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Original Research Article

Radiological Evaluation of Length of the Styloid Process of Temporal Bone in Multi-detector CT images- A Retrospective Study

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ABSTRACT

Background: Styloid process (SP) is a cylindrical piece of bony projection from petrous part of temporal bone. SP is clinically important anatomical entity due to pathologies caused by changes in its length. The average length is 25mm- 30mm, measurements of 30mm & greater indicate elongation of SP. It is necessary to have knowledge of normal anatomy of the structures involved & standardized morphometric measurements to evaluate the pathological changes related to the disease.

Objectives: To evaluate the Length of the styloid process of temporal bone using 3D reconstructed images of MDCT (Multi-detector Computed Tomography).

To investigate the possibility of occurrence of Eagle's syndrome in asymptomatic individuals.

Materials and methods: This study was conducted on CT(Computed Tomography) images of 400 patients who underwent para nasal and Head and neck MDCT between March 2024 and June2024. The images were assessed retrospectively. The length of the styloid process from its attachment on the temporal bone to the tip was measured in 3D reconstructed images using Volume rendering technique(VRT) and an inbuilt dedicated workstation. The measurements were undertaken in centimeters, obtained data was tabulated and analysed statistically.

Results: The mean length of Styloid process among 400 CT images evaluated is 3.1± 0.5cm on the right side and 3.3± 0.61cm on the left side. Mean length of SP in males is 3.13±0.57cm on right side and 3.12±0.56 on the left side, in females it is 3.07±0.62cm and 3.08± 0.68cm on the right and left side respectively. Elongated Styloid process(e"3cm) is observed in 60.5% and 59% on the right and left side respectively. Elongated SP is noted in 23.75% of males and 21.75% of females.

Conclusion: The average length of the styloid process is consistent with the results of other studies reported in the literature. This data guides the clinicians in diagnosing Eagle's syndrome in asymptomatic individuals. It can also help the clinicians to avoid misinterpretation of symptoms like tonsillar pain, pain of dental or muscular origin.

KEY WORDS: Styloid process, Eagle's syndrome, elongated styloid process, stylohyoid ligament.

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INTRODUCTION

The name styloid process(SP) was derived from the Greek word 'stylos'meaning a pillar. Embryologically SP,the stylohoid ligament and the lesser cornu of hyoid bone are developed from the second branchial arch called Reichert's cartilage.Because of the cartilaginous origin the ligament has the potential to mineralize[1]. The SP is a cylindrical, long cartilaginous bone which arises from the temporal bone in front of the stylomastoid foramen.The attached structures include stylopharyngeus, stylohyoid and styloglossus muscles, stylohyoid and stylomandibular ligaments. Many nerve and vessels, such as carotid arteries are adjacent to the SP[2,3]. Eagle's syndrome was first defined by Eagle in 1937.It describes a series of symptoms caused by an elongated styloid process(SP) and/or the mineralisation of part or the entire stylohyoid ligament[4]. It is seen in approximately 4% of the general population. Although it is generally asymptomatic,4% of patients are symptomatic. This syndrome has been greatly observed in females in their 4^{th} and 5^{th} decades[7,8,9].

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 process on the ipsilateral side[19]. other symptoms are pain on rotation of the head, recurrent headache, vertigo, facial pain, otalgia and cephalgia[5]. If there is a clinical suspicion MDCT of the neck and skull base should be the first imaging modality[6,7]. In conditions of vascular compression CT angiography of the neck can be useful [8]. Three dimensional reconstruction is considered to be the gold standard in the radiological diagnosis.It allows an exact measurement of the length and angulation of the SP[18].Thus the main aim of this study is to evaluate the length of the Styloid process in patients who underwent paranasal and Head and neck MDCT imaging for headache, sinusitis and any other diseases related to head and neck region.

MATERIALS AND METHODS

This study was conducted in department of Radiology , Rajarajeswari medical college and hospital, Bengaluru, Karnataka. Ethical clearance for the study was obtained from RRMCH-IEC(231/2022). CT images of 400 patients who underwent para nasal and Head and neck MDCT between March 2024 and June 2024. Among the images, 152 CT images were of females and 248 CT images were of males. MDCT images with fractured Styloid process and Styloid processes with gross pathology were excluded from the study.The images were assessed retrospectively.

The length of the styloid process from its base (attachment on the temporal bone) to the tip was measured in 3D reconstructed/ Volume rendering technique(VRT) images using an inbuilt dedicated workstation. A sample VTR image is given in Figure -1. The measurements were undertaken in centimeters, obtained data was tabulated and analysed statistically.

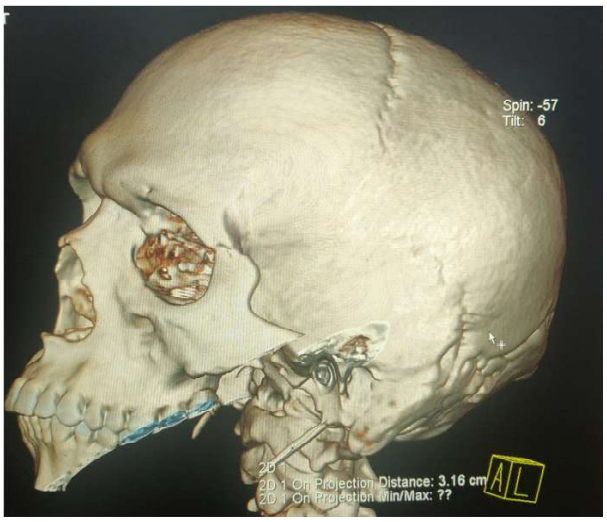

Fig. 1: Showing the sample of VRT image.

RESULTS

A total of 400 CT images (248 males and 152 females) studied. The mean length of Styloid process among 400 CT images evaluated is 3.1± 0.5cm on the right side and 3.3± 0.61cm on the left side. Mean length of SP in males is 3.13±0.57cm on right side and 3.12±0.56 on the left side, in females it is 3.07±0.62cm and 3.08± 0.68cm on the right and left side respectively.

The mean age of the patients in the images was 45.98±18.44(range 28-64) years.Age distribution and mean length of SP are illustrated in Table 1. Elongated Styloid process (≥3cm)

was observed in 60.5%(242 images) and 59% (236 images) on the right and left side respectively. Elongated SP was noted in 23.75% of males and 21.75% of females. Few images of elongated SP are shown in Figure-2.

Table 1: Showing the Age distribution and Mean length of SP.

Age in years	Mean lenth of SP in cms
0- 24	2.92±0.55
25- 50	3.09±0.63
> 51	3.1±0.54

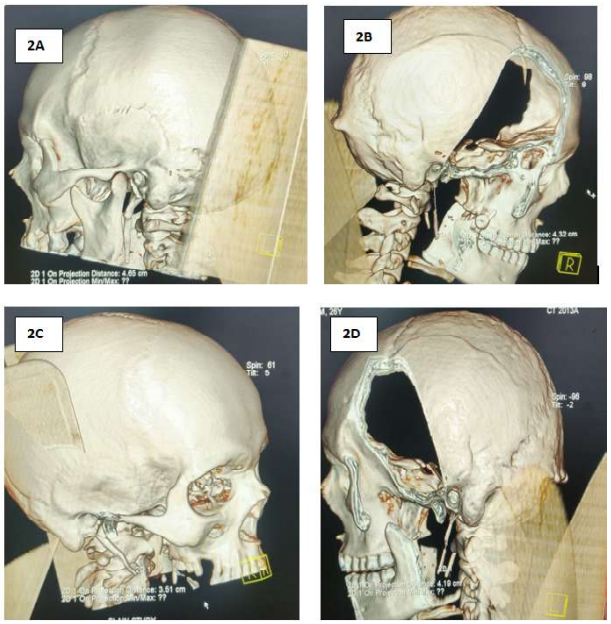

Fig. 2: Showing few images with elongated Styloid process (2A- 4.65cm, 2B- 4.32cm, 2C- 3.51cm, 2D- 4.19cm).

DISCUSSION

Styloid process is an important anatomical landmark that gives attachment to muscles and ligaments. Due to its close proximity to the many important structures in head and neck region it gains the attention of both medical doctors and and also Dental surgeons[5].

In studies investigating Styloid process length the normal length was reported as 25to 30 mm by Eagle[9], less than 30mm by Kaufman et al[10], and 15.2mm by Moffat et al[11]. When the literature is reviewed, it was observed that the length of SP varies from 15to 47mm, the values above 30mm are considered to indicate elongation of SP, which is Eagle's Syndrome[9]. In our study the mean legth of SP was 30 mm in females and 32 mm in males. The mean length varied greatly with differences being observed in the same individual between right and left sides. This suggests that it is possible to observe variations in the different anatomical regions of the same person. Elongated SP frequency is highly variable and reported between 1.4% and 83.6%, however radiographic incidence is between 2%and 32%[12]. Gokce C et al have have reported the prevalence of Eagle syndrome in 1.1% to 7.7% in Turkish population[13]. Kaufman et al have found elongated Styloid process to be 28%[10]. In a study by Gulam Anwer Khan et al elongated SP was observed in 16% and 17.8% on the left and right side respectively[3]. In our study elongated Styloid process was observed in 60.5%(242 images) and 59% (236 images) on the right and left side respectively.Higher incidence might be because of the different age groups as the Styloid process length increases with age and ossification and calcification of stylohyoid ligament are also considered as the major factors[13].

Studies have shown different results concerning the relationship between the SP length and gender[14,15,16,17] .Nalcaci et al found no significant difference between the SP length gender.A.H Baykan et al have found the signicant difference between SP length and gender[5]. In this study Mean length of SP in males is 3.13±0.57cm on right side and 3.12±0.56 on the left side, in females it is 3.07±0.62cm and 3.08± 0.68cm on the right and left side respectively. Elongated SP was noted in 23.75% of males and 21.75% of females.It is believed that the significantly longer SP in males is due to the anatomical variations related to gender.

CONCLUSION

The average length of the styloid process is consistent with the results of other studies reported in the literature. Since it is possible to observe gender based variations and also variations in different anatomical regions of same person , it is very important to consider the gender based and right and left differences in clinical approaches .

This data guides the clinicians in diagnosing Eagle's syndrome in asymptomatic individuals. Knowing the radiological measurements of SP

acts as a guide for the diagnosis and monitoring of heath problems which impair quality life of an individual such as tinnitus and vertigo. It can also help the clinicians to avoid misinterpretation of symptoms like tonsillar pain, pain of dental or muscular origin.

LIST OF ABBREVIATIONS

SP- Styloid process
MDCT- Multi-detector Computed Tomography
CT- Computed Tomography
VRT- Volume Rendering Technique

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Author Contributions

Dr. Sarala HS and Dr. Jyothilakshmi GL have contributed for Manuscript preparation, analysing the photographs, preparation of illustrations and tables they have also done the proof reading. **Dr.Prvin GU and Dr. Sindhu N** have contributed for taking the measurements on Styloid process using VRT software and they have contributed for discussion writing and helped in overall preparation of the manuscript.

Conflicts of Interests: None

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