

Index of Orthodontic Treatment Need on an Iraqi Student Sample

Dr. Oqba N. AL-Me'mar

B.D.S., M.Sc.*

Abstract

A thorough investigation of the occurrence of malocclusions among schoolchildren would be of major importance in the planning of orthodontic treatment in the public dental health services. For this purpose it is necessary to have available detailed information on the prevalence of individual malocclusions among students at different ages and more over , an analysis of the need for orthodontic treatment in the different school classes .

The sample consisted of (4808), 13-18 years old student taken from Baghdad intermediate and preparatory female schools. A clinical examination was used to determine the prevalence of occlusal features and the need for Orthodontic treatment based on the definitions of grades for the Index of Orthodontic Treatment Need (IOTN).

Of the sample (29.68%), (17.55%), (16.7%), (26.04%). In addition (10.02%) have been categorizer under Grad 1 (No need), Grad 2 (little need), Grad 3 (moderate need), Grad 4 (great need) and Grad 5 (very great need) respectively. The statistical differences between these grades were non- significant ($P > 0.05$). The scarcity of orthodontic treatment may be explained by the lack of dental health education programs , lack of a health insurance system concerned with orthodontic treatment in Iraq , history of failed orthodontic treatment and most of general practitioners favor not to advice , motivate and refer the patient for orthodontist.

(Key words: Index, Orthodontic treatment, Malocclusions)

Introduction

As growing public interest in oral health increases the demand for orthodontic treatment, it is important and valuable to have epidemiologic data to estimate the total need and demand for orthodontic care services ⁽¹⁾. The potential interest in orthodontic treatment for an increasing proportion of children will undoubtedly affect the type of services provided, as well as organization and delivery systems in the future ⁽²⁾. The orthodontic need assessment is of interest for dental public health programs, clinical treatment, screening for treatment priority, resource planning, and third party funding ⁽³⁾. Surveys on the

prevalence of received orthodontic treatment have been concentrated in the Scandinavian countries giving percentages ranging from 16% to 57% whereas Ast et al. ⁽⁴⁾ found that (9.6%) of his American sample had undergone extractions or appliance treatment. On the other hand, Ng'ang'a et al. ⁽⁵⁾ found that 4% of Kenyan 13-15 year olds were orthodontically treated.

Several studies have investigated the prevalence and severity of malocclusion for specific ethnic groups, age distribution, and country-specific populations; however, fewer reports ⁽⁶⁻¹⁰⁾ specifically address the need and demand issues for the orthodontic treatment of children and adolescents.

* Assistant Lecturer, Orthodontic Dept., College of Dentistry, Baghdad University.

In planning orthodontic care, one should not only consider the prevalence of a disorder, but as importantly, the need for such care as expressed by specialists and the demand for treatment shown by the patients and their parents⁽⁶⁾.

Prahl-Anderson⁽¹¹⁾ found that 14% of parents who were aware of their child's malocclusion did not want orthodontic treatment. In a study by Ingervall and Hedegard⁽¹²⁾, 60% of 18-year-old Swedish men were evaluated to have orthodontic need; however, only 4% were aware of the malocclusion and desired treatment. Similarly, Myrberg and Thilander⁽⁸⁾ reported that, in a group of 7- to 13-year-old children who had very urgent or urgent need, as many as 52.2% declined orthodontic treatment.

Gravely⁽¹⁰⁾ compared two regional areas where the number of practicing orthodontists and treatment levels were variable. He found that where treatment levels were high. The unacceptability of appliance therapy was reduced, thereby increasing demand for treatment.

Materials & Methods

The sample consisted of (4808), aged (13-18) years old student taken from Baghdad intermediate and preparatory female schools. Permission was obtained from the general directorate of education in Baghdad. The school's authorities were contacted and the purpose of the study was explained to them to assure full cooperation. After exclusion of students who have received any type of orthodontic treatment and those currently undergoing orthodontic treatment. The students were subjected to an interview and clinical examination, were seated in a chair with a high backrest with their head supported in an upright position and

the examiner standing in front of the chair^(13,14). The examination area was arranged in such a way that student entered at one point and left at another, student were not permitted to crowd around the examiner. Natural day light was utilized as the light source for examination and a portable light was used to supplement the natural day light during examination when needed. In the absence of electricity, the portable light was connected to 12 V batteries.

The examiner reviewed each day's case sheets on the same day for completeness and accuracy of recording. Before any dental examination was done, schools name, school class and other information of the students was registered. Then the students were each interviewed individually to obtain first demographic information regarding their name and birth date.

The student was asked some questions regarding her perception of occlusion. Before the intra oral clinical examination was commenced, gross anomalies, cleft lip and/or palate, traumatic or surgical defects were noted and described. The intra-oral examination was derived from the Index of Orthodontic Treatment Need (IOTN), the later was developed from an index used by the dental board in Sweden designed to reflect those occlusal traits, which could affect the function and longevity of the dentition. The single worst feature of a malocclusion is noted (the index is not cumulative) and categorized into one of five grades reflecting need for treatment⁽¹⁵⁾ (table1), during examination the students have received the orthodontic advice, instruction and motivation as needed for orthodontic treatment.

The following materials were used (Plane mouth mirrors (No.4), Tweezers, Calibrated vernier, Kidney

dishes, Pans for sterilization, Cotton and paper tissue, Disinfectant solution).

The following steps of examination were taken:-

(1) Sagittal Occlusion :

In the permanent dentition, the sagittal occlusion was defined at the first molar according to Angle⁽¹⁶⁾; the key to occlusion in Angle's classification is the relationship between the first permanent molars, in which there are three groups:

- Class I or neutroclusion: the mesio buccal cusp of the upper first permanent molar occludes with the mesiobuccal groove of the lower first permanent molar.
- Class II or distocclusion: The mesiobuccal cusp of the lower first molar occludes distal to the Class I position. This is known as post-normal relationship.
- Class III or mesiocclusion: The mesiobuccal cusp of the lower first molar occludes mesial to the class I position. This is known as a pre-normal relationship.

When the first molar was lacking, the sagittal occlusion was defined at the canines according to Barrow et al,⁽¹⁷⁾. Discrepancies less than half a cusp width were recorded as normal occlusion.

(2) Overjet and Overbite:-

The overjet was measured according to Baume et al.⁽¹³⁾ with the aid of a calibrated vernier while the subject is in centric occlusion and with his occlusal plane horizontal. The end of the fixed scale is placed on the labial surface of the lower incisor and the sliding scate is adjusted to touch the most labial part of the corresponding upper incisor, measurement is recorded to the nearest whole millimeter.

Increased overjet was considered as > 4 mm and decreased overjet was considered as < 1 mm.

An increased, decreased, or reversed overjet value was considered as a single occlusal anomaly.

The over bite was measured according to Draker⁽¹⁸⁾ while the subject is in centric occlusion with his occlusal plane horizontal. The amount of vertical overlap of the upper incisor on the lower incisor is marked with the pencil on the labial surface of the lower incisor using the incisal edge of the upper incisor to guide the pencil with conical plane of the sharpened point of the pencil itself parallel to the subject's occlusal plane. If there is lack of vertical overlap between any of the opposing pairs of incisors (Open bite), the amount of open bite is measured directly and recorded to the nearest whole millimeter. Increased over bite was considered as > 4 mm and decreased overbite as < 1 mm.

An increased or decreased over bite including anterior open bite was considered as a single occlusal anomaly.

(3) Transverse Occlusion:

a- Crossbite:

Recorded according to Björk et al⁽¹⁹⁾ for each side, for the canine and premolar section, and for the molar section. When the buccal cusp of the upper tooth occludes lingually to the buccal cusp of the corresponding lower tooth. Crossbite is thus recorded only when the cusps have passed one another. The registration is made in the appropriate segment as soon as one tooth is deviating.

Anterior crossbite was also recorded according to Bjork et al⁽¹⁹⁾ in which one, two or three of the upper incisors occlude lingual to the lowers.

b- Scissorsbite:-

Recorded according to Bjork et al⁽¹⁹⁾ on each side for the canine and premolar section and for the molar

section, if the lingual cusp of the upper tooth occludes buccally to the buccal cusp of the corresponding lower tooth. Scissors bite is thus recorded only when the cusps have passed one another. The registration is performed in the appropriate section as soon as one tooth is deviating.

(4) Crowding and Spacing:

Crowding and spacing was recorded for each jaw according to Bjork et al ⁽¹⁹⁾, it was recorded for the incisor section comprising all the incisors and for the lateral section comprising the canine and premolars of each side.

The incisor section is demarcated by the distal contact point of the two lateral incisors, when the lateral incisors do not deviate labially or lingually in relation to the midline of the alveolar process. The lateral sections are limited by these points and the mesial contact point of the first molars.

The diagnosis of spacing was registered if there was a deviation of > 2 mm in a section and the diagnosis of crowding if the deviation was < -2 mm.

Registration of the maxillary medial diastema was made in the upper anterior segment and the measurement of diastema is made to the nearest whole millimeter at the level of the gingival margin according to Bjork et al ⁽¹⁹⁾. The diagnosis of medial diastema was made if there was a spacing of > 2 mm.

(5) Missing Teeth

Notations on missing teeth either due to extraction. Hypodontia, trauma and impaction were taken. The presence of spacing, the contour of the underlying alveolar ridge, the caries-experience of present teeth and pertinent questions to the subject will usually allow a correct assessment of missing teeth due to trauma or

extraction. Considering the subjects chronological and dental ages, if the contour of the underlying alveolar ridge does not indicate an impacted tooth, the tooth is considered to be congenitally absent ⁽¹³⁾.

(6) Rotated and Displaced teeth

Fully erupted teeth that were rotated more than 15° were registered under mesial or distal rotation ⁽¹⁹⁾. Any tooth displaced bodily from the ideal arch line by more than 1 mm was registered under buccal or palatal displacement ⁽²⁰⁾.

(7) Transverse – Midline shift

The distance from the midpoint between the two mandibular central incisors to the midpoint between the two maxillary central incisors in a horizontal plane was recorded to the nearest whole millimeter with the student in centric occlusion ⁽¹³⁾.

(8) Soft tissue impingement

A record was made of any occlusal palatal impingement due to the mandibular incisors, or any mandibular labial impingement due to the maxillary incisors ⁽¹³⁾.

(9) Lip form:

The lips were categorized according to Foster and Day ⁽²¹⁾ as:

- A. Normal: Lips meet in front of the maxillary incisors in the relaxed posture without circumoral contraction.
- B. Contracting: lips which because of their shape or size, can only meet in front of the maxillary incisors with contraction of the circumoral musculature.
- C. Lip trap: The lower lip rests or contacts completely or partly behind the maxillary incisors.

Data analysis was carried out using the statistical package for social sciences (SPSS 10) and the use of Excel 2000 program. The number and

percentage (%) were calculated for each grade and sub grades. The mean and standard deviation (SD) were calculated for each grade. Statistical analysis concerning comparison between grades of index were conducted to investigate any significant differences using t-test. The differences were considered significant (S) when P-value ($P < 0.05$) and high significant (HS) when ($P < 0.0001$) and non-significant (NS) when ($P > 0.05$).

Results

Of the sample, (1427) student (29.68%) have been categorized under grade - 1- of the index of orthodontic treatment needs who have extremely minor malocclusions including displacements less than 1 mm and have no need for orthodontic treatment (table 2) .

Where as (844) student (17.55 %) have been categorized under grade - 2 - of the index of orthodontic treatment needs, who have a little need for orthodontic treatment (table 2) . of that number of grade - 2- the statistical data showing that (322) student (6.69 %) having increased over jet 3.6-6 mm with competent lips (2a), (29) student (0.6 %) having reverse overjet 0.1-1 mm (2b), (49) student (1.01 %) showing anterior or posterior cross bite up to 1mm discrepancy (2c), (289) student (6.01 %) showing displacement of teeth 1.1-2mm (2d), (53) student (1.1 %) having anterior or posterior open bite 1.1–2 mm (2e), (83) student (1.72 %) having increased over bite 3.5 mm or more without gingival contact (2f), (19) student (0.39%) showing pre-normal or post-normal occlusions with no other anomalies, includes up to half a unit discrepancy (2g). (figure 1) .

The statistical number of grade -3- of the index who have moderate need for orthodontic treatment was (803) student (16.7 %) (table 2), of that (233)

student (4.84 %) have been classified with increased overjet 3.6-6 mm with incompetent lips (3a), (43) student (0.89 %) having reverse overjet 1.1-3.5 mm (3b), (109) student (2.26%) showing anterior or posterior cross bites with 1.1-2mm discrepancy (3c), (236) student (4.9%) having displacement of teeth 2.1- 4mm (3d), (96) student (1.99 %) having lateral or anterior open bite 2.1- 4mm (3e), where as (86) student (1.78 %) showing increased and complete over bite with out gingival trauma (3f). (figure 2) .

On the other hand, the statistical number of grade -4- of the index how great need have for orthodontic treatment was (1252) student (26.04 %) (Table 2). This grade showing that (192) student (3.99%) having increased overjet 6.1-9mm (4a), while (45) student (0.93 %) showing reverse overjet 1.1-3.5 mm (4b), (65) student (1.35 %) showing anterior or posterior cross bites with greater than 2mm discrepancy (4c), (353) student (7.34%) having sever displacement of teeth greater than 4mm (4d), (150) student (3.11%) having extreme lateral or anterior open bites greater than 4 mm (4e), (127) student (2.64 %) having increased and complete over bite with gingival or palatal trauma (4f), (78) student (1.62%) were classified as having less extensive hypodontia requiring pre-restorative orthodontic space closure to obviate the need for a prosthesis (4h), (35) student (0.72 %) have been categorized under the cases having posterior lingual cross bite with no functional occlusal contact in one or both buccal segments (4I), (130) students (2.70 %) having reverse over jet 1.1-3.5mm with recorded masticatory and speech difficulties (4m), (48) students (0.99 %) having partially erupted teeth , tipped and impacted against adjacent teeth (4t) , (29) student (0.6 %)

showing supplemental teeth (4x). (Figure 3).

However, the statistical number for grade -5- of the index who have very great need for orthodontic treatment was (482) student (10.02 %) (Table 2). This grade showing that (150) student (3.11%) having increased over jet greater than 9 mm (5a) while (29) student (0.6%) showing extensive hypodontia with restorative implications (more than one tooth missing in any quadrant) requiring pre-restorative orthodontics (5h), where as (126) student (2.62 %) have been classified as having impeded eruption of teeth (with the exception of third molars) due to crowding, displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause (5f), (121) student (2.51%) having reverse overjet greater than 3.5 mm with reported masticatory and speech difficulties (5m), (15) student (0.31 %) showing defects of cleft lip and palate (5P), and (41) students (0.82 %) having submerged deciduous teeth (5S) (figure 4).

The statistical differences between grades 1,2,3,4 and 5 was non-significant ($p>0.05$) (table 3) and (figure 5).

Discussion

Of the sample, the higher statistical percentage (29.68%) have been categorized under grade -1- of the index of orthodontic treatment need, which mean there is extremely minor malocclusions and there is no need for orthodontic treatment. This is followed by the statistical percentage of (26.04 %) for grade -4- of the index in which there is a more advanced or complicated orthodontic anomalies and can be classified as in great need for orthodontic treatment.

This is followed by the statistical percentage of (17.55 %) for grade -2-

of the index, which represents relatively minor malocclusions categorized as in little need for orthodontic treatment. This is followed by the statistical percentage (16.7 %) for grade -3- of the index in which the students showing moderate orthodontic anomalies and were in moderate need for orthodontic treatment. Finally, the grade -5- of the index has a statistical percentage of (10.02 %) in which the students having a very complicated orthodontic anomalies and be classified under the very great need for orthodontic treatment (figure 5).

However, the statistical differences between all these grades were non-significant, this mean that the prevalence of orthodontic anomalies in these grades were distributed relatively in a simultaneous way with in the population.

These results are agreed with the survey of 6298 Swedish school children, in which the commonest deviant occlusal traits were as : (crowding 26%, post - normal occlusion 14%, anterior cross bite 11%, over jet greater than 6mm 8% , implication of teeth (excluding third molars) 5% , pre- normal occlusion 4%)⁽⁸⁾.

While it is accepted that dentofacial anomalies and sever malocclusion do have a negative effect on the psychological well-being and self-esteem of the individual, the impact of more minor occlusal problems is more variable and is modified by social and cultural factors.

Research has shown that an unattractive dentofacial appearance does have a negative effect on the expectations of teachers and employers. However, in this respect, background facial appearance would appear to have more impact than dental appearance⁽¹⁵⁾.

A patient's perceptions of the impact of dental variation upon his or her self

image is subject to enormous diversity and is modified by cultural and racial influences. This results in some individuals being unaware of marked malocclusions whilst others complain bitterly about very minor irregularities.

The dental health component of the index of orthodontic treatment need was developed to try and quantify the impact of a particular malocclusion upon long-term dental health. The index also comprises an aesthetic element, which is an attempt to quantify the aesthetic handicap that a particular arrangement of the teeth poses for a patient.

After working with the general public for a short period of time. It can readily be appreciated that demand for treatment does not necessarily reflect need for treatment. Some patients will complain bitterly about mild rotations of the upper incisors. While others are blithely unaware of markedly increased over jets. It has been demonstrated, that awareness of tooth alignment and malocclusion, and willingness to undergo orthodontic treatment are greater in (females, higher socio-economic

families and in areas which have a smaller population to orthodontist ratio. Presumably because appliances become more accepted)^(15,22).

One interesting example of the latter has been observed in countries where provision of orthodontic treatment is mainly privately funded, for example the USA, as orthodontic appliances are now perceived as a "status symbol."

However, comparison with other studies is not always possible because of the differences in definitions of the examined occlusal features, varying examination techniques and different indices used. Thus, comparison will only be made with those studies carried out on a similar age group using similar methodology emphasizing on those performed on Iraqi samples. The scarcity of orthodontic treatment may be explained by the lack of dental health education programs, lack of a health insurance system concern with orthodontic treatment in Iraq, history of failed orthodontic treatment and most of general practitioners favor not to advice , motivate and refer the patient for orthodontist .

Table (1): The Index of Orthodontic Treatment Need (IOTN) ⁽¹⁵⁾:-

•Grade 1 -no need	1	Extremely minor malocclusions including displacements less than 1 mm
•Grade 2 - little need	2a	Increased overjet 3.6-6 mm with competent lips
	2b	Reverse overjet 0.1-1 mm
	2c	Anterior or posterior cross bite with up to 1 mm discrepancy between retruded contact position and intercuspal position
	2d	Displacement of teeth 1.1-2mm
	2e	Anterior or posterior open bite 1.1-2mm
	2f	Increased overbite 3.5mm or more, without gingival contact
	2g	Prenormal or postnormal occlusions with no other anomalies: includes up to half a unit discrepancy
•Grade3 - moderate need	3a	Increased overjet 3.6-6mm with incompetent lips
	3b	Reverse overjet 1.1-3.5mm
	3c	Anterior or posterior cross bites with 1.1-2mm discrepancy
	3d	Displacement of teeth 2.1 -4mm
	3e	Lateral or anterior open bite 2.1-4mm
	3f	Increased and complete overbite without gingival trauma
•Grade 4 - great need	4a	Increased overjet 6.1-9 mm
	4b	Reversed overjet greater than 3.5mm with no masticatory or speech difficulties
	4c	Anterior or posterior cross bites with greater than 2mm discrepancy between retruded contact position and intercuspal position
	4d	Severe displacement of teeth, greater than 4mm
	4e	Extreme lateral or anterior open bites, greater than 4mm
	4f	Increased and complete overbite with gingival or palatal trauma
	4h	Less extensive hypodontia requiring pre-restorative orthodontic space closure to obviate the need for a prosthesis
	4l	Posterior lingual cross bite with no functional occlusal contact in one or both buccal segments
	4m	Reverse overjet 1.1 -3.5mm with recorded masticatory and speech difficulties
	4t	Partially erupted teeth, tipped and impacted against adjacent teeth
	4x	Supplemental teeth
•Grade 5 - very great need	5a	increased overjet greater than 9mm
	5h	Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant) requiring pre-restorative orthodontics
	5f	Impeded eruption of teeth (with the exception of third molars) due to crowding displacement, the presence of supernumerary teeth, retained deciduous teeth, and any pathological cause
	5m	reverse overjet greater than 3.5mm with reported masticatory and speech difficulties
	5p	defects of cleft lip and palate
	5s	Submerged deciduous teeth

Table (2) :Statistical number, mean, standard deviation and percentage of total grades

Grades	Number	Mean	SD	Percentage
Grade 1	1427	203.8571	192.2511	29.68%
Grade 2	844	120.5714	121.1498	17.55%
Grade 3	803	114.7143	63.30012	16.7%
Grade 4	1252	178.8571	75.40873	26.04%
Grade 5	482	68.85714	59.5215	10.02%
Total	4808	961.6	377.5	100%

Table (3): Statistical differences between grade-1- and grades 2,3,4,&5(total)

Grades	t-test	df	P-value	Significance
Grade 1&2	1.029	6	0.343	NS
Grade 1&3	1.348	6	0.226	NS
Grade 1&4	0.442	6	0.674	NS
Grade 1&5	2.355	6	0.057	NS

(P> 0.05) non significant (NS)

Fig(1) No. of Grade 2

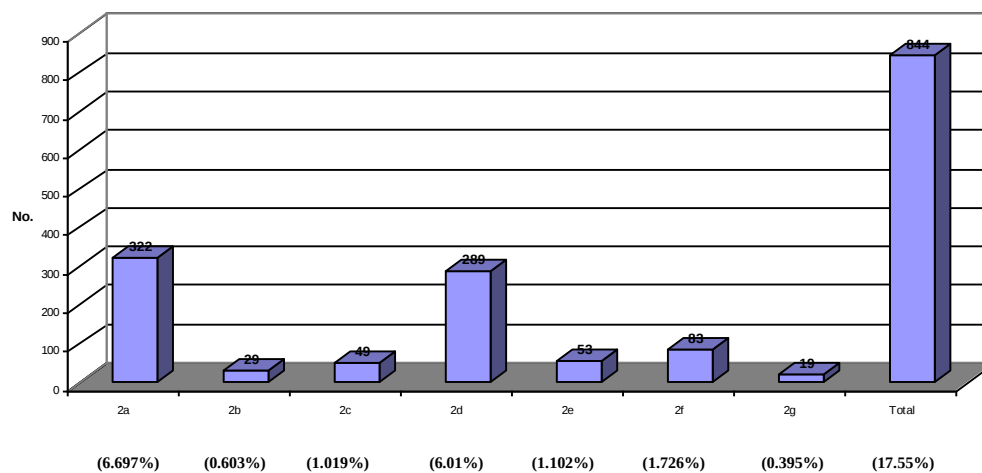


Figure (1): Statistical number and percentage of grade -2-

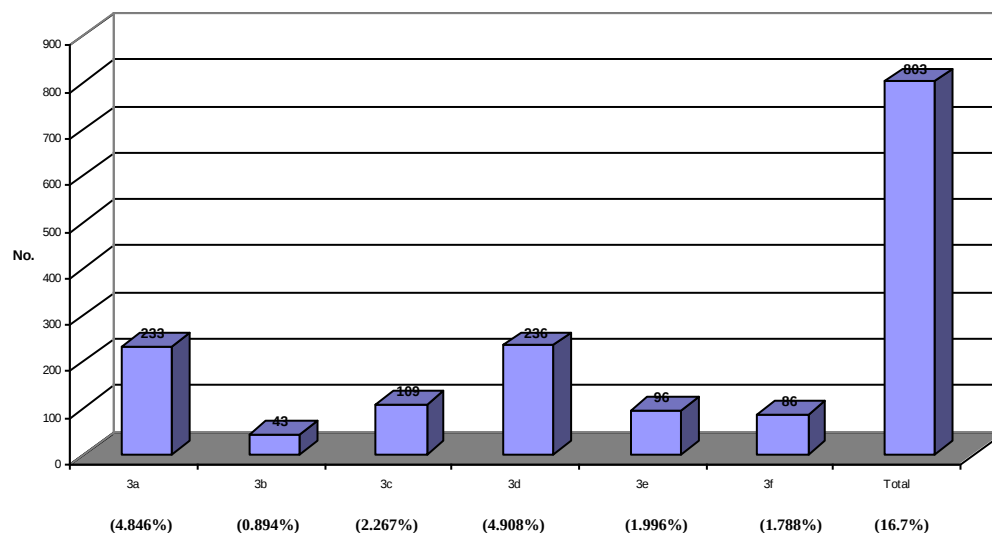


Figure (2): Statistical number and percentage of grade -3-

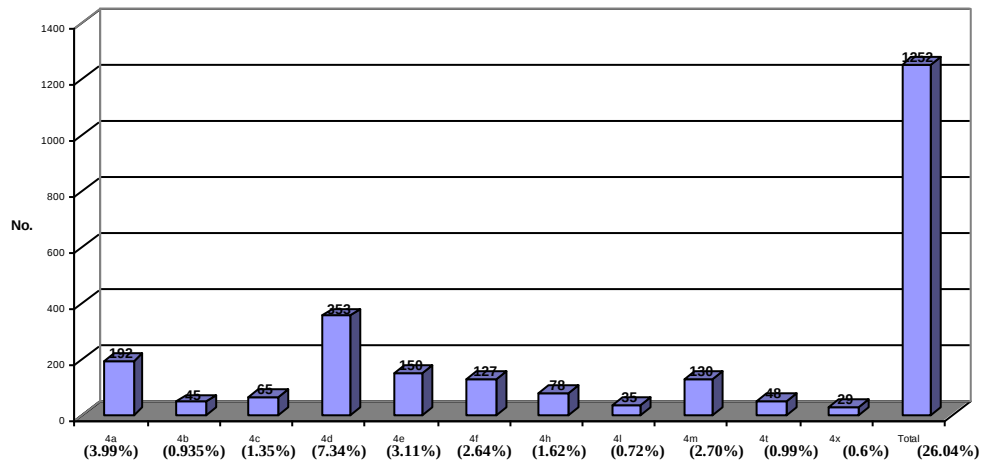


Figure (3): Statistical number and percentage of grade -4-

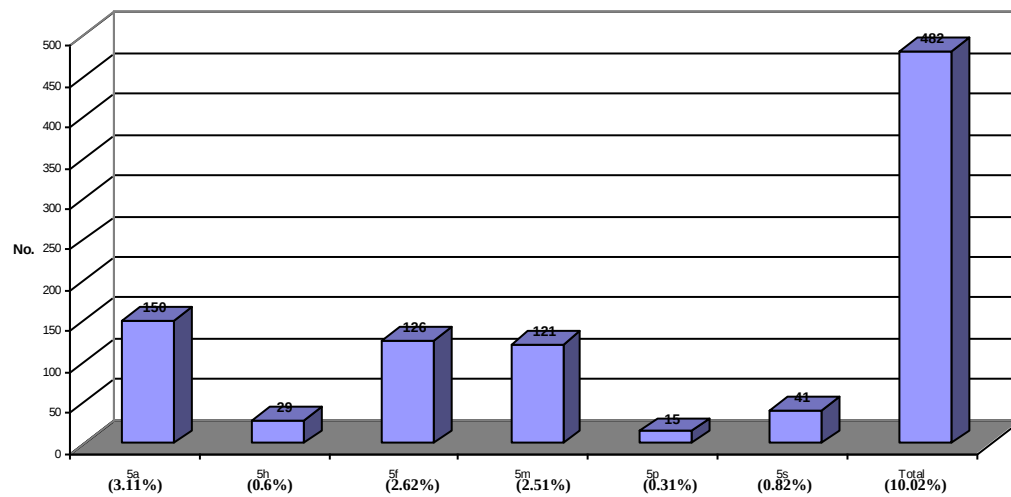


Figure (4): Statistical number and percentage of grade -5-

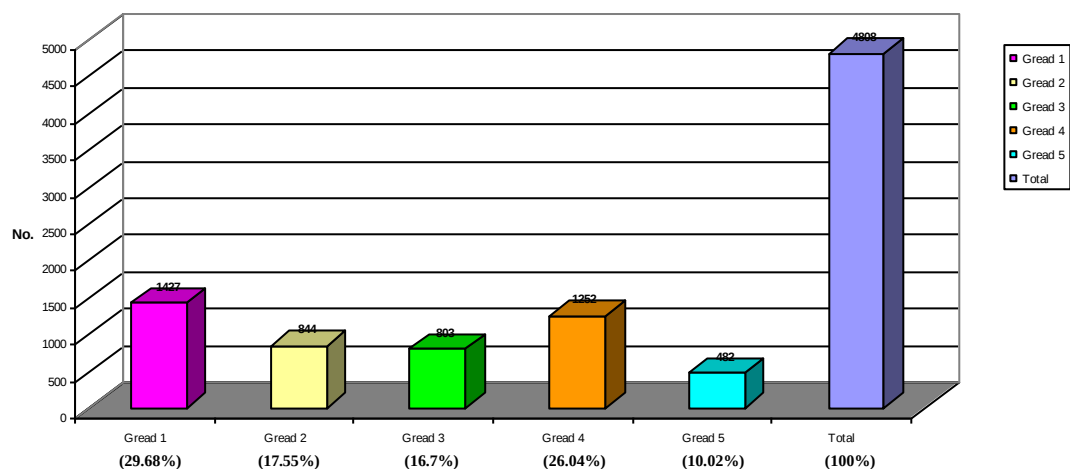


Figure (5): Statistical differences between all grades (total)

References

- 1- Wheeler TT, Mc Gorry SP, Yuriewicz L, Keeling SD, King GJ: orthodontic treatment demand and need in third and fourth grade school children. *Am J Orthod Dentofac Orthop*; 1994(106): 22-23.
- 2- Jenny J: A social perspective on need and demand for orthodontic treatment. *Int. Dent. J*; 1975 (25): 248-53.
- 3- Foster TD: The public health interest in assessment for orthodontic treatment. *J. Public Health Dent*; 1979, 39 (2): 137-42..
- 4- Ast DB, Carlos IP, Cons NC: The prevalence and characteristics of malocclusion among senior high school students in upstate New York. *Am J. orthod*; 1965 (51): 437-45.
- 5- Ng'ang'a PM, Ohiot F, Ogaard B, Valder Hang J: The prevalence of malocclusion in 13- to 15 years old children in Nairobi, Kenya. *Acta odontol scand* ;1996, 54 (2): 126-30.
- 6- Lindegard B, Lindegard L, Carison M, Larsson S: Need and demand for orthodontic treatment. *Tandlaege blad* ; 1971, 75 (12): 1198-210.
- 7- Kelly JE, Sanchez M, Van Kirk LE: An assessment of the occlusion of the teeth of children 6-11 years. Washington DC: National Center for Health Statistic. DHEW publication no. (HRA) 74-1612 (vital and health statistics; 1973, 11 (130):1-49.
- 8- Myberg N, Thilander B: Orthodontic need of treatment in Swedish school children from objective and subjective aspects. *Scand J Dent Res*; 1973 (81): 85-91 (81-4).
- 9- Haynes S : An epidemiologic study of the relationship between overbite in English children aged 11-12 years . *Comm Dent Oral Epideemiol*; 1974 (2): 193-5.
- 10- Gravely J: A study of need and demand for orthodontic treatment in two contrasting National Health Service regions . *Br J Orthod*; 1990, 17 (4) 287-92.
- 11- Prah- Anderson B: The need for orthodontic treatment . *Angle orthod*; 1978 (48): 1-9.
- 12- Ingervall B and Hedegard B: Awareness of malocclusion and desire for orthodontic treatment in 18- year - old Swedish men. *Acta Odontol Scand*; 1974 (32): 93-101.
- 13- Baume LJ, Horowitz HS , Summers CJ, Backer Dirks O, Carlos JP, Cohen LK: A method for measuring occlusal traits developed by the FDI commission on classification and statistics for oral conditions. *Int. Dent. J*; 1973 (23): 530-7.
- 14- World Health Organization :Oral health surveys: basic methods. 4th ed. Geneva: WHO, The organization 1997.
- 15- Shaw WC, O'Brien KD, Richmond S: Quality control in orthodontics indices of treatment need and treatment standards . *British Dental J* , 1991 (170) : 107-12.
- 16- Angle E.H.,: Classification of malocclusion. *D. Cosmos*, 1899 (41): 248-264.
- 17- Barrow G.U and White J.R: Developmental changes of the maxillary and mandibular dental arches. *Angles Ortho.*; 1952 (23):43-49.
- 18- Draker HL: Handicapping labio-lingual deviations proposed for public health purposes. *Am. J. Orthod*; 1960, 46 (4):295-305.
- 19- Bjork A, Krebs AA, Solow B.: A method for epidemiological registration of malocclusion. *Acta. Odontol. Scand*; 1964 (22):27-41.
- 20- Van Kirk LE Jr , Pennell EH: Assessment of malocclusion in population groups . *Am J Orthod* ; 1959 , 45(10): 752-8.
- 21- Foster TD, Day AJW: A survey of malocclusion and the need for orthodontic treatment in shropshire school population . *Brit J Orthod*; 1974, 1(3):73-8.
- 22- AL-Huwaizi AF, AL-Alousi WS, AL-Mulla AA: Orthodontic Treatment Demand in Iraqi 13 year olds- A National Survey. *J Coll. Dent* ; 2002 (13): 134-139.