



# Incidental discovery of a sacral rib: a case report

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## Abstract

**Purpose** The observation of an accessory bone joined to the sacrum (suggestive of a sacral rib) prompted us to describe the structure's morphology and its anatomic relationships and to consider its morphogenesis and clinical implications.

**Method** A 38-year-old woman underwent computed tomography, to characterize the extension of a thoracic mass. We compared our observations with the literature data.

**Results** We observed a voluminous accessory bone located behind and to the right of the sacrum. The bone was articulated with the third sacral vertebra and featured a head and three processes. These characteristics were suggestive of a sacral rib. We also observed involution of the gluteus maximus.

**Conclusion** This accessory bone probably resulted from overdevelopment of a costal process and an absence of fusion with the primitive vertebral body. Sacral ribs are rare and usually asymptomatic but appear to be more prevalent in young women. The adjacent muscles are often abnormal. Awareness of the potential presence of this bone is essential for surgeons who operate on the lumbosacral junction.

**Keywords** Extra rib · Accessory bone · Sacral rib · Coccygeal rib

## Introduction

The number of bones in the skeleton can vary from one individual to another, due to transitional anomalies in the spine (sometimes leading to bi- or tripartite bones), accessory bones, or anomalies during morphogenesis (such as the presence of cervical ribs). Here, we report on the case of a 38-year-old woman with a suspected sacral rib. We describe the bone's morphology and anatomic relationships (notably with regard to the surrounding muscles). Lastly, we discuss the morphogenesis of sacral ribs and the latter's clinical implications.

## Method

A 38-year-old woman underwent computed tomography (CT) of the thorax, abdomen and pelvis (portal-phase, contrast-enhanced helical acquisition on an OPTIMA CT660 scanner (GE Healthcare, Chicago, IL, USA), to characterize the extension of a thoracic mass.

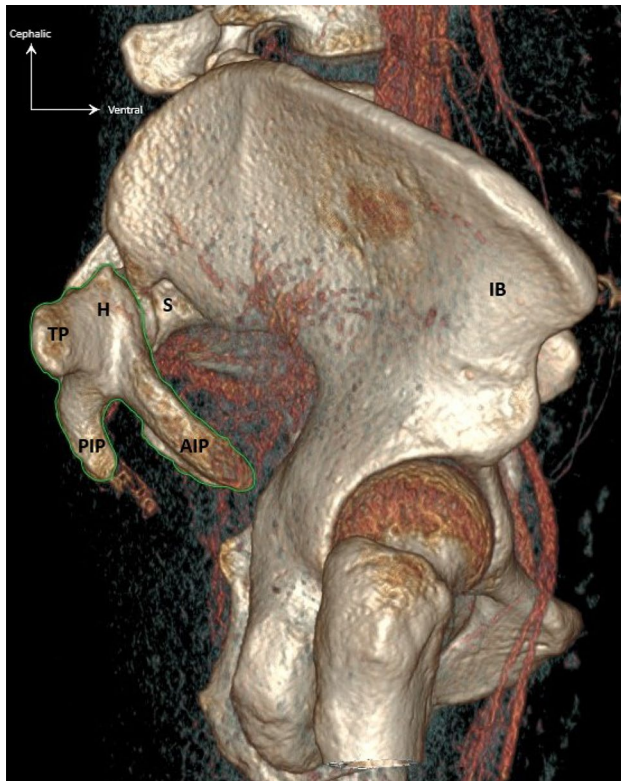
## Results

Assessment of the CT image of the pelvis revealed the presence of an accessory bone located on behind the sacrum, on the right side. The bone featured a head and three bony growths that resembled processes: a transverse process, an antero-inferior process, and a postero-inferior process (Fig. 1). Furthermore, the bone had three facets: medial, anterior, and posterior face. The medial facet was articulated medially and anteriorly with the sacrum, via a concave surface. This articulation with the lateral sacral crest was located opposite the third sacral foramen. We observed a ventral tubercle in front of this articulating surface and behind it a dorsal tubercle. This joint appeared to be an amphiarthrosis type. The anterior face was linked to the iliac

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**Fig. 1** A right lateral view (three-dimensional reconstruction) of the sacral rib. *H* head, *TP* transverse process, *PIP* postero-inferior process, *AIP* Antero-inferior process, *S* sacrum, *IB* iliac bone



**Fig. 2** A cross-sectional view on CT, passing through the transverse process of the sacral rib. *H* head, *TP* transverse process, *IB* iliac bone, *LSC* lateral sacral crest, *S* sacrum, *GM* gluteus maximus, *ES* erector spinae

bone. It had muscle origins from the right gluteus maximus, which was hypoplastic (Fig. 2). The gluteus maximus did not originate from the sacrum or the coccyx on the right side; on the left, the anatomy was unremarkable. The gluteus medius and gluteus minimus were anatomically normal. The

posterior facet of the accessory bone was linked to cutaneous and subcutaneous tissues. It received insertions from the erector spinae. The head of this accessory bone also received insertions from the latissimus dorsi. The sacrum's anatomy was normal, with no hypoplasia or deviations. No spinal deformities (e.g., scoliosis) were present.

## Discussion

We hypothesized that the accessory bone linked to the sacrum was a sacral rib. This anatomic variant is very rare [4]. The morphogenesis of the ribs begins with the formation of a costal process, as the primary vertebral mass recedes during the second month of embryonic life. It is only in the thoracic region that these costal processes develop into thoracic ribs. In the other regions, the costal processes remain fused to the primitive vertebral body and do not develop [2]. The original union between the costal process and the vertebra is replaced by a joint in which the concave facet of the vertebra receives the head of the rib. At week 9, an ossification center appears close to the future angle of the rib and gives rise to cartilage that then gradually transforms into costal bone except at the distal end [1].

We surmised that the presence of this accessory bone was probably due to the very extensive development of the right costal process on the second or third sacral vertebra and a lack of fusion with the primitive vertebral body. The original union between this right costal process and the third sacral vertebra was replaced by the joint on the bone's medial facet. The transverse process might be that of the third sacral vertebra, and the antero-inferior process might correspond to the rib's posterior arch. The lack of an ossification center at this angle in the rib at week 9 might explain the agenesis of the middle and anterior arches. The postero-inferior process is more difficult to explain; it might be a caudal articular process or even a prominent costal tubercle.

Although accessory ribs can be found at all levels of the spine, they are usually observed in the cervical and lumbar regions [2]. Sacral ribs are rare; the prevalence appears to be higher in women, with a mean age on diagnosis of 22 years [6]. Abnormal gluteus maximus insertions have been described and can be detected in a clinical examination or on imaging (CT or MRI) [2, 3, 6–8]. However, the sacral rib in the present case had characteristics that were not mentioned in the literature, such as the presence of voluminous transverse and postero-inferior processes. Nevertheless, a sacral rib is the most probable diagnosis.

In asymptomatic patients, the discovery of a sacral or coccygeal rib is usually fortuitous. In case of disabling pain, treatment with simple analgesics may be justified [6]. Surgical resections of sacro-coccygeal ribs have sometimes been necessary to treat symptoms resistant to medical treatment,

such as functional impotence of the hip or to prevent obstetrical problems [3, 5, 7, 8]. Even though our patient was nulliparous, the sacral rib's extrapelvic location meant that it would not have been problematic during childbirth. Practitioners performing interventional procedures (such as infiltration of the sacroiliac joints or surgery on the lumbosacral junction, i.e., posterolateral arthrodesis) should be aware of this malformation.

## Conclusion

The accessory bone observed in the present case was probably a sacral rib located behind the sacrum and solely on the right side. This anomaly is usually asymptomatic and so is typically discovered incidentally. If symptoms are present, they can be treated with medication, although costotomy may be an option. Awareness of the potential presence of a sacral rib is essential for surgeons who operate on the lumbosacral junction.

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## Declarations

**Conflict of interest** The authors declare that they have no competing interests.

**Ethical approval** Not applicable.

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