



The Hidden Tail: Discovery of a Rare Inion Hook on Lateral Cephalometric Imaging

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Abstract : Occipital spurs, which are also referred to as inion hooks, are uncommon anatomorphological variants of the external occipital protuberance. They are large enthesophytes that are frequently asymptomatic but can cause discomfort in some people, especially those with certain postural habits. This case report presents a case series of two adolescent males from Davangere City who sought for orthodontic correction of malaligned teeth and were referred for routine diagnostic imaging, where an incidental finding of an elongated occipital spur was discovered in lateral cephalogram. When the patient's history was reviewed, it was discovered that prolonged use of electronic devices and forward neck posture were associated with neck discomfort symptoms, underscoring the significance of modern lifestyle variables in exacerbating these conditions. This paper highlights the coincidental finding of an elongated hook-shaped occipital spur that may be related to postural patterns.

Keywords - *External Occipital Protuberance, Occipital Spur, Large Enthesophytes, Inion Hook, Postural Habits, Modern Lifestyle.*

I. Case Scenario

A 20-year-old male patient was referred from the Department of Orthodontics and Dentofacial Orthopedics to the Department of Oral Medicine and Radiology for routine lateral cephalometric evaluation as part of his orthodontic diagnostic work-up. On subjecting the patient to a lateral cephalogram, an incidental finding of a bony extension arising from the external occipital region, as an elongated hook-like projection, approximately 27 mm in length, exhibiting a distinct downward, curved configuration was noted.

Following this incidental radiographic discovery, a detailed clinical history and examination were revisited. On extraoral examination, a distinct bony protuberance was evident in the occipital region. On palpation, the swelling was firm, bony hard in consistency, and non-tender. The patient further disclosed that he occasionally

experienced neck discomfort while combing his hair and during the supine sleeping posture. Additionally, neck discomfort was reported to increase while maintaining a forward-bent posture for prolonged periods, especially during smartphone use exceeding 12 hours per day.



Fig 1: Type III (spine type) elongated external occipital protuberance

II. Case Scenario

A 21-year-old male college student was referred from the Department of Orthodontics and Dentofacial Orthopedics to the Department of Oral Medicine and Radiology for routine lateral cephalometric evaluation as part of orthodontic diagnostic imaging. Examination of the lateral cephalogram revealed an elongated, pyramid-like projection arising from the external occipital protuberance. The bony outgrowth measured approximately 25.4×22.9 mm and displayed a sharp, apex-like tip.

After Revisiting the patient's clinical history and extraoral examination, a distinct bony protuberance was noted in the occipital region. Palpation confirmed a firm, bony hard & non-tender. The patient further disclosed a history of prolonged laptop use due to academic requirements of more than 10 hours in a day, along with irregular sleep postures, both of which were associated with recurrent neck discomfort and localized pain in the occipital region.

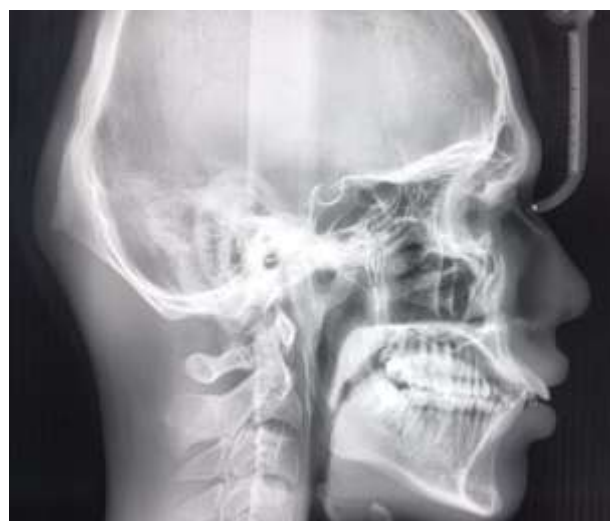


Fig 2: Type II (crest type) elongated external occipital protuberance

III. DISCUSSION

Bone spurs (Enthesophytes) are commonly characterized by sharp, irregular projections extending from the bone cortex into the ligament or tendon at the insertion site [1]. The term "enthesis" was derived from ancient Greek referring to the structures that connect ligaments, tendons, and joint capsules to bone. These structures serve as transition zones between two tissues with significantly different histological characteristics. Multiple research groups have demonstrated that entheses can be classified into two categories: fibrous entheses and fibrocartilaginous entheses.[2]

Anthropologists typically describe the occipital bun as a distinctive trait of Neanderthals, whereas medical researchers consider it a common anatomical variant. These bony outgrowths can manifest in both the axial and appendicular skeleton, including notable sites such as the external occipital protuberance at muscular attachment points.[3]

The occurrence of external occipital protuberance (EOP) exostosis varies among different populations. A study conducted by Shahar and Sayers (2018) on young adults from the Sunshine Coast of Australia found that approximately 41% displayed a prominent exostosis protruding from the occipital squama, with sizes ranging between 10- and 31-mm. [4] In another CT-based cross-sectional study in Jordan, Al-Ryalat et al. (2021) found that 27.4% of individuals showed an enlarged EOP, with a higher prevalence noted in males.[5]

Multiple factors influence the development of EOP enlargement, including repetitive mechanical loading, forward head posture (FHP), genetic predisposition, and tensile stress from attached muscles and ligaments. Shahar et al. recorded anterior head protraction >40 mm in young adults, far exceeding the normal mean of 16 mm, suggesting excessive tensile forces act on the EOP during growth and postural strain represented at these sites is likely due an adaptive response to increased mechanical load rather than a purely pathological process.[6]

The development of these structures may serve as an adaptive mechanism to enhance the surface area at the tendon-bone interface in regions subjected to frequent tensile stress. Bone growth occurs in the direction of the tensile stress applied to the bone at the insertion. Bone spurs are typically asymptomatic and do not necessarily indicate disease in otherwise healthy individuals. This condition is a common postural abnormality that has been frequently associated with fatigue and excessive contraction of the neck and shoulder muscles. It is theorized that an increase in forward head posture (FHP) raises the mechanical load on the external occipital protuberance (EOP) due to the direct tensile stress exerted by the upper trapezius fibers and the ligamentum nuchae. The tensile loads on ligaments during puberty may influence the morphology and surface area of the enthesis suggesting that excessive forces may have been acting on the EOP of our participants from a young age.[4]

Singal et al. (2023) classified the external occipital protuberance (EOP) into three types based on its morphology:

1. **Type 1 (Smooth or Flat):** Characterized by a smooth or flat surface without any prominent bony projections.
2. **Type 2 (Crest Type):** Features a prominent bony ridge or crest along the midline of the occipital bone.
3. **Type 3 (Spine Type):** Exhibits a pronounced, spine-like projection extending from the occipital bone.[7]

While exostoses of the EOP and superior nuchal lines are often asymptomatic, they can cause occipital headaches, especially in individuals who engage in activities involving vertical biomechanical movements of the neck, such as tree climbing and playing basketball or volleyball.[8] Exostoses of the external occipital protuberance (EOP) and superior nuchal lines that can potentially impinge on the greater and third occipital nerves, leading to occipital headaches.[9]

A study by Gülekon and Turgut (2003), investigated the potential of using the external occipital protuberance (EOP) as a criterion for sex determination in forensic anthropology. The study concluded that the external occipital protuberance, particularly the spine-type (Type 3), is more prevalent in males, while the less prominent (Type 1) is more common in females. However, the crest-type (Type 2) EOP does not show significant sexual dimorphism and is less useful for sex determination.[10]

In the case report by Gómez Zubiaur et al. (2019), two adolescent males, aged 14 and 15, presented with slow-growing, painless occipital masses. Ultrasonographic examination revealed a spine-shaped bony protuberance on the occipital bone, consistent with Type 3 EOP. The lesions were asymptomatic, and conservative follow-up was recommended. The report emphasized that ultrasonography is a valuable, non-invasive diagnostic tool for identifying Type 3 EOP, helping to differentiate it from other scalp masses and avoid unnecessary biopsies or imaging studies.[11]

Similarly, Guru Dutta et al in 2019 also described in a case report of a 14-year-old boy who presented with a five-year history of localized occipital pain and a slowly growing, curved bony mass. On Physical examination, he revealed a non-tender, stony-hard swelling approximately 1.2 cm in length, with a downward projection over the occipital protuberance region. X-ray imaging showed a downward-pointing external occipital tubercle. The patient experienced difficulty combing his hair and sleeping in a supine position. The study suggested that the patient's symptoms may be due to impingement of the trapezius muscle and the third occipital nerve, leading to localized occipital neuralgia.[12]

While a study by Porrino et al. (2021) examined the prevalence of exophytic external occipital protuberances (EEOPs) in two cohorts: one before the iPhone's release in 2007 and another approximately a decade later. The researchers analyzed 82 cervical spine radiographs from March to June 2007 and 147 from October 2017 to January 2018. They found that 50% of individuals in the pre-iPhone group had an EEOP, compared to 33.3% in the post-iPhone group. Additionally, males were 5.9 times more likely to have an EEOP than females, and the average size of EEOPs was larger in males (11 mm) compared to females (2.9 mm). Further this study concluded that there was no significant association between iPhone accessibility and the presence or size of an EEOP, suggesting that factors other than smartphone usage may influence the development of EEOPs.[9]

Shakeel et al (2022) reported the incidental discovery of the occipital spur via CBCT imaging allowed the patient to be promptly informed about the condition. While occipital spurs are typically asymptomatic, recognizing this uncommon presentation can expedite emergency care and management in a cost-effective manner, particularly in cases of pain or trauma that may lead to fracture or avulsion of the spur fragment. In such scenarios, the readily available CBCT data will be invaluable to the surgeon in planning and performing surgery. This reported the first instance of measuring the size of an occipital spur using cone-beam computed tomography and 3D imaging software. This imaging technique is more sensitive than conventional radiography for precise linear and volumetric measurements, as well as for detecting changes in bone spur morphology.[13]

In a report by Bahadir (2023), two cases were presented where exostoses of the EOP and superior nuchal lines were associated with occipital headaches. In one case, a 34-year-old man with a prominent EOP and superior nuchal lines experienced headaches in the distribution of the greater occipital nerve, with tenderness near the bony protrusion on palpation. In another case, a 44-year-old woman experienced stabbing pain in the lateral orbital region upon pressure on the ossified insertion of the ipsilateral trapezius muscle near the EOP. Local nerve block achieved temporary relief of pain in this case.[14]

A study by Çağlayan et al. (2024) examined the prevalence of occipital spurs (OS) and their correlation with cranial morphology using cone beam computed tomography (CBCT). The cephalic index (CI), a measure of cranial shape, was used to classify cranial types and assess their relationship with OS. Among 523 patients, the most common cranial types were brachycephalic (44.7%), mesocephalic (28.3%), and hyper brachycephalic (21.2%), with dolichocephalic skulls being the least common (5.7%). Occipital Spur was identified in 45.7% of the participants, with the flat type being the most common and spine type being the least common. A significant

variation in Occipital Spur frequency was observed across cranial types, with mesocephalic and dolichocephalic skulls showing higher Occipital Spur prevalence. The study also noted a higher incidence of Occipital Spur in males.[15]

Macri et al (2024) revealed the prevalence and severity of EOP in contemporary individuals compared to ancient populations. The occurrence of EOP was linked to modern postural habits, particularly the "tech neck" posture resulting from prolonged use of electronic devices. It also suggested that while modern postural habits may influence EOP morphology, other factors such as genetics and overall health may also play significant roles.[8]

IV. Conclusion:

The knowledge of this tubercle is of paramount importance to anatomists, neurosurgeons, sports physicians, maxillofacial radiologists, forensic experts, and anthropologists. Sports physicians who are aware of this anomaly will be better equipped to provide appropriate protection to athletes under their care.

The identification of occipital spurs on lateral cephalograms by oral and maxillofacial radiologists, particularly the uncommon type 2 and 3 variants, is crucial as this asymptomatic bony projection can significantly become symptomatic when associated with postural or musculoskeletal factors.

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