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Junction Between Well-Developed Paracondylar Process and Transverse Process of the Atlas: A Very Rare Case Report

Unión Entre el Proceso Paracondíleo Bien Desarrollado y el Proceso Transverso del Atlas: Un Caso Clínico Muy Raro

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SUMMARY: The paracondylar process (PCP) is a wide-based, bony cone that stems from the exo-occipital bone beside the occipital condyle. In this case report, the morphology of a well-developed PCP, which we incidentally encountered in our previous craniovertebral region computed tomography (CT) study, and its relationship with the TVP of the atlas and the rectus capitis lateralis muscle were evaluated. Case Report: A well-developed PCP unilateral (left-sided) is noted in a 41-year-old male. The PCP is terminated by articulating with the transverse process (TVP) of the atlas medially from the mastoid process. The PCP widths were measured as 14, 9.8, and 10 mm at the base, middle, and apex, respectively. The base-to-apex length was 15.6 mm. The well-developed PCP is classified as a molar type. The rectus capitis lateralis muscle was atrophic on the left side of the PCP and normal on the right side. The area and circumference of the rectus capitis lateralis muscle were measured as 123.89 mm^2, 50.9 mm, 91.66 mm^2, and 40.9 mm on the right and left sides, respectively. In this rare case report, the well-developed PCP articulated with the TVP of the atlas and caused atrophy of the rectus capitis lateralis muscle, highlighting potential surgical challenges and the importance of recognizing this variation for clinical practice.

KEY WORDS: Craniovertebral region; Paracondylar process; Atlas; Junction; Variant anatomy.

INTRODUCTION

The paracondylar process (PCP) is a wide-based, bony cone that stems from the exo-occipital bone beside the occipital condyle. It is directed toward the transverse process (TVP) of the atlas and may be connected with it by a joint (Prescher *et al*., 1996; Çimen, 2025).

Erbengi and Öge (1994) classified PCP among the minor mesodermal asymptomatic anomalies of the craniovertebral region. Also included in this classification are occipital condyle asymmetries, atlatooccipital articulation anomalies, and arch anomalies of the atlas or axis. Minor mesodermal asymptomatic anomalies may be accidentally diagnosed by routine X-ray examination and generally do not produce neurological symptoms and signs(Erbengi & Öge, 1994). However, in extreme cases, the PCP can fuse to the TVP of the atlas, causing functional limitations in neck movement and may cause clinical symptoms due to alterations in posture and restricted range of movement (Nolet *et al*., 1999).

In this case report, the morphology of a well-developed PCP, which we incidentally encountered in our previous craniovertebral region computed tomography (CT) study (Çimen & Gül, 2005), and its relationship with the TVP of the atlas and the rectus capitis lateralis muscle were evaluated.

CASE REPORT

During our recent retrospective study, unilateral (left-sided) PCP was determined in a 41-year-old male. The patient presented to the emergency department, and the cause of admission was reported as assault. Examination and radiological evaluations revealed no craniovertebral involvement.

All evaluations and measurements were performed using our institution's picture archiving and communication system (PACS, Sectra Workstation IDS7, v. 26.2.16.8574,

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Teknikringen 20, SE-583 30 Linköping, SWEDEN). The PCP is terminated by articulating with the TVP of the atlas medially from the mastoid process. Therefore, it was evaluated as a well-developed PCP. The PCP widths were measured as 14, 9.8, and 10 mm at the base, middle, and apex, respectively. The base-to-apex length was 15.6 mm. According to the Anderson classification of well-developed PCP, it was of the molar type. The rectus capitis lateralis muscle was atrophic on the left side of the PCP and normal on the right side. The area and circumference of the rectus capitis lateralis muscle were measured as 123.89 mm^2, 50.9 mm, 91.66 mm^2, and 40.9 mm on the right and left sides, respectively. Figs. 1,2,3.

No other variant was encountered in the craniovertebral region except for PCP.

Fig. 1. Shows sagittal computed tomography images of the left (a) and right (b) sides. (a) Star (black) indicates the paracondylar process. TVP, transverse process of the atlas. A: Anterior, P: Posterior, S: Superior, I: Inferior.

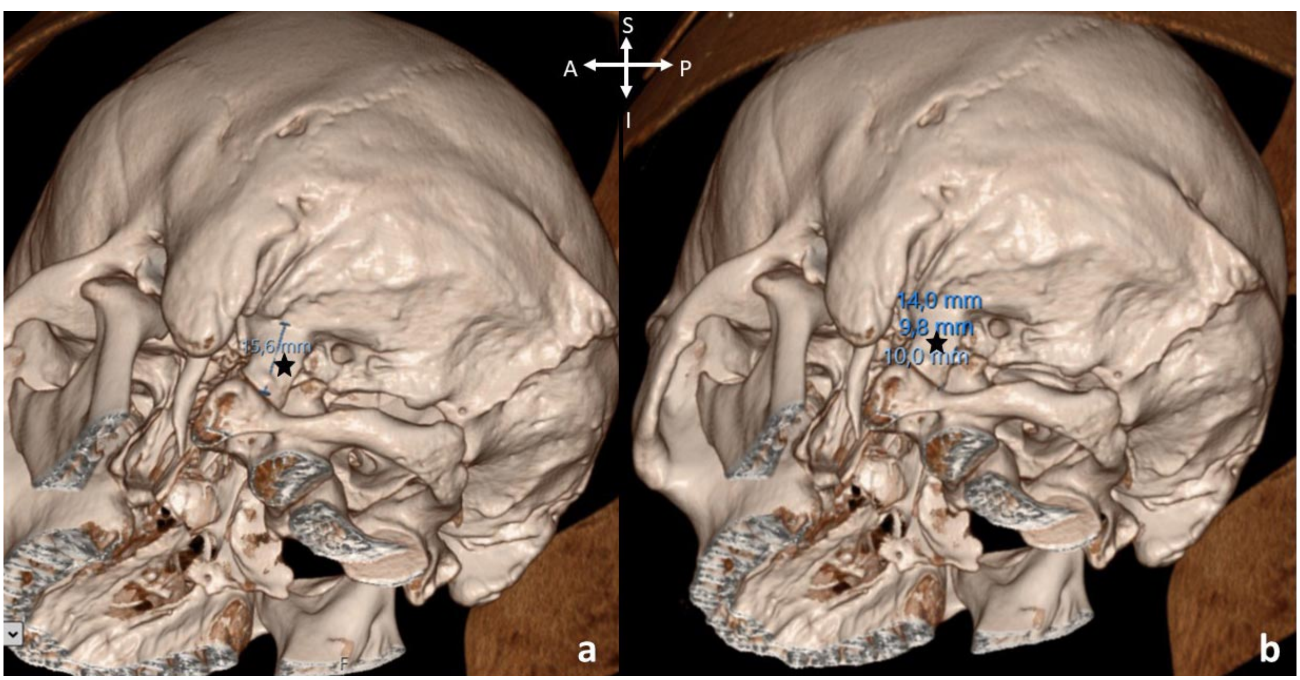

Fig. 2. Three-dimensional computed tomography images of the craniovertebral region and paracondylar process. (a) Shows total length of the paracondylar process (black star) (15.6 mm). (b) Shows paracondylar process's (black star) base, midpoint, and apex lengths (14, 9.8, and 10 mm, respectively). A: Anterior, P: Posterior, S: Superior, I: Inferior.

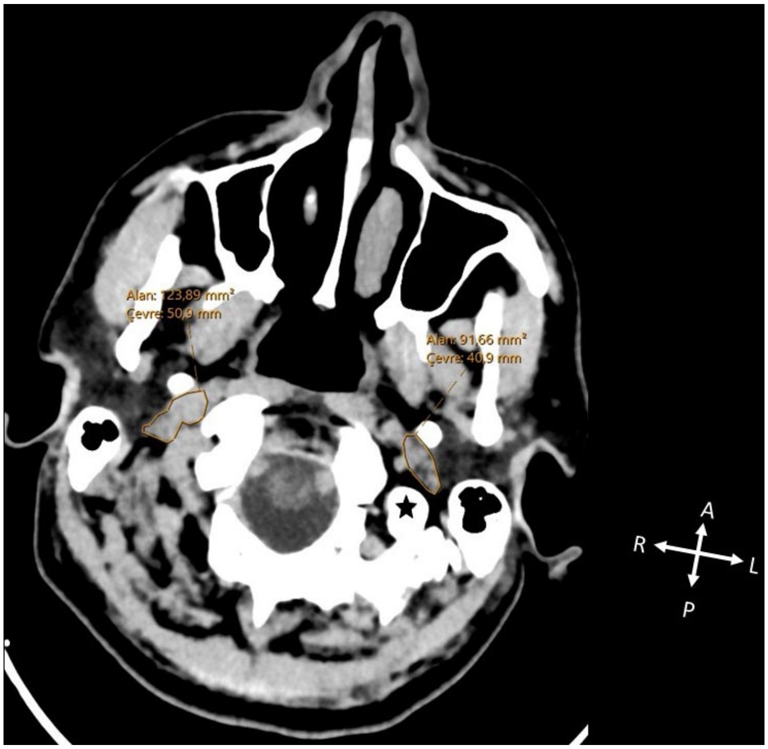

Fig. 3. Shows the relationship between the paracondylar process (black star) and the rectus capitis lateralis muscle (orange circle). Area (Alan in Turkish) and Circumference (Çevre in Turkish). Area, and circle of the rectus capitis muscles were 123.99 mm^2, 50.9 mm, and 91.66 mm^2, 40.9 mm, right and left sides, respectively. This indicates atrophy of the left paracondylar process (black star). A: Anterior, P: Posterior, R: Right, L: Left.

DISCUSSION

There is debate as to whether PCP is congenital or acquired. There are two theories regarding this variation in the craniovertebral junction. The first concerns the embryology of the atlantooccipital region. Embryologically, the occipital bone consists of the basioccipital, exoccipital, and supraoccipital parts surrounding the foramen magnum (FM) (Smoker, 1994). The basiocciput continues to develop into four occipital somites. The caudal part of the fourth occipital somite fuses with the cranial part of the first cervical somite to form the proatlas. The proatlas assimilates into the occiput, forming the condyles and the tip of the odontoid process. The caudal half of the first cervical somite continues with the cranial part of the second cervical somite to form the atlas and the odontoid process of the axis (Black & Scheuer, 1996). The PCP is thought to represent the remains of the cranial half of the first cervical sclerotome (occipital vertebra) (Shapiro & Robinson, 1976). According to the second theory, the PCP is thought to be acquired rather than congenital. According to this theory, PCP occurs due to overuse or trauma of the rectus capitis lateralis muscle during infancy. In this case report, the left rectus capitis lateralis muscle was determined to be atrophic based on areal and circumferential measurements. This result is consistent with the theory that PCP may be acquired.

The rectus capitis lateralis provides an excellent landmark for estimating the position of the jugular foramen and the facial nerve during paracondylar exposure that accesses the posterior margin of the jugular foramen, the jugular bulb, and the mastoid process (Wen *et al*., 1997). When the rectus capitis lateralis is replaced by the PCP, this can pose an obstacle during surgery (Keskil *et al*., 2003). As seen in this case report, the atrophic rectus capitis lateralis muscle may compromise neuronavigation. Well-developed PCP may need to be considered clinically in craniovertebral surgical procedures.

If the PCP is shaped as a small hump, then it is called the paracondylar tubercle. Anderson (1996) stated that well-developed PCP is much rarer than small humps and that this rate was 0.077 % in his study. It has been determined that well-developed PCP can be molar, saw-like, or conical in shape (Anderson, 1996). Pace (1969) reported a prevalence of 2% for PCP in his study of 890 Maltese skulls. He reported the molar type (one skull, prevalence 0.11 %) as the rarest among PCP types. In the reported case, PCP was observed with a broader base (14 mm) than the apex (10 mm) and a molar shape, which is one of the rarest. The prevalence of PCP in the population is between 0.5% and 2 % (Schumacher *et al*., 2018). Our previous study sample consisted of 2000 individuals, and the only case of PCP occurred in this sample (0.05 %) (Çimen & Gül, 2025). Compared with the literature, this reported case appears quite rare.

Radiographically, a PCP can usually be seen on an anteroposterior open-mouth (APOM) view. The mastoid process may obstruct the small processes on the lateral radiograph, although larger processes may be visible (Prescher *et al*., 1996). CT scans will help differentiate smaller processes from traumatic changes (Bertini *et al*., 1991). Larger processes may need CT scans to differentiate between fusion or articulation with the TVP of the atlas (Prescher *et al*., 1996). Nolet *et al*. (1999), state that, "when the PCP is fused to or articulating with the transverse process of the atlas, head movement may be limited or completely blocked." Posturally, an osseous torticollis may be seen (Prescher *et al*., 1996) or the head may be forced into an attitude of flexion (caput obstipum) (Lombardi, 1961). De

Graauw *et al*. (2008), reported a case of a 21-year-old woman who was seen for severe, persistent daily headache and neck pain after a minor head and neck injury. They state that after resection of the PCP, headache and cervical pain were substantially reduced.

Limitations. Because this case report was incidental, the patient's craniovertebral region and neurological complaints could not be evaluated. Future studies evaluating these factors may better elucidate the relationship between clinical symptoms and well-developed PCP.

CONCLUSIONS

In this extremely rare case report, a well-developed PCP articulated with the TVP of the atlas. The PCP caused atrophy of the rectus capitis lateralis muscle on the same side. To our knowledge, this is the first case report in the literature to demonstrate atrophy of the rectus capitis lateralis muscle due to PCP. This will be a valuable resource for surgical and radiology clinicians.

Ethical Standards. Ethical approval is not provided. The report was prepared in accordance with the ethical standards outlined in the 1964 Declaration of Helsinki and its subsequent amendments, or comparable ethical standards.

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RESUMEN: El proceso paracondíleo (PPC) es un cono óseo de base ancha que se origina en el hueso exooccipital junto al cóndilo occipital. En este caso clínico, se evaluó la morfología de un PPC bien desarrollado, hallado incidentalmente en un estudio previo de tomografía computarizada (TC) de la región craneovertebral, y su relación con el proceso transverso del atlas y el músculo recto lateral de la cabeza. Caso clínico: Se observó un PPC unilateral (izquierdo) bien desarrollado en un hombre de 41 años. El proceso articular posterior (PAP) terminaba articulándose con el proceso transverso (PT) del atlas medialmente al proceso mastoides. El ancho de PPC se midió en 14, 9,8 y 10 mm en la base, la parte media y el ápice, respectivamente. La longitud de la base al ápice fue de 15,6 mm. El PPC bien desarrollado se clasifica como de tipo molar. El músculo recto lateral de la cabeza estaba atrófico en el lado izquierdo del PPC y normal en el lado derecho. El área y la circunferencia del músculo recto lateral de la cabeza se midieron en 123,89 mm^2, 50,9 mm, 91,66 mm^2 y 40,9 mm en los lados derecho e izquierdo, respectivamente. En este caso clínico poco frecuente, el PPC bien desarrollado se articuló con la PT del atlas y causó atrofia del músculo recto lateral de la cabeza, lo que pone de manifiesto posibles dificultades quirúrgicas y la importancia de reconocer esta variación en la práctica clínica.

PALABRAS CLAVE: Región craneovertebral; Proceso paracondíleo; Atlas; Unión; Anatomía variante.

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