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

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Abstract

This study is carried out to find the dental arch form for patients with Down's syndrome and to compare the lower dental arch parameters of those patients with the corresponding norms, and to gain a correlation between the upper and lower arches for the Down's syndrome patients from previous study. A total sample of 50 patients with Down's syndrome were examined with an age ranged 14-18 years, the lower 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 upper and lower arches were constructed, then dental arch measurements were carried out and evaluated. The results show that the lower arch parameters for the patients with Down's syndrome were 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 upper and lower jaws. The wide arch form is the dominated arch form while the flat is the least to appear. The conclusion of the study is that the growth pattern of dental arches in Down's syndrome patients 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 in 1866. The condition has typical physical features and multi system anomalies⁴. 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

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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 sexes.

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
- Ocular anomalies - Narrow and upward and outward slanting 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, sex 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 main aims of the present study are to compare the lower dental arch parameters of the Down's syndrome patients with the corresponding norms and to find out the dominate arch form and to gain a correlation between the upper and lower dental arches.

Materials and methods

Patient attended 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 consisted of 25 male and 25 female who fulfill 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 group¹⁴⁻¹⁵.

I. 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 used due to their recognizability:*

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 canines¹⁸.
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 molars¹⁷.
5. Premolar cusp tip (P): The buccal cusp tip of the right and left second premolars¹⁹.

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 mesiolingual cusp tip of the right and left first molars²³.
- Inter first molar distance (MM buccal): The linear distance between the mesiobuccal cusp tip of the right and left first molars¹⁷.
- Inter premolar distance (PP): The linear distance between the buccal cusp tip of the right and left second premolars²³.

2. Dental arch segmental measurement:

- Right incisal canine distance: The linear distance from the incisal point to the right canine cusp tip²⁴
- Left incisal canine distance: The linear distance from the incisal point to the left canine cusp tip²⁴.
- 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 determined by applying the approach of Raberin et al²⁶ that categorized the lower 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 lower 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 coefficients 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 ($p > 0.05$) appears 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 significant level between the Down's syndrome patient and the control group, the former shows a significant decrease ($p < 0.05$) on the posterior region as the intermolar, vertical molar distance and the canine molar distance.

There is high positive correlation between the lower and the upper jaws, from previous study¹³ which appeared obviously on table 5.

The lower jaw demonstrates all the arch forms, anteriorly, proposed by Raberin et al²⁶ 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 mentally 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, 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 CI III basal relation, All these causes jeopardized the authors to apply a data base to figure out the behaviors of the disease on the lower jaw parameters, there are different types of Down's syndrome, with wide range of variety in mental and physical anomalies⁶. It is an 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 result appear on the control group, this agreed with many results counted on norms^{25,27,28,29} 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 behavior¹⁷, these results suggested a

proportional reduced growth of the jaws in Down's syndrome with a symmetrical arch dimensions, this is true not only in lower jaw, but on the upper 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. Cohen²⁹ depend on the cellular and tissue mosaicism that enhances the different features of Down's Syndrome in which there are 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 fissured tongue, small teeth,etc. The control group exhibited an anticipated larger values with a significant difference in some parameters when compared with the study group in both sides of the different gender which come with the agreement of several studies^{3,13,25}. This may be attributed 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^{30,31,32}.

2. Anterior arch form:

On the other hand, it is found that the dominant arch form for those patients is the wide form which means that the vertical canine distance is relatively reduced rather than increased inter canine width, this is true when we compare the arch form with the least prevalence of dental crowding¹². Probably the dominant 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.

Conclusions

1. The Down's syndrome patients showed a smaller lower arch dimensions in all parameters when compared with the control group in both genders.
2. The upper jaw showed a higher value and overlaps the lower arch with a positive correlation.
3. The growth pattern of dental arches is proportionally reduced when compared with those of norms, with a symmetrical configuration.
4. The wide arch form is the dominant type for Down's syndrome patient.

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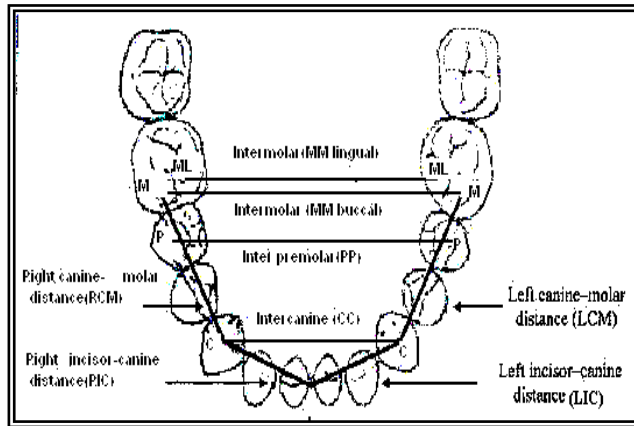


Figure 1: The lower dental arch dimension.

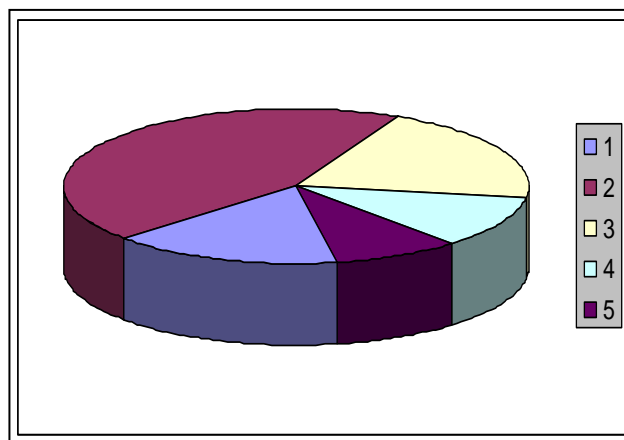


Figure 2: Pie chart to define the percentage distribution of the anterior arch form of Down's syndrome patients (1;narrow , 2;wide , 3;mid , 4;pointed , 5;flat)

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

Measurements	Male		Female	
	mean	S.D	mean	S.D
I-C(incis-canine)Rt.	13.9	0.94	13.44	0.63
I-C(incis-canine)Lft.	14	1.00	13.44	0.63
C-M(canine-mol)Rt.	20.7	1.34	20.44	1.01
C-M(canine-mol)Lft.	20.6	1.43	20.33	0.87
IC(Vertical)	5.4	1.54	5.33	1.00
IP(Vertical)	10.3	1.69	11.89	2.42
IM(Vertical)	23.2	1.84	20.78	2.17
MM(buccal)*	45.7	1.92	40.22	1.52
CC	27.4	0.91	24.00	1.22
PP	36	2.08	32.00	2.15
MM(lingual)	36.6	1.17	31.78	2.92

*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

	I-C right		I-C left		T test Reliability		C-M right		C-m left		T test Reliability	
	mean	S.D	mean	S.D	P value	Sig.	mean	S.D	mean	S.D	P value	Sig.
male	13.9	.94	14	.63	.847	NS	20.7	1.34	20.6	1.01	.709	NS
female	13.4	1.0	13.4	.63	.992	NS	20.4	1.43	20.3	.87	.883	NS

(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

	Male		Female		T test Reliability	
	mean	S.D	mean	P value	P value	Sig.
C-C	27.4	.91	24	1.22	0.042	S
M-M(lingual)	36.6	1.17	31.7	5.92	0.005	S
I-M (Vertical)	23.2	1.84	20.7	2.17	0.028	S

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

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

	Parameter	Control		Down's		T test Reliability	
		Mean	S.D	Mean	S.D	P value	Sig.
Male	C-M(canine-mol)Rt.	24.2	1.2	20.7	1.3	0.021	S
	C-M(canine-mol)Lft.	24.8	1.2	20.6	1.4	0.017	S
	IM(Vertical)	25.3	1.1	23.2	1.8	0.036	S
	MM(lingual)	40.5	2	36.6	1.1	0.025	S
Female	C-M(canine-mol)Rt.	24.7	1.2	20.4	1.0	0.026	S
	C-M(canine-mol)Lft.	24.3	1.1	20.3	0.8	0.009	S
	IM(Vertical)	24.9	1.5	20.7	2.1	0.028	S
	MM(lingual)	38.1	2	31.8	2.9	0.002	S

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

Table 5: Correlation between the upper and lower jaws in Mongolic patient

parameters	upper jaw		lower jaw		r	
	male	female	male	female		
I-C(incis-canine)	16	15.8	13.9	13.3	.979	High correlation
C-M(canine-mol)	22	21.5	20.6	20.3		
MM	43.6	42.1	36.6	31.78		
CC	30.4	30	27.4	24		

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

	Narrow	Wide	Mid	Pointed	Flat
Down's	16	44	20	11	9
control	24	19	18	19	18