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REVIEW ARTICLE

Elongated Styloid Process: Anatomical Variations and Their Clinical Relevance: A Review

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ABSTRACT

Background: The styloid process is a slender bony projection of the temporal bone that varies considerably in length, morphology, and calcification. When it becomes abnormally elongated, it can produce a symptomatic condition broadly known as Eagle syndrome, with craniofacial pain, dysphagia, and, less often, neurovascular compromise. Objective: To review the anatomical variations of the styloid process reported in the peer-reviewed literature and to relate these to symptomatology, diagnostic imaging, and management.

Methods: A PubMed database search using the Boolean string: ("elongated styloid process" OR "styloid process elongation" OR "elongated styloid" OR "Eagle syndrome") AND ("anatomical variation" OR "morphological variation" OR "styloid length" OR "styloid morphology" OR "calcified stylohyoid ligament") AND ("clinical relevance" OR "clinical significance" OR "clinical symptoms" OR "dysphagia" OR "neuralgia") filtered automatically by date, free full text, English language, and human studies, then screened and synthesised narratively. Risk of bias was appraised using the Joanna Briggs Institute checklists for case reports/ series and the Newcastle–Ottawa criteria for cross-sectional and retrospective studies.

Results: Of 93 records identified, 14 studies met the eligibility criteria. Reported normal styloid length ranged from roughly 20–32 mm, with elongation thresholds of 30 mm most often applied and individual elongated processes measuring up to 75–80 mm. Morphological variants like continuous, segmented, and pseudo-articulated were most often classified using the Langlais system. Clinical presentations clustered into three overlapping phenotypes: classic

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oropharyngeal/cervicofacial pain with dysphagia; stylocarotid/neurovascular compression (transient ischaemic attack, stroke, carotid dissection, aneurysm); and styloidogenic jugular compression (headache, intracranial venous hypertension). Three-dimensional CT was the diagnostic reference standard throughout. Surgical styloidectomy achieved remission of symptoms.

Conclusions: Elongation and morphological variation of the styloid process are anatomically diverse but clinically important, producing a recognisable yet frequently under-diagnosed spectrum of craniofacial, pharyngeal, and neurovascular symptoms. Standardised measurement and greater clinical awareness are needed to reduce diagnostic delay; surgical shortening remains the most reliably effective treatment for symptomatic cases.

KEYWORDS:

• Styloid Apparatus • Eagle Syndrome • Stylohyoid Ligament • Dysphagia

INTRODUCTION

The styloid process is a slender bony spicule projecting from the inferior surface of the temporal bone, running downward and forward into the parapharyngeal space, near the internal and external carotid arteries, the internal jugular vein, and the lower four cranial nerves. Three muscles and two ligaments take origin from its tip.[1]

The styloid apparatus develops from Reichert's cartilage, the cartilaginous derivative of the second pharyngeal arch. In most people, the middle portion of this cartilage resorbs and is replaced by the fibrous stylohyoid ligament, while the two ends ossify to form the styloid process and the lesser horn of the hyoid bone. When this resorption is incomplete, or when ossification extends further along the ligament than usual, the result is an abnormally long, segmented, or partly jointed styloid-stylohyoid complex.[2] Radiographically, these variants are commonly graded using the Langlais system into continuous, pseudo-articulated, and segmented types.[3]

An elongated or calcified styloid process presents in three forms: the classic presentation features pharyngeal pain and difficulty swallowing, often after a tonsillectomy; the stylocarotid variant involves vascular compression of carotid vessels; and styloidogenic jugular compression occurs when the process compresses the internal jugular vein, causing headaches.[4]

An extended styloid process is still easily missed even after decades of Eagle's initial description. In a significant minority of the general population, it appears incidentally on imaging, but only a small percentage of these people ever experience symptoms.[3] Patients frequently go through multiple specialists and repeated, ineffective investigations before anyone considers the styloid process at all because the presenting complaints heavily overlap with temporomandibular joint dysfunction, trigeminal or glossopharyngeal neuralgia, migraine, and common dental pain.[5] One case report famously described this pattern as "medical nomadism."[5]

For anatomists, the styloid process is a useful teaching example of how a purely skeletal variant becomes clinically important simply through its spatial relationship to soft tissue. For clinicians, recognising its variant forms has real consequences for differential diagnosis, choice of imaging, and surgical planning. Yet the literature on this subject remains dominated by isolated case reports and small case series that disagree on measurement thresholds, imaging protocols, and even terminology.

Therefore, a thorough review of the evidence on variability in the anatomy of the styloid process is necessary to synthesize the current knowledge, to standardize the terminology and morphometric description, and to critically appraise their clinical significance, diagnostic implications, and impact on patient management.

METHODS

Eligibility criteria

We included studies of patients, radiographic and cadaveric samples in which the styloid process and/or stylohyoid ligament complex was assessed anatomically, whether or not a formal diagnosis of Eagle syndrome (classic, stylocarotid, or styloidogenic jugular) had been made. Eligible studies had to report at least one of: styloid process length, morphology, or calcification pattern, clinical symptoms or signs, diagnostic imaging findings or treatment and outcome, conservative or surgical. We accepted studies specifically addressing styloid process. We excluded studies in which the styloid process was noted only incidentally without measurement or clinical correlation, animal or cadaveric-only studies lacking clinical correlation, and narrative reviews, editorials, or conference abstracts without extractable primary data.

Search strategy

A thorough literature search was conducted in PubMed database using the Boolean string: ("elongated styloid process" OR "styloid process elongation" OR "elongated styloid" OR "Eagle syndrome") AND ("anatomical variation" OR "morphological variation" OR "styloid length" OR "styloid morphology" OR "calcified stylohyoid ligament") AND ("clinical relevance" OR "clinical significance" OR "clinical symptoms" OR "dysphagia" OR "neuralgia"). Sequential PubMed automated filters were applied and the free full text articles in last 10 years were considered, followed by a relevance filter against the eligibility criteria above, before formal screening began.

Study selection

Records surviving the automatic filters were screened in two stages: title/abstract screening, then full-text review of anything potentially eligible. Screening judged clinical relevance to elongated styloid process or Eagle syndrome, use of a validated imaging-based measurement, a clear description of measurement methodology, adequate description of the study population, an independent focus on the styloid process rather than an incidental secondary finding, and an appropriate study design.

Data extraction

Data were extracted from the full text of each included article using a standardised form: first author and year, country, study design, sample size and reported styloid length and the elongation threshold used, morphological classification and calcification pattern, clinical presentation, diagnostic work-up, along with treatment and outcome.

Risk-of-bias assessment

Because most eligible studies were case reports or small case series, we used the Joanna Briggs Institute (JBI) checklist domains for case reports and case seriesadequacy of demographic and clinical history, clarity of the diagnostic/imaging work-up, description of the intervention, and completeness of outcome reporting. Cross-sectional and retrospective cohort studies were assessed with Newcastle-Ottawa Scale-based criteria adapted for cross-sectional design, covering sample selection, control for confounders (chiefly age), and ascertainment of outcome or exposure. No study was excluded on the basis of its risk-of-bias rating alone, methodological limitations are instead discussed qualitatively.

Data synthesis

Given the marked heterogeneity in design, sample size, outcome definitions, and reporting of styloid length from single-patient case reports to a retrospective series of 1,475 operated patients, a quantitative meta-analysis was not appropriate. Findings were synthesised narratively around three domains: anatomical/morphological variation, associated clinical presentation, and diagnostic approach and outcome. Descriptive quantitative data were tabulated where possible to allow cross-study comparison.

RESULTS

Study selection

The PubMed search returned 93 records. Sequential automatic filters reduced this to 22 (free full text, n = 29; English language, n = 28; human studies, n = 22), of which 17 were judged relevant to the eligibility criteria. 15 of these were screened in full; one was excluded because it did not independently address styloid process variation as its primary focus. 14 studies met all eligibility criteria and were included in the qualitative synthesis (Figure 1).

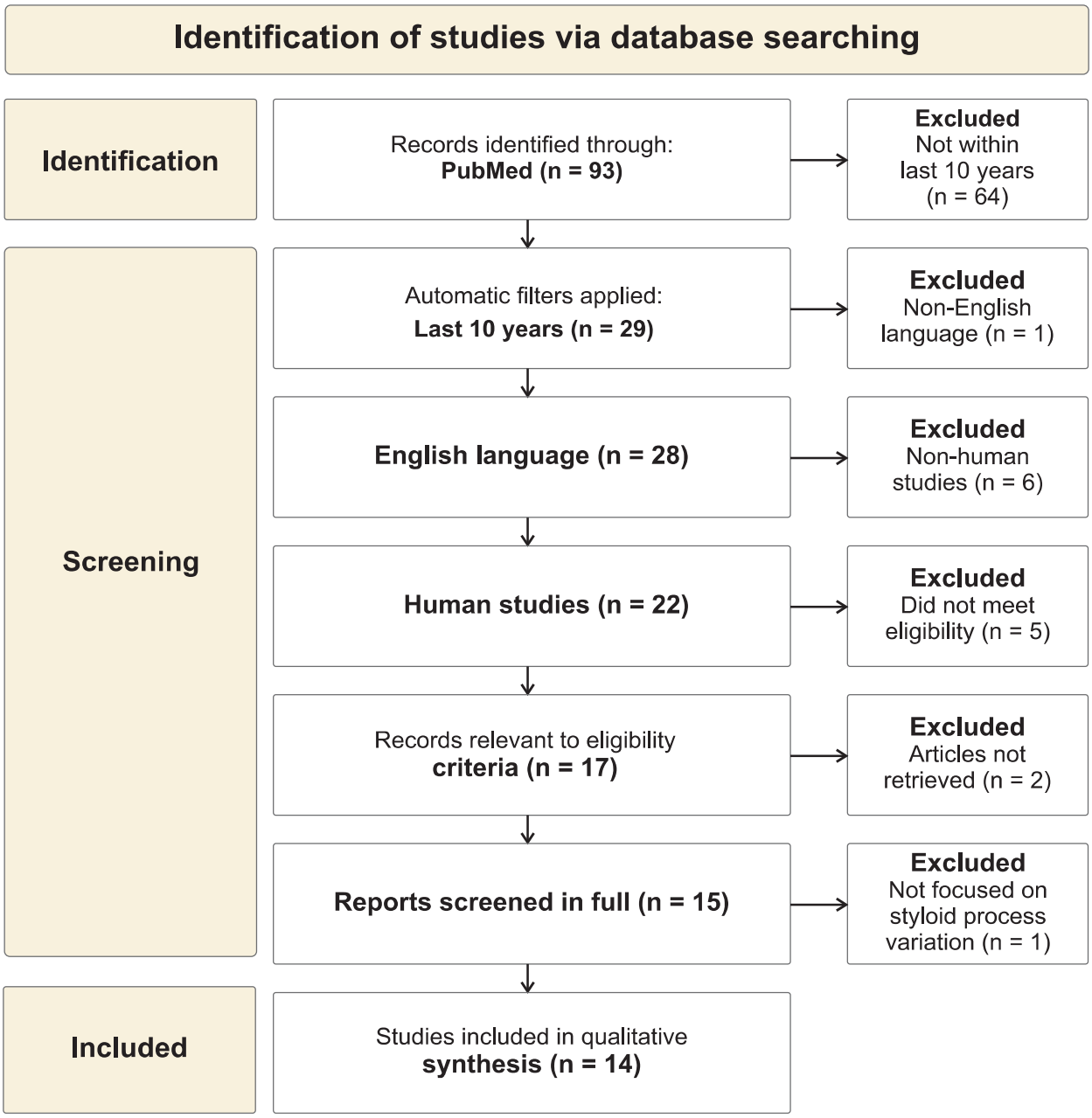

Figure 1: PRISMA 2020 flow diagram

Study characteristics

The 14 included studies were published between 2011 and 2024 and came from 12 countries: Iran, Italy, Turkey, France, Nepal, Sudan/USA, Germany, Sweden, India, the United Kingdom, China, and Canada reflecting how widely scattered Eagle syndrome reporting is. Two studies were cross-sectional or retrospective analyses of radiographic or clinical cohorts: a panoramic-radiograph study of 108 patients (207 stylohyoid complexes)[3], and a six-year retrospective review of 23 patients with classic, carotid, and jugular variants of Eagle syndrome.[4] A large surgical cross-sectional series described the prevalence of styloidectomy among 1,475 otolaryngology patients, of whom 24 (1.62%) underwent trans-oral extratonsillar styloidectomy.[6] Two further retrospective surgical case series covered five neurologically symptomatic patients[7] and six patients treated by a transoral, retromolar, para-tonsillar approach.[8] The remaining nine studies were single-patient case reports or small case series describing individual, often diagnostically difficult, presentations.[5,9,10-16]

Patient age across the included studies ranged from 19 to 77 years, with a female predominance noted in several series, consistent with previously reported demographics of Eagle syndrome.[3,12,13] Imaging modalities used to characterise the styloid process included panoramic radiography, multidetector CT with multiplanar and three-dimensional reconstruction, cone-beam CT, CT angiography, MRI/MR angiography, and colour Doppler ultrasound, most often used in combination.

Anatomical variation: length, morphology, and calcification

Reported "normal" styloid process length clustered between 20 and 32 mm, and the elongation threshold applied to define an abnormal process, with 30 mm the most commonly cited cut-off.[3,6,11] In the largest radiographic series, mean stylohyoid complex length was 31.7 mm (median 30.0 mm; range 15-80 mm) across 207 complexes, with a statistically significant positive correlation between length and age (Spearman $r = 0.323$, $p < 0.001$) and no significant sex difference.[3] Individual elongated processes of striking length were documented in several case reports, including 75 mm bilaterally[16], up to 71.74 mm on the affected side[8], and 5.1 cm bilaterally[14]; one surgical series reported an affected-side mean of 48.5 ± 11.6 mm versus 30.7 ± 10.7 mm on the asymptomatic contralateral side.[8] Morphological classification, most often following the Langlais system, identified continuous (Type I), pseudo-articulated (Type II), and segmented (Type III) patterns, with segmented and pseudo-articulated variants over-represented among symptomatic, elongated processes relative to normal-length processes.[3,12] Calcification ranged from a thin calcified outline to complete ossification, including rare cases of fully articulated ossification and aberrant thickening of the entire stylohyoid chain from skull base to hyoid bone.[9,15]

Clinical presentation

Clinical presentations grouped into three overlapping but distinguishable phenotypes. The classic, oropharyngeal phenotype reported in most case reports and in the largest surgical series, the combined dysphagia, foreign-body sensation, and pharyngeal, facial, dental, or cervical pain, frequently mistaken for temporomandibular dysfunction, neuralgia, or dental disease before the correct diagnosis was made.[5,6,8,9,10,12,14,16] The stylocarotid, or neurovascular, phenotype presented as transient ischaemic attacks, ischaemic stroke, internal carotid dissection, or aneurysm formation, attributed to mechanical impingement of the carotid vessels by an elongated or medially deviated process.[7,11,13] The styloidogenic jugular compression phenotype, described specifically in one cohort, was clinically distinct: it was significantly associated with headache ($p = 0.009$) and peri-mesencephalic subarachnoid haemorrhage ($p = 0.0003$), while ipsilateral pharyngeal pain was significantly more characteristic of the classic/carotid group ($p = 0.0003$).[4]

Diagnostic approach

All included studies combined clinical examination of the tonsillar fossa, which worsened symptoms when the process was elongated with imaging confirmation. Panoramic radiography was often used as an initial screening tool, but multidetector or cone-beam CT with three-dimensional reconstruction was consistently identified as the reference standard for measuring length, angulation, and spatial relationship to adjacent neurovascular structures, and was considered essential for surgical planning.[3,5,7,8,9,10,12,14,16] CT or MR angiography was required whenever vascular compression, dissection, or aneurysm was suspected.[4,7,11,13]

Treatment and outcomes

Conservative management using non-steroidal anti-inflammatory drugs or tonsillar-fossa infiltration with local anaesthetic or corticosteroidgave only partial or temporary relief in most reported cases, and was generally reserved for patients unfit for surgery, those with mild symptoms, or as a diagnostic trial.[4,7] Surgical styloidectomy, performed transorally or transcervically, was the definitive treatment in most symptomatic cases and achieved complete or near-complete remission in the majority of operated patients,[8] symptom-free outcomes at 6-month to 5-year follow-up in individual case reports,[5,10.12,15,16] and remission in all 24 patients undergoing trans-oral extratonsillar styloidectomy in the largest surgical series.[6] Reported complications were generally minor and transient like trismus, wound dehiscence, mucosal swelling, temporary dysphagia,[6,8] although marginal mandibular or hypoglossal nerve paresis was reported after transcervical procedures in isolated cases.[9,12]

Data extraction and risk-of-bias tables

Table 1 summarises design, population, anatomical, clinical, diagnostic, and treatment characteristics for each of the 14 included studies; Table 2 presents the risk-of-bias appraisal.

Table 1: Data extraction summary of included studies (n = 14)

Sl. no.	Author, Year (Country)	Design	N	SP length / threshold	Morphology / calcification	Clinical presentation	Treatment	Outcome
1	Anbiaee & Javadzadeh, 2011 (Iran)	Cross-sectional	108 pts / 207 complexes	Mean 31.7 mm; median 30.0 mm (threshold 30 mm)	Continuous most common; calcified-outline pattern most common	15% reported symptoms (dizziness, headache); not correlated with length	None (observational)	No causal symptom–length relationship; elongation regarded as physiologic
2	Zamboni et al., 2019 (Italy)	Retrospective cohort	23 (11M/12F): 14 classic, 1 carotid, 8 jugular	Not uniformly reported; jugular variant defined by course adjacent to C1	Styloid coursing adjacent to transverse process of C1 in jugular variant	Classic: ipsilateral pain (p=0.0003); Jugular: headache (p=0.009), peri-mesencephalic haemorrhage (p=0.0003)	Mostly conservative; 1 jugular case – transcervical styloidectomy + balloon angioplasty	Symptom relief in operated case; conservative group partially controlled
3	Boucher et al., 2022 (France)	Case report	1 (51F)	37.3 mm + 32.5 mm segments (left, pseudo-articulated)	Langlais Type II (pseudo-articulated)	72-month oropharyngeal pain, dysphagia, mechanical allodynia; extensive medical nomadism	Left stylectomy (external approach)	Complete pain relief and normal swallowing at 4-year follow-up
4	Regmi et al., 2021 (Nepal)	Cross-sectional surgical series	1475 operated ENT patients; 24 (1.62%) styloidectomy	36 mm (range 32–46 mm)	Not classified	Recurrent throat pain, dysphagia, facial pain	Trans-oral extratonsillar styloidectomy	Symptom-free after surgery; 2 wound dehiscence, 3 transient pain/ trismus
5	Aydin et al., 2018 (Turkey)	Retrospective case series	5 (4M/1F), 22–68 y	Long styloid process (venous/ arterial compression)	Bilateral elongation in several cases	2 venous compression (sinus thrombosis, papilloedema); 3 TIA due to ICA compression	Anticoagulation/ antiplatelet therapy (4); surgical resection (1)	All patients improved (KPS 50–100%); no residual symptoms
6	Scheller et al., 2014 (Germany)	Retrospective surgical series	6 (2M/4F), mean age 49.8 y	Affected side 48.5±11.6 mm vs unaffected 30.7±10.7 mm	Elongated / pseudo-articulated	Pharyngeal foreign-body sensation, dysphagia, painful neck movement	Transoral, retromolar, para-tonsillar styloidectomy	Complete remission in 5/6; partial remission in 1/6; no major complications
7	Elimairi et al., 2015 (Sudan/ USA)	Case report	1 (48F)	Voluminous ossified complex (length not stated numerically)	Complete ossification of stylohyoid complex	Dysphagia, altered speech, dry mouth, hypoglossal nerve palsy	Surgical removal (approach per case)	Improved clinical picture; hypoglossal palsy attributed to mass effect
8	Saccomanno et al., 2018 (Italy)	Case report	1 (60F)	30 mm (left) vs 27 mm (right)	Not specified	Trigeminal then glossopharyngeal neuralgia, throat/ neck pain	Transcervical styloidectomy	Sudden, complete remission of symptoms

table cont....

Sl. no.	Author, Year (Country)	Design	N	SP length / threshold	Morphology / calcification	Clinical presentation	Treatment	Outcome
9	Sveinsson et al., 2013 (Sweden)	Case series	2 (1M/1F), 38 y and 41 y	Elongated, calcified stylohyoid ligament in close contact with ICA	Calcified stylohyoid ligament	Case 1: stroke/ hemiparesis; Case 2: headache, TIA-like episodes (amaurosis fugax)	Case 1: surgical resection + anticoagulation; Case 2: anticoagulation only	Case 1: clinically intact at 6 months; Case 2: complete angiographic resolution at 6 months
10	Gupta et al., 2021 (India)	Case report	1 (35M)	5.26 cm (right), 5.54 cm (left)	Type III (segmented, multiple pseudo-articulations, Langlais classification)	Neck pain, dysphagia, odynophagia; history of trauma	Transcervical styloidectomy (left) with piezosurgery	Symptom-free post-operatively; no recurrence at follow-up
11	Hall et al., 2024 (UK)	Case report	1 (66M)	Elongated right styloid process impinging on ICA aneurysm	Elongated process abutting vessel wall	Glossopharyngeal neuralgia; jaw/ throat pain on mastication and swallowing	Conservative pain management (aneurysm not surgically treated initially)	Pain syndrome attributed to aneurysm secondary to styloid impingement; managed conservatively
12	Uludağ et al., 2013 (Turkey)	Case report	1 (70M)	5.1 cm bilaterally	Elongated, extending into tonsillar fossa bilaterally	27-year history of right facial pain; previously misdiagnosed as trigeminal neuralgia	Surgical removal of elongated styloid process	Findings compatible with Eagle syndrome; symptom resolution after surgery
13	Lei et al., 2017 (China)	Case report	1 (49M)	~90 mm length, 10 mm width (complete ossified chain)	Complete articulated ossification and aberrant thickening of stylohyoid chain	6-month foreign-body sensation, dysphagia, submandibular pain, worse on head rotation	Extraoral surgical resection	Significant symptom relief by postoperative day 2; total remission at 1 month
14	Michaud & Gebril, 2021 (Canada)	Case report	1 (23M)	~75 mm bilaterally, ~8 mm width	Calcification of stylohyoid ligament immobilising hyoid bone	Atypical presentation: pain on mouth opening/ protrusion/ head tilt, not on rotation/ swallowing/ chewing; mimicked dental pain	Bilateral transoral styloidectomy	Pain resolved completely within 5 years; no recalcification at 13-year follow-up

Table 2: Risk-of-bias assessment of included studies

Sl. No	Study	Appraisal tool	Demographic/ Clinical history	Diagnostic/ Imaging clarity	Intervention description	Outcome/ Follow-up reporting	Confounding (age/sex) control*	Risk-of-bias
1	Anbiaee & Javadzadeh, 2011	NOS (cross-sectional)	L	L	n/a	Lss	M – age association reported, sex not adjusted	Low
2	Zamboni et al., 2019	NOS (retrospective cohort)	L	L	M	M – short follow-up in some patients	M – small carotid subgroup (n=1)	Moderate

table cont....

3	Boucher et al., 2022	JBI case report	L	L	L	L – 4-year follow-up reported	n/a	Low
4	Regmi et al., 2021	NOS (cross-sectional surgical)	L	L	L	L	M – convenience sampling	Low–Moderate
5	Aydin et al., 2018	JBI case series	L	L	L	M – variable follow-up duration	n/a	Low–Moderate
6	Scheller et al., 2014	JBI case series	L	L	L	L	n/a	Low
7	Elimairi et al., 2015	JBI case report	L	L	L	M – limited long-term follow-up	n/a	Moderate
8	Saccomanno et al., 2018	JBI case report	L	L	L	M – follow-up duration not specified	n/a	Moderate
9	Sveinsson et al., 2013	JBI case series	L	L	L	L	n/a	Low
10	Gupta et al., 2021	JBI case report	L	L	L	M – follow-up duration not specified	n/a	Moderate
11	Hall et al., 2024	JBI case report	L	L	M – definitive treatment not yet performed	M – short-term follow-up only	n/a	Moderate
12	Uludağ et al., 2013	JBI case report	L	L	L	M – follow-up duration not specified	n/a	Moderate
13	Lei et al., 2017	JBI case report	L	L	L	L – 1-month follow-up with histopathology	n/a	Low
14	Michaud & Gebril, 2021	JBI case report	L	L	L	L – 13-year follow-up reported	n/a	Low

***Confounding control** refers to statistical adjustment for age/sex where group comparisons were performed; not applicable (n/a) to single-patient case reports.

DISCUSSION

This review of 14 studies confirms that the styloid process shows clinically relevant variation in length, morphology and calcification, and that this variation underlies a recognisable but genuinely heterogeneous clinical syndrome.

The largest anatomical dataset here, 207 stylohyoid complexes, found a mean length of 31.7 mm with a positive correlation between length and age, and concluded that radiographic elongation should be regarded mainly as a physiological, age-related phenomenon rather than an inherently pathological one, since no symptom in that cohort correlated with length.[3] Certain case-based literature reports that some symptomatic patients had processes measuring 75-80 mm[14,16], while another series documented long, even bilaterally elongated, processes that caused no symptoms at all on the unaffected side.[8] Rather than the absolute length, alone as a predictor of symptom severity, its angulation and its precise relationship to the carotid sheath, jugular vein, and lower cranial nerves appear more decisive.[4,8,12]

Several studies used the Langlais scheme to separate continuous, pseudo-articulated, and segmented patterns.[3,12] Segmented and pseudo-articulated variants were over-represented among elongated, symptomatic processes in the largest cross-sectional study.[3] The most extreme morphological variant identified was complete articulated ossification with aberrant thickening of the entire stylohyoid chain, confirmed as mature bone with marrow in histological report. This case produced pronounced dysphagia that resolved quickly after resection.[15] This suggests that the degree of ossification and the presence of pseudo-

articulation, rather than simple linear length, may better reflect the mechanical irritation that ultimately produces symptoms.

Oropharyngeal, stylocarotid or neurovascular and styloidogenic jugular presentations are usually determined by the direction of styloid impingement.[4,12] The neurovascular type presents severe consequences that may include carotid aneurysm[13] and ischemic stroke.[7,11] In the jugular variant, intracranial venous hypertension and peri-mesencephalic subarachnoid haemorrhage[4] weredocumented. Thus, an elongated styloid process should be considered in the differential diagnosis of not only atypical facial or pharyngeal pain but also of unexplained transient ischaemic events or non-aneurysmal subarachnoid haemorrhage in patients without the usual cerebrovascular risk factors.

A recurring theme across the case reports was substantial diagnostic delay, with repeated unnecessary treatment such as dental extractions, sinus surgery, prolonged and ineffective drug trials before Eagle syndrome was finally recognised.[5,14,16] One patient's elongated process was misdiagnosed as trigeminal neuralgia for 27 years despite classic findings on tonsillar fossa palpation.[14] These cases are a reminder that atypical presentations are not rare and should not be used to rule out the diagnosis when an elongated or calcified styloid-stylohyoid complex is radiographically evident and clinically plausible.

Three-dimensional CT offered better delineation of length, angulation, and proximity to neurovascular structures than panoramic radiography, and was considered essential for surgical planning.[14-16] Several authors nonetheless noted that panoramic radiography remains a reasonable, lower-radiation first-line screening tool, particularly in dental settings.[8] CT or MR angiography was uniformly required once vascular compression, dissection, or aneurysm was suspected clinically.[4,7,11,13]

Surgical styloidectomy through transoral, retromolar/para-tonsillar, or transcervical approach was consistently reported as an effective intervention, producing complete or near-complete remission in the large majority of operated patients with long-term symptom-free follow-up in several case reports.[5,16] Conservative pharmacological management gave variable, often incomplete relief and was generally used as a bridge to surgery or the definitive approach in patients unable or unwilling to undergo surgery.[4,7]

This review has the limitations where in the literature mostly consists of case reports and small caseseries. The search was limited to a single database. Considerable heterogeneity in elongation thresholds (25 mm to over 40 mm) and outcome reporting limited direct cross-study comparison and led us to synthesise findings narratively rather than quantitatively. This review does not describe regarding the true population-level prevalence or what happens to people who have an elongated process that is not treated.

The findings of the present review suggest that rather than teaching styloid process as an isolated bony landmark, emphasize should be made on its clinical behaviour by its relationship to the carotid sheath, jugular vein, and lower cranial nerves. Clinically, the results support considering an elongated or calcified styloid process in the differential diagnosis of unexplained cervicofacial pain and dysphagia and also in cases of unexplained transient ischaemic events or non-aneurysmal subarachnoid haemorrhage. Future research may be focussed on prospective multicentre cohort studies using a standardised CT-based measurement protocol.

CONCLUSION

Elongation and morphological variation of the styloid process in relation to its length, angulation, segmentation, pseudo-articulation, and calcification of the stylohyoid ligamentform an anatomically diverse but clinically coherent spectrum with direct relevance to head and neck practice. Given how often diagnosis is delayed in the literature reviewed here, greater awareness of styloid process variation among anatomists, dentists, radiologists, otolaryngologists, and neurologists is required, alongside prospective research using standardised measurement and outcome criteria to sharpen diagnostic thresholds and treatment selection.

Declarations

Conflicts of interest: The authors declare no conflicts of interest.

Data availability: All data extracted for this review are derived from the published,

publicly available articles cited in the reference list and are presented in Table 1 and 2.

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