# Clarifying lucent oval skull markings in children:

## craniolacunia, convolutional markings and copper-beaten skull

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### Abstract

Large oval lucencies seen on the paediatric skull radiograph (SXR) may be normal or pathological. The radiologist, however, must be clear about which findings are pathological and the appropriate terminology when reporting on a paediatric SXR. By noting the clinical setting, the age of the patient and associated skull abnormalities, the appropriate terms can be used so that normal convolutional markings can be distinguished from accentuated markings of copper (silver)-beaten skull in raised intracranial pressure (ICP) and the lacunae in patients with Lückenschadel accompanying spinal dysraphism.

**Key words**
*Craniolacunia, convolutional markings, copper-beaten skull*

### Introduction

Large oval lucencies seen on the paediatric skull radiograph (SXR) may be normal or pathological. Differentiation of these does not usually affect management in current radiology practice, where an SXR is not commonly performed. The radiologist, however, must be clear about which findings are pathological and what the appropriate terminology is when reporting on a paediatric SXR. By noting the clinical setting, the age of the patient and associated skull abnormalities, the appropriate terms can be used so that normal convolutional markings can be distinguished from accentuated markings of copper (silver)-beaten skull in raised intracranial pressure (ICP) and the lacunae in patients with Lückenschadel accompanying spinal dysraphism.

### Discussion

#### Lückenschadel/lacunar skull/craniolacunia

These numerous oval, lucent defects of the skull vault, varying in size, shape, number and degree, are due to a mesenchymal dysplasia (Figure 1a). They are found in association with myelomeningocoele, meningocoele and encephalocoele (Figure 1b). Only

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*Figure 1a: Frontal SXR in a three-day-old child with spinal dysraphism demonstrating oval lucencies surrounded by dense ridges. This is the mesenchymal dysplasia termed Lückenschadel.*

very rarely does this occur without dysraphism or cranioschisis. The process begins *in utero* but disappears at six months of age (whether or not a ventriculo-peritoneal shunt has been placed). Appearances vary from shallow depressions on the inner vault of the skull to deep cavitations (lacunae) that extend to the outer skull surface. The lacunae do not correspond to the underlying convolutional pattern of the brain. Between the lacunae, linear ridges of higher density bone are seen. The parietal and upper occipital bones are commonly involved. The skull base is usually spared. As these features occur independently of raised ICP, the sutures and sella turcica are usually normal.[1-3]

## Convolutional markings/ digital impressions

These are normal markings seen as areas of decreased density in the calvarium (Figure 2). They correspond

*Figure 1b: A thoracic spine radiograph in the same child as in Figure 1a demonstrates the dorsal dysraphism (arrows) with widening of the spinal canal and numerous vertebral anomalies. This patient had a clinically visible thoracic myelomeningocoele present at birth.*

closely to the location and configuration of the underlying cerebral convolutions. They occur throughout the calvaria and those seen involving the floor of the anterior and middle fossae are most closely related to cerebral gyri. The rest of the lacunae on the vault are probably affected by pulsation of cerebrospinal fluid (CSF) in the sulci of a normal growing brain, which causes impressions on the inner table. Even though convolutional markings may be seen as early as eight months of age (in premature infants), they usually appear after the first year of life. They are most marked during the periods of rapid brain growth, which occur between 2-3 years and 5-7 years of age. They usually disappear by eight years of age. The sutures and sella turcica remain normal.[1,2]

## Hammer/copper/silver/ pewter-beaten skull

*Figure 2: This six-year-old boy shows normal convolutional markings during the period of rapid brain growth. Note that the sutures (arrow) are visible and normal and that there are no changes involving the sella turcica (open arrow).*

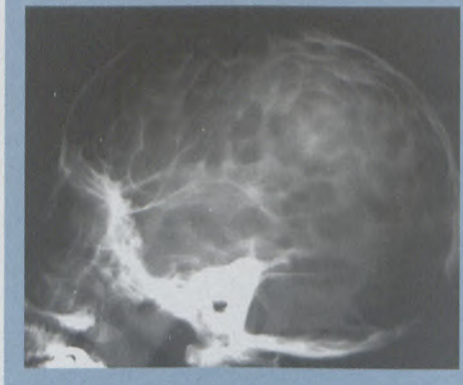

*Figure 3: This six-year-old boy shows accentuation of convolutional markings of a silver/copper-beaten skull. The sagittal (not shown on this radiograph) and coronal sutures are completely fused, in keeping with craniosynostosis. The sellar demineralisation is in keeping with the resultant chronically raised ICP.*

This terminology is used when there are deep or accentuated convolutional markings in long-standing severely raised ICP (Figure 3). Such markings are not present at birth and do not occur before two months of age. Associated with this are features of raised ICP such as sutural diastasis and/or sellar demineralisation. The sutural changes are more common in younger children, while the sellar changes occur more commonly in older children. The copper-beaten

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skull is most marked when multiple sutures are fused, as occurs in primary craniosynostosis.[2,3]

## Conclusion

The differentiation of oval skull lucencies seen on children's SXRs can be undertaken by assessing the age of the child, clinical features and associated SXR findings (Tables 1 and 2).

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**Table 1: Differentiation of lucent oval skull markings based on the age of the child**

| Present at birth but disappear by 6 months of age | Usually appear after 1st year of life and disappear by 8 years of age. Most marked between 2 and 7 years of age | Occur in later childhood and adolescence (usually after 10 years of age) |
|---|---|---|
| Lückenschadel | Normal convolutional markings | Accentuated abnormal convolutional markings (copper-beaten skull) |

**Table 2: Differentiation of lucent oval skull markings in children**

| Associated with spinal dysraphism | Normal sutures are easily visible and not prematurely closed. Normal pituitary fossa. No clinical features of raised intracranial pressure. | Associated with craniosynostosis. Clinical and radiological features of raised intracranial pressure such as pituitary sella demineralisation and sometimes sutural diastasis |
|---|---|---|
| Lückenschadel | Normal convolutional markings | Accentuated abnormal convolutional markings (copper-beaten skull) |