



RADIOLOGICAL EVALUATION OF STYLOID PROCESS LENGTH AND MORPHOLOGICAL VARIATIONS USING MULTIDETECTOR COMPUTED TOMOGRAPHY AND THEIR CLINICAL SIGNIFICANCE.

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Abstract

Background: The styloid process (SP) is a slender bony projection of the temporal bone, whose elongation can lead to Eagle's syndrome. Knowledge of SP length and morphological variations is essential for accurate diagnosis and surgical planning.

Objective: To evaluate the length and morphological variations of the styloid process using multidetector computed tomography (MDCT) and assess their clinical significance.

Materials and Methods: A cross-sectional study was conducted on 289 patients (156 males, 133 females) aged 10–85 years who underwent head and paranasal sinus CT scans at Department of Radiology, Maa Vindhyavasini Autonomous State Medical College Mirzapur Uttar Pradesh associated with the department of Anatomy from March 2024 to February 2025. SP length was measured bilaterally, and the prevalence of elongation (>3 cm) was recorded. Patients with fractures or incomplete visualization of SP were excluded.

Results: The mean SP length was 3.10 ± 0.50 cm on the right and 3.30 ± 0.61 cm on the left. Elongated SP (>3 cm) was observed in 40.1% of patients, with slightly higher prevalence on the left side. Gender-wise, elongation was seen in 23.7% of males and 21.8% of females. Most patients had a normal SP, and differences between genders were minimal.

Conclusion: Styloid process elongation is a common anatomical variation, slightly more prevalent in males, with the left SP generally longer than the right. Awareness of SP length and variations is crucial for the clinical and radiological evaluation of head and neck complaints, particularly in diagnosing Eagle's syndrome.

Keywords: Styloid process, Elongation, Eagle's syndrome, Multidetector CT, Morphological variations

Introduction:

The term styloid process (SP) originates from the Greek word “stylos,” meaning pillar. Embryologically, the styloid process, stylohyoid ligament, and lesser horn (cornu) of the hyoid bone develop from the second branchial arch, known as Reichert’s cartilage. Due to their cartilaginous origin, the stylohyoid ligament has the potential to undergo mineralization.¹ The Styloid Process (SP) is a needle-like cylindrical bony projection that originates from the base of the petrous temporal bone. It develops from Reichert's cartilage, which forms from the second pharyngeal arch during embryological development. Positioned antero-inferior to the external auditory meatus, anteromedial to the mastoid process, and anterior to the stylomastoid foramen.²

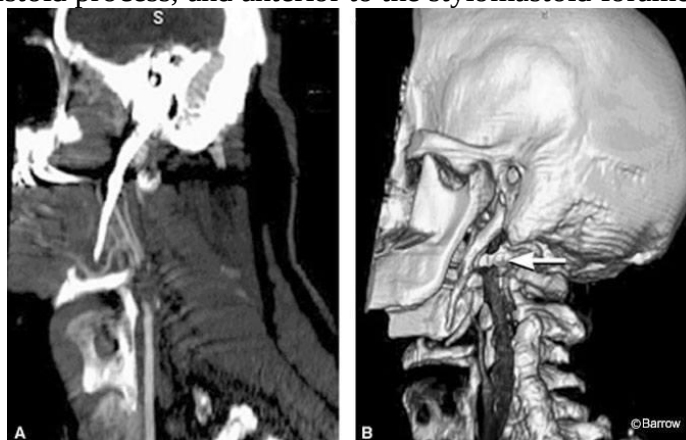


Figure 1: CT and 3D Reconstruction Images Showing Elongated Styloid Process.³

The SP consists of a proximal base within the vaginal process of the temporal bone and a distal shaft from which the stylohyoid, styloglossus, and stylopharyngeus muscles arise.⁴ Ligaments, namely the stylomandibular and stylohyoid ligaments, connect the tip of the SP to the ramus of the mandible and the hyoid bone, respectively.⁵

Surrounding the SP are vital neurovascular structures, including the internal and external carotid arteries, internal jugular vein, and cranial nerves V, VII, IX, X, XI, and XII. The SP serves as a surgical landmark, dividing the parapharyngeal space into pre-styloid and poststyloid compartments.⁶ However, the clinical significance of the SP lies in the constellation of symptoms associated with Eagle's syndrome.⁷

Material and Methods: A study was conducted in the of department of Anatomy in collaboration with department of Radiology a period from March 2024- February 2025 at Maa Vindhyavasini autonomous State medical College, Mirzapur Uttar Pradesh

Study design:

Inclusion criteria:

1. Patients aged 10 to 85 years.
2. Patients who underwent CT scans of the head and paranasal sinuses (PNS) for various indications such as headache, trauma, and sinusitis.
3. Scans in which the styloid process (SP) was clearly visualized and completely included in the imaging field.

Exclusion criteria:

1. Patients with fractured styloid process (SP).
2. SP not clearly visualized due to imaging artifacts.
3. SP not completely included in the scan.
4. Patients with symptoms suggestive of Eagle’s syndrome.

Result:

Table 1: age distribution of the patients

Age Group (years)	Male (%)	Female (%)	Total (%)	p-value*
10–20	18 (11)	14 (10)	32 (11)	0.78
21–40	56 (40)	42 (32)	98 (40)	0.48
41–60	58 (37)	50 (38)	108 (37)	0.92
61–85	24 (16)	27 (20)	51 (18)	0.29
Total	156 (100)	133 (100)	289 (100)	—

The study included 289 patients, with 156 males (54%) and 133 females (46%). Most patients were aged 21–40 years (40%), followed by 41–60 years (37%). The 10–20 and 61–85 years age groups comprised 11% and 18% of the population, respectively. Gender distribution across age groups was balanced, with no significant differences ($p > 0.05$).

Table 2: Gender distribution of the patients.

Gender	Number of Patients (n)	Percentage (%)	P value
Male	156	54.0	0.32
Female	133	46.0	

Among the 289 patients included in the study, 156 were males (54%) and 133 were females (46%). The difference in gender distribution was not statistically significant ($p=0.32$), indicating a relatively balanced representation of both sexes in the study population.

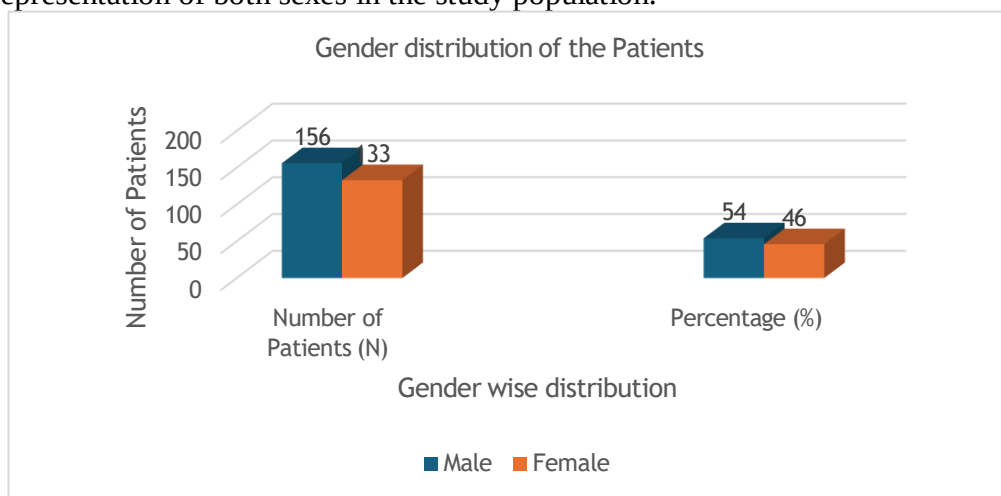


Figure 2: Graphical represents gender distribution of the patients.

Table 3: Mean Length of Styloid Process (SP) in Relation to Side and Gender.

Gender	Number of Patients (N)	Right Side (Mean $\pm$ SD, cm)	Left Side (Mean $\pm$ SD, cm)
Male	156	3.13 $\pm$ 0.57	3.12 $\pm$ 0.56
Female	133	3.07 $\pm$ 0.62	3.08 $\pm$ 0.68
Overall Mean	289	3.10 $\pm$ 0.50	3.30 $\pm$ 0.61

The mean length of the styloid process among the study population was 3.10 ± 0.50 cm on the right side and 3.30 ± 0.61 cm on the left side. In males, the mean SP length was 3.13 ± 0.57 cm on the right and 3.12 ± 0.56 cm on the left, while in females it was slightly lower at 3.07 ± 0.62 cm on the right and 3.08 ± 0.68 cm on the left. Overall, the left styloid process tended to be marginally longer than the right in both sexes, with only minimal differences observed between males and females.

Table 4: Frequency of normal and elongated styloid process.

Styloid Process Type	Right Side N (%)	Left Side N (%)	Total N (%)
Normal SP (≤ 3 cm)	175 (60.5%)	171 (59.0%)	346 (59.9%)
Elongated SP (> 3 cm)	114 (39.5%)	118 (41.0%)	232 (40.1%)
Total	289 (100%)	289 (100%)	-

Among the study population, a normal styloid process (≤ 3 cm) was observed in 60.5% of cases on the right side and 59.0% on the left side. Elongation of the styloid process (> 3 cm) was present in 39.5% of right-sided and 41.0% of left-sided processes. Overall, 40.1% of the patients exhibited an elongated styloid process, indicating that elongation is a relatively common anatomical variation in the population studied.

Table 5: Gender-wise Prevalence of Elongated Styloid Process.

Gender	Number of Patients	Elongated SP (n, %)	Normal SP (n, %)
Male	156	37 (23.7%)	119 (76.3%)
Female	133	29 (21.8%)	104 (78.2%)
Total	289	66 (22.8%)	223 (77.2%)

Among the 289 patients, elongated styloid process (>3 cm) was observed in 23.7% of males and 21.8% of females. The majority of patients in both genders had a normal styloid process, with 76.3% of males and 78.2% of females showing no elongation. Overall, the prevalence of elongated styloid process in the study population was 22.8%, with only a slight, non-significant difference between males and females.

Table 6: Morphological Variations of the Styloid Process (SP) on MDCT.

Type of Morphology	Description	Number (N)	Percentage (%)
Type I-Elongated	Continuous, uninterrupted bony projection	122	42%
Type II - Pseudoarticulated	Bony segment with pseudo-joint or partial articulation	87	30%
Type III-Segmented	Multiple ossified segments with clear separation	80	28%
Total		289	100%

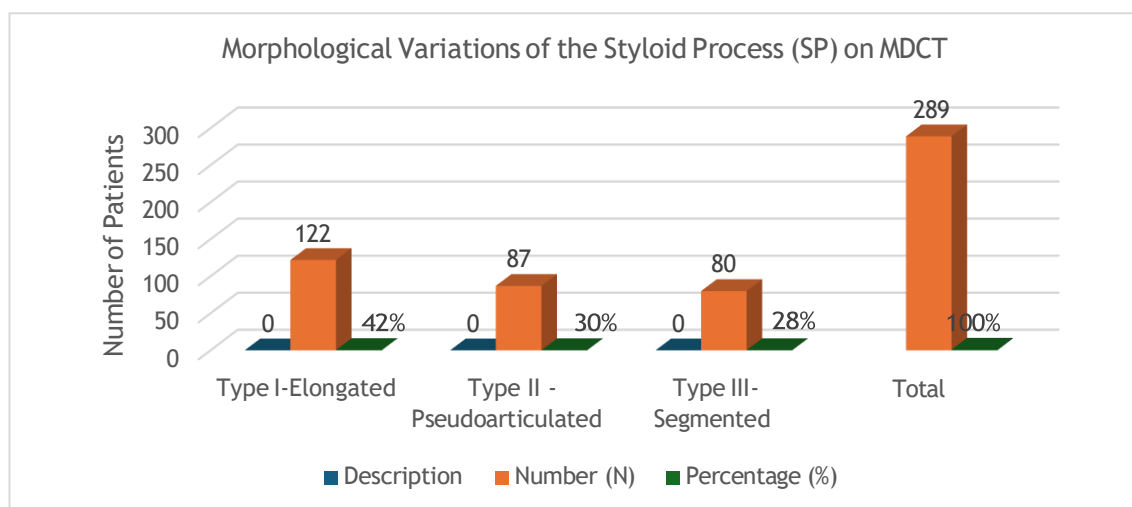


Figure 3: Graphical represents Morphological Variations of the Styloid Process (SP) on MDCT. The most common morphology was Type I-Elongated (42%), followed by Type-II Pseudoarticulated (30%) and Type III-Segmented (28%). This indicates that the elongated continuous type predominates, emphasizing the need to recognize such variations for accurate diagnosis of Eagle's syndrome.

Discussion:

In this study of 289 patients, the mean styloid process (SP) length was slightly longer on the left (3.30 ± 0.61 cm) than the right (3.10 ± 0.50 cm), with minimal differences between males and females.⁸ Elongated SP (>3 cm) was observed in 40.1% of cases, slightly more on the left side. Gender-wise, 23.7% of males and 21.8% of females had elongation. These findings indicate that SP elongation is a common anatomical variation. Knowledge of SP length and variations is important for diagnosing Eagle's syndrome and planning surgical or radiological procedures.⁹

Conclusion:

Styloid process elongation is a common anatomical variation, observed in 40.1% of patients, with slightly higher prevalence in males, and the mean SP length was 3.10 cm on the right and 3.30 cm on the left; awareness of these variations is important for clinical and radiological evaluation of head and neck complaints.

Conflict of Interest:

The authors declare that there is no conflict of interest regarding the publication of this study.

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