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Prevalence of late lower incisor crowding (cross sectional study)

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

By

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Certification of the Supervisor

I certify that this project entitled "Prevalence of late lower incisor crowding" was prepared by the fifth-year student **Sajjad Riad Qasim** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

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Dedication

Praise be to God, Lord of the worlds, and prayers and peace be upon the most honorable of the prophets and messengers, Muhammad, and upon his pure, chosen, righteous family.

To those who are not equal to anyone in the universe, to those whom God commanded us to honor them, to those who gave a lot, and gave what can not be returned, to you those words my dear mother and father, I dedicate this research to you; You have been the best support for me throughout my academic career.

To my brothers, sisters and friends who have been my source of inspiration and strength, thank you for supporting me through this and teaching me to always have faith and believe in myself.

To the souls that burned our hearts and left us to the Kingdom of God this year, to the soul of my grandfather who was always supportive of me and wished to see this day, to the soul of my dear uncle, and to the soul of my dear uncle.

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Introduction

Crowding of the mandibular incisors is one of the most common problems encountered in the permanent dentition and lower incisor alignment is one of the most likely things to relapse after orthodontic treatment. Studies of untreated subjects followed from the mixed dentition into adulthood have shown a tendency for the width and length of the mandibular arch to decrease and for crowding of the anterior teeth to increase (**Das et al., 2017**).

Primary crowding refers to a discrepancy of tooth dimension and jaw size, mainly determined genetically. Secondary crowding is caused by environmental factors, including local space conditions in the dental arches and the position and function of the tongue, the lips and the buccal musculature. Tertiary crowding occurs during adolescence and post-adolescence with a predilection for the lower labial segment.

The crowding of the front lower teeth is multifactorial, are distally directed forces, mesially directed forces, periodontal forces, direction of eruption, orthodontic treatment, degenerative tissue changes, and occlusal factors.

The aim of the present study was, therefore, to know the prevalence of crowding of the late lower incisors among certain young people and provide suggestions and guidance to them to treatment for this problem to improve the performance of dental functions naturally and also in addition to improving the aesthetics of the teeth.

Aim of the study

The aim of this study was to predict the prevalence of late lower incisors crowding among young Iraqi people.

Chapter one: Review of literature

1.1 Definition

Occlusion: Is defined as the contact relationship of the maxillary and mandibular teeth when the mouth is fully closed (**Türp et al., 2008**).

Ideal occlusion: A theoretical concept of an ideal arrangement of the teeth within the dental arches, combined with an ideal inter-arch relationship, which concentrates optimal esthetic, function, and stability of the dentition and supporting structures. But it is almost never found in nature (**Barman, 2014**).

Normal occlusion: The term 'normal occlusion' encompasses minor deviations from the ideal that do not constitute aesthetic or functional problems. It is not possible to specify precisely the limits of normal occlusion and so there can be disagreement even between experienced clinicians about the categorization of borderline cases (**Hassan and Rahimah, 2007**).

Dental crowding: also referred as swarming, can be characterized as an inconsistency between tooth size and arch dimension which results in malocclusion. Dental crowding occurs because of the absence of coordination between the tooth size and arch dimensions and results in positioning the teeth on each other (**Das et al., 2017**).

1.2 Late Lower Incisor Crowding

Late crowding of the mandibular incisors beginning between the ages of 17 and mid-twenties and progressing through into late adult life is common (**Sakuda, 1977**).

Approximately 2/3 of adolescents with good alignment and "normal" occlusions will develop incisor irregularity be early adulthood. Richardson, M.E., reported that patients with crowding of the early permanent dentition are more likely to result in impaction of the third molars (**Richardson, 1982**).

Van der linden class crowding to (**Van der Linden, 1974**):

1- **Primary crowding** refers to a discrepancy of tooth dimension and jaw size, mainly determined genetically.
2- **Secondary crowding** is caused by environmental factors, including local space conditions in the dental arches and the position and function of the tongue, the lips and the buccal musculature.
3- **Tertiary crowding** occurs during adolescence and post-adolescence with a predilection for the lower labial segment.

1.3 Etiology of late lower incisor crowding

Factors contributing to development of late lower incisor crowding may include:

1.3.1 Distally Directed Forces

Forces acting in a distal direction may cause retroclination of the lower incisors, with reduction in arch length and consequent crowding. Distally directed forces may be due to:

- Complex growth patterns.
- Skeletal structure.
- Soft tissue maturation.

1.3.1.1 Complex Growth Patterns

Extreme degrees of mandibular rotation in a forward or backward direction could result in increased crowding (**Björk, 1969; Perera, 1987**).

When the mandible rotates upwards and forwards the paths of eruption are displaced in a mesial direction, resulting in what Björk called 'packing of the lower anterior segment' (**Björk, 1969**).

In extreme downwards and backwards rotation the lower incisors become retroclined through their functional relationship with the upper incisors. The posterior teeth are not guided distally in their eruption and crowding develops (**Richardson, 1994**).

1.3.1.2 Skeletal Structure

A specific type of skeleton, which is susceptible to crowding, and a specific pattern of growth have been implicated in the aetiology of late crowding (**Sakuda, 1977**).

One study found crowding to be associated with a high mandibular angle, a retrognathic face and an increased overjet (**Meng et al., 1985**).

However, in another study, analysis of measurements of various cephalometric parameters representative of skeletal morphology at age 13 years in relation to increased crowding from 13 to 18 years could not conclusively identify a particular skeletal type that is susceptible to crowding (**Richardson, 1986**).

1.3.1.3 Soft Tissue Maturation

It is generally recognized that tooth position is influenced by the oral soft tissues. Although there is no direct evidence of a relationship between soft tissue changes and increased crowding, there is some indirect evidence:

1- A reduction in mandibular arch length found in an untreated control group was prevented in subjects treated with the Functional Regulator (**Fränkel and Löffler, 1990**).

The researchers argued that the vestibular shields of the appliance favourably influenced the sagittal development of the mandibular dental arch by eliminating the restraining forces of the external muscular environment.

2- The lower incisors of children who were mouth breathers were more retroclined and crowded than in controls and proclined after adenoidectomy and changes to the mode of breathing that altered the muscular environment (**Woodside et al., 1991; Linder-Aronson et al., 1993**).

These studies show that lower arch alignment can improve after the removal of adverse muscle forces, and suggest that the reverse may also be true. There are various ways in which the perioral musculature may change over time:

- Late mandibular growth changes may bring the lower incisors into a different soft-tissue environment.
- Soft-tissue growth continues up to 19 years and may not proceed at the same rate as skeletal growth (**Vig and Cohen, 1979**).
- Teenagers with incompetent lips, becoming more aware of their appearance, may make a conscious effort to hold their lips together and cause an increase in perioral pressure.
- Orthodontic treatment involving changes in incisor position may alter the pressure environment of the teeth.

1.3.2 Mesially Directed Forces

Mesial migration of human teeth has been recognized since the late 18th century, when it was described by John Hunter, and has been demonstrated more recently by the forward movement of the first molars measured radiological in subjects examined at 13 and again at 18 years (**Hunter 1778; Richardson, 1979**).

There is evidence to support the view that it is largely responsible for the increase in crowding during the teenage years. Mesial migration may be caused by: (**Richardson, 1999**)

- Physiological mesial drift.
- The anterior component of the force of occlusion on mesially inclined teeth.
- The mesial vectors of muscular contraction.
- The contraction of the trans-septal fibres of the periodontal ligament.
- The presence of a developing third molar.

It should be stressed that it is eruption of third molars that is likely to cause increased crowding: the commonly held opinion that it is only impacted third molars that cause the problem is erroneous (**Richardson, 2002**).

The eruption path of the posterior teeth is in an upward and forward direction, and a third molar that is erupting or attempting to erupt in reduced space will undoubtedly exert an influence on the eruption vectors of the second and first molars.

Third molars that increase their mesial inclination to become horizontally impacted are unlikely to cause much pressure on the lower arch (**Richardson, 2002).**

The milder mesioangular and vertical third molars may cause pressure while they are trying to erupt, but once they become impacted (and especially once the apices close) they probably cease to do so as do the Distoangular impactions once they begin to tip distally. Those third molars which force their way into the arch and erupt are the ones most likely to cause crowding (**Richardson, 1999**).

Extraction of third molars, impacted or not, does not solve the problem: in any one individual the aetiology of late crowding may be due to a combination of factors (**Richardson, 2002**).

1.3.3 Periodontal Forces

The presence of a continuous periodontal force acting to maintain interproximal contacts in a state of compression has been demonstrated in humans, and significant correlations between interproximal force and mandibular anterior malalignment have been found (**Southard et al., 1992; Southard et al., 1990**).

Thus, periodontal forces could contribute to the development of lower arch crowding. It is difficult to see how periodontal forces alone could initiate crowding

but in combination with other factors they may well exacerbate the process (**Richardson, 2002**).

1.3.4 Direction of Eruption

The concept of continuous eruption of teeth to maintain occlusal equilibrium is fundamental to orthodontic theory and practice. The amount and direction of eruption may vary in relation to mandibular growth (**Richardson, 2002**).

It has been suggested that the axial inclination of teeth is indicative of the direction of eruption and that there may be favourable and unfavorable relationships between the axial inclinations of molars and incisors, contributing to a decrease or increase in lower arch crowding during the change over from the mixed to the permanent dentition (**Sanin and Savara, 1973**).

Mesially inclined molars and distally inclined incisors that continue to erupt in the same direction would result in reduction in arch depth and increased crowding.

No relationship between axial inclinations and increased crowding could be demonstrated in older children in the early teenage years: in fact, the axial inclinations tended to change and were not always indicative of the direction of eruption. However, this does not preclude the possibility of an unfavourable direction of eruption resulting in increased crowding in individual cases (**Richardson, 2002).**

1.3.5 Orthodontic Treatment

Teeth that have been moved orthodontically have a natural tendency to return to their original (crowded) positions. This is particularly true in the case of rotations. Inadequate distalization of canine roots and excessive arch expansion in the canine region have a strong tendency to relapse (**Richardson, 2002**).

1.3.6 Degenerative Tissue Changes

Bone and periodontal membrane are thought to be biologically labile in response to the hormonal changes that occur during adolescence. Elongation of clinical crowns as a result of gingival recession and bone loss is a well recognized part of the ageing process, and can be hastened or exaggerated by periodontal disease. The resultant weakening of the supporting tissues will render the teeth more susceptible to pressures that they were previously able to resist. In the upper arch, the incisors frequently become spaced and in the lower more crowded (**Richardson, 2002**).

These degenerative changes are more likely to be the cause of crowding that develops in later life.

1.3.7 Occlusal Factors

Alterations in functional occlusion may produce a different pattern of masticatory forces or an occlusion with premature contacts. Occlusal changes may be due to: (**Ishigaki et al., 2006**)

- Tooth loss.
- Restorations.
- Development of parafunctional habits.
- Orthodontic treatment.

Children with Class II division 1 malocclusion treated by extraction of upper first premolars and fixed appliances showed a significantly greater increase in lower arch crowding (2.0 mm) than untreated children (**Owman et al., 1989**).

This was thought to be due to the transmission of reciprocal forces through functional tooth contact to the lower arch. Alternatively, with reduction of the overjet and establishment of tooth contact, occlusal forces and soft-tissue pressures may be transmitted through the upper incisors to the lower ones, causing them to become retroclined and crowded (**Richardson, 2002**).

Canine guidance in lateral excursion may produce a lingually directed force on the lower canines, causing narrowing of the arch in the canine region with consequent crowding **(Richardson, 2002).**

1.4 Treatment of late lower incisor crowding

Factors that should be considered: (**Vanarsdall and Secchi, 1994**)

1- Clinical condition of the teeth
2- Patient and clinician preference must be taken into consideration.
3- Amount of the attached gingiva
4- Overjet and overbite
5- Degree and site of crowding
6- Canine inclination

1.4.1 The treatment options are:

i. Accept and monitor:

As this is a normal maturational change in the lower arch, and if its mild it can be kept under observation. Where more marked crowding is present intervention can be considered (**Gambardela-Tkacz et al., 2023**).

ii. Interproximal stripping:

It done for adult with mild lower incisor crowding < 2mm by removing 0.25 mm from the mesial and distal aspect of each incisor then incisor alignment done by localized fixed appliance then bonded retainer is required for retention (**Millett and Day, 2016**).

iii. Extraction of the lower incisor:

This is done when the lower labial crowding is marked, but the patient should be warned of the possibility of the upper labial segment moving palataly with resultant misalignment in response to the lower labial segment being aligned slightly lingually. Fixed appliance is indicated for alignment of the remaining labial segment teeth then bonded lingual retention is required (**Naini and Gill, 2023**).

iv. Extraction of the lower premolars:

Where the buccal segment occlusion is well interdigitated and crowding is confined to the lower labial segment, its preferable to avoid lower premolar extraction and instead (**Bishara et al., 1986**).

1.5 Little's Irregularity Index (LII)

Little's Irregularity Index (LII) is an index that was created to objectively measure the crowding of the mandibular anterior arch for epidemiological studies. It has also been used to assess the performance of orthodontic brackets, retainers and treatment modalities. The index was first introduced in 1975 by Robert M. Little, in his paper titled The Irregularity Index: A quantitative score of mandibular anterior alignment (**Macauley et al., 2012**).

The index evaluates the anatomical contact points of the anterior incisors. A contact point is defined by the touching of edges of two different teeth. When mandibular crowding occurs, the teeth are often rotated and displaced either palatally or buccally. The LII works by measuring the horizontal linear displacement of anatomic contact points of each mandibular incisor from the adjacent anatomic point and sums the five displacement together. Once the sum is calculated, the value represents the overall degree of anterior irregularity (**Littlewood and Mitchell, 2019**).

A perfect alignment from canine to canine will result in a score of 0 based on LII. As the level of crowding increases, the score also increases. Little used Dial Calipers in order to measure the distances on a plaster model taken of the mandibular arches. The caliper is accurate within a tenth of a millimeter. The vertical discrepancy between the two contact points does not impact the index score. The scale of the index is provided below. The number listed corresponds to the distance in mm of the sum of horizontal displacements of the anatomical contact points of the mandibular anterior teeth (**Årtun et al., 1996**).

Disadvantages

One of the disadvantages of Little's Irregularity Index is assigning a high score to the Malocclusion which involves a severe rotation of one or more teeth. The treatment in a case like this may be simple compared to the high score of crowding assigned using this index. The index also fails to consider the other features of the malocclusion prior to assigning a score (**Singh et al., 2019**).

Chapter two: Material and Method

2.1 Subjects

Forty-five participants of both genders were examined and recorded at age 18 – 23 years old. The sample included variety of occlusions. None was treated orthodontically. All had intact lower arches anterior to and including second molars.

2.2 Materials and methods

Our material consisted of dental Vernier caliper gauge stainless-steel Orthodontic and Cuban pen. 45 Iraqi participants have been examined. We used the method of Little's Irregularity Index.

The LII was used to describe the contact point displacement of the mandibular anterior teeth. The LII is the sum (in millimeters) of the 5 distances between the anatomic contact areas from the mesial aspect of the left canine through the mesial aspect of the right canine (**Little, 1975**).

Each participant was subjectively ranked on a scale ranging from 0 to 10, using the following criteria:

0: Perfect Alignment

1-3: Minimal Irregularity

4-6: Moderate Irregularity

7-9: Severe Irregularity

10: Very Severe Irregularity

When anatomic contact points of adjacent teeth are touching, the measurement was zero. With increased irregularity, greater displacement leads to an increased index score.

Before measurement, the anatomic contact areas of the mandibular incisors and the mesial anatomic contact areas of the canines were marked on lower anterior teeth from mesial aspect of lower right canine to mesial aspect of lower left canine, by using Cuban pen. The linear distance between the markings was then measured, and the 5 values were added.

The reliability of LII measurement was examined with an intraclass correlation coefficient, it used to test inter-and intra-examiner reliability of 5 study models measured twice with a two weeks interval.

2.3 Statistics

Descriptive statistic using SPSS program has been made including Mean, minimum, maximum, frequency and percent.

Chapter three: Result

Out of 45 cases comprising of 20 females and 25 males. **Table 3.1**, showed that 25 male, lower incisors crowding occurred in (55.6%) of the total number of cases, whereas in females are 20, lower incisors crowding occurred in (44.4%)of the total number of cases.

Table (3.1): Frequency distribution of participants according to gender

		Number	Percentages
Gender	Female	20	44.4 %
	Male	25	55.6 %
	Total	45	100.0 %

Table 3.2, showed that people between the ages of (18-19 years old) whose number is 7, lower incisors crowding occurring in (15.6%) of the total number of cases, and who are their ages between (20-21 years old) whose in 17, lower incisors crowding occurring in (37.8%) of the total number of cases, whereas who are their ages between (22-23 years old) whose in 21, lower incisors crowding occurring in (46.7%) of the total number of cases.

Table (3.2): Frequency distribution of participants according to age range

		Number	Percentages
Age range	18-19 years old	7	15.6 %
	20-21 years old	17	37.8 %
	22-23 years old	21	46.7 %
	Total	45	100.0 %

Table (3.3), showed proportion lower incisors crowding according to Little's Irregularity Index, people who had minimal alignment and they are 20, representing

(44.4%) of the total number of cases, and this percentage also represents the largest percentage, who had moderate alignment and they are 8, representing (17.8%) of the total number of cases, who had sever alignment and they are 10, representing (22.3%) of the total number of cases.

Table (3.3): Frequency distribution of participants according to LII

		Number	Percentages
LII	Perfect	6	13.3 %
	Minimal	20	44.4 %
	Moderate	8	17.8 %
	Sever	10	22.3 %
	Very sever	1	2.2 %
	Total	45	100.0 %

Chapter four: Discussion

Subjective evaluation of mandibular anterior irregularity is an unreliable method of ranking severity, as was evident by the divergence of opinion among a group of orthodontists when judging the crowding present, in a series of cases.

To minimize the multiple variables which enter into an orthodontic diagnosis and influence the assessment of case severity and prognosis, only the mandibular anterior teeth were evaluated, omitting cephalometric films, maxillary anterior teeth, facial photographs, and other diagnostic data.

Either the age factor had a clear effect on the lower incisors crowding, as lower incisors crowding is evident in a significant increase in the ages between 22-23 years by 46.7%, It is followed by ages between 20-21 years at 37.8%, and ages between 18-19 years at 15.6%.

We have also classified the cases in this project according to severity of case. It is noted that 44.4% of cases are mild in severity, either cases that are severe were 22.3% of the total, as well as in moderate cases, whose percentage does not exceed 17.8% of the total number of cases, either those who had a perfect alignment condition did not exceed 13.3% of the total number of cases.

The evidence on the aetiology of late crowding remains inconclusive, which is not altogether surprising in view of its multifactorial nature. Some factors may have more influence than others. They may act in various combinations in different individuals at different stages of development.

Chapter five: Conclusion

5.1 Conclusion

Based on the aforementioned evidence, it can be inferred that a significant proportion of individuals who experience crowding in their lower front teeth attribute it to factors such as mesial migration or periodontal forces, as well as potentially other causes.

5.2 Suggestions

1. One option for treating late lower incisor crowding is through clear aligner therapy, which involves wearing a series of clear plastic trays that gradually shift the teeth into the desired position. This can be a less noticeable and more comfortable alternative to traditional braces.

2. It's important to address any underlying issues that may be contributing to the crowding, such as tongue thrusting or mouth breathing habits. Treating these habits may help prevent further crowding in the future.

3. Regular check-ups with a dentist or orthodontist can help monitor the progress of treatment and make adjustments as needed to ensure the best possible outcome.

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