



Rupture or traumatic dislocation of cranial suture on infants, involvement of the lambdoidal accessory bones (Wormian bones): case presentation and analysis

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Abstract

Background Sutural or Wormian bones are accessory bones of genetic and hereditary relevance, considered as ethnic and anatomical variables. Recently, they have been related to a certain type of congenital alterations such as osteogenesis imperfecta; however, there is no description in the literature of their involvement in skull fractures in infants.

Case presentation We present a case of a male patient aged 15 months who suffered a fall from the stairs of his home approximately 6 h before arrival in the emergency room. This fall of approximately 1 m in height and with an area of direct impact on the right occipito-parietal region with no apparent loss of consciousness. At admission, with a Glasgow of 14 for irritability with subgaleal hematoma and cranial endostosis on occipitoparietal region, no more neurological signs were present. A CT scan of the skull was performed showing an occipital-parietal discontinuity at the lambdoid suture, and the scan also showed that a displacement occurred below the thickness of the adjacent bone. In addition, radiographic evidence showed a high possibility of dural penetration and an area of adjacent hemorrhagic contusion. Due to these findings, a surgical approach was decided upon. The findings in the surgical procedure were a complete dislocation (rupture) of lambdoidal cranial suture on the occipital border of the accessory bone (Wormian bone) with dura mater tear on the rupture tracing. A craniotomy was performed with dural plasty without eventualities. Forty-eight hours after surgery, he was discharged home in a stable neurologic condition.

Conclusions The present report shows the implications of approaching this type of injury, which can be confused as a depressed skull fracture. There is no description in the literature of a sutural rupture associated with Wormian bones.

Keywords Depressed skull fracture · Wormian bones · Rupture/dislocation of cranial suture · Accessory cranial bones

Introduction

Sutural or Wormian bones are accessory bones of genetic and hereditary importance, considered as ethnic and anatomical variables. Recently, they have been related to certain congenital alterations like osteogenesis imperfecta as well as in the differential diagnosis of non-accidental trauma in cases of

cranial fractures of unknown origin. On the other hand, there is no description in literature mentioning Wormian bones and sutures as a different mechanism of intracranial injury in cranial trauma. The present article describes the case of an infant who suffered from head trauma and displacement of one of the bony edges below the internal table through the lambdoid suture with extensive injury of the underlying dura mater. The implication of the mechanical effect hinge type of the accessory bones and the cut in shear by the sutural rupture in one of its edges are analyzed.

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Background

Sutural or Wormian bones are accessory bones of genetic and hereditary importance, considered as ethnic variables [1–3, 6, 7]. They are characterized for being diverse in

number, size and shape, located in sutures and fontanel, preferably in posterior sutures, predominating at the level of lambdoidea or parieto-occipital suture [2–5, 8, 11–13].

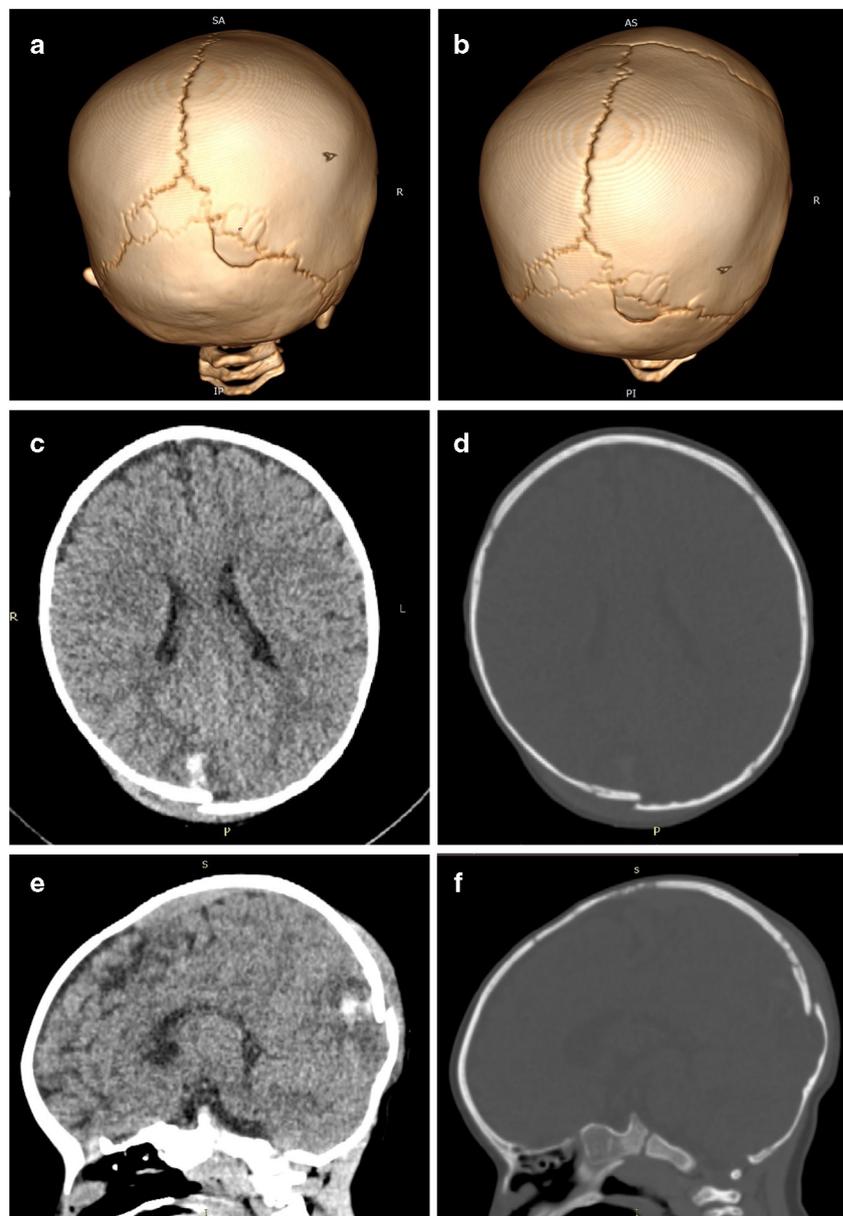
Recently, these Wormian bones have been related to certain types of diseases in patients with bone dysplasia, such as cleidocranial dysostosis, pycnodysostosis, and other anomalies, for example, congenital hypothyroidism, rickets, alterations in the absorption of copper, and osteogenesis imperfecta [7, 9]. Especially, however, osteogenesis imperfecta is related to specific pathologies where the search for Wormian bones is an important step in radiographic research performed for unexplained fracture(s) in children, in order to be able to clarify if the

child has been subject to physical abuse or he/she has brittle bones [7].

The relationship of Wormian bones with alterations of neurological development and/or deficit, mentioned in literature, is still under discussion [7].

As far as we know, no cases have been described in the literature that associate the rupture of sutures with Wormian bones and a traumatic injury. We can highlight only one case that has revealed similarities between a traumatic injury and an orifice of a Wormian bone. The emphasis here was on the differential diagnosis during routine anthropological examinations of the skull of a young man who died from a cranial injury caused by a firearm [10].

Fig. 1 **a, b** Posterior view of the initial (preoperative) 3D CT scan reconstruction that shows the irregular linear sutural rupture and the depressed fragment of the Wormian bond on the right side. **c, e** CT scan: parenchymal occipital right side hemorrhagic contusion under sutural rupture and depressed Wormian bond. **d, f** Sutural rupture and depressed Wormian bond shown on the bone windows CT scan



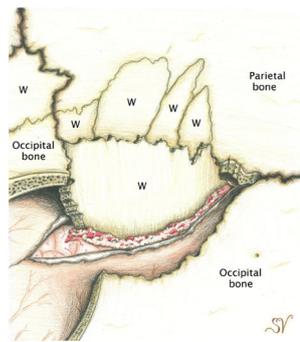


Fig. 2 Illustrating the rupture-luxation of the right side lambdoidal suture with occipital border of the Wormian bone depressed and it stands attached on the parietal border; the dura mater tear on the rupture tracing with the parenchymal hemorrhagic injury and the adjacent Wormian bones (W)

Case presentation

A 15-month-old male was brought to the Pediatric Emergency Unit due to a fall of approximately 1 m in height from the stairs of his home, causing head trauma in the right parieto-occipital region. The relatives reported that he cried immediately after the fall, without registering a loss of consciousness, as well as having presented vomiting of alimentary content three times during the transfer to the hospital. At admission, the infant is well hydrated; with a GCS of 14 points for irritability and crying (M6, V4, O4, Glasgow coma scale adapted to his age); at the inspection site, a traumatic contusion was observed in the right parieto-occipital region with a subgaleal hematoma formation, where the central zone is softened by cranial endostosis. The patient did not present focal neurological signs or alteration of the cranial pairs.

A simple cranial computed tomography study was performed with 3D reconstruction in which an irregular tract of approximately 5 cm in length was shown at the level of the right parieto-occipital junction. The lesion was in an arcuate form with convexity towards the occipital region. The region is joined at the ends to the lambdoidal suture line in its parasagittal and middle thirds. This area has a

displacement below the thickness of the adjacent bone, and radiographic evidence demonstrates a high possibility of dural penetration. In the parenchyma, there is a small area of cortical-subcortical hemorrhagic contusion below the site of the described bone injury, with no mass effect (Fig. 1).

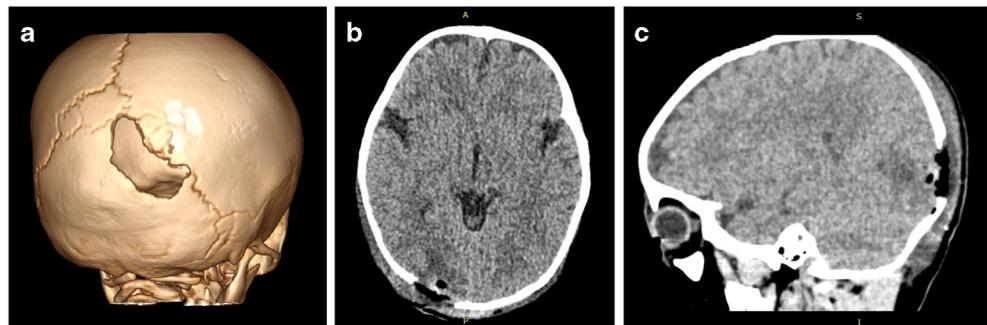
The patient was operated on and a trans-sutural bone fragment depression of < 5 mm was found on the occipital borderline. The bone fragment was attached to the end of the of the parietal suture line, mimicking a hinge-type mechanism. When attempting to remove the bone fragment through a trephine, an exit of encephalic material was observed (Fig. 2). The trephine was enlarged with a craniectomy following the tracing of the dura mater, thus exposing an irregular linear path corresponding to the sutural separation trace of the bone fragment or Wormian bone of approximately 3.5 cm in length. Through the dural opening, the area of hemorrhagic contusion of the cerebral parenchyma was observed. Prior to the closure of the dura, the removal of the hematoma and hemostasis of bleeding cortical vessels was done above the traumatic contusion area. At the end of the dura mater closure, the galea was placed and a bone defect zone corresponding to a craniectomy of approximately 5 cm in length and 3 cm in width was left. At the end of the procedure, the skin was closed with suture.

The patient was discharged from the hospital to his home 48 h after surgery due to improvement, with good evolution, and no neurological deficits (Fig. 3).

Discussion

The developing skull, its bones, sutures, and fontanels, can act as a specific mechanism to counteract the force(s) exerted by trauma or accident. The present case shows how a structure of solid consistency (accessory bone), when it is affected by a direct and focal force, can cause the rupture of one of its edges and keep the opposite edge attached, forming a hinge axis of movement, and thus causing a shearing mechanism at the rupture edge with

Fig. 3 a Posterior view of the 3D CT scan reconstruction that shows an occipital craniectomy over the right side of the lambdoidal suture affected. b, c Post-surgical changes and without hemorrhagic contusion on axial and sagittal CT scan views



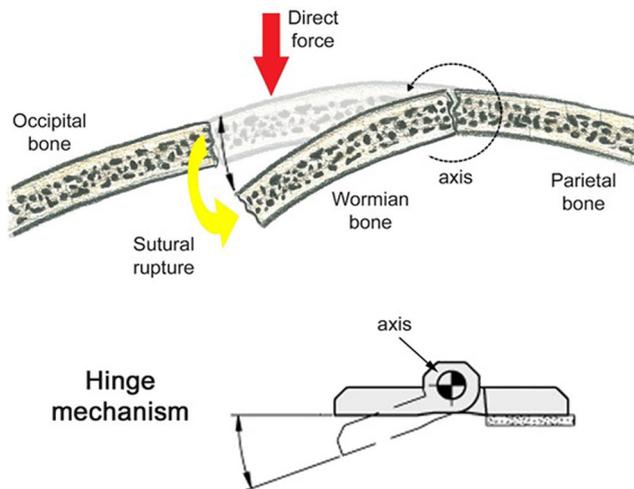


Fig. 4 Hinge mechanism

extensive involvement of the underlying dura and the cerebral parenchyma (Fig. 4). It is important to keep this mechanism in mind, in which no bone fracture is observed. However, a bone sinking and an irregular linear trace over the border of one of the margins of union of the sutural bone are seen. In this case, it is with the occipital bone, differentiating between a simple sinking fracture and the rupture of the suture of one of the margins of the Wormian bone. Considering above, the management would be suggested, not to make a trephine and lift, but to perform a craniotomy that covers the entire path of the sutural rupture to see the extent of the dural tear.

Although the present report makes the considerations for the skull of developing infants, it can also be kept in mind for other cases with similar dynamics and mechanics, in which the hinge and shear mechanism is presumed.

Conclusions

There is currently no description in the literature of cases of sutural rupture associated with Wormian bones, where the etiological studies and treatment implications should be addressed in a broader way to optimize the diagnostic process that allows adequate and integral management of possible underlying causes.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

The present report shows the implications of a surgical approach to this type of injury, which could be misinterpreted as a depressed skull fracture, as well as a description of the mechanics of trauma in these cases.

References

1. Braga MTT, Gabrielli C, De Souza A, Rodrigues CFS, Marino JC (2000) Sutural bones in the pterion. *Rev Chil Anat* 18(1):7–101. <https://doi.org/10.4067/S0716-9868200000100013>
2. Figún ME, Garino RR (1992) *Anatomía Odontológica funcional y aplicada*, 2nd edn. El Ateneo, Buenos Aires, pp 15
3. García Hernández F, Murphy Echeverría GT (2009) Frecuencia de hueso lambdoideo en cráneos con deformación artificial en el norte de Chile. *Int J Morphol* 27(3):933–938. <https://doi.org/10.4067/S0717-95022009000300046>
4. Henríquez Pino J, Buarque LC, Prates JC (1992) Anatomical study of sutural bones in 200 Brazilian individual's skulls. *Rev Chil Anat* 10(2):89–95
5. Kahle W, Leonhardt H, Platzer W (1977) *Atlas de Anatomía para estudiantes y médicos*, 1st edn. Omega, Barcelona
6. Lips W, García Hernández F (1983) Estudios comparativos de la presencia de huesos wormianos en cráneos indígenas y su comparación con otras muestras poblacionales de Chile. *Anal. Anat. Normal*, 1:95–9
7. Marti B, Sirinelli L, Maurin L, Carpentier E (2013) Wormian bones in a general paediatric population. *Diagn Interv Imaging* 94:428–432. <https://doi.org/10.1016/j.diii.2013.01.001>
8. Ossenberg NS (1970) The influence of artificial cranial deformation of Wormian bones. *Am J Phys Anthropol* 33:375–382. <https://doi.org/10.1002/ajpa.1330330310>
9. Pérez Marruecos E, Iturre de Aguirre L, Obeid Pedemonte R, Varela A, Romano S (2004) Enfermedad de Menkes. *Arh Argent Dermatol* 54:57–63
10. Salles Machado MP, Pereira Simoes M, de Oliveira Gamba T et al (2016) A Wormian bone, mimicking an entry gunshot wound of the skull, in an anthropological specimen. *J Forensic Sci* 61(3):855–857. <https://doi.org/10.1111/1556-4029.13043>
11. Sánchez Lara PA, Graham Jr. JM, Hing AV, Lee J, Cunningham M (2004) The morphogenesis of Wormian bones: a study of cranio-synostosis and purposeful cranial deformation. *Am J Phys Anthropol* 123(2):146–155. <https://doi.org/10.1002/ajmg.a.32073>
12. Sappey PHC (1867) *Traité d'Anatomie Descriptive*, 4th edn. Adrien Delahaye et Emile Lecroisner Editeur, Paris, p 161
13. Sicher (1965) *Oral Anatomy*, 4th edn. Mosby, Saint Louis

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