NON-SYNOSTOTIC OCCIPITAL PLAGIOCEPHALY: Radiographic Changes of the “Sticky-Suture”

Manoj Ketkar, MD, Joseph E. Losse, MD, Scott P. Bartlett, MD, Evan Feldman, BS, Richard E. Kirschner, MD, Davinder Singh, MD, and Per-Lennart Westesson, MD, PhD, DDS

1University of Rochester, Children’s Hospital at Strong, Rochester, NY
2University of Pennsylvania, Children’s Hospital of Philadelphia, Philadelphia, PA

“Back-to-Sleep”

Since 1994, when the AAP recommended that infants sleep in a supine position, the incidence of Occipital Plagiocephaly has dramatically increased.

**Occipital Plagiocephaly: OP**

OP may result from either:
- Non-synostotic occipital plagiocephaly (NSOP): positional molded
- Deformational plagiocephaly
- Landolt occipital synostosis (LO): posterior synostotic plagiocephaly

**OP: Diagnosis**

- **Hisotologically confirmed:**
  - **OP:** thought to be a unique characteristic of plagiocephaly not necessary for diagnosis
  - **Non-affected:** described as functionally fused or “sticky sutures”

**OP: Radiological Diagnosis**

- Recent clinical criteria for diagnosis NSOP and LC have been debated
- However, radiographic differentiation is elusive

**Materials and Methods**

- CT scans children clinically diagnosed with NSOP and LC were evaluated by both neuroradiologists and landolt surgeons to compare:
  - Landolt suture curvature
  - Convexity morphology
  - Concave regions
  - Remodeling base angulations
- Statistical analysis was performed:
  - CT scans of 33 children with NSOP (18 male, 15 female)
  - 13 right-sided, 10 left-sided, 14 bilateral
  - 14 cases diagnosed with LC
  - 1 male, 2 female
  - 9 right side, 8 left side
- All sutures of NSOP and 7 sutures of LC were compared

**Sutures of NSOP evaluated for**

- Landolt
- Endocranial abutment/occlusion
- Postnatal remodeling
- Occlusion
- Change in orientation/overlapping in mid-cranial and base
  - Compared to suture of LC (no change)

**Aim of the study**

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

**NSOP: Clinical Exam**

Clinical NSOP presents with a palpable, irregular occipital crest and asymmetrical mandibular base.

**Materials and Methods**

- CT scans children clinically diagnosed with NSOP and LC were evaluated by both neuroradiologists and landolt surgeons to compare:
  - Landolt suture curvature
  - Convexity morphology
  - Concave regions
  - Remodeling base angulations
- Statistical analysis was performed:
  - CT scans of 33 children with NSOP (18 male, 13 female)
  - 13 right-sided, 10 left-sided, 14 bilateral
  - 14 cases diagnosed with LC
  - 1 male, 2 female
  - 9 right side, 8 left side
- All sutures of NSOP and 7 sutures of LC were compared

**Sutures of NSOP evaluated for**

- Landolt
- Endocranial abutment/occlusion
- Postnatal remodeling
- Occlusion
- Change in orientation/overlapping in mid-cranial and base
  - Compared to suture of LC (no change)

**NSOP: Clinical Exam**

Clinical LC presents with a palpable, irregular occipital crest and asymmetrical mandibular base.

**Clinical**

- No characteristic changes of lambdoid sutures in NSOP
- To establish radiographic criteria for NSOP
- To compare affected sutures in NSOP and LC

**Materials and Methods**

- CT scans children clinically diagnosed with NSOP and LC were evaluated by both neuroradiologists and landolt surgeons to compare:
  - Lambdoid suture curvature
  - Convexity morphology
  - Concave regions
  - Remodeling base angulations
- Statistical analysis was performed:
  - CT scans of 33 children with NSOP (18 male, 25 female)
  - 13 right-sided, 10 left-sided, 14 bilateral
  - 14 cases diagnosed with LC
  - 1 male, 2 female
  - 9 right side, 8 left side
- All sutures of NSOP and 7 sutures of LC were compared

**Sutures of NSOP evaluated for**

- Lambdoid
- Endocranial abutment/occlusion
- Postnatal remodeling
- Occlusion
- Change in orientation/overlapping in mid-cranial and base
  - Compared to suture of LC (no change)

**Conclusions**

- Cranial sutures:
  - **Open:** fat pad
  - **Closed:** deciduous
- Deformational: remodeling (not prematurely fused)
- Ommatization: “sticky” non-synostotic plagiocephaly
- Changes in lambdoid sutures previously considered in the LC:
  - Postnatal remodeling
  - Cranial: open/closed
  - **Closed:** deciduous
  - Deformational: remodeling (not prematurely fused)

**Midline Cranial Base Deviation Angle**

- Significant differences between affected and non-affected side determined by affected side in NSOP and LC
- NSOP:
  - Yeold (the affected side) 112.8°
  - Yeold (the non-affected side) 154.0°
  - p < 0.001

**Petrus Ridge Angle**

- Significant differences between affected and non-affected side determined by affected side in NSOP and LC
- NSOP:
  - Yeold (the affected side) 11.2°
  - Yeold (the non-affected side) 11.6°
  - p = 0.068

**Ear Position**

- Yeold (the affected side) 16.4°
- Yeold (the non-affected side) 15.8°
- p = 0.05

**Sutures Morphology: NSOP**

- Comparing affected to contralateral non-affected plagiocephaly/craniotomy
- Significant difference (p < 0.001)
- Enlarged clival winging/bulging
- Postnatal remodeling

**Cranial Morphology: NSOP**

- Contralateral occipital flattening in all cases (not)
- Postnatal remodeling
- Basilar flattening

**Midline Cranial Base Deviation Angle**

- Significant differences between affected and non-affected side determined by affected side in NSOP and LC
- NSOP:
  - Yeold (the affected side) 112.8°
  - Yeold (the non-affected side) 154.0°
  - p < 0.001

**Petrus Ridge Angle**

- Significant differences between affected and non-affected side determined by affected side in NSOP and LC
- NSOP:
  - Yeold (the affected side) 11.2°
  - Yeold (the non-affected side) 11.6°
  - p = 0.068

**Ear Position**

- Yeold (the affected side) 16.4°
- Yeold (the non-affected side) 15.8°
- p = 0.05

**Sutures Morphology: LC**

- Comparing affected to contralateral non-affected plagiocephaly/craniotomy
- Significant difference (p < 0.001)
- Enlarged clival winging/bulging
- Postnatal remodeling

**Cranial Morphology: LC**

- Contralateral occipital flattening in all cases (not)
- Postnatal remodeling
- Basilar flattening
- Compensatory remodeling

**Conclusions**

- Cranial sutures:
  - **Open:** fat pad
  - **Closed:** deciduous
- Deformational: remodeling (not prematurely fused)
- Ommatization: “sticky” non-synostotic plagiocephaly
- Changes in lambdoid sutures previously considered in the LC:
  - Postnatal remodeling
  - Cranial: open/closed
  - **Closed:** deciduous
  - Deformational: remodeling (not prematurely fused)

**Non-Synostotic Occipital Plagiocephaly:**

- Clinical Diagnosis
- Radiographic Changes of the “Sticky-Suture”
- Materials and Methods
- Aims of the Study
- Sutures of NSOP evaluated for
- Sutures of LC evaluated for
- Conclusions

**Radiographic Changes of the “Sticky-Suture”**

- Comparison to Affected Suture
- Postnatal Remodeling
- Enlarged Clival Winging/Bulging
- Postnatal Remodeling

**Midline Cranial Base Deviation Angle**

- Yeold (the affected side) 112.8°
- Yeold (the non-affected side) 154.0°
- p < 0.001

**Petrus Ridge Angle**

- Yeold (the affected side) 11.2°
- Yeold (the non-affected side) 11.6°
- p = 0.068

**Ear Position**

- Yeold (the affected side) 16.4°
- Yeold (the non-affected side) 15.8°
- p = 0.05

**Sutures Morphology: NSOP**

- Yeold (the affected side) 11.2°
- Yeold (the non-affected side) 11.6°
- p = 0.068

**Cranial Morphology: NSOP**

- Yeold (the affected side) 112.8°
- Yeold (the non-affected side) 154.0°
- p < 0.001

**Conclusions**

- Cranial sutures:
  - **Open:** fat pad
  - **Closed:** deciduous
- Deformational: remodeling (not prematurely fused)
  - Ommatization: “sticky” non-synostotic plagiocephaly
  - Changes in lambdoid sutures previously considered in the LC:
    - Postnatal remodeling
    - Cranial: open/closed
    - **Closed:** deciduous
    - Deformational: remodeling (not prematurely fused)
  - LC is not unique among craniofacial
    - Compensatory remodeling