**Background**

Absent cervical spine pedicle (ACSP) is a very rare congenital abnormality of the spine. It has been described first in 1946 by Hadley [1-4] and is characterized by the absence of a pedicle of the affected vertebral body. ACSP may be associated with other congenital osseous abnormalities of the cervical spine [2, 5-6]. Since most patients are asymptomatic for many years, the majority of them remain undiagnosed until neck injury or until pain or paresthesias in the neck or arm warrant an imaging evaluation. In a setting of acute trauma however, ACSP can be a source for radiologic misdiagnosis i.e. on radiographs.

**Case Presentation**

Following a motor vehicle accident, a 38 year-old male patient experienced acute neck pain. He was immediately transferred to the emergency room of our hospital and seen by the emergency physician. Patient history revealed untreated chronic neck pain since many years. At the clinical examination, the patient presented with mild neck tenderness to palpation as well as with a slight restricted range of motion. No sensomotor deficits of the neck or arms were present.

Antero-posterior and lateral radiographs as well as 45° oblique views of the cervical spine were taken (Fig. 1). Radiographs showed slightly incongruent articular pillars of C5 and an enlarged, elongated right C4-C5 neuroforamen with absence of the right C5 pedicle. The opposite lamina projected through this space and the articular pillar was dorsally displaced. In addition, a vertical gap in the midline of the C5 arch was seen on the antero-posterior radiograph. Independently from each other, both the emergency medicine physician as well as the radiology resident on-call read the radiographs as abnormal with both suspecting a fracture of the right pedicle and
median arch of the fifth cervical vertebra C5. The patient was therefore scheduled for an emergency operation. According to established guidelines at our hospital, computed tomography (CT) with multiplanar reconstructions in the sagittal and coronal plane was performed preoperatively. CT revealed absence of the right C5 pedicle with dysplasia of the ipsilateral transverse process and spina bifida occulta at the same level, dorsal displacement of the articular pillar, reversal of the ipsilateral facet articulation with the supra-adjacent vertebra, as well as hypoplasia of the pillar of the supra-adjacent and hyperplasia of the pillar of the infra-adjacent vertebra (Fig. 2, 3). There were also some degenerative changes at the level C4-C5 with formation of a subchondral bone cyst in the body of C4 (Fig. 2). No fracture or hematoma was seen. Soft tissues were normal. Based on all CT imaging findings, diagnosis of ACSP with associated congenital osseous spinal abnormalities was established. The patient was discharged from the emergency room without surgical intervention. The patient was informed and gave informed consent that data concerning his case would be submitted for publication.

Discussion

In this case, ACSP of C5 with associated osseous spinal abnormalities in a male patient who has had a motor vehicle accident was misdiagnosed as a cervical fracture on radiographs. The correct diagnosis could only be established by the means of CT. ACSP is a very rare congenital abnormality of the spine. Any level of the cervical spine can be affected, though ACSP has been seen most frequently at the level C6 followed by the level C5 and C7 [1-5]. Although the exact pathogenesis of ACSP is
unclear, it probably relates to in-utero defects in the formation of the chondrification and/or ossification centers of the spine.

At approximately the seventh week of gestation three paired chondrification centers of each vertebral segment appear: two for the vertebral body, one for each side for the transverse processes, and one for each side of the neural arch. Outgrowths from the neural arch center become the pedicle, superior and inferior articular processes, lamina, and spinous processes [7-8]. By the eighth week of gestation ossification of the laminae and vertebral body begins. Cartilaginous connections remain between the vertebral body and neural arches (also referred to as neurocentral synchondrosis) and between the vertebral laminae while ossification progresses [9]. Complete osseous unification of the laminae starts in the lumbar region soon after birth to reach the neck in the 2nd year of life. Ossification of the neurocentral synchondrosis follows opposite direction starting in the cervical spine at 3rd year and reaching the sacrum at 6th year of age [7-8]. Failure of development of a vertebral chondrification center or failure of ossification could lead to the absence of a pedicle or a spina bifida occulta, respectively [3].

In our case, ACSP was associated with several congenital osseous abnormalities. In previous reports, associations of ACSP with hypoplasia of the pedicles, hypoplasia of the vertebral body, sagittal vertebral body clefts, vertebral body and arch fusions or spina bifida occulta at the absent pedicle level have been described in up to 51% of all cases [4]. Interestingly, hyperplasia of the contralateral pedicle at the involved level has not been encountered in the literature, as is commonly seen in absent or hypoplastic lumbar pedicle [10]. In our patient, ACSP of C5 in association with spina bifida occulta at the same level resulted in a right vertebral hemi-arch with no osseous attachment to the adjacent vertebral bones. This has, to the best of our knowledge, not been reported in the radiologic literature so far. Ligaments of the
spine and neck muscles might have maintained the anomalous fragment in its
dition, but deviation upon movement may inevitably have provoked the chronic
symptoms of the patients [2, 4, 11]. Degenerative osseous changes of the involved or
adjacent vertebral segment are frequently seen and a result of abnormal forces on
the bones and articulations [4].

Antero-posterior and lateral-view radiographs of the cervical spine as a first imaging
work-up give valuable information on the gross anatomy and the alignment of the
vertebral structures, although subtle pathologies, e.g. fracture, of the vertebral
pedicles cannot always be sufficiently ruled out [12]. Therefore many centers add
oblique-view projections to their standard-views of the spine to better depict the
intervertebral neuroforamina and their surrounding structures, especially in a setting
of acute trauma [13-14]. Even with that extra-information it is sometimes difficult to
make an exact diagnosis, since some congenital abnormalities of the spine, e.g.
ACSP or spina bifida occulta, might mimic acute traumatic injuries such as fractured
pedicles or vertebral arch fractures [15-17].

CT as a three-dimensional imaging modality with the possibility of multiplanar
reconstructions allows for the exact diagnosis of acute traumatic lesions of the
cervical spine. It also permits to reliably identify congenital osseous abnormalities
such as ACSP as well as to narrow the differential diagnosis in other pathologies that
might cause similar appearances on radiographs (e.g. neurofibroma which can also
cause an enlarged intervertebral neuroforamen) [3]. Thereby any unwarranted
surgery or inadequate conservative therapy can be avoided.

**Conclusion**

The knowledge of rare congenital osseous abnormalities of the spine such as ACSP
as well as knowledge of its typical radiographic appearance is essential for correct
diagnosis. However, in a setting of acute trauma where radiographs are likely to be misinterpreted, CT should be performed to establish the correct diagnosis.

Consent
Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent was provided to the editorial office of this journal.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
RG performed the literature search and compiled data presented in this report. GA and HS provided the expertise for selective imaging and contributed to the diagnosis. SW and SL conceived of the study, and participated in its design and coordination and helped to draft the manuscript. PS provided intellectual input and critically revised the manuscript. All authors read and approved the final manuscript.

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References


Captions for Figures

Figure 1 a-c: Conventional Radiographs of the cervical spine
Antero-posterior-, lateral- and oblique-view radiographs of the cervical spine:
A vertical gap of the C5 arch is seen on the antero-posterior-view radiograph (a). On lateral-view (b) slightly incongruent articular pillars of C5 are noted. On an oblique-view radiograph of the right side (c) an enlarged and elongated right C4-C5 neuroforamen with absence of the right C5 pedicle is seen. The opposite lamina projects through this space (arrow). There is also dorsal displacement of the articular pillar (arrowhead).

Figure 2 a-f: Computed Tomography of the cervical spine
Axial computed tomography (CT) images (a,b) and reconstructed images in the sagittal (c,d) and coronal (e,f) planes.
Axial images at the level C5 show absent right cervical pedicle (arrowhead in a), spina bifida occulta (arrow in a) and dysplasia of the ipsilateral transverse process (double arrowhead in a) as well as reversed facet-joint (arrow in b).
Images in the sagittal (c, d) and coronal (e, f) planes show degenerative changes at the level C4-5 (arrow in c) with formation of a bone cyst in C4 (arrow in e). The dorsal displacement of the articular pillar and reversal of the ipsilateral facet articulation (arrow in d) as well as hypoplasia of the pillar of the supra-adjacent (arrow in f) and hyperplasia of pillar of the infra-adjacent vertebra (arrowhead in f) are also well appreciated on the coronals.
Figure 3 a-c: Volume Rendering Technique – Images of cervical spine

Lateral view VRT images illustrate the dorsally displaced right articular pillar of C5 (arrow in a). The abnormal enlarged right intervertebral foramen of C4-5 (arrow in b) which is a consequence of the absent cervical pedicle is displayed on an oblique view VRT image. Spina bifida occulta at the same level (arrow in c) as well as a reversed facet-joint on the right (arrowhead in c) are well depicted on a dorsal view VRT images (c).