International Journal of Applied Dental Sciences 2019; 5(3): 19-24

ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2019; 5(3): 19-24

www.oraljournal.com
Received: 21-05-2019
Accepted: 03-06-2019

Inass Al Darwish
Orthodontic Department, Hama University, Faculty of Dentistry, Hama City, Syria

Hassan Farh
Orthodontic Department, Hama University, Faculty of Dentistry, Hama City, Syria

Correspondence
Inass Al Darwish
Orthodontic Department, Hama University, Faculty of Dentistry, Hama City, Syria

Assessment of maxillary and mandibular dental arches dimensions in down's syndrome children using digital study models

Inass Al Darwish and Hassan Farh

Abstract
Aims: The purpose of this study was to assessment of maxillary and mandibular dental arches dimensions in Down's Syndrome children (8-10) years using digital study models.
Materials and Methods: The study sample consisted of 30 patients (8-10) years, divided into two groups (Down's Syndrome Children Group) and (Control Group), each group consisted of 15 patients, after impressions were taken by putty impression materials, they casted and the study models have been prepared, then the plaster models have been scanned by the scanner (Identica Hybrid scanner), and obtained the digital dental models for all patients. 3Shape Software was used to view and measure these digital models. Maxillary and mandibular dental arches dimensions were measured (Intercanine width, intermolar width, dental arch length, dental arch depth), and the extracted data were analyzed using (Independent-Samples T-Test) by SPSS® v.20.
Results: this study shows statistically significant differences between the two groups in all maxillary and mandibular dental arches dimensions (P <0.05) except (mandibular dental arch length, mandibular dental arch depth) where this study didn't find any statistically significant differences between the two groups.
Conclusions: Based on this study, we found that the measurements of maxillary and mandibular dental arch dimensions were statistically smaller in down's syndrome children.

Keywords: Down's syndrome children, digital dental models, maxillary dental arch dimensions, mandibular dental arch dimension

Introduction
Down syndrome (DS), also known as trisomy 21, is one of the most common genetic abnormalities, described for the first time by John Langdon Down in 1866, and Down's Syndrome patients have 47 chromosomes instead of 46 chromosomes which exist in normal people [13, 18].
The most frequent craniofacial characteristics observed among DS children are reduction of cranial size and flattened cranial base, midface hypoplasia with deviations in shape, size and/or position of the maxilla and mandible, high palate, protruding and hypotonic tongue, narrowed oropharynx, as well as dental anomalies of number and shape are also observed(Quintanilla *et al*., 2002) (A. C. Oliveira, Pordeus, Torres, Martins, & Paiva, 2010), Oliveria and his colleagues found an increase in the prevalence of anterior cross bite (33%), posterior cross bite (31%), and open anterior bite (21%) in 100 people with down syndrome [11].

Dental Arch Width: Most of the studies in the literature compare dental arch widths of Class II patients with the normal occlusion samples. Some of them indicate that absolute arch widths of children with malocclusion did not differ appreciably from those with normal occlusion. However, in other studies, statistically significant differences were determined in dental width measurements of Class II patients, Braun *et al.* indicated that the mandibular dental arches associated with Class III malocclusions are wider than the Class I mandibular arches beginning in the premolar area. In addition, they found that Class III maxillary dental arch widths are larger than the Class I widths. This begins in the lateral incisor–canine area and proceeds distally [17].

Dental Arch Length: The length of the primary dental arch was obtained by measuring the distance from the midportion of the labial surfaces of the primary central incisors to the distal surfaces of the primary second molars, In the mixed phase, the length of the dental arch was measured from the point of contact of the central incisors in the front to the point of the anterior contact of the first permanent molar in the posterior, after permanent teeth had replaced primary ones then the measurements were made from the labial surfaces of the permanent central incisors to the distal surfaces of the permanent second premolars [2].

Dental Arch Depth: Speck studied the depth of the dental arch using the photographing oriented plaster casts on a group of 49 people from the time the deciduous denture was completed until the permanent first molars, incisors, and canines, The depth of the total dental arch was decreased when moving from the deciduous denture to the mixed denture, as well as it decreased when moving from the mixed denture to the permanent denture [15].

Orthodontic Diagnosis: Recent advancements in technology have led to the development of three-dimensional (3D) digital models, 3D imaging systems are especially favorable for patients with craniofacial syndromes and anomalies such as down syndrome and cleft lip and palate (CLP). This patient group is frequently treated for a long period starting in infancy and not finishing until adulthood, undergoes several surgeries, and requires treatment from specialists of several disciplines or, in other words, interdisciplinary approaches [12]. The concept of virtual study models is not new. Various methods have been employed to transform study models into a digital format. In 1989 *Yamamoto et al.* [19] described an optical method for creating three-dimensional computerized models using a laser beam on a cast. Since then, software development has refined this approach dramatically, and digital models have become commercially available. Plaster models are prone to degradation and breakage, whereas 3D digital models are more appealing to practitioners due to their simplicity with regard to storage and retrieval, maintenance, and rapid access of data. Furthermore, practitioners are able to analyze digital models and instantly formulate treatment planning [20]. Individuals with Down syndrome (DS) or trisomy 21, notably a syndrome exhibiting high prevalence of malocclusion, require special orthodontic care and treatment, In general the analysis of study models of DS patients is a demanding task for the orthodontist and accurate orthodontic diagnosis and analysis of studying models of Down syndrome patients is a necessary task for proper treatment planning [9]. For this reason, the aim of this study is to assessment of maxillary and mandibular dental arches dimensions in Down's Syndrome children (8-10) years using digital study models.

Materials and Methods

The study sample consisted of 30 patients (8-10) years, divided into two groups (Down's Syndrome Children Group) and (Control Group), each group consisted of 15 patients, after impressions were taken by putty impression materials (Zhermack© SPA, Polesine (RO), Italy) they casted and the study models have been prepared, then the plaster models have been scanned by the scanner (Identica Hybrid scanner) Of the production company (Medit corp, Seoul, Kore) which designed to scan a wide range of dental models and impressions for fast and accurate data and with some of the fastest scanning speeds in the world, a full arch can be scanned in only 16 seconds.

3 Shape Software (3Shape A/S • Holmens Kanal, Copenhagen K Denmark) was used to view and measure these digital models, is a computer program allows the orthodontist to study the three-dimensional digital models resulting from the laser scanning of the plaster casts of orthodontic patients and to perform the dental analyzes necessary to diagnose the case.

Table 1: Variables measured

Variable	Parameter description
Maxillary	
Upper Intercanine Width (UC-W)	distance from cusp to cusp [7]
Upper Intermolar Width (UM-W)	distance between the deepest points of the fossae of the first permanent molars [7]
Upper Arch Length (UA-L)	the distance from the mesial contact point of the first permanent molar in the posterior to the point of contact of the central incisors in the anterior (calculated for the right and left sides and then divided by 2) [8]
Upper Arch Depth (UA-D)	The vertical dimension extending from the more buccal contact point of the central incisors in the anterior to the line that connects the mesial contact points of the first permanent molar (reference line) [6]
Mandibular	
Lower Intercanine Width (LC-W)	distance from cusp to cusp [7]
Lower Intermolar Width (LM-W)	distance between the mediobuccal cusp tips of the first permanent molars [7]
Lower Arch Length (LA-L)	the distance from the mesial contact point of the first permanent molar in the posterior to the point of contact of the central incisors in the anterior (calculated for the right and left sides and then divided by 2) [8]
Lower Arch Depth (LA-D)	The vertical dimension extending from the more buccal contact point of the central incisors in the anterior to the line that connects the mesial contact points of the first permanent molar (reference line) [6]

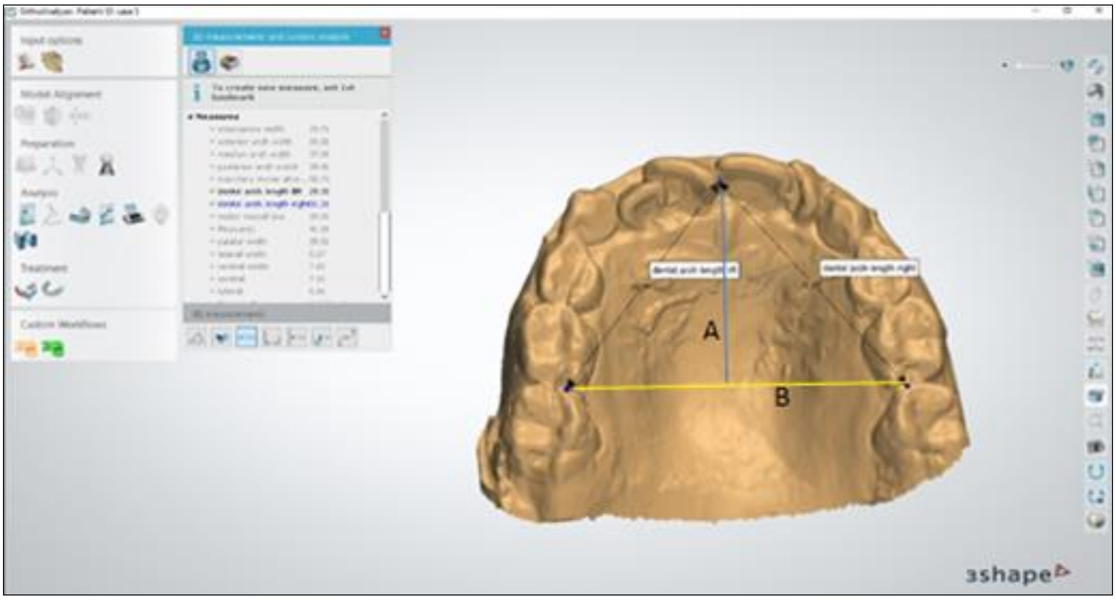

Fig 1: A: upper Intercanine width B: upper Intermolar width

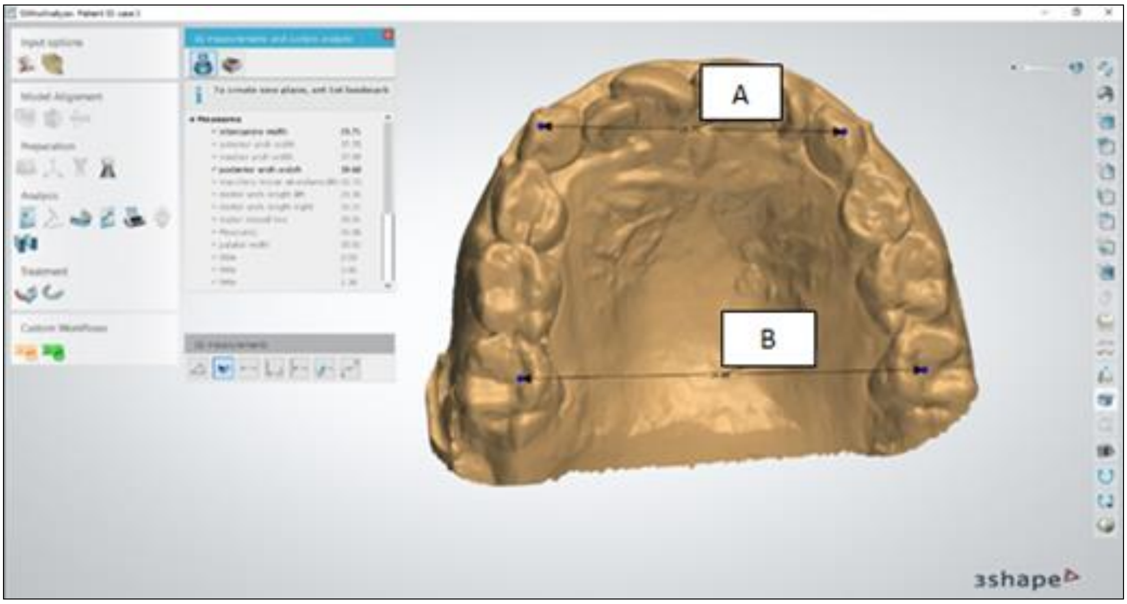

Fig 2: Upper arch length (left & right). A: upper arch depth, B: reference line

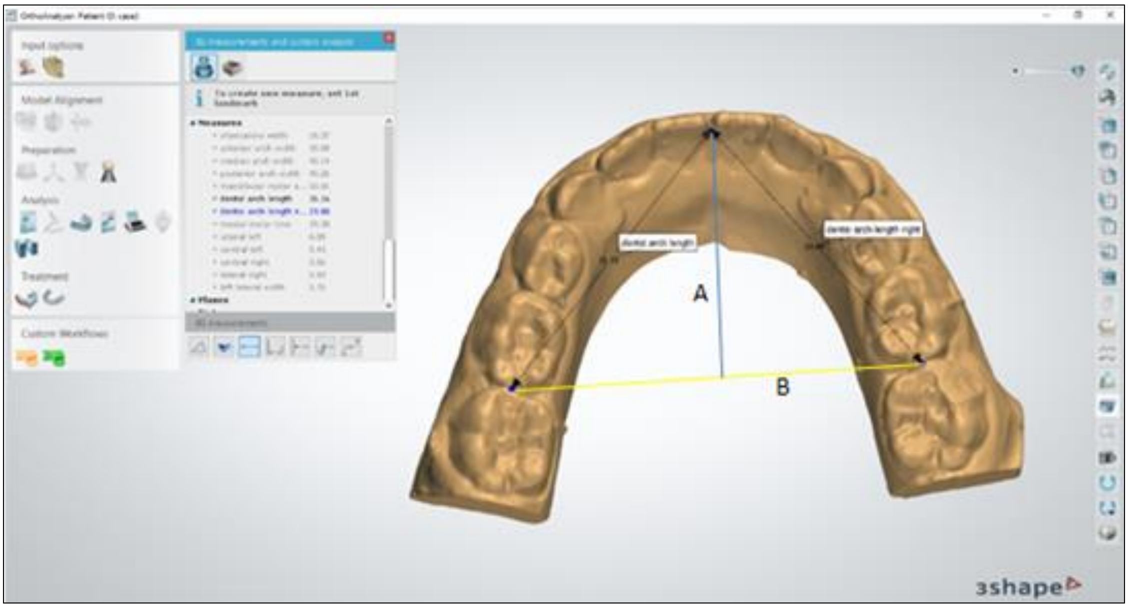

Fig 3: A: lower Intercanine width B: lower Intermolar width

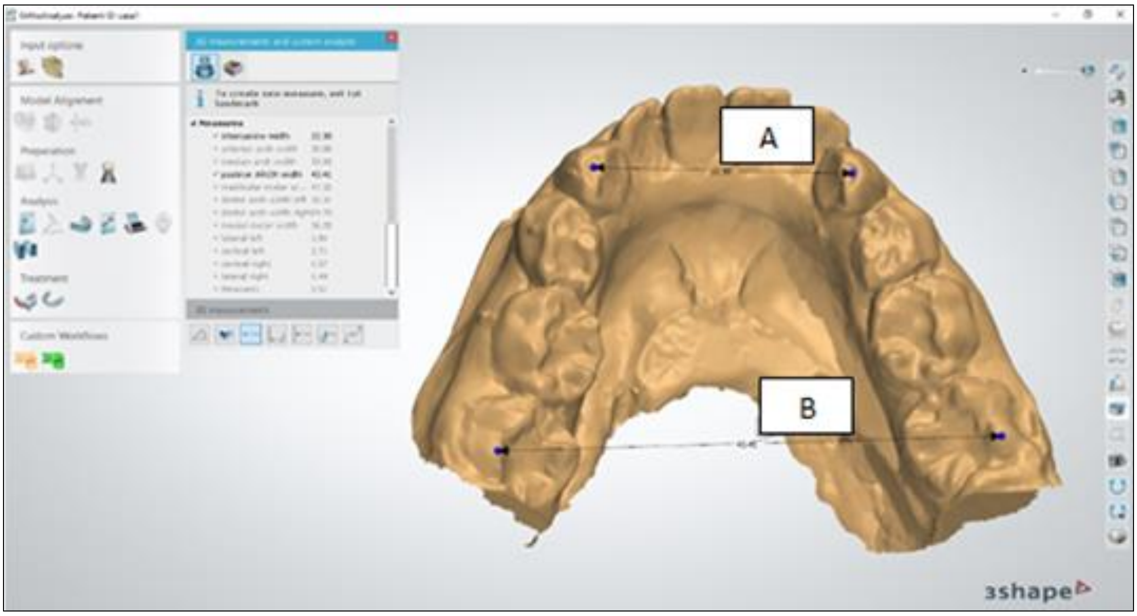

Fig 4: lower arch length (left & right). A: lower arch depth, B: reference line

Results

Tables 2 & 3 show the mean and SD values for each parameter, the graphics representation for the same values are also shown:

- (UC-W), the mean values of the study group were observed to be less than the mean values of the control and the results were found to be statistically significant.
- (UM-W): the mean values of the study group were observed to be less than the mean values of the control and the results were found to be statistically significant.
- (UA-L): the mean values of the study group were observed to be less than the mean values of the control and the results were found to be statistically significant (UA-D): the mean values of the study group were observed to be less than the mean values of the control and the results were found to be statistically significant
- (LC-W): the mean values of the study group were observed to be less than the mean values of the control and the results were found to be statistically significant.
- (LM-W): the mean values of the study group were observed to be less than the mean values of the control and the results were found to be statistically significant.
- (LA-L): there were no statistically significant differences between the two groups.
- (LA-D): there were no statistically significant differences between the two groups.

Table 2: Comparison of means and SD for study and control groups of maxillary arch measurements:

Study Group (n= 15)			Control (n= 15)		
Variable	**Mean**	**SD**	**Mean**	**SD**	**P value**
(UC-W)	29.89	1.23	33.73	1.69	P<0.05
(UM-W)	40.02	1.02	46.65	1.75	P<0.05
(UA-L)	31.76	2.19	35.50	1.25	P<0.05
(UA-D)	25.08	2.22	27.15	1.85	P<0.05

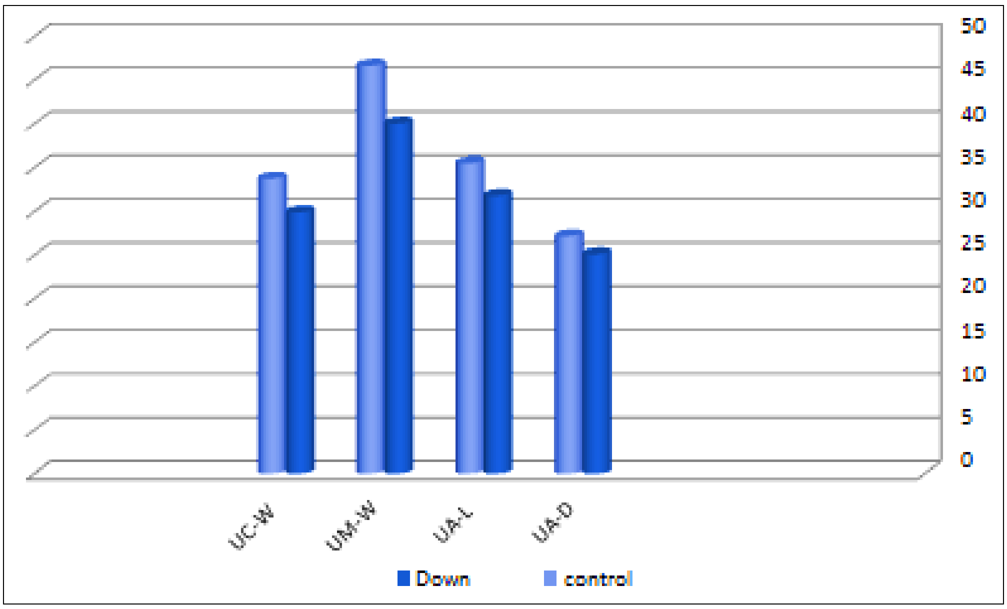

Fig 5: Comparison of means values for study and control groups of maxillary arch measurements

Table 3: Comparison of means and SD for study and control groups of mandibular arch measurements:

Study Group (n= 15)			Control (n= 15)		
Variable	**Mean**	**SD**	**Mean**	**SD**	**P value**
(LC-W)	24.32	1.83	26.51	1.48	P<0.05
(LM-W)	43.28	2.71	47.21	1.61	P<0.05
(LA-L)	30.28	1.99	31.26	1.23	P>0.05
(LA-D)	23.67	1.79	23.28	0.75	P>0.05

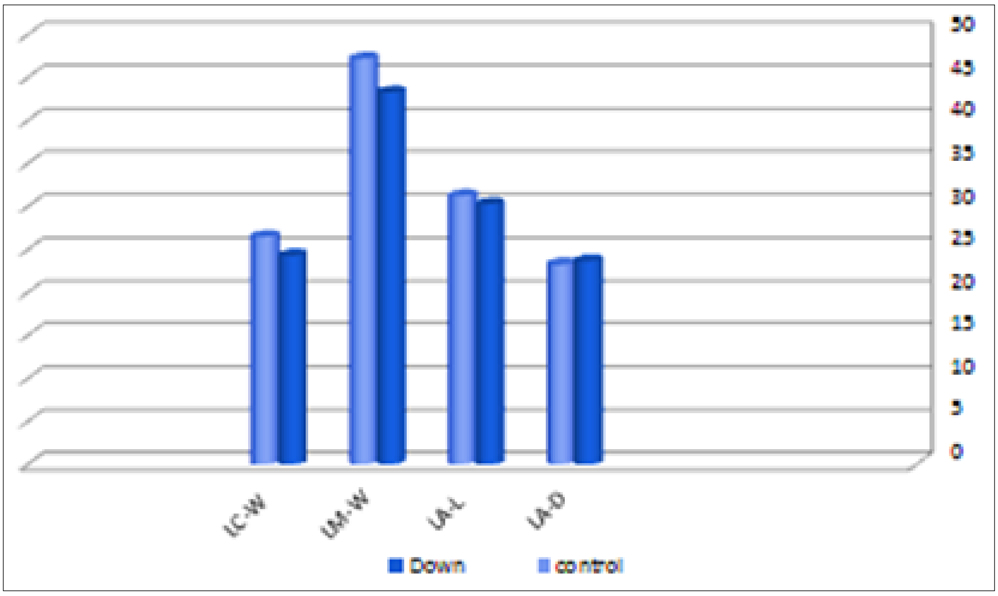

Fig 6: Comparison of means values for study and control groups of mandibular arch measurements

Discussion

The present study conducted a three-dimensional evaluation of the of maxillary and mandibular dental arches dimensions (intercanine width, intermolar width, dental arch length, dental arch depth, palatal height) in Down's Syndrome Children and compared with natural patients using 3D digital dental studies. Many researchers have conducted studies on Down syndrome patients in particular gingival and dental abnormalities (shape, number, size), oral care, and malocclusion but generally through clinical observations, However, our study focused on the diagnostic aspect of orthodontic by studying the digital dental casts and conducting the necessary analyzes to determine the correct diagnosis of the dental case, and the majority of these studies were on adult Down's syndrome patients, but we adopted the age of the participants in this study (8-10) years is the appropriate age to visit the orthodontist to detect the problems of orthodontic and treatment early because the jaw is still in growth and development. Digital dental models are increasingly accepted as an alternative to the plaster models in orthodontics, and have been used especially after many studies that have proved their accuracy, suitability and applicability as an alternative to plaster examples, such as Fleming and his colleagues **[3]** in which they systematically reviewed the subject and concluded that digital models provide a viable alternative to plaster models.

Intercanine Width: the present study found that maxillary and mandibular Intercanine width was greater in the control group, where we found significant differences and the resulting differences were clinically significant. The average difference in upper Intercanine width was (3.835mm) and the average difference in lower Intercanine width was (2.195 mm), these results are agree with the following studies: Jensen *et al.* [5] Ghaib [4], and Andersson *et al.* [1]

Intermolar Width: the present study found that upper and lower Intermolar width was greater in the control group, where we found significant differences and the resulting differences were clinically significant. The average difference in upper intermolar width was (6.637mm) and the average difference in lower Intermolar width was (3.925 mm), these results are agree with the following studies: Jensen *et al.* [5] Ghaib [4], and Andersson *et al.* [1]

Dental Arch Length: the present study found that upper arch length was greater in the control group, where we found significant differences in upper arch length (3.740 mm), these results are agree with the following studies: Jensen *et al.* [5], Ghaib [4], and Suri *et al.* [16]. Our current study did not notice significant differences in lower arch length, where the probability value P> 0.05 at 95% confidence level, and this result agree with the study of Jensen *et al.* [5]

Dental Arch Depth: The present study found that upper arch depth was greater in the control group, where we found significant differences in upper arch depth (2.071 mm), but current study did not notice significant differences in lower arch depth, where the probability value P> 0.05 at 95% confidence level, and this result is agree with the study of Andersson *et al.* [1]

Conclusions

We found that

- Maxillary in normal patients was larger in both the transverse and anterior posterior directions compared to the Down's patients, indicating that maxillary is narrowed in all directions in children with Down syndrome.
- Mandibular in normal patients was larger in the transverse direction compared to the Down's patients, indicating that mandibular is narrowed in children with

Down syndrome.

- The dimensions of mandibular in Down's children do not differ significantly in the anterior_ posterior direction compared to normal persons.

References

1. Andersson E-M, Axelsson S, Katsaris KP. Malocclusion and the need for orthodontic treatment in 8-year-old children with Down syndrome: A cross-sectional population-based study: Down Syndrome. Special Care in Dentistry. 2016; 36(4):194-200.
2. https://doi.org/10.1111/scd.12160
3. Barrow GV, White JR. Developmental changes of the maxillary and mandibular dental arches. The Angle Orthodontist. 1952; 22(1):41-46.
4. Fleming P, Marinho V, Johal A. Orthodontic measurements on digital study models compared with plaster models: A systematic review: Digital models: a systematic review. Orthodontics & Craniofacial Research. 2011; 14(1):1-16. https://doi.org/10.1111/j.1601-6343.2010.01503.x
5. Ghaib NH. Maxillary Arch Dimensions and Palatal Dimensions in Down’s Syndrome (trisomy 21). Journal of the College of Dentistry. 2003; 15:22-26.
6. Jensen GM, Cleall JF, Yip AS. Dentoalveolar morphology and developmental changes in Down’s syndrome (trisomy 21). American Journal of Orthodontics. 1973; 64(6):607-618.
7. Lindsten R, Ögaard B, Larsson E, Bjerklin K. Transverse Dental and Dental Arch Depth Dimensions in the Mixed Dentition in a Skeletal Sample from the 14th to the 19th Century and Norwegian Children and Norwegian Sami Children of Today. The Angle Orthodontist. 2002; 72(5):439-448.
8. Lippold C, Kirschneck C, Schreiber K, Abukiress S, Tahvildari A, Moiseenko T *et al*. Methodological accuracy of digital and manual model analysis in orthodontics - A retrospective clinical study. Computers in Biology and Medicine. 2015; 62:103-109. https://doi.org/10.1016/j.compbiomed.2015.04.012
9. Nance HN. The limitations of orthodontic treatment. American Journal of Orthodontics and Oral Surgery. 1947; 33(4):177-223. https://doi.org/10.1016/0096-6347(47)90051-3
10. Nawi N, Mohamed AM, Marizan Nor M, Ashar NA. Correlation and agreement of a digital and conventional method to measure arch parameters. Journal of Orofacial Orthopedics/Fortschritte Der Kieferorthopädie. 2018; 79(1):19-27. https://doi.org/10.1007/s00056-017-0111-3
11. Oliveira ACB, Paiva SM, Campos MR, Czeresnia D. Factors associated with malocclusions in children and adolescents with Down syndrome. American Journal of Orthodontics and Dentofacial Orthopedics: Official Publication of the American Association of Orthodontists, Its Constituent Societies, and the American Board of Orthodontics. 2008; 133(4):489.e1-8. https://doi.org/10.1016/j.ajodo.2007.09.014
12. Oliveira AC, Pordeus IA, Torres CS, Martins MT, Paiva SM. Feeding and nonnutritive sucking habits and prevalence of open bite and crossbite in children/adolescents with Down syndrome. The Angle Orthodontist. 2010; 80(4):748-753. https://doi.org/10.2319/072709-421.1
13. Palomo JM, Hans MG, Yang CY. Clinical Application of Three-Dimensional Craniofacial Imaging in Orthodontics. J Med Sci. 2005; 25(6):269-278.
14. Patterson D, Costa ACS. Down syndrome and genetics — a case of linked histories: History of genetic disease. Nature Reviews Genetics. 2005; 6(2):137-147. https://doi.org/10.1038/nrg1525
15. Quintanilla JS, Biedma BM, Rodríguez MQ, Mora MTJ, Cunqueiro MMS, Pazos MA. Cephalometrics in children with Down’s syndrome. Pediatric Radiology. 2002; 32(9):635-643. https://doi.org/10.1007/s00247-002-0703-x
16. Speck NT. A Longitudinal Study of Developmental Changes in Human Lower Dental Arches. The Angle Orthodontist. 1950; 20(4):215-228.
17. Suri S, Tompson BD, Cornfoot L. Cranial base, maxillary and mandibular morphology in Down syndrome. The Angle Orthodontist. 2010; 80(5):861-869. https://doi.org/10.2319/111709-650.1
18. Uysal T, Memili B, Usumez S, Sari Z. Dental and alveolar arch widths in normal occlusion, class II division 1 and class II division 2. The Angle Orthodontist, 2005; 75(6):941-947. https://doi.org/10.1043/0003-3219(2005)75[941:DAAAWI]2.0.CO;2
19. Weijerman ME, De Winter JP. Clinical practice: The care of children with Down syndrome. European Journal of Pediatrics. 2010; 169(12):1445-1452. https://doi.org/10.1007/s00431-010-1253-0
20. Weijerman ME, de Winter JP. Clinical practice: The care of children with Down syndrome. European Journal of Pediatrics. 2010; 169(12):1445-1452. https://doi.org/10.1007/s00431-010-1253-0
21. Yamamoto K, Hayashi S, Nishikawa H, Nakamura S, Mikami T. Measurements of dental cast profile and three-dimensional tooth movement during orthodontic treatment. IEEE Transactions on Biomedical Engineering. 1991; 38(4):360-365. https://doi.org/10.1109/10.133232
22. Zilberman O, Huggare JAV, Parikakis KA. Evaluation of the validity of tooth size and arch width measurements using conventional and three-dimensional virtual orthodontic models. The Angle Orthodontist. 2003; 73(3):301-306. https://doi.org/10.1043/0003-3219(2003)073<0301:EOTVOT>2.0.CO;2