 8 mm), although this difference is statistically not significant (Mann-Whitney U test, $P = .067$).

The height of the triangle correlates with some of the anthropologic characteristics of the whole body. A positive correlation was more pronounced in regard to the distance between the crown of the skull and pubic symphysis (Spearman's rho = 0.507, $P = .023$). In addition, a significant association was present between the height of Killian's triangle and the distances between the crown of the skull to the heel (Spearman's rho = 0.457, $P = .043$) and jugular incisure to pubic symphysis (Spearman's rho = 0.456, $P = .043$). In the head and neck region the triangle's height was correlated with the distance between the hyoid bone and the cricoid cartilage (Spearman's rho = 0.525, $P = .018$), and between the thyroid and cricoid cartilages (Spearman's rho = 0.536, $P = .015$). No significant correlation was noted between the triangle's height and the other investigated anthropologic measurements. Furthermore, no association was found between the height of the dehiscence and the length of the constrictor pharyngis muscle.

Killian's triangle exhibited an average breadth of 14 ± 4 mm, whereas the male triangle was significantly wider (16 ± 4 mm, maximum value 21 mm) than the female (12 ± 3 mm, maximum value 17 mm; $P = .038$). The morphometric characteristics of Killian's dehiscence are presented in Table I.

The correlation analysis of the triangle's width with the anthropologic characteristics in the whole body showed no significant associations. In contrast with that, a negative correlation was demonstrated between the breadth of the dehiscence and the distance from the jugular incisure to the cricoid cartilage (Spearman's rho = −0.502, $P = .024$). In addition, it was shown that the triangle's breadth was associated in a positive way with the distance between the hyoid bone and cricoid cartilage (Spearman's rho = 0.466, $P = .038$). The other measurements in the head and neck region, inclusive of the transversal distance between the mandibular angles and the mastoid processes, as well as the length of the whole pharyngis constrictor muscle, showed no association with the breadth of the dehiscence.

In seven of the 20 (35%) existent triangles of Killian, the main area was found to be in the middle of the dorsal wall of the hypopharynx. The triangle was displaced to the right side of the dorsal hypopharynx wall in eight cadavers (40%), and to the left side in five cases (25%). This different topographic distribution of the main area of the dehiscence on the hypopharyngeal wall was without a statistical significance (one-dimensional χ^2 test; goodness-of-fit test, $P = .705$).

Table II summarizes the significant correlations between the morphometric characteristics of Killian's triangle and the anthropometric measurements.

A recess on the muscular wall due to a constriction of the CPM was found in 15 of the 47 examined specimens (31.9%), whereas the rest of the cadavers showed a smooth pharyngoesophageal transition (Fig. 4). The incidence of the cricopharyngeal recess showed no differences between men (5 of 15 or 33.3%) and women (10 of 32 or 31.3%), whereas there was a great difference in regard to the existence of the triangle of Killian. It was found that only two of the dehiscence-positive subjects (10%) exhibited a recess due to the CPM, whereas for the triangle-negative specimens this quotient was much greater (13 of 27 or 48.1%). The average height of the CPM found in this study was 11 ± 2 mm without differences between men (12 ± 2 mm) and women (11 ± 2 mm, Mann-Whitney U test, $P = .282$). No significant correlation was noted between the muscle's height and the investigated anthropologic measurements.

DISCUSSION

Despite the importance of Killian's triangle, there is no consensus regarding the prevalence of its existence. Gustav Killian indicated that the dehiscence is always present.[1] Since then most authors appear to agree with this opinion.[6–9] However, Wilson denied the existence of the triangle. According to him, the oblique part always

TABLE II.
Significant Correlations Between the Morphometric Characteristics of Killian's Triangle and the Anthropometric Measurements.

Killian's Triangle	Anthropometric Measurement	Spearman's Rho	Level of Significance
Height	Crown of the skull-pubic symphysis	+0.507	$P < .05$
	Crown of the skull-heel	+0.457	$P < .05$
	Jugular incisure-pubic symphysis	+0.456	$P < .05$
	Hyoid bone-cricoid cartilage	+0.525	$P < .05$
	Thyroid cartilage-cricoid cartilage	+0.536	$P < .05$
Width	Jugular incisure-cricoid cartilage	−0.502	$P < .05$
	Hyoid bone and cricoid cartilage	+0.466	$P < .05$

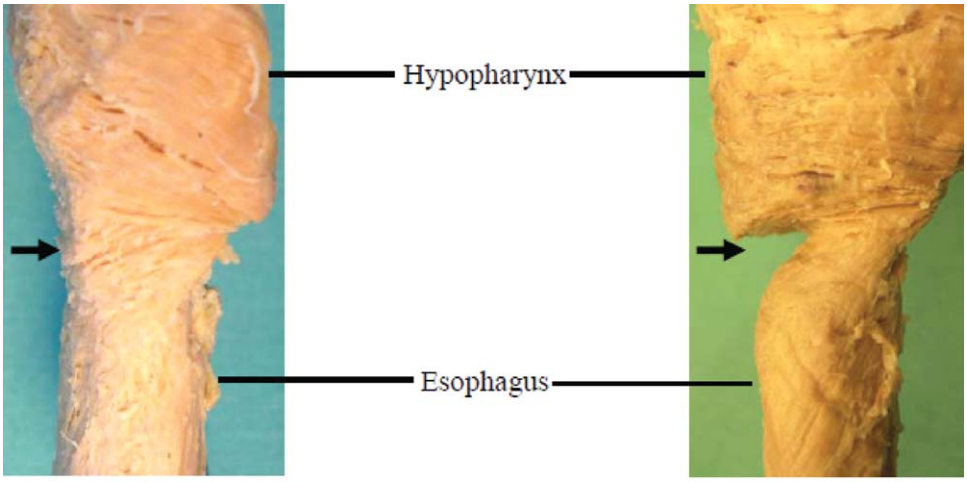

Fig. 4. Variability of the form of the cricopharyngeal muscle (arrow) (lateral view). (a) Smooth pharyngoesophageal transition (female, 99 years old). (b) Recess on the muscular wall due to a constriction of the cricopharyngeal muscle (female, 85 years old). [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

overlaps the fundiform part, so that an area of muscle weakness does not exist.[12] Perrott described such a weak place in the cricopharyngeal region in a part of the 40 specimens that he examined but without giving more detailed anatomical information on it.[13] The only report on the accurate prevalence of Killian's triangle comes from Kelly and Kuncl, who report an existent triangle on six of the 21 (28.6%) nonfixed specimens they examined with the same percentage for males (4/14) and females (2/7).[14] However, they did not mention a precise method of definition of the Killian's triangle. To our knowledge there is no study in the literature on the dimensions and the morphology of the triangle.

The major challenge on the dissection of the dorsal hypopharyngeal wall and the demonstration of its anatomical structures is the variation of the muscle pattern of this area.[13] In the present study, we followed a standardized method of dissection to define the parts of the IPC and consequently the dehiscence of Killian. The anatomical criteria used in our study are based on the classical knowledge of the local anatomy and were the same that Killian described more than 100 years ago. According to the established descriptions, the oblique part of the cricopharyngeal part of the inferior constrictor muscle (sites of Killian's triangle) arises from the site plane of the cricoid cartilage, runs inclined cranially and medially, forms an entity without gaps, and crosses the contralateral part near or in the middle line at the pharyngeal raphe. The fundiform or transverse part of the muscle, that is, the cricopharyngeal muscle (basis of Killian's triangle), must meet the criteria of arising from the site plane of the cricoid cartilage, running more or less horizontally, forming an entity without gaps, and going across the middle line without a raphe. The existence or absence of Killian's dehiscence is determined through the topographic relationship of the two parts of the inferior pharyngeal constrictor muscle (Fig. 5).[1–3,7]

The standardized method of dissection using a magnifying loupe allowed us to show that a few scanty irregular muscle fibers are almost always present in the borders between the oblique and the fundiform muscle fibers and have a close topographic relationship with them. According to the findings of the present study, these irregular muscle fibers are characterized first by an irregular course, and are abundant and not a coincidence either with the oblique or the fundiform fibers. A second characteristic is that they do not meet the contralateral fibers on the level of the raphe in the middle line of the pharynx, but in every possible point on the dorsal pharyngeal wall. The third distinct feature of these fibers is that they are scanty, very thick, and flattened. In the case of an existent triangle of Killian, they are embedded in loose connective tissue, and constitute the content of the dehiscence. Their identification is thus crucial in anatomical studies in which Killian's triangle must be recognized, whereas their presence should not lead to the false impression of a continuous, thick muscle layer. The dehiscence demonstrates an area of muscle weakness and not an area free of muscle fibers.[6,8]

In our study and after dissection with a standardized method, we reported the existence of Killian's triangle on 60% of the males (nine of 15) and on 34% of the females (11 of 32). That means that the dehiscence is almost two times more frequent in men than in women. The triangle of Killian on the examined specimens was found to vary in its dimensions, namely from a small cleft of 2-mm high up to a noticeable area of 12-mm high, with an average height of 6 $\pm$ 3 mm. The dehiscence was almost two times higher in males (7 $\pm$ 4 mm) than in females (4 $\pm$ 2 mm). The borderline value of statistical significance of this relationship indicates that a study with more specimens can potentially validate it. On the contrary, we report a statistically wider male triangle (16 $\pm$ 4 mm) compared to the female (12 $\pm$ 3 mm), whereas on men the triangle can reach a breadth of 21 mm and on women of 17 mm. No triangle smaller than 8 mm on both genders was found in this study.

van Overbeek,[8,9] in particular, believes that people with a long neck might have a larger triangle of Killian than would those with a short neck. This could happen due to the greater descensus of the larynx and could predispose for the development of Zenker's diverticulum. Up to now this hypothesis has not been investigated.

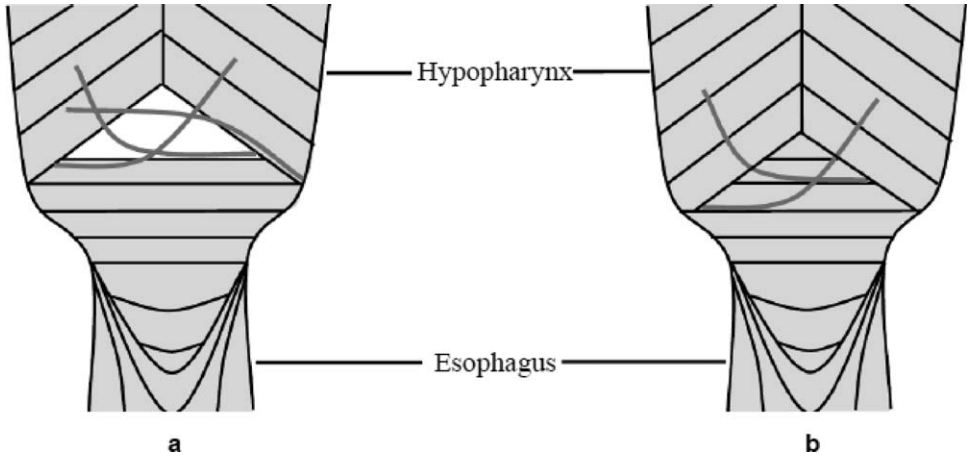

Fig. 5. Schematic demonstration of the hypopharyngeal wall and existence (a) and absence (b) of Killian's dehiscence (dorsal view). The gray lines represent some possible forms and courses of the irregular muscle fibers on the dorsal wall of the hypopharynx.

According to our study, there is a trend toward increased presence of a triangle of Killian on people with longer necks and greater body length. However, due to the borderline statistical significance, a study with more subjects is needed either to confirm or to reject this tendency.

A correlation of the height of the dehiscence with the anthropometric characteristics is indeed identified. The height of Killian's triangle shows an association with the length of the upper part of the body, the length of the trunk, and with the whole body length. In contrast, there is no correlation with the length of the lower part of the body.

In the head and neck area, the height of the triangle of Killian correlates with the length of the larynx, and particularly with the distance between thyroid and cricoid cartilages. The insertions of the parts of the IPC on the two great larynx cartilages could be an explanation for this relationship, whereas a longer distance between the cartilages may cause a greater gap between the oblique and the transversal fibers. The length of the larynx also correlates with the width of the triangle, which means that the descensus of the larynx favors a larger triangle of Killian on both dimensions. Furthermore, we reported a negative relationship between the breadth of the triangle and the distance from the jugular incisure to the cricoid cartilage. The latest denotes that the closer the cricoid cartilage is to the upper thoracic aperture the wider the triangle of Killian.

The findings of this study regarding the prevalence and the dimensions of the triangle of Killian and its relation to the anthropometric characteristics of the subject provide new knowledge of the dehiscence as an anatomical feature and its role in the pathophysiology of Zenker's diverticulum. We believe that these findings support the hypothesis of van Overbeek.[8,9] First, we showed in this study that Killian's dehiscence presents no universal existence. Second, the finding that people with longer body dimensions, a longer larynx, and a greater larynx descensus appear to have a greater triangle, supports the hypothesis that the anthropometric characteristics might lead to the development of the diverticulum. This finding can be a possible explanation not only for the more frequent occurrence of the hypopharyngeal diverticulum on men, but also for the geographical differences of its prevalence. Zenker's diverticulum is seen more often in places with tall people, such as Northern Europe, the United States, Canada, and Australia, but it is very rare in Japan and Indonesia. Furthermore, our findings document gender specificity in regard to the appearance and the dimensions of the triangle of Killian. The dehiscence appears to be more often and greater in male subjects than in females. This fact corresponds to the more frequent appearance of the diverticulum in males. The ratio of males to females in regard to the prevalence of the triangle of Killian arising from the present study is 1.75 to 1, whereas the corresponding ratio for Zenker's diverticulum is at least 1.5 to 1.[8,9,11] Thus, we believe that the local anatomy plays a significant role in the development of the hypopharyngeal diverticulum.

The assumption that extraesophageal reflux may be a factor contributing to the development of Zenker's diverticulum can be based not only on its effects on the CPM but on Killian's dehiscence as well. It is believed that due to the reflux, the CPM shows various structural changes, such as hypertrophy, myositis, or fibrosis, and therefore, a shortening of its length, persistent elevated tone, or spasm.[10,11] In addition to these theories, we can assume that the gastric acid fluid arising up to the hypopharynx could produce an injury of the mucosa and submucosa, so that the Killian weak area could become more vulnerable to high-intrabolus pressures.

At present the most accepted theory for the development of Zenker's diverticulum are the changes in the structure, morphology, and functional properties of the CPM.[10] In this study we investigated the variability in the macroscopic morphology of this muscle, and found that in about one third of the examined cases the muscle showed a deformation that was causing a constriction or recess on the pharyngoesophageal transition. These findings seem to agree with those of other studies about the structural changes of the CPM in the elderly cadaver,[15,16] and suggest that the consequent protrusion in the pharyngeal lumen in the living person may become a physical barrier affecting normal swallowing and causing increased intrabolus pressures. The cricopharyngeal protrusion can appear as a cricopharyngeal

bar on the lateral radiographs of barium swallows. An interesting finding of our study is that the specimens with a present Killian's dehiscence show such a change of the CPM very rarely (10%). On the contrary, a deformation of the CPM with a recess at the pharyngoesophageal transition is present in about one half of the triangle-negative specimens. At the moment there is no obvious explanation of this relationship. However, we can suggest that this phenomenon might play a role on the development of Zenker's diverticulum. The rare coexistence of the anatomical constriction at the pharyngoesophageal transition with the weak area on the pharyngeal wall could be a possible explanation for the rareness of the diverticulum.

Regarding the craniocaudal height of the CPM, our results agree with the general opinion that this comes up to approximately 1 cm (in our study 11 mm).[5] A correlation of the height of the muscle with the anthropometric characteristics seems not to exist.

In addition, we investigated to what extent the local anatomy of the hypopharyngeal wall can influence the side of predominance of Zenker's diverticulum. In contrast to the preferred left side of development of the diverticulum, the dehiscence of Killian on the 47 investigated specimens shows no side of preference. This finding is in agreement with the observation of Gustav Killian that the entrance of the diverticula that he examined lays always in the middle,[1] and indicates that the left predisposition side of Zenker's diverticulum is not due to the morphology of the muscle weakness point. Until now the convexity of the cervical esophagus to the left and the greater distance between the hypopharynx and esophagus, and the left common carotid artery compared with the right side were proposed as a possible explanation of this phenomenon.[2,10,17]

CONCLUSION

After standardized dissection methods we concluded that Killian's triangle shows no universal existence, and that it appears twice as often in men (60%) than in women (34%). The dehiscence varies in its dimensions and can exist as a thin cleft on the dorsal wall of the hypopharynx until becoming a distinct bordered muscle weak point of 12 mm in height and 21 mm in breadth. The dimensions of the triangle correlate with the anthropometric characteristics, and this fact explains the greater triangle in males. These findings could be an explanation for the greater incidence of Zenker's diverticulum in men and for the geographical differences of the diverticulum's incidence. Apart from the central role of the cricopharyngeal muscle in the development of the diverticulum, the existence and perhaps the dimensions of Killian's dehiscence should be considered as a main factor as well.

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