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CONTENTS

Editorial
Giuliano Falcolini 59

SCIENTIFIC PAPERS

T. Peric, D. Markovic
In vitro effectiveness of a chemo-mechanical method for caries removal 61

L. Giannetti, A. Murri, F. Vecchi, R. Gatto
Dental avulsion: therapeutic protocols and oral health-related quality of life 69

P. Crucchi, M. Portelli, G. Maresc, R. Nocera, A. Militi, M. Mazza, G. Cordasco
Correlations between cephalometric posture and facial type in patients suffering from breathing obstructive syndrome 77

P. Cozza, S. Di Girolamo, P. Ballanti, F. Purlili
Orthodontist-otolaryngologist: an interdisciplinary approach to solve otitis media 83

G. Olivi, M.D. Genove, P. Maturo, R. Decino
Pulp capping: advantages of using laser technology 89

CASE REPORT

G.A. Scardina, G. Fucà, P. Messina
Oral diseases in a patient affected with Prader-Willi syndrome 96

COMMENTARY

H.B. Waldman, S.P. Perlman
A need for health services for children with disabilities in Europe. A commentary 100
Correlations between cephalic posture and facial type in patients suffering from breathing obstructive syndrome

P. CRUPI, M. PORTELLI, G. MATARESE, R. NUCERA, A. MILITI, M. MAZZA, G. CORDASCO

ABSTRACT: Aim: In this teleradiographic study, the authors investigate the correlations between facial kind, breathing pattern and cephalic posture. Methods: The research was conducted on a 94 schoolchildren sample. For each patient teleradiographic analysis in L.L. projection and rhinomanometric examination were performed. On the basis of clinical evidences, rhinomanometric results and nasopharyngeal space evaluation, the sample was divided into two groups: the first one included 38 oral breather patients (OB), the second one 56 nasal breathers (NB). Results: The two groups do not differ significantly; with the exception of divergence values, frequently higher in OB than NB. The comparison of craniofacial features and cephalic posture among the groups points out to correlations between large craniofacial angle and skeletal Class II, mandibular retrognathia and increased gnarial angle, respectively, not related to breathing patterns. Conclusion: According to the authors’ results, it can be stated that morphological characteristics classically associated with breathing obstructive syndrome could be induced by altered cephalic posture instead.

KEYWORDS: Cephalic posture, Breathing obstructive syndrome, Facial type.

Introduction

Cephalic posture is the result of a complex and delicate balance between all muscles involved in the craniofacial-mandibular system: masticatory muscles, suprahyoid, infrahyoid and posterior cervical muscles. Such balance is established in the early months of life as a consequence of sensorial and mechanical stimuli that according to Bosma [Bosma, 1963] are all dependent from a main factor: maintenance of pharyngeal airway. This mechanism, known as “airway-maintenance mechanism”, involves not only the cephalic posture but also anatomical structures such as neck postural muscles, mandible, tongue and hyoid bone, all strictly related to each other both from an anatomical and a functional point of view, and whose reciprocal position influences the nasopharyngeal diameter.

Recent studies performed by Ono [Ono et al., 2000, 2002] showed that the tridimensional upper airways configuration is also related to the subject’s whole body position, in addition to the above mentioned anatomical structures.

Ricketts [1968] described the maintenance of a forward head posture pattern in OB since 1968, and observed the spontaneous reversion to orthologic cephalic posture after adenoidectomy. Comparable results have been also reported by Woodside and Linerl-Aronson [Woodside et al., 1979].

In a study on 24 healthy children Solow and Greve [Solow et al., 1984] reported the correlation between narrow rhinopharynx, large craniofacial angle, retrognathia or mandibular hypodevelopment, wide cranio-mandibular angle and upper incisors buccolingual inclination.

The relationship between cephalic posture and maintenance of pharyngeal airway was experimentally demonstrated by Vig, Showlty and Phillips [Vig et al., 1980] in a sample of students with no respiratory problems, in which OB pattern was induced by mean of nasal obturators application; the authors showed
that increased anterior nasal resistance is related to head hyperextension. Similar results were obtained in a teleradiographic study performed by Huggare e Laine [Huggare et al., 1997] on 58 young adults.

Solow & Tallgren [Solow et al., 1976] investigated the correlations between facial morphology and cephalic posture. They observed that head hyperextension is associated with a morphologic type characterized by increased facial height, steep mandibular plane, facial retrognathia and reduced rhinopharyngeal space; patients with flexed head feature opposite characteristics.

Research performed by Kumar [Kumar et al., 1995], Huggare [Huggare, 1991] and Sandikcioglu [Sandikcioglu et al., 1994] report modifications in shape and morphology of the first cervical vertebra, related to cephalic posture and facial type. Authors observed statistically significant correlations between atlas morphology, linear and angular measurements of craniofacial structures and cephalic posture. Hence, correlations between cephalic posture, craniofacial morphology and pharyngeal airway are likely to exist.

Materials and methods
The research was performed on a sample of 94 schoolchildren (45 males, 49 females; mean age 12.9), at the Department of Orthodontics and Paediatric Dentistry of the University of Messina Dental School.

Orthodontic medical records were compiled for each patient: anamorphic and anamnestic data, clinically determined facial type parameters and the results of the following instrumental examinations were recorded:

1. Active anterior rhinomanometry;
2. Rhinofibroscopy;
3. Latero-lateral teleradiography.

Teleradiography was performed with the head in self balance position [Arrajo-Olive S. et al., 2006], during maximum inspiration and maximum intersupination.

The cephalometric tracing on film considered the following parameters:
1) mutual relationships on a sagittal plane between maxilla and mandible and between these bone segments and the cranial base by means of ANB, SNA, SNB angles measurements;
2) inclination of the upper maxilla through the evaluation of SN-SnpSra angle;
3) divergence through SN-CgoGa angle measurement;
4) gonial angle's width;
5) cephalic posture evaluated on the basis of the craniofacial angle of Solow and Tallgren [Solow et al., 1976]: nasopharyngeal space, assessed according to Messina Orthodontic School method [Cordasco et al., 1987].

This method considers 5 segments linear values, identified on the following straight lines (Fig. 1):
- straight line 1: pm-aa (most anterior point of the first vertebral corpus);
- straight line 2: pm-ba (basion);
- straight line 3: pm-s0 (midpoint of the S-ba line);
- straight line 4: pm-s (geometric center of sella turcica);
- straight line 5: pm-s1 (S0-ba midpoint).

On each straight line a segment is traced, delimited by the intersection with the pharyngeal wall at the back and by the intersection with the upper profile of

![Fig. 1 - Nasopharyngeal space analysis.](image-url)
soft palate in the front; the 5 segments obtained are, from top to bottom: Pm-A1, Pm-A2, Pm-A3, Pm-A4, Pm-A5.

On the basis of clinical evidences, rhinomanometric results, rhinolitotroscopic evaluation and the above mentioned cephalometric data, the sample was divided into 2 subgroups. The first one comprised 41 patients (21 F, 20 M), mainly oral breathers; the second subgroup included 53 subjects (28 F, 25 M), mainly nasal breathers. The clinical evaluation assessed the presence of characteristic oral breather’s features, such as severe under-eye dark circles, facial palleness, narrow and sharp nose, labial incompetence, glosal palate, mono- or bilateral cross bite, Rosenthal’s Test.

The results of rhinomanometric examinations were relatively taken into consideration, since they can be strongly influenced by the status and ponderal development and facial bones dimensions. Regarding the nasopharyngeal space measurement on film, 13.8 mm was considered as the reference value: below this figure, in fact, all the subjects showed mainly oral breathing pattern [Cordovos et al., 1987].

The values obtained for each group are reported in tables 1 and 2, where the prevalence of the considered morphologic parameters are shown, both for subjects affected from breathing obstructive syndrome and healthy patients, respectively.

The t-test was used to perform the inferential statistics. The level of significance was set at p<0.05.

**Results**

Percentages of the considered cephalometric parameters are summarised in tables 1 and 3, while in tables 2 and 4 descriptive statistics are reported; from the results emerge the following. Divergency values are increased in more than half of OB patients.

<table>
<thead>
<tr>
<th>Nasal Breathers</th>
<th>Increased</th>
<th>Normal</th>
<th>Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN°GoGa</td>
<td>37.93</td>
<td>56.89</td>
<td>5.17</td>
</tr>
<tr>
<td>ANB Angle</td>
<td>51.70</td>
<td>42.10</td>
<td>6.15</td>
</tr>
<tr>
<td>SNA Angle</td>
<td>20.06</td>
<td>62.06</td>
<td>17.80</td>
</tr>
<tr>
<td>SNB Angle</td>
<td>5.67</td>
<td>33.93</td>
<td>56.99</td>
</tr>
<tr>
<td>SN°Snp-Snp</td>
<td>65.51</td>
<td>32.75</td>
<td>1.72</td>
</tr>
<tr>
<td>ArGo/GoMe</td>
<td>5.17</td>
<td>58.62</td>
<td>36.20</td>
</tr>
<tr>
<td>SN°GoGa</td>
<td>72.41</td>
<td>24.13</td>
<td>3.41</td>
</tr>
</tbody>
</table>

**Table 1 - Cephalometric values in NB.**

<table>
<thead>
<tr>
<th>Cephalometric Parameters</th>
<th>Average</th>
<th>Median</th>
<th>Sd</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN°GoGa</td>
<td>33.54</td>
<td>34.50</td>
<td>4.72</td>
<td>23.10</td>
<td>40.50</td>
</tr>
<tr>
<td>ANB Angle</td>
<td>5.58</td>
<td>3.90</td>
<td>2.54</td>
<td>-2.50</td>
<td>7.80</td>
</tr>
<tr>
<td>SNA Angle</td>
<td>81.75</td>
<td>82.60</td>
<td>3.02</td>
<td>75.00</td>
<td>86.10</td>
</tr>
<tr>
<td>SNB Angle</td>
<td>77.59</td>
<td>77.60</td>
<td>3.10</td>
<td>73.60</td>
<td>85.00</td>
</tr>
<tr>
<td>SN°Snp-Snp</td>
<td>8.79</td>
<td>8.20</td>
<td>3.24</td>
<td>4.10</td>
<td>15.80</td>
</tr>
<tr>
<td>ArGo/GoMe</td>
<td>136.50</td>
<td>137.60</td>
<td>5.44</td>
<td>122.00</td>
<td>147.00</td>
</tr>
<tr>
<td>SN°cv 2</td>
<td>95.25</td>
<td>94.10</td>
<td>3.29</td>
<td>86.00</td>
<td>99.30</td>
</tr>
</tbody>
</table>

**Table 2 - Descriptive statistics (nasal breathers).**

<table>
<thead>
<tr>
<th>Nasal Breathers</th>
<th>Increased</th>
<th>Normal</th>
<th>Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN°GoGa</td>
<td>52.67</td>
<td>33.54</td>
<td>3.77</td>
</tr>
<tr>
<td>ANB Angle</td>
<td>58.53</td>
<td>36.11</td>
<td>5.25</td>
</tr>
<tr>
<td>SNA Angle</td>
<td>50.11</td>
<td>36.11</td>
<td>27.77</td>
</tr>
<tr>
<td>SNB Angle</td>
<td>11.11</td>
<td>3.33</td>
<td>55.55</td>
</tr>
<tr>
<td>SN°Snp-Snp</td>
<td>72.22</td>
<td>27.77</td>
<td>0.00</td>
</tr>
<tr>
<td>ArGo/GoMe</td>
<td>5.55</td>
<td>72.22</td>
<td>22.22</td>
</tr>
<tr>
<td>SN°GoGa</td>
<td>86.11</td>
<td>11.11</td>
<td>2.77</td>
</tr>
</tbody>
</table>

**Table 3 - Cephalometric values in OB.**

(52.67%): while most NB are mesiodivergent.

Skeletal classes distribution overlaps between the two groups, with a slight prevalence of Class II findings (51.70% in NB, 58.33% in OB) secondary to mandibular retrognathia (reduced SNB in 56.99% of NB, 58.33% in OB).

Gonial angle increases in both groups, being higher in percentage in OB (72.22%) and among which no reduction of such value has been registered.

SN-Snp angle shows normal values for the most part of both groups (58.62% in NB, 72.22% in OB).

Craniofacial angle is increased in most of the OB (86.11%); the angle is also increased in the NB group.
TABLE 4 - Descriptive statistics (Oral breathers).

<table>
<thead>
<tr>
<th>Cephalometric Parameters</th>
<th>Average</th>
<th>Median</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN°GoGn</td>
<td>33.54</td>
<td>34.50</td>
<td>4.92</td>
<td>23.10</td>
<td>40.50</td>
</tr>
<tr>
<td>ANB Angle</td>
<td>3.58</td>
<td>3.90</td>
<td>2.64</td>
<td>-2.50</td>
<td>7.50</td>
</tr>
<tr>
<td>SNA Angle</td>
<td>81.75</td>
<td>82.00</td>
<td>3.02</td>
<td>75.00</td>
<td>88.10</td>
</tr>
<tr>
<td>SNB Angle</td>
<td>77.59</td>
<td>77.00</td>
<td>3.10</td>
<td>73.60</td>
<td>85.00</td>
</tr>
<tr>
<td>SN°Sna-Snp</td>
<td>8.79</td>
<td>8.20</td>
<td>3.24</td>
<td>4.10</td>
<td>15.80</td>
</tr>
<tr>
<td>ArGo°GoMe</td>
<td>136.50</td>
<td>137.60</td>
<td>5.44</td>
<td>122.00</td>
<td>147.00</td>
</tr>
<tr>
<td>SN°ex 2</td>
<td>95.25</td>
<td>96.10</td>
<td>3.29</td>
<td>86.00</td>
<td>99.30</td>
</tr>
</tbody>
</table>

TABLE 5 - Inferential statistics. Differences between oral breathers and nasal breathers.

<table>
<thead>
<tr>
<th>Cephalometric Parameters</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN°GoGn</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>ANB Angle</td>
<td>Not Significant</td>
</tr>
<tr>
<td>SNA Angle</td>
<td>Not Significant</td>
</tr>
<tr>
<td>SNB Angle</td>
<td>Not Significant</td>
</tr>
<tr>
<td>SN°Sna-Snp</td>
<td>Not Significant</td>
</tr>
<tr>
<td>ArGo°GoMe</td>
<td>Not Significant</td>
</tr>
<tr>
<td>SN°GoGn</td>
<td>Not Significant</td>
</tr>
</tbody>
</table>

but in lower percentage (58.62%). Craniospinal (SN°Sna-Snp) angle is normal for the majority of the subjects in both groups.

The only statistical significant difference between OB and NB is related to the divergence, as reported in table 5.

Correlations between craniofacial angle, facial type variations and respiratory pattern are summarised in table 6 and 7; according to the results it can be stated as follows. Craniofacial angle increasing prevails in OB hyperdivergent patients (50%), while NB are mainly mesodivergent (37.93%). Increased craniofacial angle is related to a clearly prevalent

TABLE 6 - Descriptive statistics (Oral breathers).

<table>
<thead>
<tr>
<th>Craniofacial Angle</th>
<th>Increased</th>
<th>Normal</th>
<th>Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN°GoGn (Divergence)</td>
<td>&gt;</td>
<td>50.00</td>
<td>2.77</td>
</tr>
<tr>
<td></td>
<td>=</td>
<td>36.11</td>
<td>8.33</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>ANB</td>
<td>&gt;</td>
<td>52.77</td>
<td>5.55</td>
</tr>
<tr>
<td></td>
<td>=</td>
<td>27.77</td>
<td>5.55</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
<td>5.55</td>
<td>0.00</td>
</tr>
<tr>
<td>SNA</td>
<td>&gt;</td>
<td>25.00</td>
<td>8.33</td>
</tr>
<tr>
<td></td>
<td>=</td>
<td>33.33</td>
<td>2.77</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
<td>27.77</td>
<td>0.00</td>
</tr>
<tr>
<td>SNB</td>
<td>&gt;</td>
<td>5.55</td>
<td>2.77</td>
</tr>
<tr>
<td></td>
<td>=</td>
<td>25.00</td>
<td>8.33</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
<td>55.55</td>
<td>0.00</td>
</tr>
<tr>
<td>Gonial angle</td>
<td>&gt;</td>
<td>63.88</td>
<td>5.55</td>
</tr>
<tr>
<td></td>
<td>=</td>
<td>22.22</td>
<td>5.55</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>SN Sna SNP</td>
<td>&gt;</td>
<td>5.52</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>=</td>
<td>63.88</td>
<td>8.33</td>
</tr>
<tr>
<td></td>
<td>&lt;</td>
<td>16.66</td>
<td>2.77</td>
</tr>
</tbody>
</table>
skeletal Class II in both groups (52.77% in OB, 37.93% in NB). In both groups the increased craniocervical angle is related to an increased Gomol angle (63.88 in OB, 51.72 in NB).

**Discussion**

The obtained data show a statistical correlation (p<0.05) between oral breathing pattern and increased divergence; this result reflects what is found in literature [Howard, 2000; Ono et al., 2000], where the association between oral breathing pattern and cleft face Syndrome emerges. The divergence angle, in fact, is increased in more than half of OB; this result is even more significant when it is taken into account that NB subjects are mainly mesiodivergent.

Skeletal classes' distribution is similar in both groups, with a slight prevalence of skeletal Class II.

The clear prevalence of a reduced SNB angle could be due to the fact that the subjects examined dysgnathic subjects, and secondly to mandibular posterior rotation, which reflects the high percentage of hyperdivergent patients observed.

The main finding emerged from the study is the increased gomol angle in both groups, mainly in OB, among which no cases of reduced angle have been reported.

The high percentage of hyperdivergent subjects and skeletal Class II in the whole sample is related to the increased gomol angle.

According to what was previously observed by Solow [Solow et al., 1984], the value of SN-SnpSna angle is normal for the majority of the subjects in both groups.

Cranioventral angle increased substantially in both groups, but it assumes higher values in OB.

This result can be explained by the high percentage in the whole sample of subjects showing skeletal Class II secondary to mandibular retrognathia, among which the altered cephalic posture (Forward Head Position) is a common finding, being related to a tendency to compensate the dysgnathia through an anteriorised chin position.

In OB group, the subjects with increased craniocervical angle are mainly hyperdivergent, while they are mesiodivergent in NB group.

It can be inferred, independently from the craniocervical angle wideness, that divergence can be influenced by breathing patterns. Presumably this is related to the sum of postural alterations in presence of
upper airways obstruction, among which modifications of the lingual-mandibular-hyoid baseline is included [Takahashi et al., 2002]; this also explains the goniometric angle increasing, especially in OB.

Craniocephalic angle wideness increase is related, in both groups, to a marked prevalence of skeletal Class II; in contrast with the data reported by Solow et Tallgren [Solow et al., 1976] significant percentages of retrognathic maxilla were not recorded, but instead retrognathic mandible prevalence was observed.

Craniospinal angle is normal in the majority of the subjects in both groups.

Conclusion

According to the authors' results it can be stated that morphological characteristics classically associated with breathing obstructive syndrome could be induced by altered cephalic posture.

References


Editorial

Giuliano Falcolini

Scientific Papers

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Commentary

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