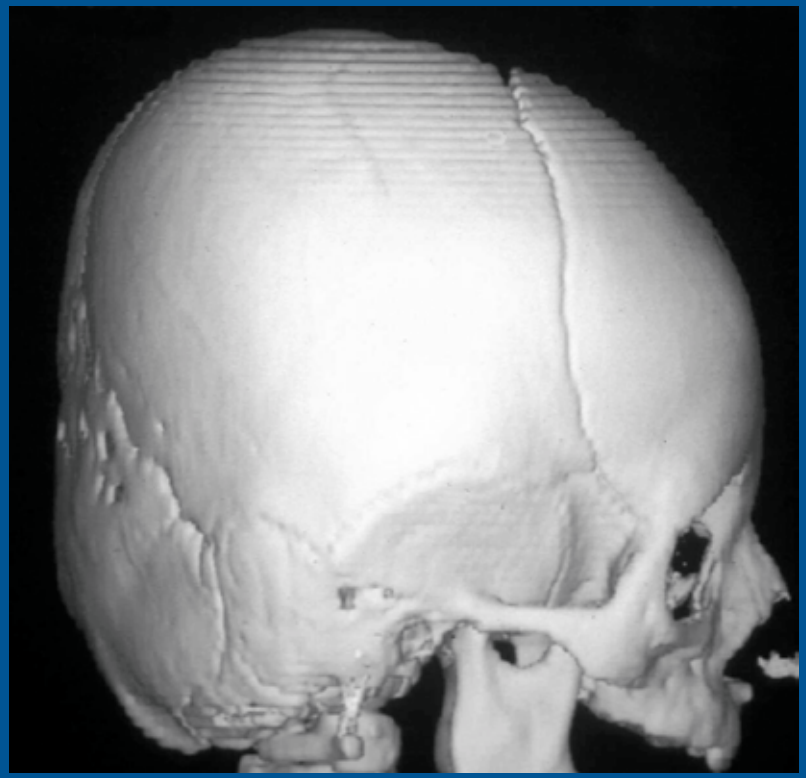
Skull Deformity: Radiographic Diagnosis of "Sticky Suture" in Occipital Plagiocephaly

J. E. Losee,[1] P.-L. Westesson,[2] M. Ketkar,[2] D. Singh,[3] R. E. Kirschner,[3] and S. P. Bartlett[3]

[1]The Children's Hospital of Pittsburgh, PA, USA,
[2]University of Rochester School of Medicine & Dentistry, Rochester, NY, USA,
[3]Children's Hospital of Philadelphia, PA, USA

"Back-to-Sleep"

Since 1992 when the AAP suggested supine sleep position, the incidence of Occipital Plagiocephaly has dramatically risen.



Occipital Plagiocephaly: OC

OC may result from either:

- Non-synostotic occipital plagiocephaly (NSOP)
  - positional molding
  - deformational plagiocephaly
- Lambdoid craniosynostosis (LC)
  - posterior synostotic plagiocephaly

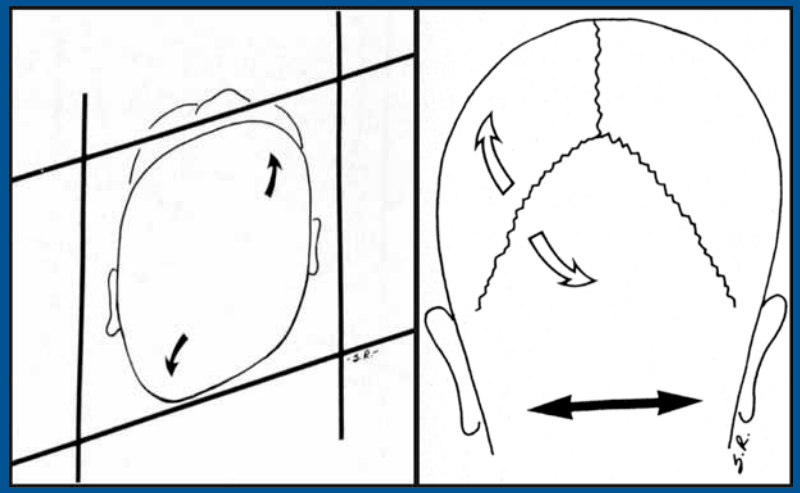
Occipital Plagiocephaly: Diagnosis

- Historically controversial
- LC thought to be unique: characteristic radiographic findings not necessary for diagnosis
- Lambdoid suture described as functionally fused or "sticky-suture"

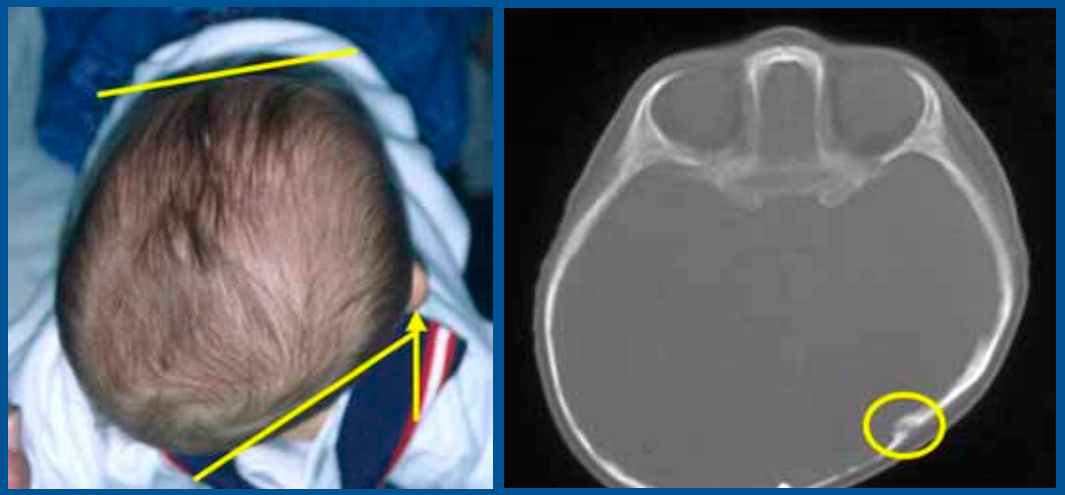
Occipital Plagiocephaly

- Recent clinical criteria for diagnosis NSOP and LC have been delineated
- However radiographic differentiation is obscure

NSOP: Clinical Exam

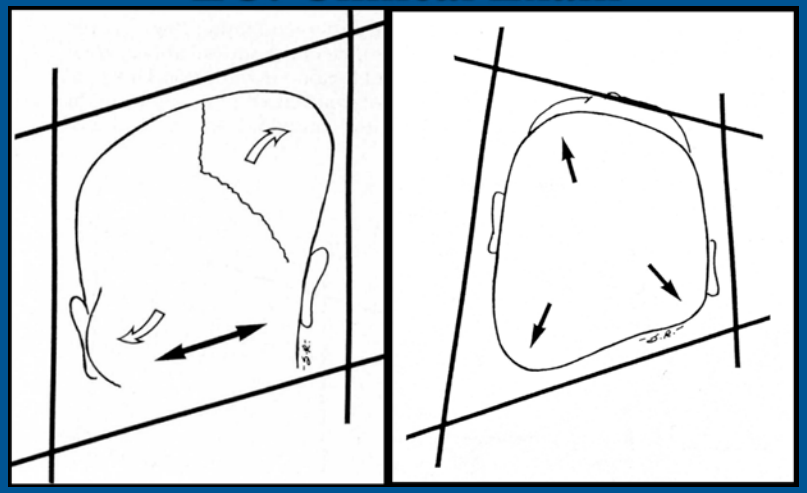


Clinically NSOP presents with a parallelogram shaped vertex cranial morphology and a symmetric mastoid skull base.

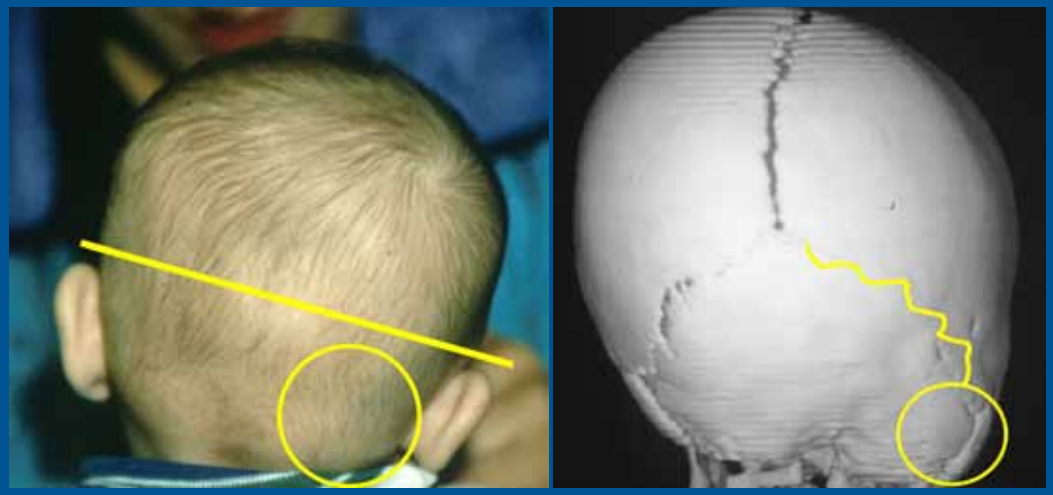


As seen in this clinical case, with an abnormal, however patent and non-fused lambdoid suture.

LC: Clinical Exam



Clinically LC presents with a trapezoid shaped vertex cranial morphology with ipsilateral mastoid skull base bossing.



As illustrated in this clinical case of right sided LC.

Aim of the study

- To characterize changes of lambdoid suture in NSOP
- To establish radiographic criteria for NSOP
- To compare affected sutures in NSOP and LC

Methods

- CT scans children clinically diagnosed with NSOP and LC were evaluated by both Neuroradiologist and Craniofacial Surgeon to compare:
  - lambdoid suture
  - cranial morphology
  - ear position
  - endocranial base angles
- Statistical analysis was performed

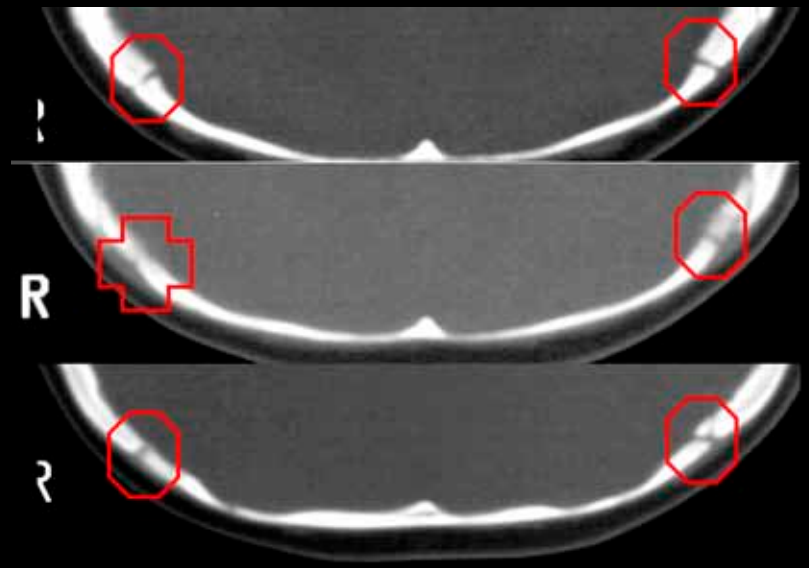
Methods

- CT scans of 26 children with NSOP
  - 18 male, 8 female
  - 12 right side, 8 left side, 6 bilateral
- 7 children diagnosed with LC
  - 5 male, 2 female
  - 4 left side, 3 right side
- 32 sutures of NSOP and 7 sutures LC were compared

Sutures of NSOP evaluated for

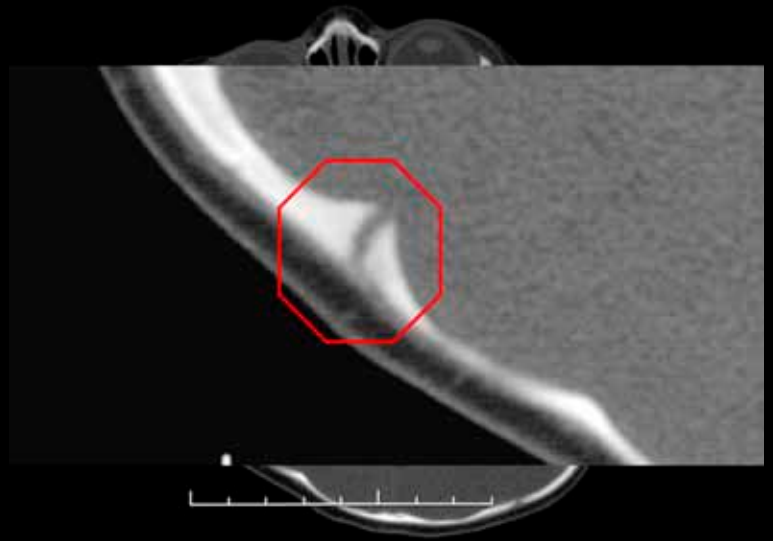
- focal fusion
- endocranial heaping/ridging
- narrowing
- perisutural thining
- sclerosis
- change in orientation: overlapping to end-to-end and were

Compared to sutures of LC (p values)



NSOP
Focal-Skip Fusion:
25% (p=0.308)

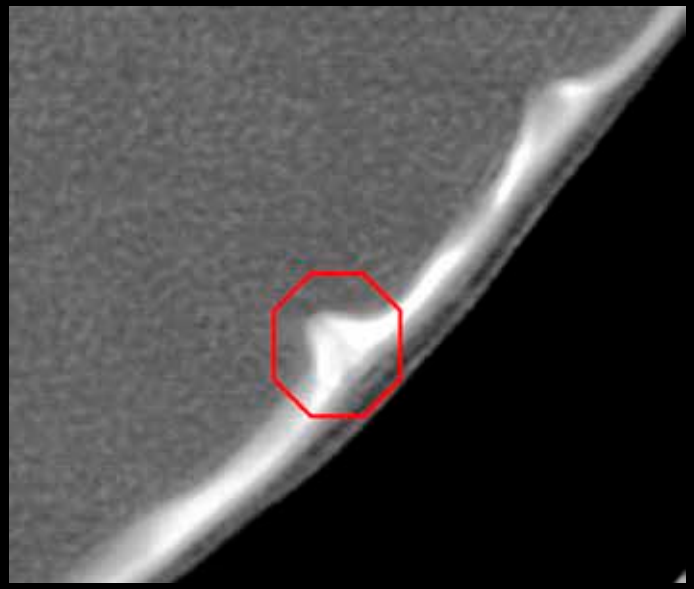
NSOP sutures demonstrated areas of skip fusion 25% of the time.

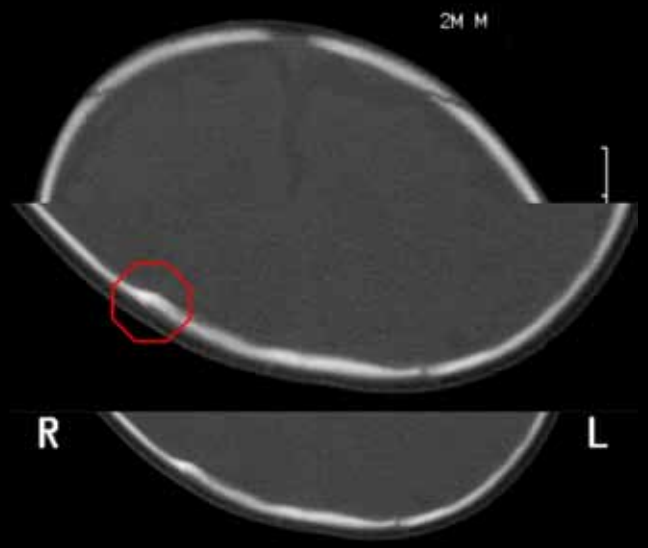


NSOP
Endocranial Heaping:
78% (p=0.313)

Ectocranial Heaping:
0% (p=<0.001)

No ectocranial heaping was noted in NSOP.



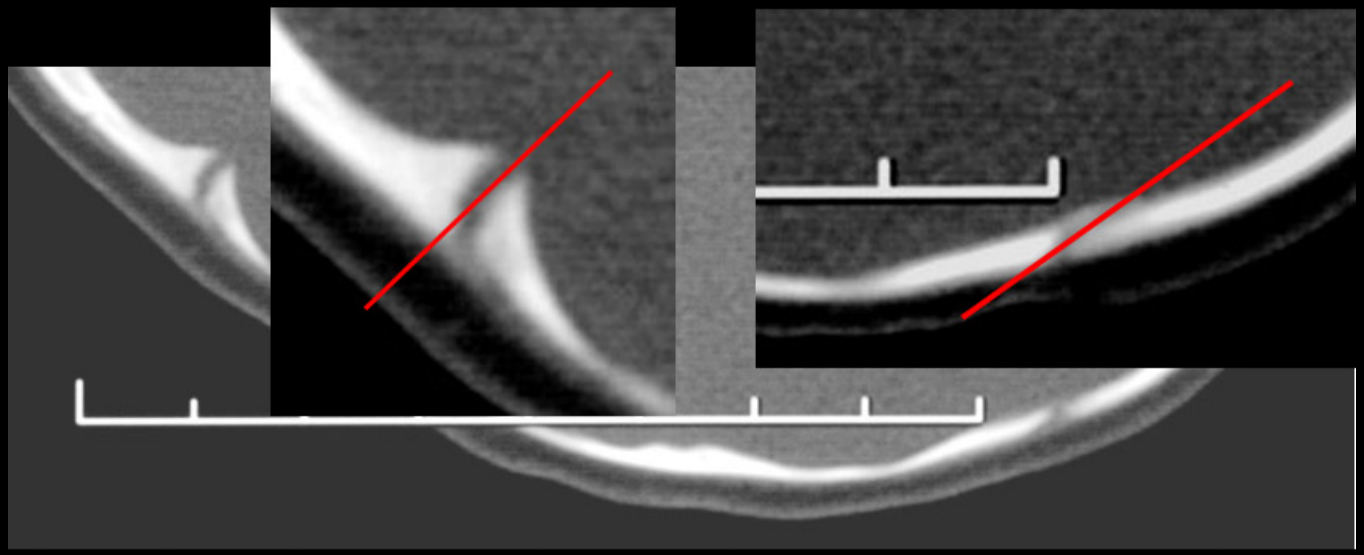


NSOP Suture Narrowing: 63% (p=0.008)

NSOP sutures demonstrated sutural narrowing in 63% of cases.

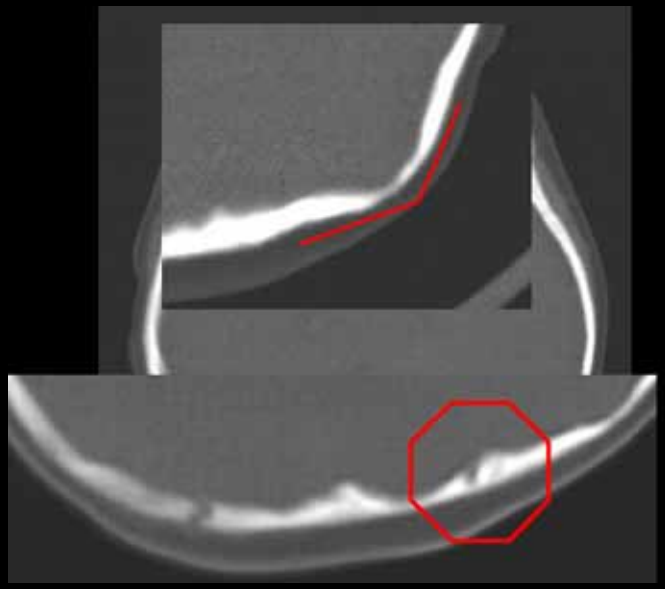
NSOP Sclerosis: 16% (p=0.319)

Sutural sclerosis was noted in 16% cases.



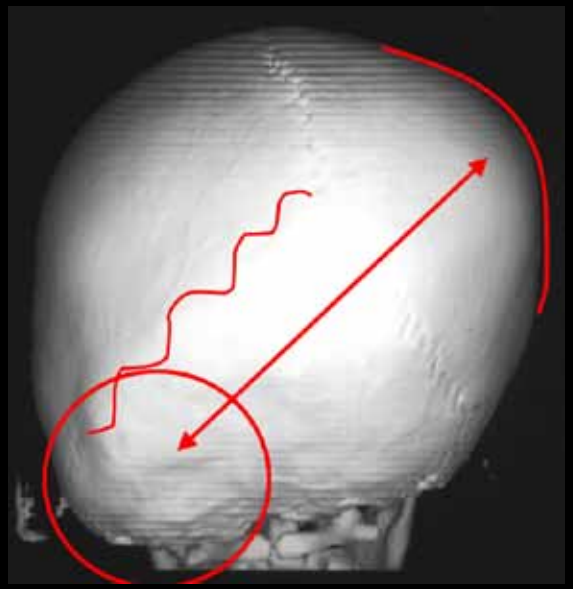
NSOP Change in Suture Orientation: 63% (p=0.001)

Sutures of NSOP demonstrated a change in suture orientation from overlapping to end-to-end morphology.



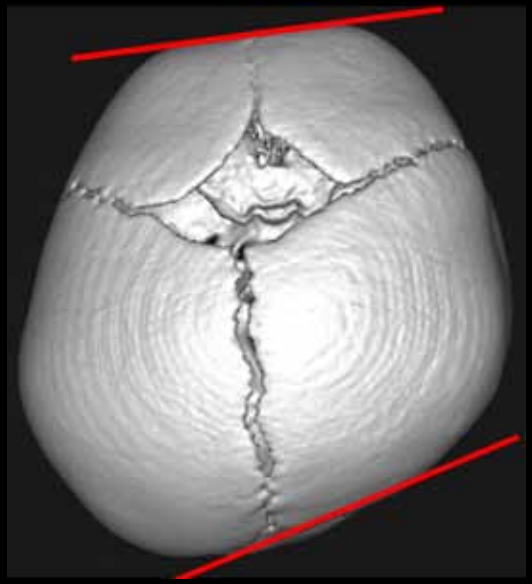
Suture Morphology: LC

- Near complete obliteration: 100% (p=<0.001)
- Endocranial heaping: 100% (p=0.313)
- Ectocranial heaping: 100% (p=0.001)



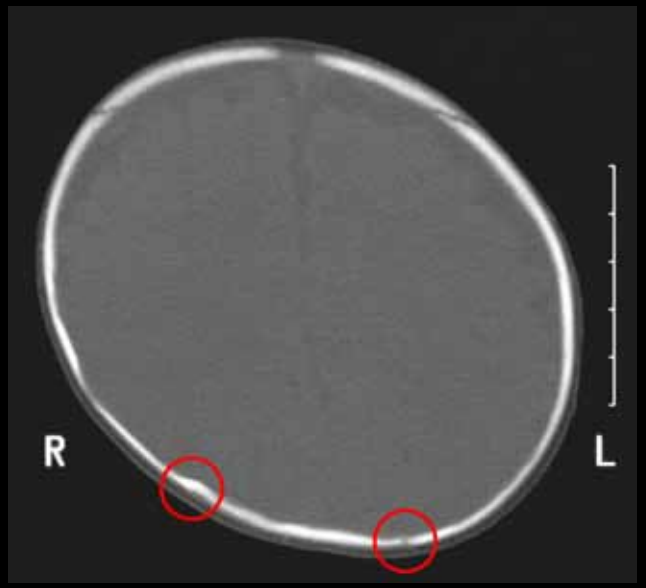
Cranial Morphology: LC

- Ipsilateral occipital flattening: 100%
- Compensatory ipsilateral mastoid bossing: 100% (p=<0.001)
- Contralateral parietal bossing: 100% (p=0.003)
- Trapezoid vertex morphology



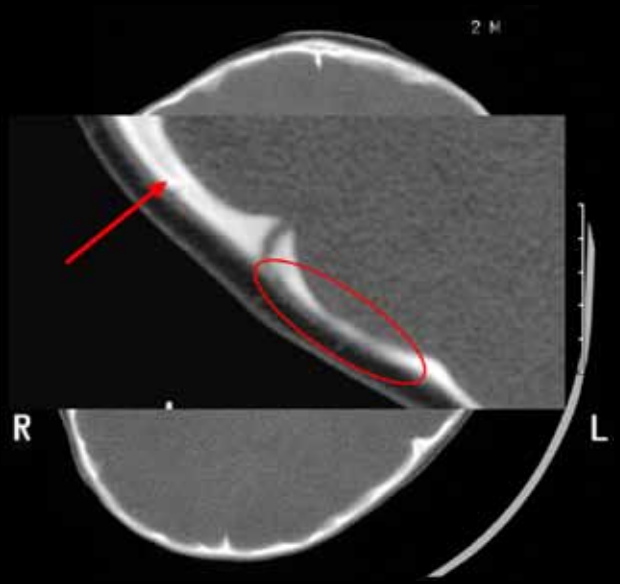
Cranial Morphology: NSOP

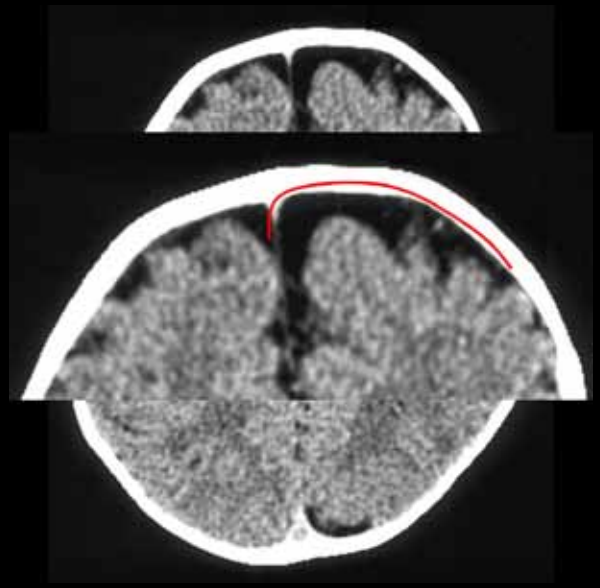
- Ipsilateral occipital flattening in all cases: 100%
- Ipsilateral frontal bossing: 85% (p=0.012)
- Contralateral occipital bossing: 95% (p=0.003)



Suture Morphology: NSOP

- Comparing affected to contra-lateral non-affected "control" suture
- Significant difference (p<0.05):
  - overlapping
  - endocranial ridging/heaping
  - perisutural bone thinning

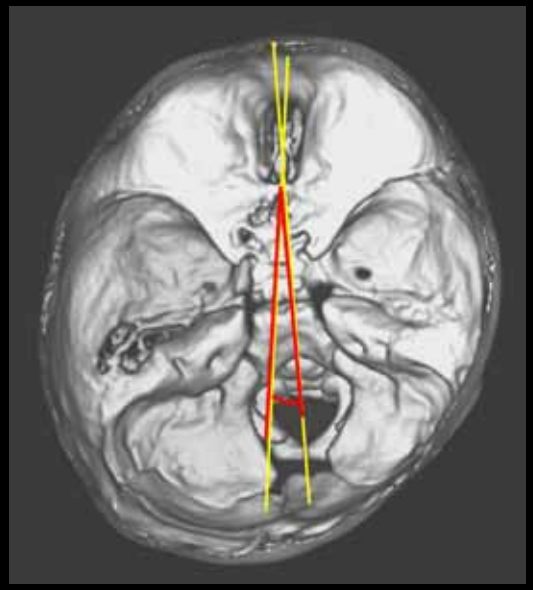




NSOP Perisutural Thinning: 78% (p=0.313)

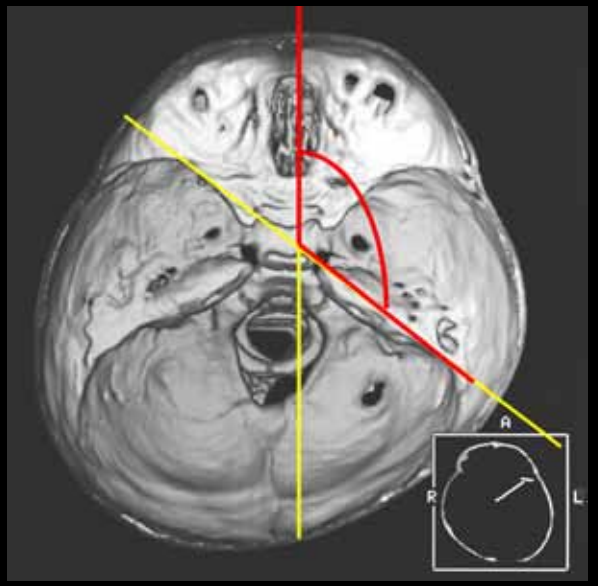
Subarachnoid Spacing: 47%

Ipsilateral increase in sub-arachnoid spacing was noted in 47% of NSOP and in no cases of OP.



Midline Cranial Base Deviation Angle

- Significant difference was found
- LC: Angles were greater and represented a larger deviation from
- mid sagittal cranial base axis
  - average 10.3^0 (range $0\text{-}15^0$)
- NSOP
  - average 4.1^0 (range $0\text{-}9^0$)
- p=0.02



Petrus Ridge Angle

- Significant difference between affected and non affected side also between the affected sides in NSOP and LC
- NSOP
  - affected: av. 121.8^0 (range $117\text{-}127^0$)
  - non-affected: av. 125.8^0 (range $117\text{-}134^0$)
  - p=0.0016
- LC
  - affected: av. 115.7^0 (range $112\text{-}120^0$)
  - non-affected: av. 132^0 (range $128\text{-}140^0$)
  - p=0.0156
- NSOP vs. LC
  - p=0.0039

Ear Position

- Vertex view
- LC
  - -anterior 14%
  - -symmetric 86%
- NSOP
  - -anterior 85%
  - -symmetric 15%

Conclusions

- Cranial sutures
  - Open - infants
  - Closed - adults
  - Obliterated - craniosynostosis (not prematurely fused)
  - Deformed or "sticky" - non-synostotic plagiocephaly

Conclusion: Radiographic Diagnosis

- Changes in lamboid suture previously considered to be LC:
  - endocranial heaping
  - focal fusions
  - sutural narrowing
  - perisutural thinning
  - Sclerosis
- LC not unique among craniosynostosis:
  - suture obliteration
  - compensatory bossing