Khalij Libya Journal of Dental and Medical Research. 2025;9(1):68-75
https://doi.org/10.47705/kjdmr.25911011
eISSN:2708-888X

The Estimation of Dental Arch Discrepancy Among Libyan Adolescents and Adults with Irregular Teeth.

Ahmed Ben Omran

Althager Orthodontic Center, Misurata, Libya
Email. ahmedbenomran349@gmail.com

Abstract
The objective of this clinical study was to estimate the amount of dental discrepancy in patients seeking orthodontic treatment to correct irregular and crowded teeth in the Region of Misurata, to know the severity of the problem and the possibility of prevention and treatment, and to provide data for future comparisons with other regions in Libya. 120 orthodontic diagnostic models (60 males and 60 females aged from 14-24 years) from the authors' courtesy for patients with a Class I malocclusion and a full set of permanent teeth (except third molars) were manually analyzed using the segmented arch approach for space analysis. To test the intra-examiner reliability, 20 modes were randomly selected and analyzed twice in a one-week interval. The difference between the two measurements was tested using a sample t-test, and the difference was statistically not significant (p=0.832). Statistical analysis was done using SPSS version 7.5 software (LEAD Technologies Inc). There was neither a difference between males and females nor an age influence regarding the severity of dental crowding. The mean dental discrepancy of the upper and lower jaws, respectively, are (-4.60± 2.90 and -4.96±3.05 mms), indicating that generally the studied sample has a severe dental discrepancy in both jaws (space deficiency> 4 mms). %50<of the studied group showed a severe crowding (space deficiency >4mms), >35% had a moderate crowding (space deficiency > 2≤ 4mms). There is a strong correlation between the total discrepancy and the amount of discrepancy at the canine premolar segment (r>0.7 p<0.01) suggesting that arch perimeter loss due to premature loss of primary teeth may be the major etiologic factor among the study sample, but further studies are needed to explore other possible factors.
Keywords: Dental Discrepancy, Segmental Analysis, Crowding.

Received: *12/02/25*
Accepted: *30/03/25*
Published: *08/04/25*

Introduction

Dental crowding is defined as the asymmetry between the size of the teeth and the available space to position them in a smooth line of occlusion. It is considered a common problem in many countries around the world and is one and the most common features of malocclusion [1-3]. Crowded and mal-aligned teeth are among the most common causes of patients seeking orthodontic treatment[4]. Although there is still controversies about the etiology of dental crowding, crowding can be primary as a result of large teeth, small jaw or both [2,5-7], secondary as a result of space loss because of early loss of primary teeth[8-12], or tertiary as a result of late growth effects and third molar eruption [13-18].

From our daily practice, a very high percentage of patients seeking orthodontic treatment are worried about their irregular teeth, and most of them are treated by extraction protocols because of the severity of their dental arch discrepancies, although many of these discrepancies may be preventable. The objective of this study is to estimate the amount of dental crowding (dental arch discrepancy) in young adult patients with irregular teeth in the Region of Misurata to know the severity of the problem and the possibility of prevention, and to provide data for future comparisons.

Materials

A sample of 120 pairs of orthodontic study models, 60 females and 60 males aged 14-24 years (inclusive) with a mean age of 16.68 years, complaining of irregular teeth, was selected from the courtesy of the author with the following preconditions: Permanent dentition, Angle Class I malocclusion, Presence of all the permanent teeth through the 2nd molars in both jaws, Skeletal Class I relationships, and no Posterior cross bite.

Methods

The models were manually analyzed [19,20]to compare the available space to arrange the teeth and the required space to ideally arrange them [2,6,7,10,21,22]. Measurements were done in millimeters using the segmented arch approach to space analysis as proposed by Lundstrom [18,21,23,24] as follows: The 1st step is to calculate the space available, i.e., measurement of the jaw size from the mesial contact point of the 1st molar on one side to the mesial contact point of the 1st molar on the opposite side. The upper and lower models are divided into four segments each, which can be measured as straight lines (Figure 1). The segments are labeled a, b, c, and d.

Khalij Libya Journal of Dental and Medical Research. 2025;9(1):68-75
https://doi.org/10.47705/kjdmr.25911011
eISSN:2708-888X

a- is the left canine-premolar are, b- is the left incisor area, c- is the right incisor area, and d- is the right canine-premolar area.

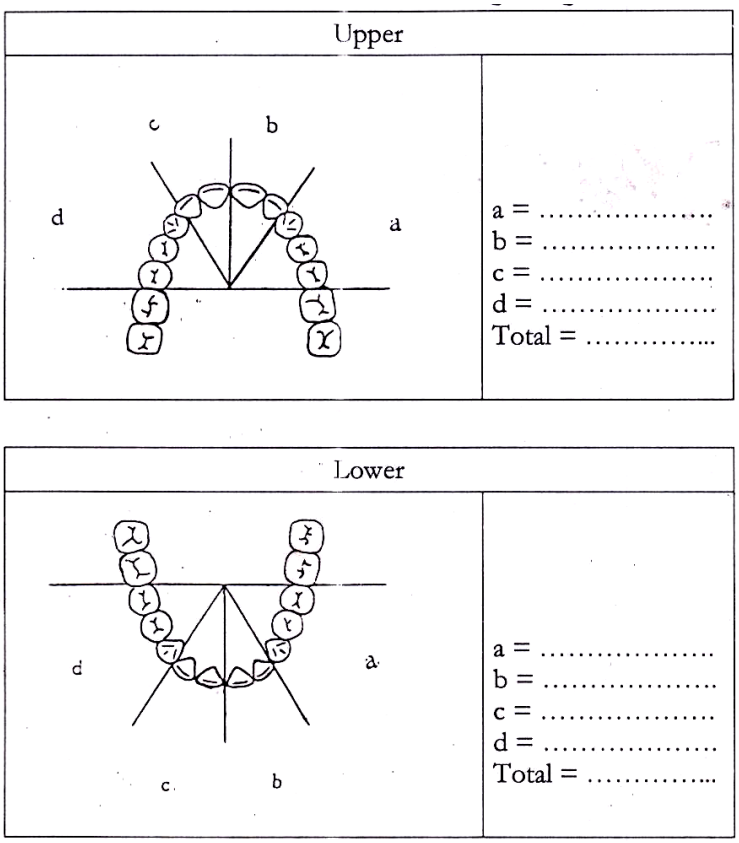

Figure 1: method used in space analysis. a) the left canine premolar segment; b) the left incisor segment; c) the right incisor segment and d) the right canine premolar segment

a and d measured from the mesial contact area of the 1st molar to the distal surface of the lateral incisor, b and c measured from the distal surface of the lateral incisor to the mesial surface of the central incisor.
The 2nd step is the measurement of the required space to properly align the teeth by measuring the mesio-distal diameter for every tooth from the 2nd premolar on one side to the 2nd premolar on the opposite side. All measurements are carried out using a Vernier gauge.
The amount of dental crowding was calculated for each segment by measuring the space available and was recorded on the outside of Fig 1, and measuring the space required and recorded for each tooth alone on the inside of Fig 1. The difference between the available space and the required space is the space deficiency and was calculated using the following formula:

Available space – Required space = Dental Discrepancy [21 2] .

If it is a negative value, it means that the space is deficient, and if it is a positive value, it indicates that the space is an excess, and if it is zero, it means that the teeth can be properly arranged without the need for extra space and without residual spaces to be left.
To test the inter-examiner reliability 20 modes were randomly selected and analyzed twice in a week's interval. The difference between the two measurements was tested using t-test, p was >0.05, indicating no statistically significant difference between the measurements.
The measurements are arranged in a table of the database and the data was analyzed using SPSS version 7.5 software (LEAD Technologies Inc) to calculate the mean, the standard deviation for each segment, the total mean and standard deviation of each jaw, and the severity of crowding was interpreted as [3 7 22 24 25] :
Mild:- if the dental discrepancy is >0 and ≤2mms.
Moderate:- if the dental discrepancy is >2 ≤4mms.
Severe:- if the dental discrepancy is > 4 mm, noting that dental crowding means space deficiency, and so the dental discrepancy is expressed as a negative value.
The means of each segment of both the upper and lower jaw and the total mean dental discrepancy of both jaws were compared using (*t*) test and significance was tested at P=0.05. A Pearson correlation (*r*) was used to correlate the means of the different measurements.

Khalij Libya Journal of Dental and Medical Research. 2025;9(1):68-75
https://doi.org/10.47705/kjdmr.25911011
eISSN:2708-888X

Results

The mean and standard deviation for different measurements are shown in Table 1.

Table 1: Descriptive Statistics

	Age	Minimum	Maximum	Mean	Std. Deviation
		13.40	17.00	15.0908	1.0569
UPPER	a	-5.50	1.00	-1.1625	1.3111
	b	-7.50	2.00	-1.1208	1.1264
	c	-4.50	1.50	-1.1000	1.1855
	d	-6.50	1.00	-1.1474	1.2921
	Total	-18.00	-0.50	-4.642	2.9089
LOWER	a	-8.50	0.50	-1.6792	1.6913
	b	-5.00	0.50	-1.0042	0.9776
	c	-6.00	0.00	-0.8917	0.7674
	d	-7.50	0.50	-1.5875	1.3560
	Total	-17.00	-0.50	-4.9592	3.0501

There is no statistically significant difference between males and females (p=.938 for upper total discrepancy and p=0.324 for the lower total discrepancy) and so the data was pooled consequently. The mean dental discrepancy of the upper and lower jaws, respectively, are (-4.60± 2.90 and -4.96±3.05 mms), indicating that generally the studied population has a severe dental discrepancy in both jaws [21,22] (space deficiency> 4 mms). The difference between the amount of dental arch discrepancy between jaws is statistically not significant (t=.248, p=0.215).

The prevalence of the severity of the dental discrepancy can be summarized as follows: In the upper arch: 19.166% of the study sample (23 cases) have a mild crowding (dental discrepancy >0≤- 2 mms). 37.5% (45 cases) have a moderate crowding (dental discrepancy>-2≤-4 mms) andn43.33% (52 cases) have severe crowding (dental discrepancy > -4 mms). In the lower arch, 9.166% of the study sample (11 cases) have a mild crowding (dental discrepancy >0≤- 2 mms). 35.83% (43 cases) have a moderate crowding (dental discrepancy>-2≤-4 mms) and 55% (66 cases) have severe crowding (dental discrepancy > -4 mms). Bar charts 1-4 show the percentage distribution of upper and lower dental discrepancies.

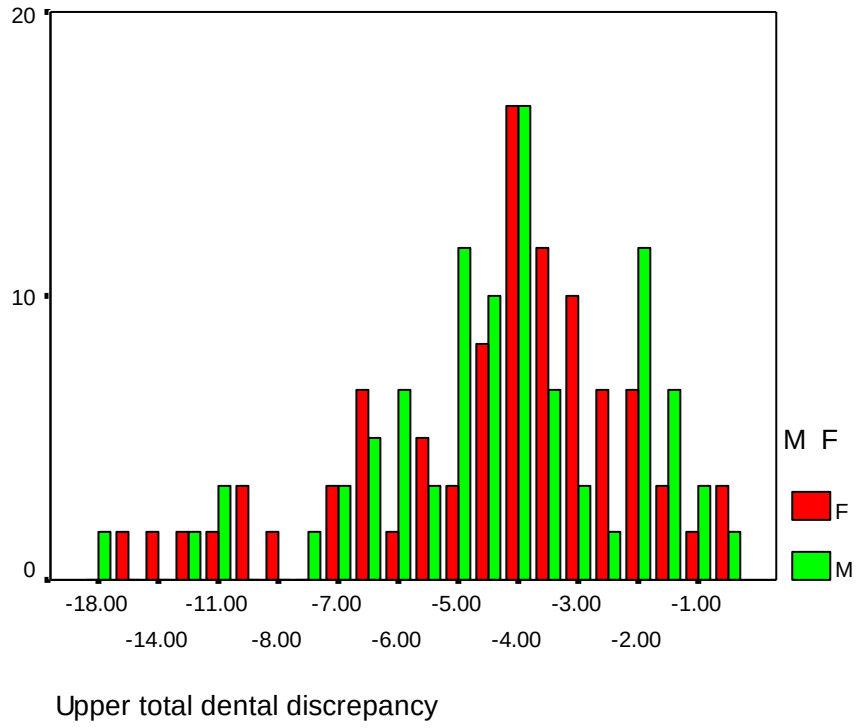

Figure 1. The percentage distribution of the upper dental discrepancy in males and females

Khalij Libya Journal of Dental and Medical Research. 2025;9(1):68-75
https://doi.org/10.47705/kjdmr.25911011
eISSN:2708-888X

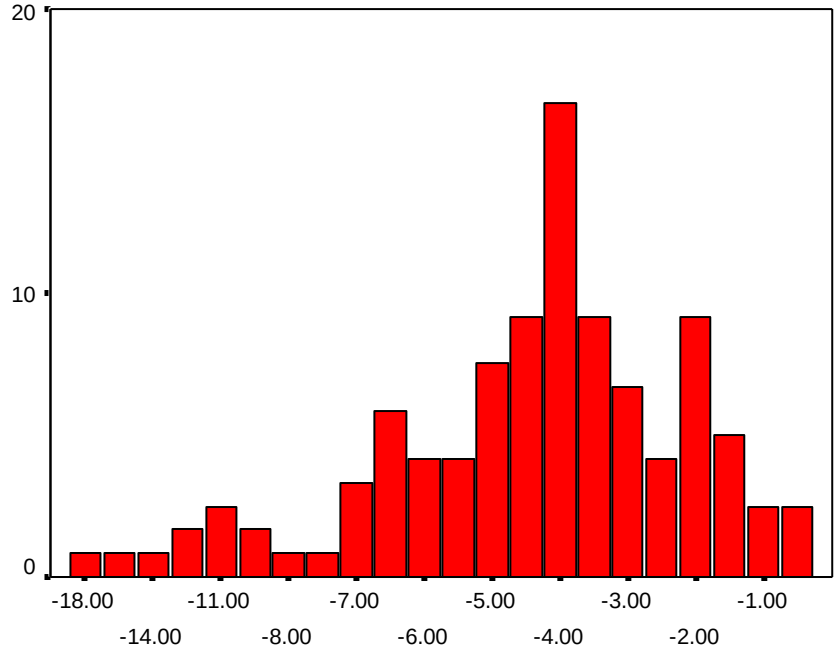

Figure 2. The percentage distribution of the upper dental discrepancy (accumulative)

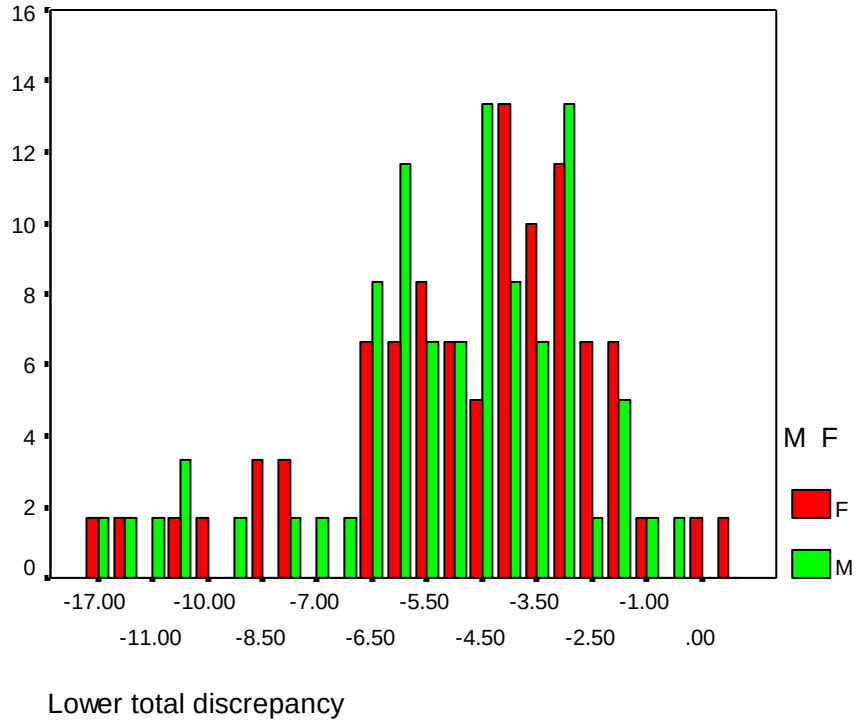

Figure 3. The percentage distribution of the lower dental discrepancy for males and females.

Khalij Libya Journal of Dental and Medical Research. 2025;9(1):68-75
https://doi.org/10.47705/kjdmr.25911011
eISSN:2708-888X

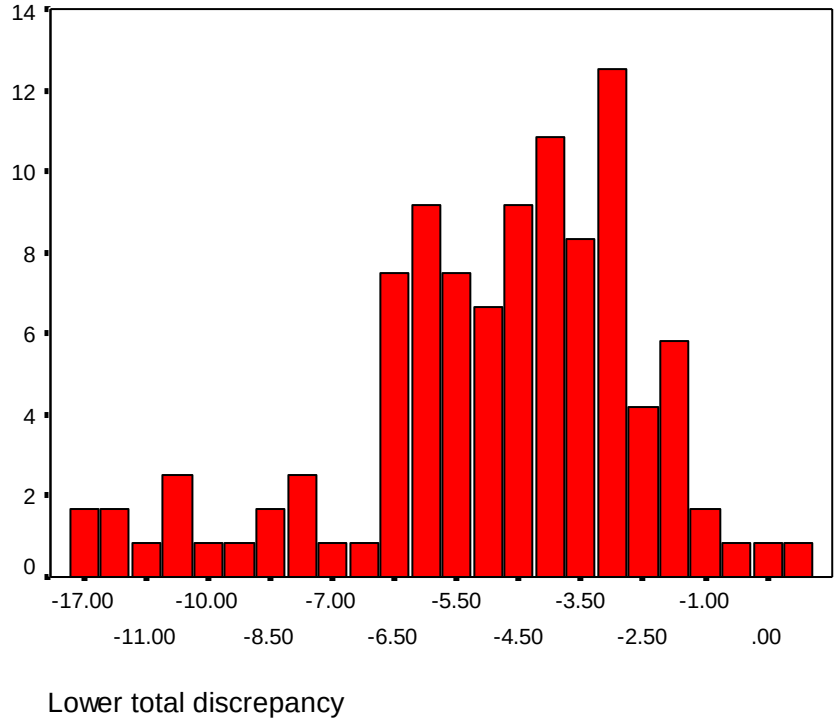

Figure 4. The percentage distribution of the lower dental discrepancy (cumulative)

The canine premolar segments of both jaws were more crowded than the incisor segments, with a significant correlation to the total dental discrepancy ($r>0.7$, $p<0.01$) (Table 2). Also, there is a significant correlation between the total dental discrepancy of both jaws (r 0.454, $p<0.01$) and between canine premolar segments of the same jaw and opposite jaw ($p<0.01$) (Table 3)

Table 2. Pearson Correlations (r)

Pearson Correlations	a	b	c	d
Upper Total Discrepancy	.750**	.656*	.306*	.740**
Lower Total Discrepancy	.701**	.376*	.098	.760**

*** Correlation is significant at the 0.01 level (2-tailed).*

Table 3. Correlation between the total dental discrepancy of both jaws

Upper Total Discrepancy	Lower Total Discrepancy
	.454**

*** Correlation is significant at the 0.01 level (2-tailed).*

Discussion

Dental crowding is a very common problem. Proffit[1] stated that 13% of American white youths aged 12-17 years have mild crowding and mal-alignment problems, 43.6% have moderate problems, and 43.4% have severe problems, which is the main cause for patients to seek orthodontic treatment. The psychological impact of crowded and irregular teeth is very well known[26,26]. Irregular teeth can be a risk factor in causing dental caries and periodontal diseases. Staufer (2004) [24] in a study of 125 adult patients, concluded that patients with greater than 3mm of crowding experienced an increased risk of periodontal disease, and this tends to worsen as the patient gets older. Chung (2000) [28] in a study included 30 adult patients with anterior crowding revealed that more plaque accumulates in the crowded area of the mouth and more species of perio-dontopathogns were present in the subgingival plaque of the crowded regions, Jensen (1989) [29] claimed that in periodontal patients local crowding and tooth angulation predisposes to increased bone loss, Ainamo(1974)[30] in a study included 154 army recruits aged 19-22 concluded that malalignment does not enhance periodontal brakedown but it does decrease the effect of average oral hygiene measures.

The tooth size and jaw size are both etiological factors in dental crowding, Hamid (2005)[6] in a comparative study of tooth size and jaw size between crowded and non-crowded samples of Pakistani population found that there is no difference in tooth size between crowded and noncrowded arches but dental arches were smaller in the crowded group. Similar findings were obtained by Lestrel (2004) [2] in a

https://doi.org/10.47705/kjdmr.25911011
eISSN:2708-888X

sample of 118 Japanese students. In contrast, Bernabe (2005) [7] in studying 200 Peruvian students, found that there is a significant difference between mesio-distal tooth size in crowded and noncrowded arches.

Lavelle (1976) [4] in a study of multiracial malocclusion investigated 1,000 British Caucasoid, 70 Medieval British, 60 Anglo-Saxonians 100 Negriod and 100 Mongoloid and he revealed that marked contrasts between various samples with dental crowding were markedly prevalent in modern British Caucasiod sample. Gibson and Calgano (1988) [31] claimed that the increase in severity of dental crowding is a side effect of a more general reduction in body size, which resulted from an increase in population density. These are indications that dental crowding is different in different ethnic groups. The effect of third molar retention on incisor crowding has been investigated for a long time. Richardson (1970) [13] observed first molar drift and incisor crowding in patients with retained third molars. She believed that third molar impaction was one of the causative factors because anterior crowding was found more frequently in patients with third molar impaction than in subjects in home the teeth were correctly positioned in the dental arch (Richardson 1982,1989, 1996) [14-16] . Lundstrom (1969) [23] who examined the dental arches of 111(thirteen-year-old boys), and Moorrees and Reed (1952) [32] who studied the mandibular dentition in 72 female American patients between 18 and 20 years of age, both found a decrease in crowding when the third molars were missing.

There are, however, opponents of the hypothesis that third molars affect anterior teeth position. An attempt to determine the relationship between the third molars and changes in lower dental arch parameters was undertaken by Ades (1990) [33]. The investigation was based on the analysis of models and lateral cephalograms of 97 subjects with bilaterally erupted, impacted, developmentally missing, or extracted third molars. Because there was no difference between the groups in dental arch length and width or incisor crowding, the author proposed that third molar removal to decrease incisor crowding was unjustified. This was in agreement with a later study in which Southard (1992) [17] concluded that 'removing these teeth (i.e., third molars) for the exclusive purpose of relieving interdental force and thereby preventing incisor crowding is unwarranted.

Pederson (1978) [12] in a study of 324 children with early loss of primary teeth due to caries, found that early loss of primary teeth would result in an increased frequency of sagittal, vertical, and transversal malocclusions. Kerr (1980) [11] in an analysis of longitudinal records of 126 subjects stated that earlier loss appeared to promote earlier eruption, except in the lower premolar region where early loss of the deciduous tooth was followed by late eruption of the permanent successor predisposing to space loss and less than average maturity of the relevant quadrant. Kumari (2006) [9] concluded that early extraction of deciduous teeth causes space loss, especially in the first four months.

Among Libyan children, the DMFT score showed an extremely higher percentage of premature loss of primary teeth compared to the filled teeth, and this increases with age [34]. This is an important factor in the development of crowding in the permanent dentition, especially in the canine premolar segment, which showed the highest correlation with the total dental discrepancy in both jaws in this study.

In the present study, it was found that the canine premolar segments of both jaws were more crowded than the incisor segments, with a significant correlation to the total dental discrepancy ($r>0.7$, $p<0.01$) (Table 3). Also, there is a significant correlation between the total dental discrepancy of both jaws (r 0.454, $p<0.01$) and between canine premolar segments of the same jaw and opposite jaw ($p<0.01$) (Table 2). This may indicate that the premature loss of primary molars and subsequent space loss is a major factor in the etiology of dental crowding in the Libyan population.

Data concerning tooth size and jaw dimensions for the Libyan population and third molar status are not available to further explore the other possible causes of crowding in patients with Class I malocclusion.

Conclusion

Among patients with dental discrepancies in the studied sample, more than half are suffering from a severe crowding problem in both jaws, which is difficult to treat orthodontically without extractions. The high percentage of the incidence of severe crowding in this study and its correlation with the amount of crowding at the canine premolar region may indicate a perimeter loss as a result of premature loss of deciduous teeth or a tooth size/jaw size mismatch. Further studies are needed to compare the tooth size and jaw size of Libyans with other ethnic groups and third molar situation for a better understanding of the possible causes of dental arch discrepancy among the Libyan population. Unfortunately, dental crowding is usually studied as a component of orthodontic indices which makes it very difficult to compare the results of this study to other populations.

References

1. Proffit WR. Contemporary Orthodontics, 2nd edition. Mosby company 1992.Chapter 1 pp 6-7.
2. Lestrel E, Takahashi O,Kanazawa E: A quantative approach for measuring crowding in dental arches. Am J Orthod. Dentofac. Orthop. 2004;125(6)716-25

3. Radnzic D: Dental crowding and its relationship to mesiodistal crown dimension and arch dimensions. Am J Orthod.Dentofac.Orthop.
1988;94, 50-56
4. Lavelle C: A study of multiracial malocclusions. Community Dentistry and Oral Epidemiology.1976; 4 (1) 38-41.
5. Noriko S, Masataka H, Sachiko S, Nozumo M, Kunimichi S : Patterns of dental crowdings in the lower arch and contributing factors. The angle Orthod. 2006; 77; 303-10
6. Hamid W, Rahbar I : Dental crowding and its relationship to tooth size and arch dimensions. Pak Oral Dental J. 2005;25(1) 47-52.
7. Bernabe E, Flores C : Dental morphology and crowding. Angle Orthod.2005; 76(1), 20-25
8. Nortway WM.1977. Anterio-posterior arch dimension changes in French Canadian children: a study of the effects of dental caries and premature extractions. Thesis, School of Dentistry, University of Montreal, Quebec Canada.
9. Kumari P, Kumari R: Loss of space and changes in the dental arch after premature loss of the lower primary molar. A longitudinal study. J Ind.Soc.Ped&Prev.Dent. 2006 ; 24(2), 90-96.
10. Melo L, Yoshiaki O,Yuzo T: Indicators of mandibular dental crowding in the mixed dentition. Pediatr Dent. 2001;23,118-22
11. Kerr W: The effect of premature loss of deciduous canines and molars on the eruption of their successors. The European Journal of Orthodontics. 1980; 2(2),123-28.
12. Pederson J Stensgaard K, Melsen B: Prevalence of malocclusion in relation to premature loss of primary teeth. Community Dentistry and Oral Epidemiology. 1978; 6(4),204-09
13. Richardson M: Late lower arch crowding : facial growth or forward drift? European Journal of Orthdontics. 1979; 1, 219-25.
14. Richardson M: Late lower arch crowding in rlation to primary crowding. Angle orthod. 1982; 52,300-12
15. Richardson M: The role of third molar as a cause of late lower arch crowding: a review. Am.J.Ortho.Dentofa.Orthoped. 1989; 95, 79-83
16. Richardson M: Orthodontic implications of lower third molar development. Dental update. 1996; April , 96-102
17. Southard T: Third molars and incisor crowding : when removal is unwarranted. J.Am. Dent. Assoc. 1992; 123, 75-79
18. Niedzielska I : Third molar influence on dental arch crowding. European Journal of Orthodontics; 2005, 27(5), 518-23.
19. Pair JW et al 2001. Variability of study cast assessment among orthodontists. American Journal of Orthodontics and Dentofacial Orthopedics. Vol 121 No 4 PP 629-638.
20. Schirmer UR and Wiltshire WA 1997. Manual and computer aided space analysis : a comparative study. American Journal of Orthodontics and Dentofacial Orthopedics. Vol 112 No 6 PP 676-680.
21. Proffit WR , Ackerman JL 1992 Orthodontic Diagnosis: The development of a problem list In: W.R. Proffit. Contemporary Orthodontics 2nd edition .Mosby year book .Chapter 6 pp155-156.
22. Houston W, Stephens C and Tulley W. A text book of Orthodontics . 2nd edition. Wrigth1992 .Chapter 4 p 47.
23. Lundstrom A : Changes in crowding and spacing of teeth with age. Dental Practice and Dental Record. 1969, 19, 218-23
24. Staufer K, Landmasser H: Effects of crowding on the lower anterior segment- a risk evaluation depending upon the degree of crowding. J Orofac Orthop.2004, 65(1),13-25.
25. Fields HW ;Treatment of non-skeletal problems in preadolescent children .In: W.R. Proffit. Contemporary Orthodontics 2nd edition Mosby year book 1992 .Chapter 13 p 376-99
26. Macgregor F: social and psychological implications of dentofacial disfigurement. Angle orthod. 1979; 40, 231-33
27. Jenny J: A social perspective on need and demand for orthodontic treatment. Int Dent J. 1975; 25 248-56.
28. Chung C, Vanarsdall R, Cavalcanti E, BaldingerJ ,Lai C: Comparison of microbial composition in the sub-gingival plaque of adult crowded versus non-crowded dental regions. Int J Adult Orthodon Orthognath Surg. 2000, 15(4), 321-30.
29. Jensen B, Solow B : Alveolar bone loss and crowding in adult periodontal patients. Community Dent Oral Epidemiol. 1989;17(1); 47-51.
30. Aniamo J: Relationship between mal-alignment of teeth and periodontal disease . J.Periodontology 1974; 45(1);43-9.
31. Gibson K, Calgano J: A critique of the "Increasing population density effect". Journal of Human Evolution. 1989; 4 , 515-23.
32. Moorrees C ,Reed R: Biometrics of crowding and spacing of teeth in the mandible. American association of physical athropolgy.1952; 21, 77-88
33. Ades A ,Joodeph D, Little R,Chapko M: A long term study of the relationship of the third molars to the changes in the mandibular dental arch . Am J Ortho Dentofac.Othoped.1990; 97, 323-35.
34. Ingafou M, Omar S,Hamouda S, Bellal M: Oral health status and treatment needs of preschool children in Benghazi. Garyounis Medical Jour;2003,20(2);20(2) , 31-39.

Khalij Libya Journal of Dental and Medical Research. 2025;9(1):68-75
https://doi.org/10.47705/kjdmr.25911011
eISSN:2708-888X

الملخص

الهدف من هذه الدراسة السريرية تقدير مقدار عدم الأنتظام السني (أزدحام الأسنان) في المرضى الذين يريدون إجراء العلاج التقويمي لتصحيح الأسنان غير المنتظمة والمزدحمة في منطقة مصراتة، لتحديد شدة المشكلة وإمكانية الوقاية والعلاج، وتقديم بيانات للمقارنة المستقبلية مع مناطق أخرى في ليبيا. تم تحليل 120 نموذجًا تشخيصيًا تقويميًا (60 ذكرًا و60 أنثى، تتراوح أعمارهم بين 14 و24 عامًا) من ضمن عيادة المؤلف للمرضى الذين يعانون من سوء الإطباق من النوع الأول، ولديهم مجموعة كاملة من الأسنان الدائمة (باستثناء الأضراس الثالثة)، باستخدام طريقة القوس المجزاء لتحليل المسافة. من أجل اختبار موثوقية الفحص لنفس الفاحص (المؤلف)، تم اختيار 20 نموذجًا عشوائيًا وتحليلها مرتين بفاصل زمني أسبوع واحد بين القياسين و تم اختبار الفرق بين القياسين باستخدام اختبار t المزدوج، وأظهرت النتائج عدم وجود فرق ذو دلالة إحصائية .(p = 0.832) . تم إجراء التحليل الإحصائي باستخدام برنامج SPSS الإصدار 7.5 (Lead Tech. Inc) لم يكن هناك فرق ملحوظ في شدة ازدحام الأسنان بين الذكور والإناث، كما لم يكن للعمر تأثير في شدة الازدحام. كان المتوسط العام لعدم الأنتظام السني أو أزدحام الأسنان السني في الفك العلوي والسفلي على التوالي -4.60 ± 2.90 مم و -4.96 ± 3.05 مم، مما يشير إلى أن العينة المدروسة عمومًا تعاني من أزدحام سني شديد (نقص المسافة 4 <مم) في كلا الفكين. أظهر أكثر من 50% من المجموعة المدروسة ازدحامًا شديدًا (نقص المسافة 4 <مم)، بينما كان أكثر من 35% يعانون من ازدحام معتدل (نقص المسافة بين 2 و 4 مم). لوحظ ارتباط قوي بين الأزدحام الكلي والأزدحام في منطقة القواطع والأضراس الأمامية0.7 < r) ، (0.01 > p، مما يشير إلى أن فقدان محيط القوس بسبب الفقدان المبكرللأسنان اللبنية قد يكون العامل المسبب الرئيسي في هذه العينة. ومع ذلك، هناك حاجة إلى دراسات إضافية لاستكشاف العوامل المحتملة الأخرى.