

Case Report  
Trauma

# ‘Stylo-mandibular complex’ fracture from a maxillofacial surgeon’s perspective – review of the literature and proposal of a management algorithm

**G. Gayathri, P. Elavenil, B. Sasikala,  
M. Pathumai,  
V. B. Krishnakumar Raja**  
Department of Oral & Maxillofacial Surgery,  
SRM Dental College & Hospital, Ramapuram  
Campus, Ramapuram, Chennai, India

*G. Gayathri, P. Elavenil, B. Sasikala, M. Pathumai, V.B. Krishnakumar Raja: ‘Stylo-mandibular complex’ fracture from a maxillofacial surgeon’s perspective – review of the literature and proposal of a management algorithm. Int. J. Oral Maxillofac. Surg. 2016; 45: 297–303. © 2015 International Association of Oral and Maxillofacial Surgeons. Published by Elsevier Ltd. All rights reserved.*

**Abstract.** The incidence of fractures of styloid process, either in isolation or association with mandibular fractures, is rare, and frequently overlooked. When present, they pose clinical dilemma in diagnosis and management. Proper management of styloid fractures is essential, not just to alleviate the patients’ symptoms, but also to prevent potential complications like post-traumatic styloid syndrome and injury to adjacent vital structures. This article features a review of literature on ‘styloid fracture concomitant with mandibular fracture’ along with a case report. The article explores the biomechanics resulting in styloid fracture especially when co-existing with mandibular fractures. The article also enumerates the clinical features of this unusual clinical phenomenon and aims at rationalizing the need for its medical or surgical management. A simple protocol for the management of ‘stylo-mandibular complex’ fracture has been proposed.

**Key words:** styloid process fracture; mandibular angle fracture; stylo-mandibular complex fracture; biomechanics.

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Fractures of the styloid process are uncommon in occurrence as well as presentation to a maxillofacial surgical unit.<sup>1–6</sup> More infrequent, is the incidence of styloid fracture concomitant with mandibular fractures (styloid-mandibular fracture complex).<sup>7–11</sup> Parenthetically, reports of

isolated styloid fracture detailing their management are found in Otolaryngology literature<sup>12–16</sup> while in contrast there is extremely sparse discussion on management of styloid fractures occurring along with mandibular fractures.<sup>8–11</sup> Hence there is often a clinical dilemma regarding the

course of management in the following aspects: (1) whether the styloid fracture requires treatment or not, (2) if yes, the choice of treatment needed-surgical or pharmacological, (3) the type of anaesthesia needed for surgical treatment, (4) the time of surgical treatment; simultaneous

with mandibular fracture or later and finally (5) whether the surgical management of styloid process is within the purview of the maxillofacial surgeon.

The purpose of this paper is to clarify the aforementioned queries. The article also aims at exploring the biomechanics involved in such combined fractures and to analyze the treatment probabilities. It is also an attempt to compare and contrast the differences if any, in surgical management of 'isolated styloid' fracture with the combined 'stylo-mandible complex' fracture.

## Review of literature

### Incidence

Reports of trauma to the styloid process are found sporadically in maxillofacial literature. A case of styloid process fracture following administration of local anaesthesia during a minor surgical procedure has been documented.<sup>4</sup> Proof of styloid fracture in cases of death by hanging or strangulation have also been recorded in forensic medicine.<sup>17</sup>

Though the styloid process has well established anatomical association with the mandible,<sup>4</sup> the biomechanics of styloid fracture in association with mandibular fractures (styloid-mandibular fracture complex) and their clinical implications are discussed with less clarity.<sup>4,9,10</sup> The mandibular fractures previously documented with styloid fractures are parasymphysis,<sup>9,11</sup> body, angle<sup>7</sup> and the mandibular condyle.<sup>8,9</sup>

### Surgical anatomy and embryology

The styloid process is a cylindrical extension arising from the tympanic part of the temporal bone with a pointed tip. It is a part of the stylohyoid apparatus whose other components are stylohyoid ligament and hyoid bone. The spatial orientation of the styloid process is in an oblique fashion – anteromedially and inferiorly, occupying the retropharyngeal space.<sup>18</sup> Three osseous structures of significance lie in close proximity to the styloid process; the mandible, hyoid and atlas.<sup>19</sup> It is also closely associated with lingual and auriculo-temporal nerves anteriorly, the carotid space containing the internal jugular vein, internal carotid artery, sympathetic chain and cranial nerves 9–12 posteriorly (Fig. 1).<sup>3,19</sup> The process gives attachment to 3 muscles (stylohyoid, styloglossus, stylopharyngeus) and 2 ligaments (stylo-mandibular and stylohyoid).<sup>3</sup> The stylo-mandibular ligament extending from the

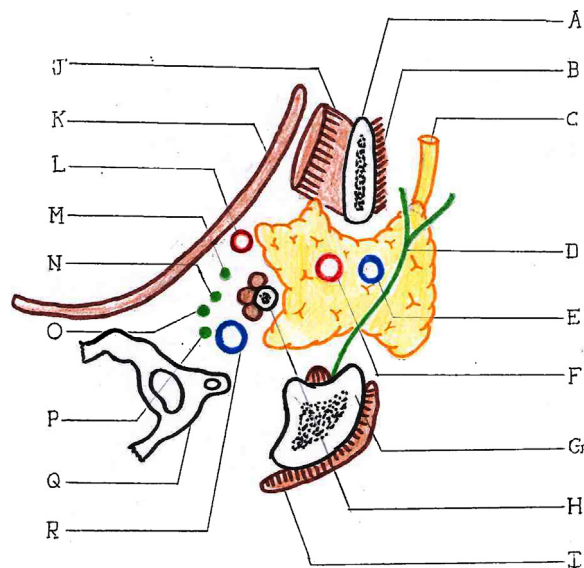


Fig. 1. Relationship of styloid process to vital structures. (A) Ramus of mandible. (B) Masseter. (C) Parotid duct. (D) Facial nerve and its branches. (E) Retromandibular vein. (F) External carotid artery. (G) Mastoid process. (H) Styloid process with its muscles. (I) Sternocleidomastoid. (J) Medial pterygoid. (K) Superior constrictor. (L) Internal carotid artery. (M) Glossopharyngeal nerve. (N) Vagus nerve. (O) Hypoglossal nerve. (P) Accessory nerve. (Q) Transverse process of atlas. (R) Internal jugular vein.

styloid process to the angle of the mandible serves to limit the excessive protrusive movement of mandible.

The styloid process originates from the Reichert's cartilage of the second branchial arch and gets ossified completely by 5–8 years.<sup>20</sup> The time period of Ossification and fusion varies with the 3 mechanisms of ossification including reactive hyperplasia, reactive metaplasia or developmental.<sup>21</sup>

### Biomechanics of styloid fracture

The styloid process is a relatively well-protected structure, directed away from extrinsic traumatic forces; with its tip oriented medially and adequately draped by soft tissue which lends to the rarity of its fracture and displacement. However, fracture of the styloid has been proposed to occur due to the following biomechanics: (1) intrinsic trauma arising/originating from muscles attached to the styloid apparatus,<sup>4,11</sup> and (2) extrinsic trauma to a comparatively weaker or trauma-prone styloid.

Intrinsic trauma may be inflicted due to un co-ordinated muscle spasms during strained swallowing patterns, epileptic seizures, laughter, singing, excessive coughing,<sup>16,22</sup> and even sudden movement during administration of inferior alveolar nerve block<sup>4</sup> and dental extraction.<sup>2</sup> The extrinsic trauma could be a direct blow to the styloid region or trauma to the anterior

mandible resulting in posterior displacement of the mandible which indirectly impacts the styloid process<sup>4</sup> (Fig. 2A). The styloid process becomes trauma-prone when it gets weakened in the following aspects: (1) structural variation – thinner in cross section, longer,<sup>1,7</sup> or multidirectionally curved,<sup>7</sup> (2) spatial variation – tip oriented laterally,<sup>7</sup> and (3) pathological alteration-infection (enthesitis).<sup>20</sup> Nevertheless, of all the factors mentioned, the propensity for the styloid process to fracture increases with its elongation.<sup>7</sup>

### Length of styloid

The normal length of the styloid process spans a wide range 2.5–4.77 cm,<sup>23,24</sup> varying according to age, ethnicity, sex,<sup>25</sup> and ossification.<sup>26</sup> It increases with age<sup>27</sup> due to calcification. Though some studies mention that length is independent of sex.<sup>25</sup> Kishore et al. found that the average length of styloid process in women was found to be higher than in men.<sup>28</sup> Length has also been shown to increase due to increased weight on head.<sup>29</sup>

The actual length of the styloid refers to the length of the osseous styloid process and the ossified ligaments<sup>30</sup> and is measured on the posterior aspect from the base to the tip.<sup>3</sup> After an extensive anatomic study, Eagle stated that a styloid process longer than 30 mm may be termed as elongated styloid process (ESP) which is clinically significant.<sup>31</sup>

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