Deformational Brachycephaly: The Clinical Utility of Cranial Index
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Disclosures

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• The other authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper. The authors have no personal or institutional financial interest in drugs, materials, or devices described in their submissions.
Brachycephaly is a symmetric flattening of the occiput due to external force on the skull\(^1\).

Rise in infant brachycephaly has been noted since the American Academy of Pediatrics recommended for infants to sleep supine\(^2\).

The Cranial Index (CI) is defined as (cephalic width/cephalic length) x100 and is used to quantify degree of brachycephaly deformation\(^3\).

Brachycephaly prevalence and evolution of the pediatric skull with respect to time is not well understood.

Purpose: Investigate CI with respect to age within the first two years of life.

Figure 1. Comparison of skull with absence of brachycephaly (Left), to skull with brachycephaly present (Right)

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Methods

- Cross-sectional review of 1,499 non-contrast CT scans at Monroe Carell Jr. Children’s Hospital at Vanderbilt (MCJCHV) between Jan. 1, 2018 and Dec. 31, 2018, for children evaluated for trauma, but with a (-) scan.
- Patients were grouped on the basis of age: 0-12 months, 13-24 months, and then greater than 24 months.
- Cranial Index (CI) was calculated using non-contrasted Computed Tomography (CT) at the lateral most point of the parietal bone (cephalic width), and from the glabella to opisthocranion (cephalic length).
- ANOVA was used to compare CI between age groups, and a scatterplot with linear regression was graphed to determine relationship between age in months and CI.

Figure 2. Graphical representation of CI calculation
Results

- Total cohort: 1,499 patients
- Mean age: 6.8 years
- Mean CI: 82.6
- Male predominance (56.8%)
- White/Caucasian predominance (67.2%)
- Not Hispanic, Latin American predominance (78.8%)

<table>
<thead>
<tr>
<th>Gender</th>
<th>N (%)</th>
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<tbody>
<tr>
<td>Male</td>
<td>851 (56.8%)</td>
</tr>
<tr>
<td>Female</td>
<td>648 (43.2%)</td>
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<table>
<thead>
<tr>
<th>Race</th>
<th>N (%)</th>
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<tbody>
<tr>
<td>White/Caucasian</td>
<td>1007 (67.2%)</td>
</tr>
<tr>
<td>Black/African American</td>
<td>248 (16.5%)</td>
</tr>
<tr>
<td>Asian/Indian</td>
<td>24 (1.5%)</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>6 (0.4%)</td>
</tr>
<tr>
<td>Other/Decline to Answer</td>
<td>214 (14.3%)</td>
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<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>N (%)</th>
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<tbody>
<tr>
<td>Hispanic/Latin American</td>
<td>138 (9.2%)</td>
</tr>
<tr>
<td>Not Hispanic, Latin American</td>
<td>1181 (78.8%)</td>
</tr>
<tr>
<td>Unknown or Decline to Answer</td>
<td>180 (12.0%)</td>
</tr>
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Table 1. Patient Demographics
### Table 2: Post hoc ANOVA demonstrating statistically significant mean CI between age groups.

Younger children also demonstrate a higher mean CI.

<table>
<thead>
<tr>
<th>Age Group (mos)</th>
<th>Mean CI (95% confidence interval)</th>
<th>Test Statistic</th>
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<tbody>
<tr>
<td>&lt;12, n = 482</td>
<td>85.047 (84.406–85.688)</td>
<td>F(2,1496) = 124.058, p &lt; 0.0005</td>
</tr>
<tr>
<td>12–24, n = 139</td>
<td>84.211 (83.158–85.263)</td>
<td></td>
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<tr>
<td>&gt;24, n = 878</td>
<td>80.410 (79.985–80.835)</td>
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</table>
Figure 3. Scatterplot demonstrating negative and linear relationship between age and CI.

Correlation between age and CI ($r=0.165$, $p<0.001$).

Equation for predicting CI $y=85.18-0.04x$

Decrease in CI by 0.038 each month for first two years of life.

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Figure 4 and 5. Consistent, significant, decrease of CI with respect to age over the first two years of life.

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Discussion

- The natural history of brachycephaly decreases as less force is placed on the skull during the first two years of life\(^4\).
- The concept of ideal skull shape should remain dynamic in nature.
- Parents and pediatricians should expect some degree of skull asymmetry.
- First study to provide tangible rate of skull change (decrease of CI by 0.038/mo)
- Hence, brachycephaly and counterpart, plagiocephaly, represent benign cosmetic defects which decrease in prevalence with time.
- As trend develops for children to sleep in the supine position, normative values of CI may need to be adjusted.

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References


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