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Determining anatomical localisations of cervical oesophagus, hiatal clamp and oesophagogastric junction with oesophagogastroduodenoscopy

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Background: *In this study, the purpose was to determine the anatomical localisations of the cervical oesophagus length, hiatal clamp, and oesophagogastric junction depending on age and gender in patients who undergo oesophagogastroduodenoscopy (EGD).*

Materials and methods: *The images of the patients who underwent EGD between 2018 and 2020 were analysed retrospectively in this study. The distance of the anatomical localisations of the cervical oesophagus length, hiatal clamp, and oesophagogastric junction to the anterior incisors, and the relations of this distance with the demographic characteristics and clinical manifestations of the patients were investigated on the EGD data.*

Results: *A total of 298 patients (174 women, 124 men) were included in the study. The cervical oesophagus length and the distance of the oesophagogastric junction and hiatal clamp localisation of the patients were found to be 15.06 ± ± 0.57 cm, 37.51 ± 2.23 cm and 38.62 ± 2.23 cm, respectively. It was also found that the mean values of all lengths in males were higher at a statistically significant level than in females ($p < 0.001$; $p < 0.01$).*

Conclusions: *Knowing these anatomical localisations may be important in predicting complications that may occur in this region in EGD and planning the precautions to be taken. We also believe that it will guide clinicians in determining hiatal hernia and related deficiencies.* (Folia Morphol 2022; 81, 3: 756–765)

Key words: oesophagogastroduodenoscopy, cervical oesophagus length, hiatal clamp, oesophagogastric junction

INTRODUCTION

Endoscopic examination of the gastrointestinal system (GIS) is accepted as the gold standard all over the world [17]. Oesophagogastroduodenoscopy (EGD) includes the imaging of the oropharynx, oesophagus, stomach, and proximal duodenum. The

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oesophagus, after the oropharynx, is approximately 25 cm long and has the form of a collapsed tube unless inflated. It has three parts; the pars cervicalis extends from the lower edge of the cartilago cricoidea to the incisura jugularis at the level of the C6–T2 vertebra (5–8 cm). Pars thoracica is located at the level of T2–T10 vertebrae in mediastinum superius and posterius (15–18 cm). Pars abdominalis is the part (1–3 cm) passing through the hiatal clamp at the level of T10 vertebra and extending to the ostium cardiacum. Oesophagogastric junction is usually 40 cm after the anterior incisors [17]. Although the oesophagogastric junction is not an endoscopically visible part in patients without a hiatal hernia, it is considered to be the *Z* line where the lower oesophageal sphincter is also located. The hiatus oesophagus is the opening on the diaphragm where the oesophagus passes from the thorax to the abdomen, and is one of the three openings of the diaphragm localised in the crus dextrum. This opening is at the T10 level, elliptical, and is located in the muscular part of the diaphragm with a diameter of approximately 2.5 cm and 2–3 cm in length in the left posterior upper part of the hiatus aorticus slightly to the left at the middle part. This anatomical localisation, which is clinically called the hiatal clamp, is detected below the oesophagogastric junction on average 1 cm if viewed with EGD [7]. In the present study, hiatus oesophagus was used as the distance of the hiatal clamp to the anterior incisors, which is in line with the literature.

The stomach fundus, which begins after it passes through the oesophagogastric junction at the level of the thoracic eleventh vertebra, continues down and to the left with the corpus. The region that is called incisura angularis at the entrance of the antrum pyloricum in the stomach is an important point for EGD because it is the most common area of helicobacter pylori. Following the pars horizontalis (1st part), which is approximately 5 cm, of the duodenum that consists of four parts, the pars descendens (2nd part) begins as the part EGD process ends [10, 17].

Oesophagogastric junction is an important anatomical area with its basic functions. Where the oesophagus ends and the stomach begins is discussed among histologists, physiologists, gastroenterologists, radiologists, and surgeons for many years. It is important to understand that there are differences in the normality range which will be recognised and interpreted easily by an experienced gastroenterologist. Although monomeric evaluation is needed to evaluate functional disorders, biopsy and EGD are essential to diagnose structural and histological abnormalities [30]. This diagnostic and therapeutic method might lead to some life-threatening complications. The most common cause of oesophageal perforations are particularly these iatrogenic damages. The incidence of this condition varies between 0.0009% and 0.01% [25]. Such iatrogenic injuries are most commonly detected in the part called "the cervical oesophagus". For this reason, preserving the tubular structure of the oesophagus when the oesophagus is entered is the most important aspect to be considered in this regard. However, since the oesophagogastric junction shows continuous peristalsis, the normal change in the mucosa can usually be distinguished with a little excess air insufflation [17]. Determining the length of these areas, which were mentioned in the present study, will guide the endoscopy specialist who performs the procedure to be more careful in the detected lengths when s/he passes through these and similar risky areas.

In the present study, the purpose was to determine the anatomic localisations of cervical oesophagus length, hiatal clamp, and oesophagogastric junction in patients who undergo EGD, depending on age and gender.

MATERIALS AND METHODS

In this study, the data of 695 patients who underwent EGD between 2018 and 2020 were retrospectively analysed. Among these patients, 56 patients who were under 18 years of age, 315 patients who had a history of upper gastrointestinal surgery, 9 patients who were diagnosed with upper gastrointestinal cancer, 1 with implanted PEG, and 16 patients with hiatal hernia were not included in the study. The present study was conducted with 298 patients.

After a full 6-hour oral intake restriction, verbal and written consent was obtained from the patient and necessary information was given. Before the procedure, pharyngeal anaesthesia was applied with 10% lidocaine spray. Afterwards, the patient was positioned to the left of the endoscopist, with the head slightly flexed and the chin closer to the chest. The Olympus GIF-Q scope was advanced by providing direct vision. The structures in the mouth were roughly evaluated, and the oesophagus was entered by observing the piriform sinuses. The distance from the anterior incisors to the first stricture after passing the epiglottis was considered as the cervical oesoph-

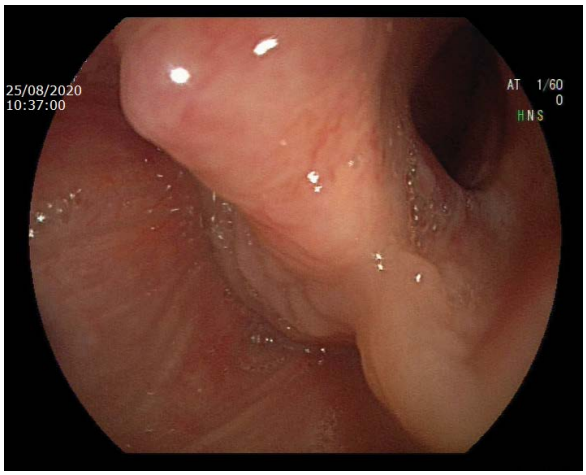

Figure 1. Entry to cervical oesophagus (oesophagogastroduodenoscopy image).

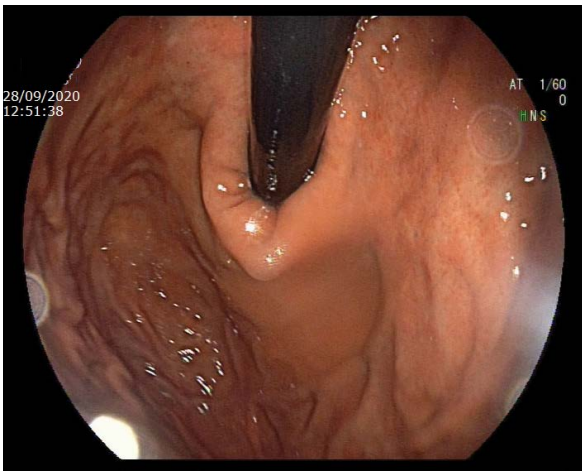

Figure 3. Hiatal clamp (oesophagogastroduodenoscopy image).

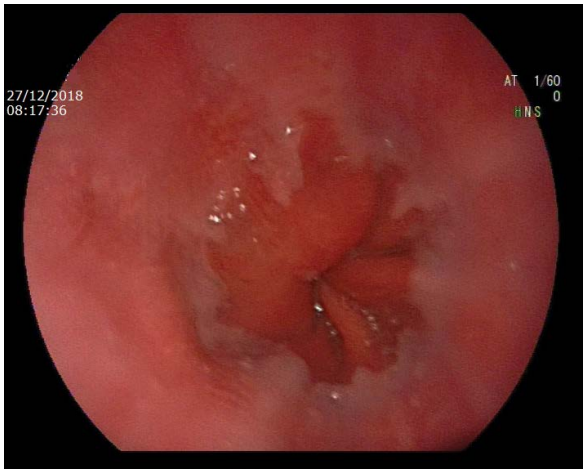

Figure 2. Oesophagogastric junction, Z line (oesophagogastroduodenoscopy image).

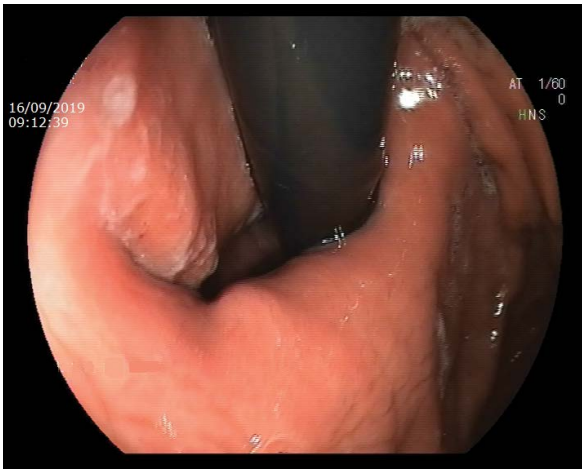

Figure 4. Hiatal hernia (loose hiatal clamp) (oesophagogastroduodenoscopy image).

agus length (Fig. 1). The oesophagus was evaluated by providing adequate insufflation and the scope was pushed distally in a controlled manner. In the most distal part of the oesophagus, the squamocolumnar epithelial region (transition zone), Z line, where the squamous epithelium of the oesophagus ends and the columnar epithelium of the stomach begins, was observed. The distance between the anterior incisors and the Z line was measured as the distance to the anatomical localisation of the oesophagogastric junction (Fig. 2). The place where the diaphragm crus are seen approximately 1 cm after the oesophagogastric junction is considered as the hiatal clamp (hiatus oesophagus). The distance from the anterior incisors to this point was measured as the distance to the anatomical localisation of the hiatal clamp (Figs. 3, 4). The stomach was entered by passing the hiatal clamps. After careful evaluation of the stomach structures, the duodenum was evaluated by passing the pylorus. The distal end portion of the duodenum, which was evaluated, was the second continent and was advanced until the scope reached this point. Afterwards, a detailed controlled examination was performed at the exit and the procedure was terminated by aspirating the air given during the procedure. All measurements were made by the same investigator. It was recommended that patients not take solid or liquid food for two hours after the procedure.

Previous studies have shown that these measurements can also be made with manometers and pH meters. If we look at the working principle of these methods, the pH meter is applied through the

nose and the lower oesophageal sphincter is directly reached without seeing the anatomical points we measured in the study. It is based on placing the catheter 5 cm above the sphincter and recording the pH changes on a digital recorder outside the catheter at 4–8 second intervals [29]. The manometer is suitable for use to detect oesophageal motor patterns and extreme motor abnormalities (e.g. achalasia and extreme hypomotility) [26]. In both methods, both the length cannot be determined objectively and the main indications differ. When these methods are considered and evaluated, the easiest, cheapest and most applicable method is endoscopy.

Statement of ethics

The approval of the Ethics Committee regarding the study was obtained from the Health Sciences University, Kartal Kosuyolu Training and Research Hospital, Non-Interventional Clinical Research Ethics Committee (IRB: 2019.4/26-203).

Statistical analysis

The population of the study consisted of approximately 1300 individuals who met the inclusion criteria in the evaluation between 2018 and 2019 based on EGD measurements. In this respect, in the calculation based on the following formula, the number of patients that would be included in the study was determined as a minimum of 297 patients, with n = 296.71 [28].

$$n = \frac{Nt^2pq}{d^2(N-1)+t^2pq}$$

(N — population; n — frequency of application to be included in the sampling; p — frequency of the occurrence of the investigated event; q — frequency of absence of the investigated event; t — the theoretical value found from the t table at a certain degree of freedom and the detected error level; d — the ± deviation desired to be done according to the incidence of the event)

When the findings obtained in the study were evaluated, the IBM® SPSS® (Statistical Package for the Social Sciences) software version 22 (IBM Corp. Armonk, NY, USA) was used for statistical analyses. The conformity of the variables to the normal distribution was evaluated with the Kolmogorov-Smirnov test, Q-Q graphs, and histograms. When the study data were evaluated, the Student-t test was used for the evaluation of the quantitative data between two groups along with descriptive statistical methods (i.e. mean, standard deviation, frequency, percentage). The Student-t test was used for the evaluation of the quantitative data between two groups. The One-Way Analysis of Variance (ANOVA) was used for the evaluation of quantitative data between more than two groups, and the Tukey Post-Hoc Test was used to determine the group which caused the difference. The Pearson Chi-Square Test, the Continuity (Yates) Corrected Chi-Square Test, and the Fisher's Full Chi-Square Test were used to evaluate qualitative data. Significance was taken as $p < 0.05$ level.

RESULTS

The present study was conducted with 298 patients who underwent EGD, 41.6% (n = 124) of whom were male, and 58.4% (n = 174) female. The ages of the patients ranged between 21 and 91 with a mean of 53.77 ± 13.47. A total of 6.7% (n = 20) of the patients were under 35 years old, 19.5% (n = 58) were 35–44 years of age, 24.2% (n = 72) were 45–54, 27.5% (n = 82) were 55–64, and 22.1% (n = 66) were at and above the age of 65.

The cervical oesophagus length of the patients varied between 14 and 16 cm with a mean of 15.06 ± ± 0.57 cm, and the oesophagogastric junction length varied between 30 and 44 cm with an average of 37.51 ± 2.23 cm, and the distance of the hiatal clamp localisation to the anterior incisors varied between 31 and 46 cm with a mean of 38.62 ± 2.23 cm.

It was found that there were statistically significant differences between the average length of the anatomical location of the hiatal clamp, the distance from the anterior incisors, and the age groups ($p = 0.031$, $p < 0.05$). As a result of the Tukey Post-Hoc Test that was applied to determine which age group the difference originated from, the mean hiatal clamp length of the patients who were under 35 years of age was significantly higher than the patients who were between the ages of 35–44 ($p = 0.030$; $p < 0.05$) (Table 1).

When the cervical oesophagus, oesophagogastric junction, and hiatus clamp lengths were compared according to gender, the mean values of all lengths were found to be higher in males at a statistically significant level than in females ($p < 0.001$; $p < 0.01$).

When the indications for EGD applied to the patients were evaluated, 48.7% (n = 145) had dyspepsia as the reason, 30.9% (n = 92) cancer screening, 6% (n = 18) follow-up, 5.4% (n = 16) gastroesophageal reflux disease (GERD), 5% (n = 12) GIS bleeding, and 4% (n = 15) other (dysphagia, intensive care patient nasogastric feeding).

Table 1. The evaluation of the oesophagogastroduodenoscopy (EGD) data according to the age groups

EGD data [cm]	Age group					F	P
	< 35 years	35–44 years	45–54 years	55–64 years	> 65 years		
Cervical oesophagus length [cm]	15.15 ± 0.67	15.07 ± 0.56	15.07 ± 0.54	15.04 ± 0.6	15.06 ± 0.58	0.161	0.958
Oesophagogastric junction length [cm]	38.35 ± 2.30	37.22 ± 2.24	37.86 ± 2.11	37.28 ± 2.41	37.42 ± 2.08	1.641	0.164
Hiatal clamp length [cm]	39.80 ± 2.71	38.14 ± 2.37	38.96 ± 2.04	38.51 ± 2.26	38.44 ± 2	**2.702**	**0.031***

Data are shown as mean ± standard deviation; F: One-Way Variance Analysis (ANOVA); *p < 0.05

Table 2. The evaluation of the patients' anatomical localizations according to the oesophagogastroduodenoscopy indications

Indications	Cervical oesophagus length [cm]	Oesophagogastric junction length [cm]	Hiatal clamp length [cm]
Dyspepsia	15.04 ± 0.54	37.36 ± 2.16	38.46 ± 2.18
Cancer screening	15.17 ± 0.72	38.75 ± 2.09	39.50 ± 2.39
Control	15.25 ± 0.58	37.56 ± 2.90	38.88 ± 2.60
GERD	15.07 ± 0.61	37.54 ± 2.30	38.66 ± 2.32
GIS bleeding	15.11 ± 0.58	37.83 ± 2.15	38.94 ± 2.13
Other	14.93 ± 0.59	37.40 ± 2.03	38.47 ± 1.92
F	0.634	0.959	0.653
P	0.674	0.443	0.660

Data are shown as mean ± standard deviation; F: One-Way Variance Analysis (ANOVA); GERD — gastroesophageal reflux disease; GIS — gastrointestinal system

Table 3. The evaluation of the indications of oesophagogastroduodenoscopy in patients according to the age groups

Indications	Age group					χ^2	P
	< 35 years	35–44 years	45–54 years	55–64 years	≥ 65 years		
Dyspepsia	10 (50%)	34 (58.6%)	34 (47.2%)	43 (52.4%)	24 (36.4%)	6.841	0.145
Cancer screen	5 (25%)	17 (29.3%)	25 (%34.7)	21 (%25.6)	24 (%36.4)	2.886	0.577
Control	1 5(%)	1 (1.7%)	6 (7.3%)	6 (7.3%)	4 (6.1%)	2.845	0.584
GERD	3 (15%)	2 (3.4%)	3 (4.2%)	3 (3.7%)	5 (7.6%)	5.382	0.250
GIS bleeding	1 (5%)	–	2 (2.8%)	6 (7.3%)	3 (4.5%)	–	–
Other	–	4 (6.9%)	2 (2.8%)	3 (3.7%)	6 (9.1%)	–	–

χ^2: Pearson Chi-Square Test; GERD — gastroesophageal reflux disease; GIS — gastrointestinal system

No statistically significant differences were detected between the indications EGD in the patients and the mean lengths of cervical oesophagus, hiatal clamp, and oesophagogastric junction localisations (p > 0.05) (Table 2).

No statistically significant differences were detected between the age groups and indications of performing EGD in patients (p > 0.05). The relations between the indications for EGD and gender were also investigated. In this respect, the rate of EGD because of dyspepsia was found to be higher in women (55.2%) at a statistically significant level than in men (39.5%) (p = 0.008; p < 0.01) (Table 3). Also, the rate of EGD because of GIS bleeding was found to be higher at a statistically significant level in males (7.3%) than in females (1.7%) (p = 0.032; p < 0.05).

A total of 27.2% (n = 81) of the patients who underwent EGD had antral gastritis diagnosis, 21.8% (n = 65) loose lower oesophageal sphincter (LES), 11.1% (n = 33) alkaline reflux, 10.4% (n = 31) pangastritis, 8.1% (n = 24) erosive gastritis, 3.4% (n = 10), ulcer (antrum), 5% (n = 15) other diagnoses (bulbitis, Barret's oesophagus, oesophagitis, pyloric strictures) and 4.7% (n = 14) normal.

No statistically significant differences were detected between the diagnoses of the patients after EGD and the mean lengths of cervical oesophagus, oesophagogastric junction, and hiatal pincer localizations (p > 0.05) (Table 4).

Table 4. The evaluation of the anatomical localisations according to the diagnosis of patients after oesophagogastroduodenoscopy

Diagnoses		Cervical oesophagus length [cm]	Oesophagogastric junction length [cm]	Hiatal clamp length [cm]
Antral gastritis	Yes	15.09 ± 0.57	37.59 ± 2.33	38.64 ± 2.30
	No	15.00 ± 0.57	37.32 ± 1.97	38.57 ± 2.06
	t	0.248	0.908	0.234
	p	0.242	0.365	0.815
Loose lower oesophagus sphincter	Yes	15.09 ± 0.49	37.43 ± 2.15	38.75 ± 2.05
	No	15.06 ± 0.60	37.54 ± 2.26	38.58 ± 2.28
	t	0.182	-0.337	0.556
	p	0.651	0.737	0.578
Alkalane reflux	Yes	14.97 ± 0.53	37.33 ± 2.07	38.82 ± 2.35
	No	15.08 ± 0.58	37.54 ± 2.26	38.59 ± 2.22
	t	–0.999	–0.490	0.547
	p	0.319	0.624	0.585
Pangastritis	Yes	15.00 ± 0.63	37.10 ± 2.48	38.39 ± 2.36
	No	15.07 ± 0.57	37.56 ± 2.21	38.64 ± 2.22
	t	–0.53	–1.097	–0.606
	p	0.514	0.274	0.545
Erosive gastritis	Yes	15.08 ± 0.50	37.25 ± 2.31	38.75 ± 1.87
	No	15.06 ± 0.58	37.54 ± 2.23	38.61 ± 2.26
	t	0.174	–0.601	0.303
	p	0.862	0.548	0.762
Polyp	Yes	15.07 ± 0.62	37.36 ± 2.21	38.43 ± 2.31
	No	15.06 ± 0.57	37.52 ± 2.24	38.63 ± 2.23
	t	0.051	–0.268	–0.324
	p	0.959	0.789	0.746
Ulcer	Yes	15.20 ± 0.63	38.30 ± 2.75	39.20 ± 2.53
	No	15.06 ± 0.57	37.49 ± 2.22	38.6 ± 2.22
	t	0.419	0.378	0.839
	p	0.446	0.258	0.402
Normal	Yes	15.07 ± 0.59	37.2 ± 2.27	38.27 ± 2.15
	No	15.06 ± 0.57	37.53 ± 2.24	38.64 ± 2.24
	t	0.981	0.903	0.677
	p	0.984	0.578	0.533

Data are shown as mean ± standard deviation; t: Student-t test

When the differences in the diagnosis were examined according to the age groups, no differences were detected except for the patients who were diagnosed with antral gastritis; however, statistically significant differences were detected in the incidence rates ($p < 0.001$; $p < 0.01$). It was also found that the rate of diagnosis of antral gastritis in those who were aged 65 and over was lower than in other age groups (Table 5).

When the diagnosis of the patients after EGD was evaluated according to gender, the rate of diagnosis of antral gastritis was found to be higher at a statistically significant level in women (77.6%) than in men (66.1%) ($p = 0.028$; $p < 0.05$) (Table 6).

The incidence of loose LES was found to be higher at a statistically significant level in men (28.2%) than in women (17.2%) ($p = 0.034$; $p < 0.05$) (Table 6).

DISCUSSION

The oesophagus is a muscular (smooth muscle) tube connecting the pharynx and the stomach, starting from the C6 vertebra level extending to the T11 level with an average length of 25–30 cm. In the literature, the oesophageal length is accepted as the distance between the upper oesophageal sphincter and the lower oesophageal sphincter [17]. Although Li et al. [21] found the oesophageal length as 22.9 cm on average in healthy individuals, Award et al. [5] found it to be 28.3 cm on average, and Yau et al. [33] as 23 cm, which is similar to the study of Li et al. [21]. In their study, Marshall et al. [22] found the oesophageal length to be significantly higher with a mean of 21.12 cm in men than in women (mean 20.15 cm). The length of the oesophagus is accepted as 25–30 cm on average in the literature, and was determined as 9–10 cm in newborns [23]. The cervical oesophagus, which starts

Table 5. The evaluation of the diagnoses of the patients after oesophagogastroduodenoscopy according to age groups

Diagnoses	Age group					χ^2	P
	< 35 years	35–44 years	45–54 years	55–64 years	≥ 65 years		
Antral gastritis	15 (75%)	50 (86.2%)	54 (75%)	63 (76.8%)	35 (53%)	**19.197**	**< 0.001***
Loose lower oesophagus sphincter	5 (25%)	13 (22.4%)	9 (12.5%)	21 (25.6%)	17 (25.8%)	5.088	0.278
Alkalane reflux	5 (25%)	5 (8.6%)	6 (8.3%)	9 (11%)	8 (12.1%)	4.917	0.296
Pangastritis	2 (10%)	4 (6.9%)	8 (11.1%)	7 (8.5%)	10 (15.2%)	2.710	0.607
Erosive gastritis	–	4 (6.9%)	4 (5.6%)	7 (8.5%)	9 (13.9%)	–	–
Ulcer (in the antrum)	–	2 (3.4%)	2 (2.8%)	1 (1.2%)	5 (7.6%)	5.548	0.236
Other	2 (10%)	2 (3.4%)	5 (6.9%)	2 (2.4%)	4 (6.1%)	3.187	0.527
Normal	1 (5%)	3 (5.2%)	1 (1.4%)	3 (3.7%)	6 (9.1%)	4.837	0.307

χ^2: Pearson Chi-Square Test; *$p < 0.01$

Table 6. The evaluation of the diagnoses of the patients after oesophagogastroduodenoscopy according to gender

Diagnoses	Gender		χ^2	P
	Male	Female		
Antral gastritis	82 (66.1%)	135 (77.6%)	**4.802**[1]	**0.028***
Loose lower oesophagus sphincter	35 (28.2%)	30 (17.2%)	**5.122**[1]	**0.034***
Alkalane reflux	14 (11.3%)	19 (10.9%)	0.010[2]	0.920
Pangastritis	14 (11.3%)	17 (9.8%)	0.053[2]	0.817
Erosive gastritis	7 (5.6%)	17 (9.8%)	1.153[2]	0.283
Ulcer (in the antrum)	4 (3.2%)	6 (3.4%)	0.011[3]	1.000
Other	8 (6.5%)	7 (4%)	0.458[2]	0.499
Normal	6 (4.8%)	8 (4.6%)	0.001[2]	1.000

[1]χ^2: Pearson Chi-Square Test; [2]χ^2: Continuity (Yates) corrected Chi-Square Test; [3]χ^2: Fisher Exact Chi-Square Test; *$p < 0.05$

from the lower edge of the cartilago cricoidea and ends at the lower edge of the first thoracic vertebra, is approximately 18 cm after the anterior incisors [3]. Because of the anatomical localisation of the cervical oesophagus in EGD procedure, it is a difficult area to measure as it activates the gag reflex when passing with the endoscope. Studies conducted on cervical oesophageal length are very limited in the literature. In the present study, in which the purpose was to investigate the cervical oesophagus length and the relations between age and gender, the average cervical oesophagus length was found to be 15.06 ± 0.57 cm. We believe that the fact that it is shorter that the value reported in the literature was because of the difference between races. Although no significant differences were detected in cervical oesophagus lengths between the age groups, cervical oesophagus length was found to be significantly higher in men (mean 15.31 cm) than in women (mean 14.85 cm) between genders.

In the clinical practice, the hiatal clamp is formed by the right and left crus of the diaphragm at the 10 vertebra level after the anterior incisors at an average of 38 cm [19]. Csendes et al. [8] investigated the localisation of the lower oesophageal sphincter in 778 patients comparing the results with 109 healthy control groups, and reported the lower oesophageal sphincter of the healthy group to be 38 cm on average [14]. Similarly, in the present study, the average length of the hiatal clamp distance from the anterior incisors was detected to be 38.6 cm. Also, the mean hiatal clamp length of patients under 35 years of age was found to be significantly higher than those of patients aged 35–44 in the study ($p = 0.030$; $p < 0.05$). It was also found that the mean hiatus oesophagus distance was statistically longer in men (39.77 cm) than women (37.8 cm) in the comparison between the genders.

Previous studies showed that the average distance from the anterior incisors to the oesophagogastric junction is 38–40 cm in men and 36–38 cm in women, which is 18 cm at birth, 22 cm at the age of 3, and 27 cm at the age of 10 [23, 27]. In the present study,

the average length of the oesophagogastric junction was found to be 37.5 cm, and no significant differences were detected between the age groups. This distance (mean 38.66 cm) was found to be longer in men than in women (mean 36.7 cm), which is consistent with the literature data.

Although the number of patients who were diagnosed with reflux oesophagitis was 43% in the study of Csendes et al. [8], it was reported that 15–25% of the patients who underwent EGB in western societies had oesophagitis. This frequency was much less common (0.8–16.3%) in other studies that were conducted in Asia [14, 31]. In the present study, the incidence of oesophagitis was found to be 6.5% under the heading of other diagnoses. We believe that the fact that this value was far below the literature data since it had a single-cantered design, and therefore the number of cases was low.

There are many accepted indications for EGD the main ones including evaluation of dysphagia, GIS bleeding, peptic ulcer disease, medically resistant GERD, oesophageal strictures, coeliac disease, and unexplained diarrhoea. The fact that the LES does not fully grasp the endoscope in endoscopic examinations performed with retroflexion from the fundus of the stomach despite deep inspiration and expiration and is considered as "LES laxity" [17]. In the present study, the incidence of LES laxity after endoscopy was found to be statistically significantly higher in men (28.2%) than in women (17.2%) ($p = 0.034$; $p < 0.05$). In a study that was conducted by Aksoy et al. [1] with geriatric patients, the rate of loose LES was reported as 34%. However, the rates were not given in this study for men and women.

Knowing the anatomical localisation of the hiatal clamp is important to diagnose hiatal hernia and identify hiatal insufficiency. Hiatal hernia is a common disease defined as the protrusion of the abdominal organs — often the stomach — from the enlarged hiatus oesophagus into the thoracic cavity [2]. Andujar et al. [3] argued that laparoscopic repair of large paraoesophageal hernia is associated with a low incidence of recurrence and reoperation. In their study conducted in 2006, Johnson et al. [16] reported that the incidence of hiatal hernia increases with age. The incidence of hiatal hernia in upper GIS endoscopies was found to be higher in men (15.5%) than in women (14%) in our country [12]. The patients who were diagnosed with hiatal hernia were not included in the present study as it would disrupt the standardisation of the normal anatomical structure. A total of 16 of 335 retrospectively screened patients were excluded from the study since they were diagnosed with hiatal hernia.

Oesophagus strictures are among the most common problems in our present day. EGD must be performed to determine the underlying cause in oesophageal strictures. The overall rate of oesophageal strictures that require dilation among the patients who undergo upper gastrointestinal endoscopy was found to be 6%, and 3% of which were malignant, 2.7% benign, and 0.3% functional strictures [17]. In the study that was conducted by Chow et al. [6], it was argued that the presence of hiatal hernia doubles the risk of oesophageal carcinoma, and that the risk even increases cumulatively with the presence of reflux symptoms, dysphagia, and previously described symptoms of oesophagitis.

The definition of the oesophagogastric junction varies among specialty groups. One definition that was made by surgeons and endoscopy specialists where there is a sudden change of gastric mucosa in the mucosa passing through the oesophagus, and this jagged line was designated as the "Z line" [23]. This line is used as a baseline in distinguishing anatomical concepts associated with the oesophagus and measuring lengths. One of these is the measurement of the length of the LES. In the clinical practice, the LES length is used often for measuring the intraluminal pressure of the oesophagus and for pH monitoring. Knowing the length of this area will ensure correct placement of the catheter, which will result in the better recognition and easier diagnosis of diseases in this area such as GERD and achalasia. For this reason, proper placement of the probes in these localisations is necessary [32]. Knowing the normal anatomy will also guide us in the diagnosis of diseases in this area. For example, measuring these parts in the detection of hiatal hernias and detecting the short oesophagus in the surgeries in the clinical practice can guide the surgeon in terms of the problems which might be faced after the surgery. Knowing that there is a short oesophagus in patients who have hiatal hernia can guide the surgeon in dealing with related problems before the surgery about recurrences and complications which might occur in the postoperative period [20]. Another problem which might be faced in this area is the perforations as a result of endoscopic interventions. These iatrogenic perforations are most commonly detected in the hypopharynx and distal oesophagus. The clinical manifestation of this varies depending on the level of

the perforated area. For example, when patient present with symptoms such as neck pain, crepitation, etc. for perforation in the cervical parts, these symptoms cause other symptoms such as epigastric and shoulder pain as they progress towards the abdomen. The success in treatment also varies according to the localisation. For example, it is already known that stent migration is more and is more difficult to place in proximal perforations, which complicates the treatment increasing stent-related treatment failure [9].

As understood with the examples, the determination of anatomical localisations not only guides the problems that might appear, it also helps to determine the treatment methods that will be chosen. The present study is an anatomy study in which it was found that the length of the anatomical localisation of the hiatal clamp from the anterior incisors differed according to age and gender. It was also found that the hiatal clamp length is longer in young age than in older ages ($p = 0.035$, Table 3), and the hiatal clamp length is longer in male gender than female gender at statistically significant levels ($p < 0.001$, Table 4). In their study conducted on 50 cadavers, Shamiyeh et al. [24] reported that this length is important in repairing the crus in hiatal hernias and in the treatment of GERD. They measured this length by measuring the area defined as the hiatal surface area. As mentioned in this example, it was seen that the evaluation was made by measuring the hiatal surface area that can be measured during the operation. In another study that was conducted by Koch et al. [18], it was reported that this length measurement could not be made accurately with radiological and endoscopy methods, and only the size of hiatal hernias could be determined with these methods. It was reported in another study that the use of width measurement instead of length measurement would yield more accurate results because of the slippery nature of this area [11]. It was seen in the literature that the measurements of these lengths were made radiologically [15]. In the present study, the measurement was made only endoscopically and was not verified radiologically. Despite these limitations, we believe that the fact that the measurement was made and recorded by a single expert endoscopy specialist to provide a certain standard, and the number of patients included in the study was 298 increases the importance of the study.

In the data obtained here, it was determined in the evaluations of the indication of the procedure and gender in the patients who underwent EGD that the EGD procedure was more common in women because of dyspepsia, and that gastritis, duodenitis, and peptic ulcer were more common in these patients than in men (Table 6). In the literature, in a study that included 12,213 people conducted by Freha et al. [13], it was reported that, unlike our study, gastritis was more common in male gender. Similarly, in the same study as well as in our study, upper GIS bleeding was found to be statistically higher in men than in women, which is consistent with the literature data ($p = 0.032$; $p < 0.05$). There are many factors, which can cause this situation such as smoking, drugs used, or accompanying comorbidities. This may be the subject of further studies.

Since no studies similar to our study were detected in the literature, it is not possible to verify and compare the relations of length measurements in these localisations with gender, age, and symptoms reported in other studies. At this point, we believe that the data found in this study will be important in terms of establishing a standardisation in Turkish society, and will also guide clinicians. We also believe that the relations between the anatomical localisations that were examined in the present study and the body mass index must be investigated in further studies.

CONCLUSIONS

Knowing the anatomical localisations of the cervical oesophagus length, hiatal clamp, and oesophagogastric junction may be important in planning the outcomes of the complications, which might occur in this region in EGD, and in planning the measures to be taken in this respect. It may also help clinicians to identify hiatal hernias and insufficiencies and to determine the treatment modalities to approach these diseases. In the future, if the present study is planned by including patients with certain symptoms and if the number of patients is increased, it will be more guiding for the interventions regarding treatment modalities. Also, these measurements should be supported with cadaver studies for the purpose of providing a standard and achieving measurements with more objective values.

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REFERENCES

1. Aksoy EK, Akpınar M, Sapmaz FP, et al. Assessment of effectiveness and safety of upper gastrointestinal system endoscopy in geriatric patients. J Ankara Univ Fac Med. 2018; 71(3): 228–233, doi: 10.4274/atfm.20982.
2. Altorki NK, Yankelevitz D, Skinner DB. Massive hiatal hernias: the anatomic basis of repair. J Thorac Cardiovasc Surg. 1998; 115(4): 828–835, doi: 10.1016/S0022-5223(98)70363-0, indexed in Pubmed: 9576218.
3. Anatomy of the Esophagus | SEER Training. (n.d.). National Cancer Institute SEER Training Modules. https://training.seer.cancer.gov/ugi/anatomy/esophagus.html.

4. Andujar JJ, Papasavas PK, Birdas T, et al. Laparoscopic repair of large paraesophageal hernia is associated with a low incidence of recurrence and reoperation. Surg Endosc. 2004; 18(3): 444–447, doi: 10.1007/s00464-003-8823-4, indexed in Pubmed: 14752653.
5. Awad ZT, Watson P, Filipi CJ, et al. Correlations between esophageal diseases and manometric length: a study of 617 patients. J Gastrointest Surg. 1999; 3(5): 483–488, doi: 10.1016/s1091-255x(99)80101-2, indexed in Pubmed: 10482704.
6. Chow WH, Finkle WD, McLaughlin JK, et al. The relation of gastroesophageal reflux disease and its treatment to adenocarcinomas of the esophagus and gastric cardia. JAMA. 1995; 274(6): 474–477, indexed in Pubmed: 7629956.
7. Collis JL, Kelly TD, Wiley AM. Anatomy of the crura of the diaphragm and the surgery of hiatus hernia. Thorax. 1954; 9(3): 175–189, doi: 10.1136/thx.9.3.175, indexed in Pubmed: 13205524.
8. Csendes A, Maluenda F, Braghetto I, et al. Location of the lower oesophageal sphincter and the squamous columnar mucosal junction in 109 healthy controls and 778 patients with different degrees of endoscopic oesophagitis. Gut. 1993; 34(1): 21–27, doi: 10.1136/gut.34.1.21, indexed in Pubmed: 8432446.
9. Dormann AJ, Eisendrath P, Wigginghaus B, et al. Palliation of esophageal carcinoma with a new self-expanding plastic stent. Endoscopy. 2003; 35(3): 207–211, doi: 10.1055/s-2003-37252, indexed in Pubmed: 12584638.
10. El-Serag HB, Johanson JF. Risk factors for the severity of erosive esophagitis in Helicobacter pylori-negative patients with gastroesophageal reflux disease. Scand J Gastroenterol. 2002; 37(8): 899–904, doi: 10.1080/003655202760230847, indexed in Pubmed: 12229963.
11. Evans RJ, Moore R. Hiatal width: a novel measure of hiatal hernia: 480. Official J Am Coll Gastroenterol ACG. 2018; 113: S276–S277.
12. Ferlengez E, Ferlengez AG, Çelik A, et al. Endoscopic and clinical characteristics of patients diagnosed at the gastroduodenoscopy unit of a secondary level state hospital our gastroduodenoscopy results. Med Bull Haseki. 2012; 50: 131–135.
13. Freha NA, Gat R, Novack V, et al. Endoscopy and gender, similiarties and differences. ESGE Days. 2020; 52(1): 12, doi: 10.1055/s-0040-1704782.
14. Goh KL. Changing epidemiology of gastroesophageal reflux disease in the Asian-Pacific region: an overview. J Gastroenterol Hepatol. 2004; 19 (Suppl 3): S22–S25, doi: 10.1111/j.1440-1746.2004.03591.x, indexed in Pubmed: 15324378.
15. Han SH, Hong SuJ. [Transient lower esophageal sphincter relaxation and the related esophageal motor activities]. Korean J Gastroenterol. 2012; 59(3): 205–210, doi: 10.4166/kjg.2012.59.3.205, indexed in Pubmed: 22460568.
16. Johnson DA, Ruffin WK. Hiatal hernia. Gastrointest Endosc Clin N Am. 1996; 6(3): 641–666, indexed in Pubmed: 8803572.
17. Kahraman Ö, Cingi A. Ed. Gastrointestinal Sistem Endoskopisi. Pelin Ofset Tipo Matbaacılık ve Tic. Ltd. Şti., Ankara 2016.
18. Koch OO, Kaindlstorfer A, Antoniou SA, et al. Influence of the esophageal hiatus size on the lower esophageal sphincter, on reflux activity and on symptomatology. Dis Esophagus. 2012; 25(3): 201–208, doi: 10.1111/j.1442-2050.2011.01238.x, indexed in Pubmed: 21895850.
19. Kumar D, Zifan A, Ghahremani G, et al. Morphology of the esophageal hiatus: is it different in 3 types of hiatus hernias? J Neurogastroenterol Motil. 2020; 26(1): 51–60, doi: 10.5056/jnm18208, indexed in Pubmed: 31677612.
20. Lal P, Tang A, Sarvepalli S, et al. Manometric esophageal length to height (MELH) ratio predicts hiatal hernia recurrence. J Clin Gastroenterol. 2020; 54(6): e56–e62, doi: 10.1097/MCG.0000000000001316, indexed in Pubmed: 31985712.
21. Li Q, Castell JA, Castell DO. Manometric determination of esophageal length. Am J Gastroenterol. 1994; 89(5): 722–725, indexed in Pubmed: 8172145.
22. Marshall RE, Anggiansah A, Anggiansah CL, et al. Esophageal body length, lower esophageal sphincter length, position and pressure in health and disease. Dis Esophagus. 1999; 12(4): 297–302, doi: 10.1046/j.1442-2050.1999.00060.x, indexed in Pubmed: 10770366.
23. Moore KL, Arthur F. Dalley. Clinically Oriented Anatomy. Lippincott Williams & Wilkins, A Wolters Kluwer Company 1999.
24. Shamiyeh A, Szabo K, Granderath FA, et al. The esophageal hiatus: what is the normal size? Surg Endosc. 2010; 24(5): 988–991, doi: 10.1007/s00464-009-0711-0, indexed in Pubmed: 19826867.
25. Sieg A, Hachmoeller-Eisenbach U, Eisenbach T. Prospective evaluation of complications in outpatient GI endoscopy: a survey among German gastroenterologists. Gastrointest Endosc. 2001; 53(6): 620–627, doi: 10.1067/mge.2001.114422, indexed in Pubmed: 11323588.
26. Staiano A, Clouse RE. Detection of incomplete lower esophageal sphincter relaxation with conventional point-pressure sensors. Am J Gastroenterol. 2001; 96(12): 3258–3267, doi: 10.1111/j.1572-0241.2001.05323.x, indexed in Pubmed: 11774934.
27. Themes U. Anatomy of the Esophagus. Thoracic Key. https://thoracickey.com/anatomy-of-the-esophagus/ . https://thoracickey.com/anatomy-of-the-esophagus/ (2016, June 25).
28. Trost J. Statistically nonrepresentative stratified sampling: A sampling technique for qualitative studies. Qualitative Sociology. 1986; 9(1): 54–57, doi: 10.1007/bf00988249.
29. Wiener GJ, Richter JE, Copper JB, et al. The symptom index: a clinically important parameter of ambulatory 24-hour esophageal pH monitoring. Am J Gastroenterol. 1988; 83(4): 358–361, indexed in Pubmed: 3348191.
30. Wilson LJ, Ma W, Hirschowitz BI. Association of obesity with hiatal hernia and esophagitis. Am J Gastroenterol. 1999; 94(10): 2840–2844, doi: 10.1111/j.1572-0241.1999.01426.x, indexed in Pubmed: 10520831.
31. Wong WM, Lim P, Wong BCY. Clinical practice pattern of gastroenterologists, primary care physicians, and otolaryngologists for the management of GERD in the Asia-Pacific region: the FAST survey. J Gastroenterol Hepatol. 2004; 19 (Suppl 3): S54–S60, doi: 10.1111/j.1440-1746.2004.03590.x, indexed in Pubmed: 15324383.
32. Yang GS, Bishop WP, Smith BJ, et al. Radiographic and endoscopic measurements of esophageal length in pediatric patients. Ann Otol Rhinol Laryngol. 2005; 114(8): 587–592, doi: 10.1177/000348940511400802, indexed in Pubmed: 16190090.
33. Yau P, Watson DI, Jamieson GG, et al. The influence of esophageal length on outcomes after laparoscopic fundoplication. J Am Coll Surg. 2000; 191(4): 360–365, doi: 10.1016/s1072-7515(00)00363-x, indexed in Pubmed: 11030240.