

**MORPHOLOGICAL ALTERATIONS OF THE STYLOID
PROCESS AND THE CLINICAL SIGNIFICANCE.****HUMBERTO FERREIRA ARQUEZ***

*Professor of Human Morphology, Medicine Program, Morphology Laboratory Coordinator,
University of Pamplona. Pamplona, Norte de Santander, Colombia, South America.*

ABSTRACT

The elongated styloid process may produce characteristic head and neck pain commonly known as Eagle's syndrome. The present study was conducted using 25 dry skull and 13 cadavers. The objective was the analysis of the morphological types of styloid process according to Langlais et al. Digital Vernier Callipers was used to measure length, thick of the styloid process. Styloid process had a thickness of 0.45 cm at the base. The average length of the elongated styloid process on the left side was more, compared to right side. Bilateral elongation was more common than the unilateral. 78.94% was normal. 13.15% having length of 3.5 cm. 52.63% having length of 2.5 cm and 39.4% having length of 3.0 cms. 7.89% were elongate with average lengths between 7.0 and 5.5 cms. An awareness of this syndrome is important to all health practitioners involved in the diagnosis and treatment of neck and head pain.

KEYWORDS: Styloid process, temporal bone, elongation, Eagle's syndrome, cadavers, dry skull.



*Corresponding author

**HUMBERTO FERREIRA ARQUEZ**

Professor of Human Morphology, Medicine Program, Morphology Laboratory Coordinator,
University of Pamplona. Pamplona, Norte de Santander, Colombia, South America.

INTRODUCTION

Styloid process of temporal bone is a slender projection attached to base of the skull and extends downwards, forwards and slightly medially. From its extremity the stylohyoid ligament passes downwards and forwards to the lesser horns of hyoid bone. The process is covered laterally by the parotid gland, facial nerve crosses its base and the external carotid artery crosses its tip, as they lie within the gland. The anterior surface of styloid gives origin to styloglossus muscle, its tip to stylohyoid muscle. On its deep surface the process is separated from internal jugular vein by the origin of stylopharyngeus muscle¹. The length of the styloid process is usually (2–3 cm)². When it is more than 3 cm it is called as elongated styloid process, and it can cause pain in throat, carotid artery compression syndrome, etc. This elongation was first described in 1652 by Italian surgeon Pietro Marchetti³. In 1937, Watt W. Eagle⁴ coined the term stylalgia to describe the pain associated with elongation of styloid process, first described vague orofacial, and head and neck pain associated with styloid elongation, and the condition became known as Eagle's syndrome. Since that time, many authors have described the various clinical symptoms, radiographic features, and treatment regimens seen with this syndrome^{5,6}. Eagle's syndrome is a condition that causes a dull, nagging pain in the oropharynx, abnormal findings when palpating through the tonsillar area⁷, intermittent glossitis and phantom foreign body discomfort of the pharynx⁸. There may be difficulty in swallowing and considerable pain may occur during the act^{9,10}. The styloid process is normally composed of dense connective tissue in adults but may retain its embryonic cartilage and the potential for ossification¹¹. The present study was undertaken to document the prevalence, morphological alterations, length, thick of the styloid process.

MATERIALS AND METHODS

A total of 25 dry skull (50 sides) and 13 cadavers (26 sides) of both sex (12 men and 1 woman) with different age groups were used. The cadavers were carefully dissected as per the standard dissection procedure in the Morphology Laboratory at the University of Pamplona. The history of the individual and the cause of death are not known. The study has encompassed the analysis of the morphological types and variations of the styloid process, evaluated and classified According to Langlais and coworkers^{6,12}(figure 1) elongated styloid process and calcified ligaments of the stylohyoid connection/ attachment can be divided into several types according to two criteria:

A) Morphological criteria (3 types):

- Elongated styloid process
- Pseudoarticulated styloid process
- Segmented styloid process

B) Criteria determined by the means of calcification (4 types):

- Surface calcified styloid process
- Partially calcified styloid process
- Nodular type calcification
- Completely calcified styloid process.

The dry skulls were evaluated by direct visual examination. The region of the styloid process of the cadavers dissected as per the standard dissection procedure in the Morphology Laboratory of the University of Pamplona. Digital Vernier Callipers was used to measure length, thick of the styloid process to analyse and examine the size. Both unilateral and bilateral measurement was made in region of styloid process of skull and cadavers, the prevalence of the same also observed and the topographic details examined and photographed.

Figure shows classification according to Langlais et al.

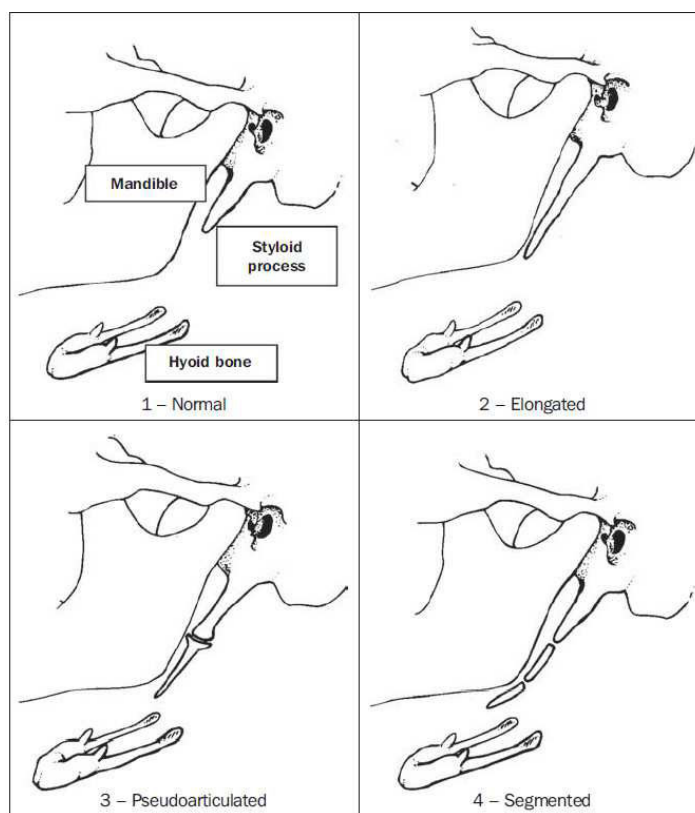


Figure 1

Scheme for classification of morphological alteration of the styloid process^{6,12}.

RESULTS

Of the 25 dry skull (50 sides) and 13 cadavers (26 sides) revised:

In 30 cases (78.94%) the styloid process was normal, classification 1 of Langlais and completely calcified. Only 5 cases (13.15%) of the styloid process having length of 3, 5 cm and presented curvature and completely calcified. of the remaining 30 cases: 20 (52.63%) having length of 2, 5 cm and 15 (39.4) having length of 3.0 cms. It was

observed in three dried human skull (7.89%) their styloid processes were elongate, classification 2 of Langlais and completely calcified (figure 2). The lengths of the styloid processes were measured (Table 1). The average length of the elongated styloid process on the left side was more, compared to right side. Bilateral elongation was more common than the unilateral elongation. In this study all styloid process had a thickness of 0.45 cm at the base.

Bilateral styloid process morphological alterations in the study

Skull	Length in cm	
	Left	Right
A	7.0	6.5
B	6.5	6.0
C	6.0	5.5

Table 1

The lengths of the styloid processes in the three cases

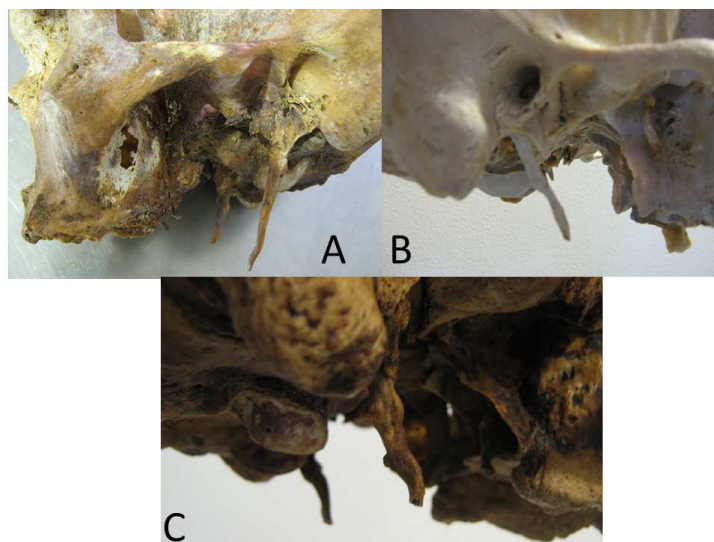
Lateral view – left and right side. Showing details of the styloid process

Figure 2
(A, B, C): Styloid process type 2 of Langlais, elongated and completely calcified. In the three cases.

DISCUSSION

The stylohyoid chain components are derived embryologically from the first and second branchial arches in four distinct segments: tympanohyal, stylohyal, ceratohyal and hypohyal segments. These segments are derived from Reichert's cartilages that ossify in two parts. The styloid process develops from the tympanohyal and stylohyal segments that usually fuse at puberty. The lesser horn of the hyoid bone arises from the hypohyal segment. Connecting these two structures, the stylohyoid ligament originates from the ceratohyal segment. The styloid process and the stylohyoid ligament have been linked to Eagle's syndrome. In adults the styloid process its tip is located between the external and internal carotid arteries, just lateral to the tonsillar fossa. The normal length of the styloid process is approximately 25-30mm. Slight medial deviation of the styloid process and lengths greater than 30 mm could result in severe atypical facial pain and could explain the symptomatology characterized by the sensation of having a foreign body in the pharynx, causing difficult and painful swallowing and earache. It has also been referred to as styloid syndrome, stylohyoid syndrome, stylalgia, stylohyoid disorder, neuralgia of styloid process, cervicopharyngeal

pain syndrome. It can also cause vertigo, tinnitus, dysphonia, carotidynia, pain on turning the head, reduced mandibular opening, and change in voice, hypersalivation, and even alteration in taste^{3,11}. The actual cause of the elongation is a poorly understood process. Several theories have been proposed: 1) congenital elongation of the styloid process due to persistence of a cartilaginous analog of the stylohyal (one of the embryologic precursors of the styloid), 2) calcification of the stylohyoid ligament by an unknown process, and 3) growth of osseous tissue at the insertion of the stylohyoid ligament^{13,15}. The elongation styloid process due to ectopic calcification in end-stage kidney disease patient has been proposed¹⁶. Report of Eagle syndrome provoked by acute parotitis has been reported¹⁷. The pathophysiological mechanism of symptoms is debated as well. Theories include the following: 1) traumatic fracture of the styloid process causing proliferation of granulation tissue, which places pressure on the surrounding structures^{14,15}; 2) compression of adjacent nerves, the glossopharyngeal, lower branch of the trigeminal, or chorda tympani; 3) degenerative and inflammatory changes in the tendinous portion of the stylohyoid insertion, called insertion tendonitis;

4) irritation of the pharyngeal mucosa by direct compression or post-tonsillectomy scarring (involves cranial nerves V, VII, IX, and X); and 5) impingement of the carotid vessels, producing irritation of the sympathetic nerves in the arterial sheath¹³. Another clinically significant manifestation of Eagle syndrome is stylocarotid manifestation caused by compression of carotid artery by elongated styloid leading to recurrent dizziness, syncope, or stroke^{17,18}. If discussion on the orofacial region is focused on the region of the styloid process it becomes clear that differential diagnostic diagnosis is hindered by numerous diseases and syndromes connected with the jaw joint. This succession of possible conditions begins with inflammation of all types and causes, congenital anomalies, traumas and, in this region rare although possible, malignant diseases. Numerous possibilities of projected pain caused by inflammation of the eustachium tube and middle ear, parotid diseases, impeded eruption of the upper and lower impacted or retinated wisdom teeth, neuralgia etc. should also be taken into account. Other diseases that complicate diagnosis of pain in the area of the ascending branch of the mandibular and joints are carcinoma of the nasopharynx and diseases of traumatic etiology. Several syndromes should certainly be mentioned which are marked by the symptom of pain in that region and whose symptoms are occasionally very similar to the symptoms of the styloid process syndrome. This group of diseases is: 1. Costen's syndrome, 2. Trotter's syndrome, 3. Miofacial painful syndrome¹⁹. Costen's syndrome manifests with several symptoms that can be divided into auricular, articular and cranial. The joint is sensitive to palpation, with pain and crepitation. Hearing is poorer with buzzing in the ears, dizziness and headache around the eyes, the crown and the back of the head. Today it is considered that only arthritic changes and neuralgia are realistic, and possibly certain auricular symptoms. One explanation for this condition is that these changes are preceded by loss of posterior or all teeth, during which the bite drops and the mandibular moves distally, pressing the joint (glavicom) discus articularis and posterior part of the joint chamber. The pressure causes the disk to deform and shift, so that it no longer protects the arch and posterior part of the joint

chamber from nerve pressure. This causes irritation of nerve auriculotemporalis, which is most probably the cause of the headaches on the crown and back of the head. In 1958 Freese gave a new explanation of the syndrome. He based his explanation on "trigger"centres. Namely, he considered that hearing disorders are caused by a "trigger" point in them asseter, dizziness a "trigger" point in the sternocleidomastoideus, and pain in the tongue and pharynx spasm of the geniohyoideus, digastricus and pterygoideus muscles¹⁹. Trotter's syndrome or Morgagni's sinus syndrome comprises three symptoms that occur in some patients suffering from nasopharyngeal carcinoma (30% patients). It manifests with neuralgi form pains in the lower jaw radiating towards the ear, with deafness and blockage in the ear, with palatal asymmetry (involving a tumour of the m. levator palatini) and trismus (involving pterigoid muscles)¹⁹. Painful myofacial syndrome manifests with muscular spasm, restricted mobility and sensitivity. There is also pain in the muscular-facial structure of masticulatory, neck and back muscles. In the relevant muscles there are areas sensitive to touch and pressure from which masticulatory impulses pass into the central nervous system and return in the form of painful sensations on some other structures. Such places in the muscles are "trigger" zones, and the places where the patient feels painful sensation are called zones of impact. The patient is well aware of these zones of impact and is conscious of their location (spasms and pain), while the "trigger" zone cannot be determined. The disorder can become more complicated by the occurrence of new "trigger" centres under the influence of previous "trigger" zones, thus creating a circulus vitiosus. For instance, a "trigger" point in the sternocleidomastoideus an effect on the area of the temporomandibular joint, temporal and frontal regions, and may induce the occurrence of new "trigger" points in the temporalis¹⁹. Treatment of Eagle syndrome is both surgical and nonsurgical. Nonsurgical treatments include reassurance, nonsteroidal anti-inflammatory medications, and steroid injections¹⁵. Surgical treatment is by one of two methods. Otolaryngologist W. Eagle preferentially used a transpharyngeal approach through which the elongated portion of the styloid process was removed⁵. Although this

technique does avoid external scarring, it has been heavily criticized because of the increased risk of deep space neck infection and poor visualization of the surgical field (must be performed through the mouth)^{5,15}. Alternatively, the elongated portion can be removed by an extraoral approach. Although both procedures are effective in removing an elongated styloid process, the extraoral approach is thought to be superior because of the decreased risk of deep space neck infection and better visualization of the surgical field^{5,15}. In a review of 1771 panoramic radiographs, the incidence of mineralization of the stylohyoid complex was found to be (18.2%)²⁰. The incidence of elongated styloid process was estimated at 3.3% out of which 55% bilateral cases in panoramic radiographs, and the male/female ratio was 1/9 in the radiographs. Average age was 43.35 ±14.88 years and no significant difference was found in the ages of the participants, according to gender²¹. Despite these figures, only 1–5% of patients are symptomatic⁶. Literatures are not in agreement with sexual dimorphism of elongated styloid. Balcioglu et al, 2009 stated that Eagle's syndrome occurs more frequently in women while others do not^{20,22}. Although 4% of the population is thought to have an elongated styloid, only 4–10% of this group may have the predisposition to develop signs and symptoms consistent with the Eagle syndrome²³. Frommer observed that the direction and curvature of styloid process were more important than its length in causing symptoms²⁴. In the study of Massey, there were only 11 cases of styloid process having length of more than 4 cm out of 2000 cases studied²⁵. Harma gives incidence of 4-7% for elongated styloid process²⁶. Elongation was seen four times more in males than females and in 75% of cases the elongation was bilateral^{3,27}. It is believed that, in cases of orofacial pains, there is a necessity of interdisciplinary intervention and cooperation of radiologists, otorhinolaryngologists, surgeon dentists, neurologists, orthopedists, ophthalmologists, phonoaudiologists, physiotherapist and psychologists, each professional acting in his/her specialty for definition of the diagnosis and appropriate therapeutical conduct²⁸.

CONCLUSION

Eagle's syndrome though it is a rare entity it is largely under diagnosed, is a complex condition caused by an elongated styloid process that is associated with a wide variety of symptoms, should be considered a possible etiology of dull pain along the jaw line or temple. Pain in this distribution is an uncommon but possible symptom of Eagle's syndrome that is easily confused with other sources of facial discomfort, such as temporomandibular joint disorder. Should be kept in mind when the clinician is faced with oropharyngeal/maxillary pain originating from impacted or unerupted third molars or dental caries. Although most commonly associated with throat and neck pain that is worsened by head rotation, swallowing, or chewing, it may also be associated with pain in a trigeminal distribution (NCV3). Although the glossopharyngeal nerve (NCIX) is most commonly implicated, involvement of the mandibular nerve is possible. Careful physical examination, palpation of the tonsillar fossa, a detailed history which elicits the patient's pain and a panoramic radiography examination which can show a correct picture of the elongated styloid process confirm the diagnosis. The elongated styloid process syndrome can be confused or mistaken for many other conditions that must be excluded. Resection of the elongated styloid process is the treatment of choice. An awareness of pain syndromes related to the styloid process is important to all health practitioners involved in the diagnosis and treatment of neck and head pain to rationalize the line of management and the ultimate clinical outcome.

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CONFLICT OF INTEREST

Conflict of interest declared none.

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