THE QUANTITATIVE ASSESSMENT OF THE UPPER AIRWAY
IN INFANTS AND CHILDREN WITH PIERRE ROBIN SEQUENCE
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Introduction

• Pierre Robin Sequence (PRS) is characterized by micrognathia, glossoptosis, and upper airway obstruction.1
• No standardized guidelines exist nor clinical or anatomic metrics exist to guide intervention.1,2,3,4
• Polysomnography if possible
• Quantitative metrics to guide therapy for PRS are lacking
• To address this need, we generated segmented 3D CT scans of infants and children with PRS and assessed the correlation with need for intervention of metrics derived from these geometries

Methods

• Children (<8 years old) with PRS who had undergone maxillofacial CT scans
• Normative data from CT scans of children without PRS
• Data segmentation analysis to create 3D geometries
• Frankfort plane to measure
  • Chin Angle (CA)
  • Mentum Angle (MA)
  • Genial Angle (GA)
• Ratios measured:
  • Minimum Body to Maximum Upper Jaw
  • Tongue Volume to Mouth Volume (TVMV)
  • Base of Tongue to posterior pharynx cross sectional area (BTXA)
• Group comparison
  • Nominal vs. PRS
  • PRS intervention
  • PRS intervention (no intervention decisions were made)

Results

Significant differences

• AHI
  PRSni = 85.1
  PRS = 28.7
  Min O2 Sat
  PRSni: 89.08 %
  PRS: 80.99 %
  Controls vs. PRSni and PRS
  • MBMU, MA, GA, TVMV
  • PRSni vs. PRS, univariate
  • MBMU, MA, GA, TVMV, BOTXA
  • PRSni vs. PRS, multivariate
  • MBMU and MA
• ROC analysis (Figure 1)
  • MBMU cutoff of 1.101 (AUC 0.9214, Sensitivity 92.86%, Specificity 90.0%)
  • MA cutoff of 51.75 (AUC 0.9357, Sensitivity 85.71%, Specificity 80.0%). (Figure 1)

Conclusions

• By utilizing 3D segmented geometries of maxillofacial CT scans of children with Pierre Robin Sequence, our results show that the ratio of the maxilla to the mandibular body as well as the mentum angle are potential discriminators for surgical intervention.
• Polysomnography results also correlated with surgical decision making
• These results combined with clinical judgment may be helpful in determining which infants would benefit from surgical intervention versus conservative management.
• Study was limited by blinded prospective nature (no intervention decisions based on available data) and study
• Correlation with type of intervention (tracheostomy, mandibular advancement osteogenesis, etc.) could not be assessed secondary to small sample size
• Further prospective studies utilizing these 3D and 4D geometries and computational fluid dynamics data may provide more confirmation of these findings.

Table 1: Geometric Measurements of Anatomical Interest

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Central</th>
<th>PRSni</th>
<th>PRS vs. Control</th>
<th>PRS</th>
<th>PRSni vs. Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBMU ratios</td>
<td>1.25 ± 0.09</td>
<td>0.73 ± 0.14</td>
<td>0.90 ± 0.10</td>
<td>0.77 ± 0.13</td>
<td>0.65 ± 0.16</td>
</tr>
<tr>
<td>Chin Angle</td>
<td>20.0 ± 4.5</td>
<td>25.0 ± 4.5</td>
<td>15.0 ± 4.5</td>
<td>20.0 ± 4.5</td>
<td>15.0 ± 4.5</td>
</tr>
<tr>
<td>Genial Angle</td>
<td>15.0 ± 4.5</td>
<td>15.0 ± 4.5</td>
<td>10.0 ± 4.5</td>
<td>15.0 ± 4.5</td>
<td>10.0 ± 4.5</td>
</tr>
<tr>
<td>Maxilla Angle</td>
<td>30.0 ± 5.0</td>
<td>30.0 ± 5.0</td>
<td>20.0 ± 5.0</td>
<td>30.0 ± 5.0</td>
<td>20.0 ± 5.0</td>
</tr>
<tr>
<td>TVMV</td>
<td>500 ± 100</td>
<td>250 ± 100</td>
<td>100 ± 100</td>
<td>250 ± 100</td>
<td>100 ± 100</td>
</tr>
<tr>
<td>BOTXA</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
</tr>
</tbody>
</table>

References


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