

Radiological evaluation of the styloid process length in the normal population

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Background: The aim of this study was to evaluate the styloid process (SP) length in the normal population using multidetector computed tomography (MDCT).

Materials and methods: In this study, 160 patients who underwent paranasal MDCT between January 2012 and December 2012 were retrospectively evaluated. The patients were divided into groups according to their age and gender: Group 1 age 31–40 years old, 111 subjects; Group 2 age 41–50 years old, 49 subjects; Group A 98 males; Group B 62 females. The mean SP length was calculated from the mean of 2 measurements. SPs were assessed for their average lengths in different gender and age groups. Student's t-test was used for the comparison of the mean SP lengths between the groups. Differences were considered to be statistically significant at $p < 0.05$.

Results: The mean SP length on both sides varied from 18 to 51 mm (28.4 ± 5.5) in all the patients. The mean SP length was 27.2 ± 5.2 mm in females and 29.2 ± 5.6 mm in males. There was a statistically significant difference between the mean SP lengths in terms of gender ($p < 0.028$). The mean SP length was 28.5 ± 5.7 mm in Group 1 and 28.2 ± 5.1 mm in Group 2. There was no statistically significant difference between the mean SP lengths in terms of age ($p > 0.718$).

Conclusions: In conclusion, there is still no consensus on the normal values of SP length. Normal values should be determined according to the geographical regions and ethnic groups for the diagnosis of Eagle's syndrome. (Folia Morphol 2013; 72, 4: 318–321)

Key words: Eagle's syndrome, multidetector computed tomography, styloid length

INTRODUCTION

Eagle's syndrome was first defined by Eagle in 1937 [6]. It describes a series of symptoms caused by an elongated styloid process (SP) and/or the mineralisation of part or the entire stylohyoid ligament [6]. It is seen in approximately 4% of the general population. Although it is generally asymptomatic, 4% of patients are symptomatic [20]. This syndrome

has been greatly observed in females in their 4th and 5th decades [7, 8]. The syndrome's symptoms may comprise pain, localised in either or both sides of the throat, with or without referred pain to the ear and mastoid area on the ipsilateral side [21]. Other symptoms are pain on rotation of the head, recurrent headache, vertigo, facial pain, otalgia and cephalgia [5, 10].

If there is a clinical suspicion, multidetector computed tomography (MDCT) of the neck and skull base should be the first imaging modality [2, 3, 23]. In conditions of vascular compression, CT angiography of the neck can also be useful in evaluating blood flow disturbance [4]. Three-dimensional reconstruction is considered to be the gold standard in the radiological diagnosis [18]. It allows an exact measurement of the length and angulation of the SP [15, 19]. It can also be used to choose surgical methods in some situations [14].

There is no consensus among the investigators about the normal values of SP length because of race and geographic location yet. By this way, the aim of this study was to evaluate the SP length via MDCT in the normal population.

MATERIALS AND METHODS

This study was approved by the Local Ethics Committee. In this study, 160 patients who underwent paranasal MDCT between January 2012 and December 2012 were retrospectively evaluated. The patients were 98 males and 62 females. They were divided into groups according to their age and gender: Group 1 age 31–40 years old, 111 subjects; Group 2 age 41–50 years old, 49 subjects; Group A 98 males; Group B 62 females.

CT was performed using 16MDCT scanners (Siemens, Somatom Emotion, USA) for all the patients. Paranasal CT scanning was obtained with slice thickness of 3 mm; 1 pitch; 110 kV; and 70 mAs. The images were transferred to the workstation (Syngo VIA console, Siemens). Then, multiplanar reconstruction (MPR) was created and the measurements were made on MPR images. The length from the attachment point to the temporal bone to the end of the SP was measured (Fig. 1). Length measurements were performed bilaterally. The mean SP length was calculated from the mean of the 2 measurements. SPs were assessed for their average lengths in different gender and age groups. All of the measurements were obtained by 2 experienced radiologists and intra/inter-observer variability was less than 5%.

SPSS for Windows 11.5 statistical package program (SPSS 20, IL, USA) was used for data evaluation. Data normal distribution conformity was evaluated by the One Sample Kolmogorov Smirnov Test. Data were expressed as the mean \pm standard deviation (SD). Student's t-test was used for the comparison of mean SP lengths between the groups. Differences

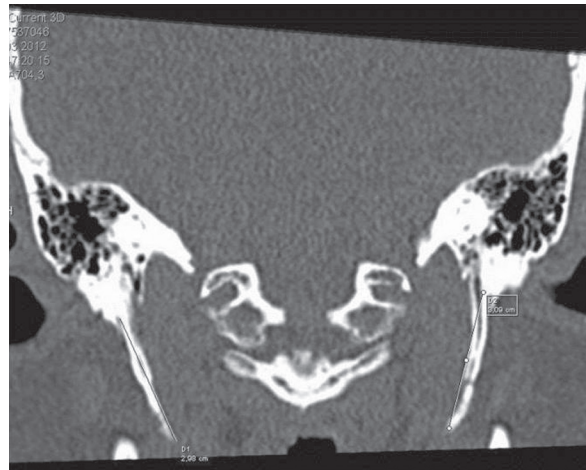


Figure 1. Coronal reformatted computed tomography image. The left styloid process (SP) length 29.8 mm and the right SP length 29.8 mm in a 42-year-old female.

were considered to be statistically significant at $p < 0.05$. The SP length measurements were compared for both intra-observer and inter-observer agreement, using Pearson's correlation test.

RESULTS

A total of 160 patients (98 males, 62 females) were included in the study. The mean age was 37.5 ± 6.4 (range 31–49) years. The mean length of the SP was 28.3 ± 5.8 (range 18–53) mm on the right and 28.6 ± 6.2 (range 18–57) mm on the left side. The mean SP length on both sides varied from 18 to 51 (28.4 ± 5.5) mm in all the patients.

The age distribution of the groups and a comparison of the mean SP lengths of the groups according to gender are given in Table 1. The mean SP length was 27.2 ± 5.2 mm in females and 29.2 ± 5.6 mm in males. There was a statistically significant difference between the mean SP lengths in terms of gender ($p < 0.028$).

The gender distribution of the groups and a comparison of the mean SP lengths of the groups according to age are given in Table 2. The mean SP length was 28.5 ± 5.7 mm in Group 1 and 28.2 ± 5.1 mm in Group 2. There was no statistically significant difference between the mean SP lengths in terms of age ($p > 0.718$). Intra/inter-observer variability for the SP length measurements was determined at less than 5%.

DISCUSSION

Pietro Marchetti first described clinical symptoms related to an elongated SP [16, 17]. However, Eagle primarily explained the clinical features which occur

Table 1. Age distribution of the groups, a comparison of the mean styloid process (SP) lengths of the groups according to gender

	Group A (n = 98)	Group B (n = 62)
Age [years]	38.6 ± 7	36.9 ± 6
SP length	29.2 ± 5.6 ^a	27.2 ± 5.2

n — number of participants, mean ± standard deviation of the SP length
^ap < 0.05 compared with Group B (student-t test)

Table 2. Gender distribution of the groups, a comparison of the mean styloid process (SP) lengths of the groups according to age

	Group 1 (n = 111)	Group 2 (n = 49)
Gender (female/male)	37/74	25/24
SP length	28.5 ± 5.7	28.2 ± 5.1

n — number of participants, mean ± standard deviation of the SP length

due to the elongated SP and/or stylohyoid ligament calcifications [12]. The morphometric and morphologic variations of the SP may be important factors in preoperative planning and during surgery [11]. MDCT is a successful technique for assessing SP length, angulation and other morphological characteristics [10].

In many studies [1, 6, 13, 22], different cut-off values have been determined for Eagle's syndrome. Eagle [6] found that the cut-off value was 25 mm, Basekim et al. [1] accepted that it was 40 mm, Jung et al. [13] determined a limit value of 45 mm and Ramadan et al. [22] recommended that any measurements above 30 mm be described as elongated SP. In a study by Ekici et al. [9] the mean SP length was found to be longer in males than in females (33.2 ± 13.2 vs. 29.6 ± 10.5 mm, $p < 0.001$). The mean SP length on both sides was 31.2 ± 11.9 mm in all the patients. The mean SP length was 30.5 ± 11.0 mm on the right and 31.7 ± 13.1 mm on the left side. The mean SP length was 29.6 ± 10.5 mm in females and 33.2 ± 13.2 mm in males, showing statistically significant difference between the genders ($p < 0.001$). The mean SP length was measured as 30.7 ± 10.5 mm in the 4th and 32.9 ± 10.2 in the 5th decade. No statistically significant difference was detected between the 4th and 5th decades. Yetiser et al. [25] identified that the mean SP length was between 20 and 32 mm. Yavuz et al. [24] determined that the mean SP length was 50 mm on the right side and 52 mm on the left side in a Turkish population.

In the current study, the mean SP length on both sides varied from 18 to 51 mm (28.4 ± 5.5) in all the

patients. The mean SP length was 27.2 ± 5.2 mm in females and 29.2 ± 5.6 mm in males. The mean SP length was 28.5 ± 5.7 mm in the 4th decade and 28.2 ± 5.1 mm in the 5th decade. The findings of the current study were similar in both age and gender groups when compared with the results of Ekici et al. [9] in respect of SP lengths in the Turkish population. However, compared with the study of Yavuz et al. [24], the values of the current study are quite low. This situation can be explained by the racial and geographical variations.

The major limitation of the current study was that the study group comprised cases in the 4th and 5th decades only and other age groups were excluded.

CONCLUSIONS

There is still no consensus on the normal values of SP length, which may vary depending on the race and geographical location. Therefore, normal values should be determined according to the regions and ethnic groups for the diagnosis of Eagle's syndrome.

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