Mandibular dental arch parameters in Down's Syndrome patients with Class I occlusion. (A comparative study)

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ABSTRACT
Background: The aim of this study was to find out the dental arch form for patients with Down's syndrome and to compare the mandibular dental arch parameters of those patients with the corresponding norms, and to gain a correlation between the maxillary and mandibular arches for the Down's syndrome patients from previous study.

Subjects and methods: A total sample of 50 patients with Down's syndrome was examined with an age ranged from 14-18 years. The mandibular dental arch parameters were compared with another group, control, on student of an intermediate school matching with the age and Angle's classification (Class I). Study models for the maxillary and mandibular arches were constructed, and then dental arch measurements were carried out and evaluated.

Results: The mandibular arch parameters for the patients with Down's syndrome showed significantly smaller mean values than the control group for both genders with the males had greater values in inter arch distance and length, with high correlation between the maxillary and mandibular jaws. The wide arch form is the dominated arch form while the flat is the least to appear.

Conclusion: The growth pattern of dental arches in Down's syndrome patients is proportionally reduced when compared with those of norms, with a symmetrical configuration. Hence all arch forms are presented with different distribution.

Keyword: Down's syndrome, Dental arch parameter, Genetic influence.

INTRODUCTION
Malocclusion is an irregularity of the teeth or malrelationship of the dental arches beyond the accepted range of normal (1,2). Many etiological factors may affect the dental arch development and may be associated with the presence of dentofacial anomalies whether of a facial or dental origin (3).

Down's syndrome is a disease associated with subnormal mentality in which an extreme wide variety of anomalies and functional disorders may occur. This disorder was first described by John Langdon Down, and the condition has typical physical features and multisystem anomalies (4).

Two different hypotheses have been proposed to explain the mechanism of gene action in Down syndrome: developmental instability (loss of chromosomal balance) and gene dosage effect (5). According to the gene dosage effect hypothesis, the genes located on chromosome 21 have been over expressed in cells and tissues of Down's syndrome patients, and this contributes to the phenotypic abnormalities (6).

Down's syndrome is the most common autosomal abnormality and occurs in approximately 1 case per 700 live births.

It accounts for about one third of all moderate and severe mental handicaps in school-aged children; it has been reported in people of all races for both genders. The characteristic morphologic features of mongolism can be recognized immediately at birth, but they are obvious in children older than 1 year. Some dermatological features increase with advancing age (7).

The major features of Down syndrome are as follows:
- Mental retardation- Mild to severe, intelligence quotient (IQ) of 25-50 (8)
  - Characteristic head appearance- Small head (brachycephaly), flat faces with increased interocular distance (hypertelorism), depressed nasal bridge, flat occiput, and broad short neck.
  - Occlusal anomalies - Narrow and upward and outward slating of the rima palpebrarum (80%).
  - Oral features - Small mouth (relatively) with protrusion of the tongue (macroglossia) and difficulty in eating and speaking, scrotal tongue, hypoplasia of the maxilla, delayed tooth eruption, juvenile periodontitis, and cleft lip or palate (rare) (9).[10]

Causes
Three cytogenic variants cause Down's syndrome.
- Trisomy 21
- Chromosomal translocation
- Mosaicism

Approximately 25-30% of patients with Down's syndrome die during the first year of life.
The most frequent causes of death are respiratory infections (bronchopneumonia) and congenital heart disease (6). The life expectancy of patients with Down's syndrome is slightly reduced.

Traditional metric studies of the dental arch form based on linear analysis have focused on age changes and esthetic control. Some of the analysis have been used for purposes as age changes, gender variation, and environmental changes, in addition to its important in the diagnosis and treatment an incipient malocclusion (11). Although ideal dental arch has no single or universal form, it may possess vital determinants of the role of growth pattern in developing arch form which in term affect other type of malocclusion (12).

There are very limited studies regarding arch size dimensions in Down's syndrome patient. Ghaib (13) found that the maxillary arch dimensions of patient with Down's syndrome were smaller and narrower than control group. The cephalometric analysis revealed length deficiency of the anterior cranial base with an anteroposterior deficiency of maxillary arch, regular but hypoplastic growth, and a diminished anteroposterior growth of the mandible (3).

The aims of the study are to compare the mandibular dental arch parameters of the Down's syndrome patients with the corresponding norms and to find the dominate arch form and to gain a correlation between the maxillary and mandibular dental arches.

SUBJECTS AND METHOD

Patients attending the center of health care for Down's syndrome (Hibbat-Allah) in Baghdad City were clinically examined. Among 150 patients with Down's syndrome, only 50 patients were selected who consisted of 25 male and 25 female and fulfilled the criteria of the sample selection which are:

1. They are known cases of Down's syndrome Iraqi nationality with an age ranged 14-18 years.
2. Full complement of permanent dentition excluding the third molar.
3. Class I molar occlusion, free of local factors distribute irregularity of dental arch, no heavy filling or build up.
4. No marked facial asymmetry.

The control group consisted of healthy students in the intermediate school having the same criteria used for the selection of the study group (14,15).

1. Dental arch dimension measurements

Certain tooth related points were marked bilaterally with sharp pencil on the study cast to facilitate the identification of the landmarks that will be used for measuring the dental arch dimensions.

The following landmarks were used due to their reconcilability:
1. Incisal point (I): The point midway between the incisal edges of the central incisors (16,17).
2. Canine point (C): The cusp tip of the right and left permanent canines (18).
3. Mesiobuccal cusp tip (M): The mesiobuccal cusp tip of the right and left permanent first molars (19,20).
4. Mesiolingual cusp tip (ML): The mesiolingual cusp tip of the right and left permanent first molars (17).
5. Premolar cusp tip (P): The buccal cusp tip of the right and left second premolars (19).

Dental arch dimension (Figure 1)

Several linear measurements were implicated to determine the dental arch width, length and segmental measurements.

1. Dental arch width
   • Inter-canine (CC) distance: The linear distance from the cusp tip of one canine to the other canine (21,22).
   • Inter first molar distance (MM lingual): The linear distance between the mesiobuccal cusp tip of the right and left first molars (23).
   • Inter first molar distance (MM buccal): The linear distance between the mesiobuccal cusp tip of the right and left first molars (17).
   • Inter premolar distance (PP): The linear distance between the buccal cusp tip of the right and left second premolars (23).

2. Dental arch segmental measurement
   • Right incisal canine distance: The linear distance from the incisal point to the right canine cusp tip (24).
   • Left incisal canine distance: The linear distance from the incisal point to the left canine cusp tip (24).
   • Right Canine molar distance: The linear distance from the right canine cusp tip to the right mesiobuccal cusp tip of the first permanent molar (16,25).
   • Left Canine molar distance: The linear distance from the left canine cusp tip to the left mesiobuccal cusp tip of the first permanent molar (16,17,25).

II. Anterior dental arch form measurements

Mandibular arch form was determined by applying the approach of Raberin et al (26) that categorize the mandibular dental arch into five forms with simple modification. Each arch form
has characteristic percentage deviation values of certain ratios.

**Narrow:** All (vertical/transverse ratios) are positive.

**Wide:** All (vertical transverse ratios) are negative.

**Mid:** None of the ratios significantly deviate from the average.

**Pointed:** Only ratio A has intensively noticeable higher than the average.

**Flat:** Only ratio A has intensively noticeable mandibular than the average.

The vertical / transverse ratios are

A: Vertical canine distance / inter canine distance.

B: Vertical molar distance / inter molar distance.

C: Vertical premolar distance / inter premolar distance.

Statistical analysis was carried out using SPSS program version 12 in which the descriptive statistic (mean and standard deviation), and inferential statistic by student’s t test and Pearson correlation coefficient were carried on.

**RESULTS**

Table 1 reveals the descriptive statistics for the collected data (male and female) in Down's syndrome patient.

There is no significant difference (p>0.05) between the left and right sides in both genders (table 2). However, males exhibited a significant increase (p<0.05) in intermolar and intercanine and vertical molar distance as shown in table 3.

Table 4 shows the significant level between the Down's syndrome patient and the control group. The former shows a significant decrease (p<0.05) in the posterior region as the intermolar, vertical molar distance and the canine molar distance.

There is a highly positive correlation between the mandibular and the maxillary jaws, from previous study which is presented in table 5.

The mandibular jaw demonstrates all the arch forms, anteriorly, proposed by Raberin et al (26) with the wide form 44% being the dominating one followed by the mid 20% then the narrow 16% and the pointed 11% to be the least with the flat arch form 9% as shown in table 6 and figure 2.

**DISCUSSION**

1. **Dental arch parameters**

The extent of mental deficiency in individuals with Down's syndrome has often been exaggerated in the literature and this may have caused the orthodontist to shy away from treating these patients, and this may brought the studies on them to be very limited. Down's patients exhibited subsequent stationary mandibular growth due to macroglossia, reduced muscle tonicity and habitual mouth breathing which lead to a high incidence of Cl.III basal relation. All these causes jeopardized the authors to apply a data base to figure out the behaviors of the disease on the mandibular jaw parameters. There are different types of Down's syndrome with wide range of variety in mental and physical anomalies (6). It is important to understand that the growth pattern of the Down's syndrome patients has a different range associated with the age, and the growth spurt may be delayed but with a very slow rate. However, in norms, the intercanine and canine-molar distance will be stable at the age of 13 years (23,24).

The results showed a non significant difference between the left and right sides in both genders, that demonstrated symmetrical dental arch dimensions for the Down's syndrome patients, a fact supported by many studies (3,13).

Males with Down's syndrome demonstrate a non significant increase in most of the linear measurements than female and with a significant level with others. Similar results appear in the control group, and this agrees with many results counted from norms (25,27-29). This may explain a similarity in growth behavior of the jaws in Down's syndrome patients and normal population.

Since the intercanine and intermolar distances are the parameters used for several purposes especially the growth changes and growth behavior (7), these results suggested a proportional reduced growth of the jaws in Down's syndrome with a symmetrical arch dimensions, this is truth not only in mandibular jaw, but on the maxillary jaw as well (13,27,28).

Although the genetic implication of a disease is not a promising issue; few studies reported some explanations of the genetic impaction on Down's syndrome patient. Cohen (29) depended on the cellular and tissue mosaicism that enhances the different features of Down's Syndrome in which there is a mixture of genes. Normal and abnormal in different cells or tissue of the same type may dominate the general features especially that of ectodermal and endodermal in origin, resulted in different physical disorders as overall undergrowth and development of skull and body texture, craniofacial structures, abnormality in skin and hair fissurated tongue, small teeth ……etc.

The control group exhibited anticipated larger values with a significant difference in
some parameters when compared with the study group in both sides of the different gender. This may attribute to the above causes in addition to the fact that those patients had high incidence of hormonal disorders especially hypothyroidism which represent a faulty development as it occurs in early life (3,30-32).

2. Anterior arch form

It was found that the dominate arch form for those patients is the wide form which means that the vertical canine distance was relatively reduced rather than increased inter canine width. This is true when we compare the arch form with the least prevalence of dental crowding (12).

Probably the dominated wide arch resulted from the resultant of the exterior and interior muscle forces in which there is hypotonic activity in the perioral musculature with relatively wide tongue.

Figure 1: The mandibular dental arch dimension.

Table 1: Mandibular jaw parameters for persons with Down's syndrome

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>S.D</td>
</tr>
<tr>
<td>I-C (incis-canine)Rt.</td>
<td>13.9</td>
<td>0.94</td>
</tr>
<tr>
<td>I-C (incis-canine)Lft.</td>
<td>14</td>
<td>1.00</td>
</tr>
<tr>
<td>C-M (canine-mol)Rt.</td>
<td>20.7</td>
<td>1.34</td>
</tr>
<tr>
<td>C-M (canine-mol)Lft.</td>
<td>20.6</td>
<td>1.43</td>
</tr>
<tr>
<td>IC (Vertical)</td>
<td>5.4</td>
<td>1.54</td>
</tr>
<tr>
<td>IP (Vertical)</td>
<td>10.3</td>
<td>1.69</td>
</tr>
<tr>
<td>IM (Vertical)</td>
<td>23.2</td>
<td>1.84</td>
</tr>
<tr>
<td>MM (buccal)*</td>
<td>45.7</td>
<td>1.92</td>
</tr>
<tr>
<td>CC</td>
<td>27.4</td>
<td>0.91</td>
</tr>
<tr>
<td>PP</td>
<td>36</td>
<td>2.08</td>
</tr>
<tr>
<td>MM (lingual)</td>
<td>36.6</td>
<td>1.17</td>
</tr>
</tbody>
</table>

*the intermolar distance from the mesiobuccal cusp tip. All measurements in mm

Table 2: Comparison between the genders in both sides in Down's syndrome

<table>
<thead>
<tr>
<th>Reliability</th>
<th>C-M right</th>
<th>C-M left</th>
<th>Reliability</th>
<th>C-M right</th>
<th>C-M left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sig. r value</td>
<td>mean</td>
<td>S.D</td>
<td>r value</td>
<td>mean</td>
<td>S.D</td>
</tr>
<tr>
<td>male</td>
<td>0.709</td>
<td>1.01</td>
<td>0.63</td>
<td>1.34</td>
<td>20.7</td>
</tr>
<tr>
<td>female</td>
<td>0.847</td>
<td>0.63</td>
<td>0.79</td>
<td>1.43</td>
<td>20.3</td>
</tr>
</tbody>
</table>

(P<0.05), d.f=48; N.S= non significant (p>0.05); S=Significant

Table 3: Comparison between male and female in Down's syndrome

<table>
<thead>
<tr>
<th>Sig. r value</th>
<th>Male mean</th>
<th>S.D</th>
<th>Female mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-C</td>
<td>27.4</td>
<td>0.91</td>
<td>24</td>
<td>1.22</td>
</tr>
<tr>
<td>M-M (lingual)</td>
<td>36.6</td>
<td>1.17</td>
<td>31.7</td>
<td>5.92</td>
</tr>
<tr>
<td>I-M (Vertical)</td>
<td>23.2</td>
<td>1.84</td>
<td>20.7</td>
<td>2.17</td>
</tr>
</tbody>
</table>

(P<0.05), d.f=48; N.S= non significant (p>0.05); S=Significant

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Table 4: Comparison between the control group and patient with Down's syndrome

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control Mean</th>
<th>Control S.D</th>
<th>Down's Mean</th>
<th>Down's S.D</th>
<th>Sig. r value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-M(canine-mol)Rt.</td>
<td>24.2</td>
<td>1.2</td>
<td>20.7</td>
<td>1.3</td>
<td>0.021 S</td>
</tr>
<tr>
<td>C-M(canine-mol)Lft.</td>
<td>24.8</td>
<td>1.2</td>
<td>20.6</td>
<td>1.4</td>
<td>0.017 S</td>
</tr>
<tr>
<td>IM(Vertical)</td>
<td>25.3</td>
<td>1.1</td>
<td>23.2</td>
<td>1.8</td>
<td>0.036 S</td>
</tr>
<tr>
<td>MM(lingual)</td>
<td>40.5</td>
<td>2</td>
<td>36.6</td>
<td>1.1</td>
<td>0.025 S</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control Mean</th>
<th>Control S.D</th>
<th>Down's Mean</th>
<th>Down's S.D</th>
<th>Sig. r value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-M(canine-mol)Rt.</td>
<td>24.7</td>
<td>1.2</td>
<td>20.4</td>
<td>1.0</td>
<td>0.026 S</td>
</tr>
<tr>
<td>C-M(canine-mol)Lft.</td>
<td>24.3</td>
<td>1.1</td>
<td>20.3</td>
<td>0.8</td>
<td>0.009 S</td>
</tr>
<tr>
<td>IM(Vertical)</td>
<td>24.9</td>
<td>1.5</td>
<td>20.7</td>
<td>2.1</td>
<td>0.028 S</td>
</tr>
<tr>
<td>MM(lingual)</td>
<td>38.1</td>
<td>2</td>
<td>31.8</td>
<td>2.9</td>
<td>0.002 S</td>
</tr>
</tbody>
</table>

(P<0.05) N.S= non significant (p>0.05) , S=Significant d.f=48;

Table 5: Correlation between the maxillary and mandibular jaws in Mongolic patient

<table>
<thead>
<tr>
<th>parameters</th>
<th>maxillary jaw</th>
<th>mandibular jaw</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>male</td>
<td>female</td>
</tr>
<tr>
<td>I-C(incis-canine)</td>
<td>16</td>
<td>15.8</td>
</tr>
<tr>
<td>C-M(canine-mol)</td>
<td>22</td>
<td>21.5</td>
</tr>
<tr>
<td>MM</td>
<td>43.6</td>
<td>42.1</td>
</tr>
<tr>
<td>CC</td>
<td>30.4</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 6: Arch form for Down's syndrome patient (in percentage)

<table>
<thead>
<tr>
<th></th>
<th>Narrow</th>
<th>Wide</th>
<th>Mid</th>
<th>Pointed</th>
<th>Flat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Down's</td>
<td>16</td>
<td>44</td>
<td>20</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>control</td>
<td>24</td>
<td>19</td>
<td>18</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>

Figure 2: Pie chart to define the percentage distribution of the anterior arch form of Down's syndrome patients (1;narrow , 2;wide , 3;mid , 4;pointed , 5;flat)

REFERENCES