Three Dimensional Study Of Dental Arches Features In Class II ,Division 2 Malocclusion Iraqi Patients
(A Cross-Sectional, Comparative study)

(Abstract)

Objective:
To estimate the dental arch features in a sample of patients with Cl II\2 malocclusion, age(11-13 years) and compare them with normals.

Material and methed:
A sample of 40 patients with Cl II\2 malocclusion were selected (14 males and 26 females),mean age 12.5±1.4 years. Study models had been prepared .43 individuals with Cl I occlusion (17 males and 26 females) mean age 12.1±1.6 years used as a control group. Total of 15 variables were examined and 3 dimensional planes measurements had been established for both groups.

Results:
A comparison between both groups showed that patients with Cl II\2 malocclusion had narrower upper and lower dental arches, shorter and more crowded anterior teeth, smaller apical base($p<0.05$)

Introduction:

Class II ,division 2 malocclusion compromise the unique combination of deep overbite, retroclined incisors, Class II skeletal discrepancy, high lip line with strap-like activity of ,and active mentalis muscle. Class II , division 2 malocclusion it is of special interest because of the gingival injury often seen in the upper and lower anterior area (TM Walkow and S Peck,2002). Facial esthetics is often problematic due to the prominent chin, deep labiomental fold , nose prominence and decreased distance between chin and nose that all together contribute to a concave face with an aged appearance (JP Xu and PM Shen,2005). A further feature of Class II.division 2 syndrome is a tendency to a forwardly rotating mandibular development, which contribute to the deep bite, chin prominence, and reduced lower face height. This last feature.in turn, has an influence in the position of lower lip relative to the upper incisors,and an increase in masticatory muscle force (T Uysal et al.,2005) .Class II , Division 2 malocclusion in the typical form the upper central incisors have a palatal tipping , whereas the laterals present a labial tipping often overlapping the centrals. In another variation the upper central and lateral incisors present palatal tipping and the canines are displaced labially. There is also another subtype of malocclusion where there is palatal tipping of all upper six anterior teeth upper curve of spee is reversed , the deep bite is very severe and the vertical dimension is extremely decreased (Fulya Isik et al.,2006). There is also traumatic occlusion at the palatal mucosa behind the upper incisors as well as at the vestibular gingiva of lower incisors. The most important characteristic of this malocclusion is the high position of lip line (stomion) on the sagittal level in relation to upper incisors . Heredity seems to play an important role in the development of class II, Division 2 malocclusion and this may be expressed through the skeletal background , muscles or dental occlusion .The palatal tipping of

upper incisors is the result of muscles acting on their crowns following their eruption in the oral cavity increased vertical development of the anterior maxilla, the floor of the nose and the lateral walls of the nasal cavity (M. R. Freitas *et al.*,2008).

Aim of study:

Aim of this study was to evaluate the dentoalveolar characteristics of patients with Class II, Division 2 malocclusion and to find possible characteristic differences from a population with normal Class I occlusion.

Material and method :

Clinical examination of 125 untreated Iraqis with Class II (skeletal and/or dental) malocclusion at age (11-13) attended to the specialized centre of orthodontics. All patients were at permanent dentition stage . Only 40 patients were included in this study (14 males and 26 females), mean age(12.5±1.4 years) who had a clinical diagnosis of angle Class/ 2 malocclusion. Upper and lower impression were taken for each one and study model have been prepared .

Inclusion criteria for Cl II/2 malocclusion:

1. Full permanent dentition except 3rd molar.
2. Cl II molar/or canine relationship.
3. retroclination of upper incisors, at least the 2 central incisors.

Exclusion criteria

1. medically compromised patients.
2. history of trauma or congenital malformation of craniofacial bones.
3. history of previous orthodontic treatments.

The control group include normal and healthy subjects presented to the centre of orthodontic with Cl II skeletal and /or dental occlusion matching age of patient group. Only 43 subjects were included in the current study(17 males and 26 females),mean age(12.1±1.6years).

Criteria for selection of this group are the followings:

1. bilateral Cl II molar and/or canine relationship.
2. Full permanent dentition except 3rd molar
3. Normal over jet and overbite.
4. no cross bite or transverse anomalies.

Measurements:

Three dimensional (three planes) measurements sagittal,vertical and horizontal measurements have been carried out on the study models of both groups using the following 15 variables:

1.Upper intermolar width : distance between the mesiobuccal cusp tips of first upper molars (or of their approximate tips in case of dental wear) (Buschang et al. , 1994) (Fig. 1)

2.Upper interpremolar width : distance between the buccal cusp tips of first upper premolars (Howes, 1947) (Fig.1)

1. Upper intercanine width : distance between the cusp tips of upper canines (Buschang *et al.*, 1994) (Fig. 1)

2. Upper arch length (Nance) : sum of right and left distances from the mesial anatomical contact point between first upper molar and second premolar to the contact point of upper central incisors or to the middle of the distance between the upper central incisors in the case of diastema (Nance , 1947) (Fig.1)

3. Upper arch irregularity index : total displacement of anatomical contact points of the six upper anterior teeth (Little , 1975) (Fig. 2)

4. Palatal height: the distance at the midpalatal suture between the palate and constricted line passing from the central fossa of 1st upper molar(Korkhaus,1939)(fig.3).

5. Upper arch depth : the intermediate of a triangle whose apex (B) is defined as the most lingual point of the buccal gingival surface of upper central incisors and its base the maximum width (AL) at the area of first upper molars , which is calculated according to the formula :

$\sqrt{(AB)^{2\cdot}/2(BL)^2/2-(AL)^2/4}$ (DeKock , 1972)

6. Upper apical base length : the length of an constructed line starting at the level of the mesial surface of permanent first upper molar at an 8 mm distance above the papilla and continuing at the same level up to the mesial surface of the same tooth on the contralateral side (Rees, 1953) (Fig.5) .

7. Lower intermolar width : distance between the mesiobuccal cusp tips of first lower molars. (Buschang et al., 1994) (Fig.6).

8. Lower interpremolar width: distance between the buccal cusp tips of first lower premolars (Howes, 1947) (Fig.6).

9. Lower intercanine width: distance between the cusp tips of lower canines (Buschang et al.1994). (Fig.6)

10. Lower arch length (Nance): Sum of right and left distances from the mesial anatomical contact point between lower first molar and second premolar to the contact point of lower central incisors or to the middle of the distance between them in the case of diastema (Nance, 1947) (Fig.6).

11. Lower arch irregularity index: Total displacement of anatomical contact points of the six lower anterior teeth (Little,1975) (Fig. 2).

12. Lower arch depth: the intermediate of a triangle whose apex (B) is defined as the most lingual point of the buccal gingival surface of lower central incisors and its base as the maximum width (AL) at the area of first mandibular molars which is calculated based on the formula.

$\sqrt{(AB)^2/2(BL)^2/2-(AL)^2/4}$ (Dekock , 1972) (Fig.7)

13. Lower apical base length : the length of a constructed line starting at the level of the mesial surface of the first permanent lower molar at a distance of 8mm above the papilla and continuing at the same level up to the mesial surface of the same tooth on the contralateral side (Rees, 1953) (Fig.5).

The insruments that used to perform the measurements above were the following:(1) copper wire for the estimation of apical base lengths, (2) a compass for all other dimensions (variables), and (3) a ruler. Measurement were accurate at the 0.5 mm level .

Measurement results were analyzed by means of SPSS 15.0 program . Mean values and standard deviations were estimated for all variables. Student t-test was applied to investigate differences in the mean values of variables between patient and control groups . ($p<0.05$) .

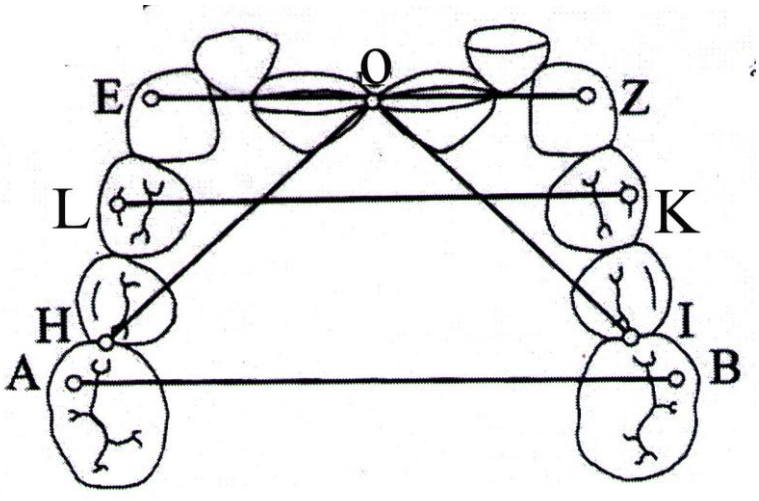

Figure 1 . Measurements preformed in the upper dental arch AB: intermolar width LK: interpremolar ,EZ: inter caninewidth ,HO + OI : dental arch length (Nance .1947)

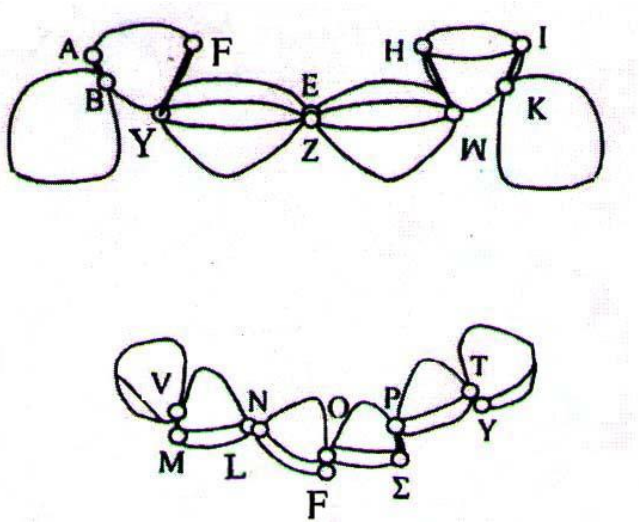

Figure 2. Little's upper arch irregularity index (AB + FY+EZ+HW+IK) and lower arch irregularity index (VM+NL+OF+P∑+TY)

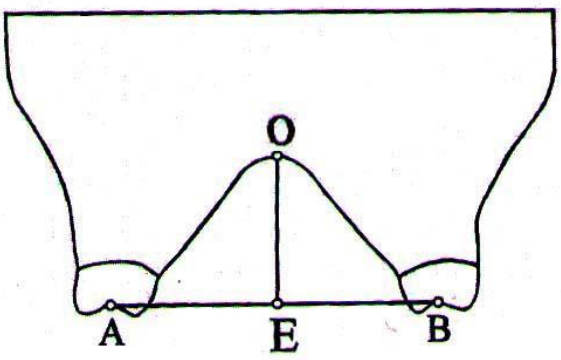

Figure 3. Palatal height OE

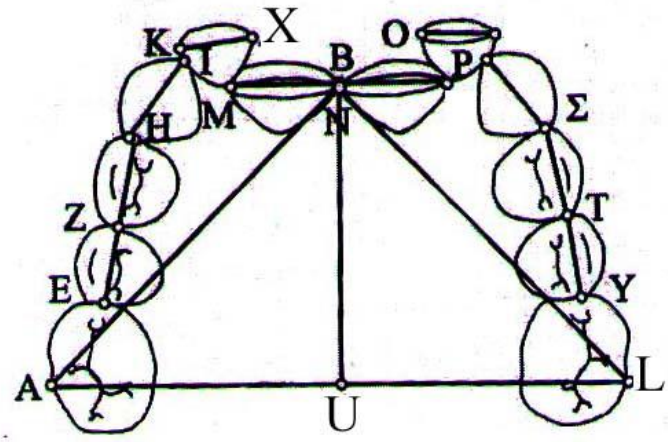

Figure 4. Upper dental arch depth BU

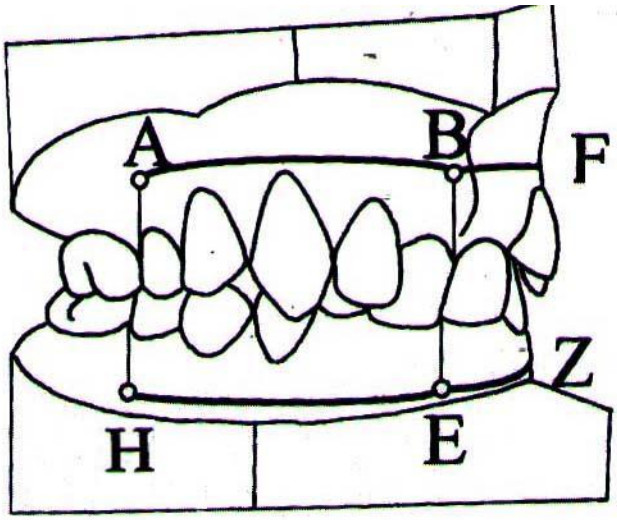

Figure 5. Upper apical base length AB + BF and lower apical base length HE + EZ (Rees , 1953)

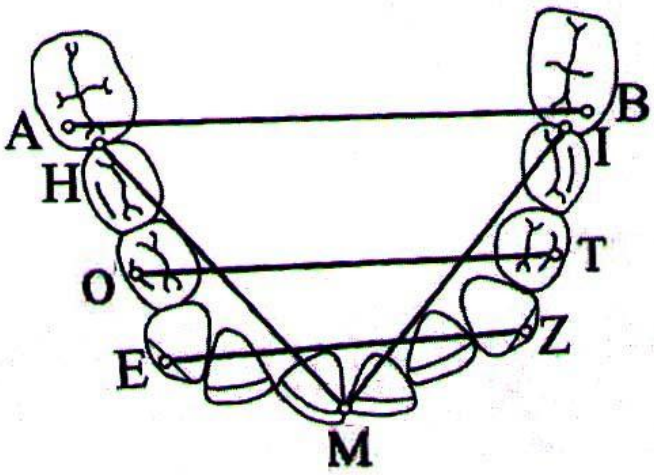

Figure 6. Measurement performed in the lower dental arch AB: intermolar width OT: interpremolar width EZ : intercanine width , HM+MI : dental arch length (Nance.1947).

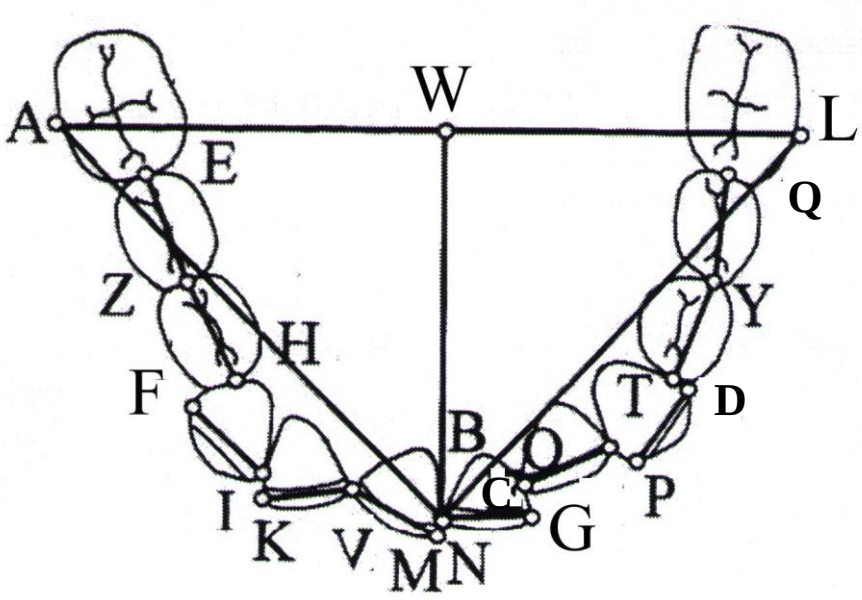

Figure 7 Lower dental arch depth BW (Dekock , 1972)

Results:

The following statistically significant results were observed :

(a) Comparison between individuals Class II , Division 2 malocclusion and subjects with Class I occlusion showed that the first ones presented , in the upper dental arch and maxilla, smaller intermolar , interpremolar and intercanine widths , length (Nance) and depth of dental arch as well as apical base length , whereas they presented a higher upper arch irregularity index (Table 1).

(b) Individuals with Class II , Division 2 malocclusion presented , in the lower dental arch and mandible , smaller intermolar , interpremolar and intercanine widths , smaller dental arch length (Nance) and depth as well as smaller apical base length . They also presented a higher lower arch irregularity index compared to subjects with Class I occlusion (Table 1).

(c) Boys with Class II , Division 2 malocclusion presented , in the upper dental arch and maxilla , smaller intermolar , interpremolar and intercanine widths , smaller apical arch length (Nance) and depth as well as smaller apical base length . They also presented a higher upper arch irregularity index compared to boys with Class I occlusion (Table 2).

(d) Boys with Class II , Division 2 malocclusion presented , in the lower dental arch and mandible , smaller dental arch length (Nance) and depth as well as smaller apical base length . They also presented a higher lower arch irregularity index compared to boys with Class I occlusion (Table 2).

(e) Girls with Class II , Division 2 malocclusion presented , in the upper dental arch and maxilla, smaller intermolar and interpremolar widths, smaller dental arch length (Nance) and depth as well as apical base length , whereas they presented a higher upper arch irregularity index in comparison to girls with Class I occlusion (Table 3)

(f) Girls with Class II, Division 2 malocclusion presented , in the lower dental arch and mandible , smaller apical base

length and a higher a lower arch irregularity index in comparison to girls with Class I occlusion (Table 4.).

(g) Comparison for any differences between the two sexes showed that boys with Class II , Division 2 malocclusion in relation to girls with the same malocclusion presented , in the upper dental arch and maxilla , greater intermolar and interpremolar widths , whereas in the lower dental arch and mandible they presented greater intermolar width greater apical base length . (Table 4).

Table 1. Measurements of upper and lower dental arches and respective apical bases in patients with Class II , Division 2 malocclusion and the control group .

Measurements	**Patients N=40**		**Control N=43**		**Significance**
	XI	**S.D.**	**X2**	**S.D.**	**P**
Upper intermolar width	47.5	2.3	51.3	2.4	***
Upper interpremolar width	38.8	2.1	42.5	1.8	***
Upper intercanine width	32.6	2.5	34.4	1.5	***
Upper arch length (Nance)	65.4	3.8	69.4	2.9	***
Upper arch irregularity index	10.7	3.9	1.9	1.7	***
Upper arch depth	34.1	2.9	35.3	2.0	*
Palatal height	17.5	1.4	17.1	1.9	NS
Upper apical base	76.9	3.9	82.5	3.3	***
Lower intermolar width	42.8	2.9	44.8	2.1	***
Lower interpremolar width	31.9	1.9	34.8	1.5	***
Lower intercanine width	25.7	1.9	26.9	1.2	***
Lower arch length (Nance)	59.6	2.3	61.4	2.8	**
Lower arch irregularity index	27.9	2.5	29.5	2.8	**
Lower arch depth	28.9	2.1	31.2	2.7	***
Lower apical base	64.8	3.6	77.1	2.9	***

NS= Not significant
*: (P< 0.05)
** : (P<0.01)
*** : (P<0.001)

Table 2. Measurements of upper and lower dental arches and respective apical bases in males with Class II , Division 2 malocclusion and males with Class I occlusion .

Measurements	**Patients N=14**		**Control N=17**		
	XI	**S.D.**	**X2**	**S.D.**	**P**
Upper intermolar width	51.6	2.4	54.3	1.2	***
Upper interprmolar width	39.8	2.2	42.9	1.3	***
Upper intercanine width	33.6	2.3	35.9	1.6	**
Upper arch length (Nance)	66.1	4.2	74.1	2.3	***
Upper arch irregularity index	11.9	2.7	1.4	1.3	***
Palatal height	18.1	1.3	17.1	1.4	NS
Upper arch depth	29.9	1.5	33.5	1.2	***
Upper apical base	79.8	3.1	85.2	3.2	***
Lower intermolar width	44.9	2.1	45.7	1.3	NS
Lower interpremolar width	34.8	2.1	35.9	1.7	NS
Lower intercanine width	25.9	1.4	26.9	1.7	NS
Lower arch length (Nance)	58.2	2.7	62.5	2.8	***
Lower arch irregularity index	4.8	3.2	2.1	0.7	***
Lower arch depth	27.6	1.5	31.9	2.7	***
Lower apical base	74.2	2.3	78.2	3.3	***

NS= Not significant
** : ($P<0.01$)
*** : ($P<0.001$)

Table 3. Measurements of upper and lower dental arches and respective apical bases in females with Class II , Division 2 malocclusion and females with Class I occlusion.

Measurements	**Patients N=26**		**Control N=26**		
	XI	**S.D.**	**X2**	**S.D.**	**P**
Upper intermolar width	47.9	3.3	52.27	3.7	***
Upper interprmolar width	37.2	2.9	41.9	2.7	***
Upper intercanine width	34.3	2.9	34.9	1.9	NS
Upper arch length (Nance)	65.7	4.2	69.3	3.2	**
Upper arch irregularity index	10.6	3.8	34.2	1.6	***
Palatal height	18.1	1.6	18.7	2.3	NS
Upper apical base	76.8	3.9	81.5	3.2	***
Lower intermolar width	44.5	2.8	45.6	2.1	NS
Lower interpremolar width	31.5	2.6	33.1	2.1	NS
Lower intercanine width	26.9	1.5	27.9	1.5	NS
Lower arch length (Nance)	57.6	2.9	58.8	2.6	NS
Lower arch irregularity index	3.9	2.8	1.9	1.3	**
Lower arch depth	27.6	2.9	28.4	2.4	NS
Lower apical base	89.2	2.7	75.3	2.8	**

NS= Not significant
** : (P<0.01)
*** : (P<0.001)

Table 4. Measurements of upper and lower dental arches and respective apical bases in males and females with Class II , Division 2 malocclusion .

Measurements	Patients N=14		N=14		
	XI	**S.D.**	**X2**	**S.D.**	**P**
Upper intermolar width	51.9	2.1	47.3	2.7	***
Upper interprmolar width	39.7	2.2	42.1	2.3	***
Upper intercanine width	33.3	2.6	32.3	2.9	NS
Upper arch length (Nance)	64.6	4.8	63.9	4.5	NS
Upper arch irregularity index	11.9	3.3	101.0	4.3	NS
Palatal height	18.5	1.3	17.2	1.5	*
Upper arch depth	32.1	1.5	31.9	2.7	NS
Upper apical base	82.4	3.6	79.9	4.2	NS
Lower intermolar width	45.1	2.8	42.3	2.3	**
Lower interpremolar width	33.4	2.1	32.9	2.6	NS
Lower intercanine width	25.6	1.3	24.9	1.6	NS
Lower arch length (Nance)	58.6	2.4	57.9	3.4	NS
Lower arch irregularity index	4.9	3.9	4.2	3.3	NS
Lower arch depth	27.3	2.1	278.6	3.8	NS
Lower apical base	73.8	2.1	69.5	2.9	***

NS= Not significant
*: (P< 0.05)
** : (P<0.01)
*** : (P<0.001)

Discussion :

The relevant literature is insufficient because of the limited number of related studies and due to the fact that studies do not include several variables describing these differences . for this reason 15 measurements in all three planes were performed aiming at describing as fully as possible these special characteristics .

The smaller intermolar, interpremolar and intercanine widths of both dental arches my be attributed to four reasons : (a) the anterior position of the upper dental arch (Swann and Calgary , 1954) while the lower dental arch simply follows the upper one , (b) the reduced length of upper and lower apical bases, (c) the increased function of the lips and buccinators muscle , and (d) the combination of factors mentioned above. The smaller length (according to Nance) and depth of the upper dental arch may be explained by the palatal inclination of upper central incisors and the crowding of upper anterior , whereas the smaller length (according to Nance) and depth of the lower dental arch may be attributed to the crowding of lower anterior . The higher values of Little's irregularity index in both dental arches may be due to increased lip function or to the fact that in Class II , Division 2 malocclusion the lower facial height is reduced and there is an anterior mandibular rotation . The deterioration of malocclusion with age is due to a progressively increasing anterior mandibular rotation because of unfavorable activity of the masticatory muscles .

Our findings are in agreement with the ones of Toutountzakis (1989) concerning the intermolar width of the upper dental arch. Our findings are also in agreement with the ones of Mitchell and Carter (1996) and Graber (1972) concerning crowding .The results of this study showed that individuals with Class II, Division 2 malocclusion compared to subjects with Class I occlusion present a generalized constriction of both dental arches (smaller arch width and length

according to Nance), more crowding in the upper and lower anterior areas as well as in their apical bases. This constriction may be due to genetic or environmental factors. Lundstrom (1984) and Harris and Smith (1980, 1982) reported that the length , width and crowding of dental arches are influenced by genetic and acquired factors .

Factors causing the constriction of dental arches , at least in width , are probably influencing the area below the most prominent points of the zygomatic arches, where the measurement of facial width was performed , and therefore , a generalized reduction of facial dimensions does not exist . Except for the absence of a generalized narrowing of the face in these malocclusions , no other conclusion may be drawn about the relationship between facial dimensions and dental arch width as there are contradictory views concerning their degree of correlation (J Huth et al.,2007)

The muscular factor seems to contribute significantly to the constriction of dental arches and their apical bases . It is well known that , in general , there is an interaction between form and function of osseous structures, but it is difficult to explain how this occurs (Proffit , 1991) . Growth of the craniofacial complex seems to be influenced more by soft tissues in rest position rather than muscle contractions and jaw movements (Proffit , 1991) .Proffit claimed that the forces exercised by soft tissues in rest position , although low (5-15gm) , are able to cause tooth movement and remodeling of alveolar processes . Teeth are positioned within the alveolar processes in a state of equilibrium due to forces exercised both by the lips and the tongue , but this equilibrium is unstable . In some areas tongue pressure is lower , whereas in other areas it is higher than lip pressure **(**H Devreese et al.,2007) .

Conclusions :

The results of this study show that patients with Class II , Division2 malocclusion present several important differences concerning their dental arches compared to people with Class I occlusion . The statistically significant differences were : (a) smaller upper and lower intermolar , interpremolar and intercanine widths . (b) smaller upper and lower dental arch lengths (according to Nance) . (c) a higher value for Little's irregularity index in both dental arches , and (e) smaller length of upper and lower apical bases .

References :

1. TM Walkow and S Peck Dental arch width in Class II Division 2 deep-bite malocclusion. Am J Orthod Dentofacial Orthop, December 1, 2002; 122(6): 608-13.
2. JP Xu and PM Shen [Study on the dental arch width in Class II malocclusion]Shanghai Kou Qiang Yi Xue, December 1, 2005; 14(6): 597-600.
3. T Uysal, B Memili, S Usumez, and Z Sari Dental and alveolar arch widths in normal occlusion, class II division 1 and class II division 2.Angle Orthod, November 1, 2005; 75(6): 941-7.
4. Fulya Isik, Didem Nalbantgil, Korkmaz Sayinsu and Tülin Arun.A comparative study of cephalometric and arch width characteristics of Class II division 1 and division 2 malocclusions The European Journal of Orthodontics 2006 28(2):179-183; doi:10.1093/ejo/cji096
5. M. R. Freitas, D. V. Lima, K. M. S. Freitas, G. Janson and J. F. C. Henriques.Cephalometric evaluation of Class II malocclusion treatment with cervical headgear and mandibular fixed appliances The European Journal of Orthodontics 2008 30(5):477-482; doi:10.1093/ejo/cjn039
6. Buschang PH , Stroud J , Alexander RG. Differences in dental morphology among adult females with untreated Class I and Class II malocclusion . Eur J Orthod 1994:16:47-52 .

7. Dekock WH. Dental arch depth and width studied longitudinally from 12 years of age to adulthood . Am J Orthod 1972: 62:56-66.
8. Graber TM. Orthodontics , Principles and Practice . Philadelphia : WB Saunders . 1972:240-6.
9. Harris EF, Smith RJ. A study of occlusion and arch widths in families Am J Orthod 1980:79:155-63.
10. Howes AE. Case analysis and treatment planning based upon the relationship of the tooth material to its supporting bone . Am J Orthod Oral Surgery 1947: 33:499-533 .
11. Little RM . The irregularity index : A quantitative score of mandibular anterior alignement . Am I Orthod 1975:68:554-64.
12. Lundstrom A. Nature versus nurture in dentofacial variation . Eur J Orthod 1984:6:77-91.
13. Mitchell L, Carter NE . An lntroduction to Orthodontics . Oxford Oxford University Press , 1996:104-13 .
14. Nance HN. The limitation of orthodontic treatment : Diagnosis and treatment in the permanent dentition . Am J Orthod Oral Surgery 1947:33:225-301 .
15. Proffit WR. Muscle pressures and tooth position : findings from studies of North American Whites and Australian Aborigines. Angle Orthod 1991:45:1-11 .
16. Rees DJ. A method for assessing the proportional relation of apical bases and contact diameters of the teeth. Am J Orthod 1953:39:695-9.
17. Swann GC. The diagnosis and interception of Class II, division 2 malocclusion, Am J Orthod 1954:40:325-40 .
18. J Huth, RN Staley, R Jacobs, H Bigelow, and J Jakobsen Arch widths in class II-2 adults compared to adults with class II-1 and normal occlusion.Angle Orthod**,** September 1, 2007; 77(5): 837-44.
19. H Devreese[*], G De Pauw[*], G Van Maele[**], AM Kuijpers-Jagtman[***] and L Dermaut[*]

Stability of upper incisor inclination changes in Class II division 2 patients The European Journal of Orthodontics 2007 29(3):314-320; doi:10.1093/ejo/cjm011