Ministry of higher education
and scientific research
University of Babylon
Faculty of Dentistry
POP Department

The Prevalence of Dental Midline Deviation in a Group of Children Aged (7-15) Years in Babylon Government.

A research submitted to the department of Orthodontics, in the Faculty of Dentistry, Babylon University as a partial requirement of degree of bachelors (B.D.S.)

By

Abdullah Ali Abdulredha
Mohammed Salah Hassan
Ahmed Fareed Saad
Ali Abdulkarim Alwan

Supervised by

Assist. Lect. Omaima Lateef Salman
B.D.S., M.Sc. (Orthodontics)

Prof. Nebras N. Al-Dabagh
PhD. (Microbiology)

Babylon – Iraq

2022 A.D.

1444 A.H

Dedication

At the end of our study life which represented the dream moment for every Student.

We are very proud to achieving this big success.

Special thanks to my supervisor Dr. for his support and

Learns us in each step of our project.

Special thanks to our family and our friends.

Praise to my god forever.

Acknowledgment

Firstly we praise Allah, the Lord of the Worlds, for giving us the strength and reconciliation to end this important stage of life.

We would like to express our thanks and appreciation to the dean of Faculty of Dentistry, University of Babylon, Assist. Prof. Dr. Ameer Alamidi.

Our deepest thanks and respect to head of POP department, Dr. Lamis khidher.

With grateful heart, I would like to thank my supervisor Assist. Dr. Omaima Lateef Salman and Prof. Nebras N. Al-Dabagh who helped us during the course of our project.

Our thanks to our doctors, classmates, and friends for their help throughout this projec

List of contents

Introduction

One of the most common problems dentists face is the midline deviation. The dental midline is a midsagittal line bisecting the maxillary and mandibular dental arches. Each arch has its own midline, and when the two lines don't coincide, the condition is called a ***midline deviation.*** The problem has a persistent nature and is rarely self-correcting. Midline deviation poses an esthetic problem **(Jayalakshmi et al., 2013),** but its importance is far beyond esthetics. It is also a sign that indicates that the occlusion is not normal bilaterally **(Lewis, 1976).**

Midline deviation can be caused by a single factor or it can be multifactorial in origin. It may occur due to dental factors such as congenital missing tooth or teeth, early loss of deciduous teeth, tooth rotation, crowding and habits such as thumb sucking and mouth breathing. Skeletal asymmetry may involve the size discrepancy or mal-positioning between the maxilla and mandible relative to the facial skeleton, or it may affect a number of skeletal structures on one side of the face, as in hemi-facial macrosomia, cleft lip and cleft palate **(Jain et al., 2015).**

Another cause of midline deviation is the presence of dental interferences that prevent proper intercuspation in the centric position and lead to the functional shift of mandible to one side upon closure, typically, to the symptomatic side, once interferences are eliminated, the mandible will shift back to its normal position with no deviation **(Fu, et al., 2003).**

Occlusion is thought of as a dynamic functional relationship rather than a static condition. It is influenced by all components of the masticatory system and undergoes constant modification throughout life **(Turp et al., 2008)**. It is important that the dentists should closely supervising the details of the developing dentition starting from the patient's first year of life until adulthood is reached (**American Academy of Pediatric**

Dentistry, 2021). That is why it is important to consider any observation a clinician might have in order to understand dentition. Clinical observations have revealed that midline deviations can occur around the time of eruption of the first permanent molars. So the aim of our study was to establish the prevalence of dental midline shift in mixed dentition period in a group of children in Babylon government.

Aim of study

- The study aimed to determine the prevalence of dental midline shifting in a group of children aged (7-15) years old in Babylon government.
- Evaluate the association between the different variables include (gender, age stages, residency, and Angle classes of malocclusions with midline shifting

Chapter One
Review of literature

1.1 Midline deviation:

Symmetry means similar arrangement in form and relationships of parts around a common axis of the body, whereas asymmetry means disproportion between two or more like parts. Any deviations from normal facial and dental proportions in homologous parts result in dentofacial asymmetry (**Bhateja et al., 2014).**

Dental midline was defined as "the reference to a vertical line drawn through the tip of the incisal embrasure between the two maxillary central incisors and parallel to the vertical lines of the esthetic frame of the face" **(Ferro et al., 2017)**

The dental midline can also define as a midsagittal line bisecting the maxillary and mandibular dental arches (Figure 1.1). Each arch has it's own midline, and when the two lines don't coincide, the condition is called a *midline deviation* **(Kharbanda, 2019).**

Figure (1.1) Dental mid line

Midline deviation is incongruence between the midlines of the maxillary and mandibular dental arch and/or between them and the facial midline (Figure 1.2). It has also been termed midline discrepancy, dental asymmetry, centre line shift or midline displacement **(Daskalogiannakis, 2000)**. It may be the outcome of discrepancies in tooth dimensions or improper placement of dental units within normal/symmetrical

underlying jaw bones or be the outcome of asymmetrical skeletal bases housing the dental units (**Kharbanda, 2019).**

Fig (1.2) Midline deviation

Midline deviation is one of the most common problems dentists face. Dental midline is evaluated at the junction of contact points of the mesial surface of the central incisors in each arch. Midline symmetry or deviations are recorded as coincident or non-coincident to face and to each other. The maxillary dental arch midline is expected to coincide with mid-sagittal line of the face and midline of the maxilla. Accordingly, mandibular dental midline is supposed to be placed in mid dental arch of the mandibular symphysis and the face. Both maxillary and mandibular midlines are expected to be coincident with each other and to the midline of the face **(**Figure 1.3) (**Kharbanda, 2019).**

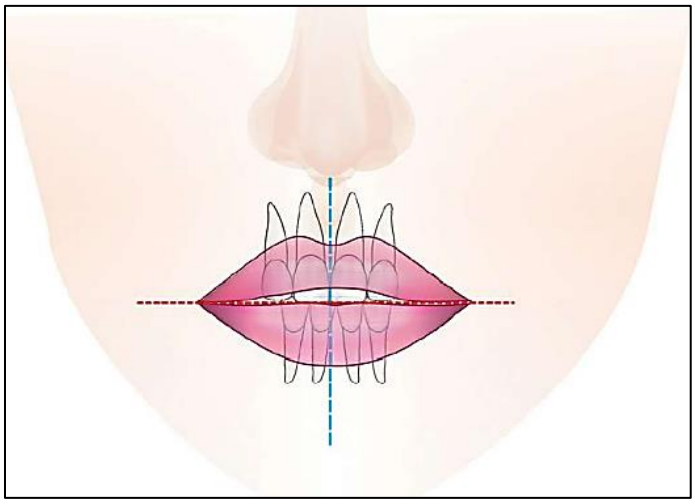

Fig (1.3) The dental midline assessed in relation to the midline of the face

Six important midlines may be determined: facial midline, skeletal midline, maxillary apical base midline, mandibular apical base midline, maxillary dental midline, and mandibular dental midline. These upper and lower midline conditions may occur in different combinations in any patient. All combinations may occur with or without a functional shift of mandible **(Jain et al., 2015).**

Based on the craniofacial structures involved, **Johnston et al. (1999)** classified midline deviation into dental, functional, skeletal, and soft tissue components. Dental midline related to the symmetry of the dentition of the maxilla and mandible. Functional midline related to the functions of the stomatognathic system. Skeletal midline related to the symmetry of the osseous structures of the craniofacial region and the soft tissue midline related to the symmetry of the soft tissue of the craniofacial region.

1.2 Facial Midline:

The right and left sides of the face are highly symmetrical because the two sides develop under the influence and direction of the same genetic information (**Simmons et al., 2004).** Face symmetry and midline coordination are essential criteria for achieving harmony and facial balance. Aesthetic criteria require that certain facial landmarks of the face (the bisector of the pupil, nasion, tip of the nose, tip of the philtrum and chin) be placed in the same axis, forming facial midline, (Figure 1.4) **(Ferro et al., 2017**).

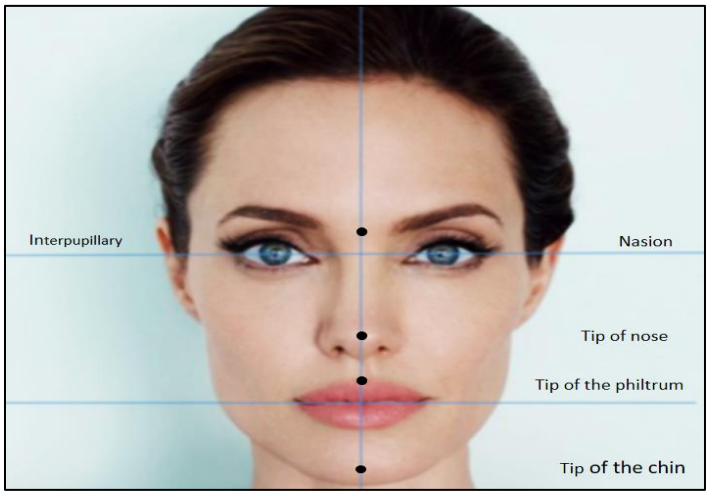

Figure (1.4) Facial Midline

1.3 Midline and esthetics:

The studies have shown that humans find symmetrical faces more attractive than asymmetrical faces. A high level of symmetry in faces is also perceived to be indicative of health, although there was no association found between facial asymmetry and actual health (**Rhodes et al., 2001**).

In dentistry, facial aesthetics is one of the main objectives of dental treatment. In order to achieve the best aesthetic results, maxillary and mandibular dental midline must coincide with the facial midline **(Khan et al., 2014).**

For each patient, there is a subtle degree of asymmetry, but the clinically noticeable deviation of the median structures (nose, upper lip philtrum, chin, or dental midline) is not considered normal (**Anistoroaei et al., 2018).**

The slight facial asymmetry can be found even in those with aesthetically attractive faces. This minor facial asymmetry is usually indiscernible and does not require any treatment. The point at which 'normal' asymmetry becomes 'abnormal' cannot be easily defined and is often determined by the clinician's sense of balance and the patient's sense of imbalance (**Bishara et al., 1994).**

Miller et al. (1979) indicates that the maxillary midline is situated in the exact middle of the mouth in approximately 70% of the individuals, but the maxillary and mandibular midline coincide in only one fourth of the population.

Severt and Profit (1997) found clinically apparent facial asymmetry in 1/3 of the dentofacial deformity population, lower third of face was affected more frequently than upper and middle third of face.

A study was done by **Beyer and Lindaur (1998)** to find the amount of dental midline deviation that is considered acceptable. One hundred twenty individuals were recruited to evaluate images of two subjects. The images used were altered digitally and different amounts of midline deviation were created. It was found that the mean threshold for aesthetically tolerable midline deviation was 2.2 mm.

Another study by **Zhang et al. (2010)** was done to evaluate the threshold under which the midline deviation was considered acceptable. Facial images of 6 subjects with variable facial types were used in the study. The images were altered digitally to change the position of the dental midline and were subjected to evaluation. The mean value of the threshold below which the midline deviation was considered acceptable was 2.4 mm.

Midline deviations are a common and persistent problem that all orthodontists must face. They are found in all types of cases, but perhaps are seen most frequently in Class II malocclusions **(Lewis, 1976).**

1.4 Midline and function:

In addition to the aesthetic problems, occlusal asymmetry is associated with functional problems such as temporomandibular joint disorder and bruxism (**Cheong, 2011).**

a) Temporomandibular Joint disorder: Temporomandibular disorder (TMD) is a collective term used to describe the signs and symptoms involving the muscles of mastication, temporomandibular joint and its related structures. It has been observed clinically an association between occlusion and TMD and TMD symptoms tend to reduce after occlusal adjustments. In addition, patients who have premature occlusal contacts causing mandibular deviation are more prone to develop TMD symptoms (**Mehta et al., 2009).**

Malocclusion can be a hidden and in dormant condition predisposing to TMDs. Midline discrepancies in such cases indicate underlying important factors such as skeletal asymmetry, subdivision malocclusion and premature occlusal contacts causing mandibular deviation. These factors have shown to be associated with TMDs. Any shift in the midline can disturb the seating of condyle in the glenoid fossa or apply unequal functional forces which can lead to disorders of the temporomandibular joint **(Jain et al., 2018**).

A study by **Fu et al. (2003)** was done on a group of TMD patients assessing the maxillo-mandibular relationship before and after a short-term flat plane bite plate therapy. Out of the 20 subjects recruited for the study, 13 were diagnosed with myofascial pain, the other 7 had disc displacement with reduction, and all the subjects had midline deviation. After the flat plane bite plate therapy was finished, the mandibular midline position drifted back to a balanced position where the labial frena are aligned, the condylar position was altered, and TMJ pain decreased significantly as well. The flat plane bite appliance allowed the mandibular to assume a more balanced position rather than a position influenced by existing dental interferences.

b) Bruxism: is a spasmodic grinding or clenching of teeth. Unlike chewing, it is nonfunctional, involuntary, and might cause occlusal trauma and damage the periodontium and oral mucosa. Bruxism is multifactorial in origin; some of the factors

known to be responsible for bruxism are abnormalities in occlusion, mental disorders, and chronic stress. While some authors believe that bruxism is a reaction to occlusal interferences. **(Wieckiewicz et al., 2014).**

1.5 Prevalence of midline deviations

The presence of midline deviations in population surveys has been reported to be close to 20% (**Murshid et al., 2010**). Midline deviations in orthodontic population and patients with facial asymmetries are close to 60% in the range of 46% to as high as78% **(Bhateja et al.,2014; Jain et al., 2015).** Maxillary midline deviations ranged from 21 to 39% with an average of 30%. Midline deviations and asymmetries are more common in mandible owing to its more extended period of growth, which makes it susceptible to be influenced by environmental factors affecting normal growth till adulthood. In the mandible, midline deviations are reported in the range of 43%–67.5% (**Kharbanda, 2019).**

Table 1.2: Reported prevalence of midline shift

Author	Sample			Midline Shift %
	Population	Size	Age	
Mohlin (1982)	Sweden	272	20-45	29.3
Al-Naddawi & Shereef (1989)	Iraq	443	16-80	36.4
Sheats et al. (1998)	America, Florida	5817	9-14	21
Al-Dailami (2000)	Yemen	400 400	10-12 13-15	54 50.75
Al-Huwaizi et al. (2003)	Iraq	7000	13	44.8
Brozabadi (2009)	Iran	755	11-14	23.7
Murshid et al. (2010)	Jeddah, Sudia Arabia	1024	13-14	24
Bhateja et al. (2014)	Pakistan	280	11-18	78
Jain et al. (2015)	India, Indore	300 orthodontic	13-30	77

		patients		
Anistoroaei et al. (2018)	Romania	384 orthodontic patients	6-23	20.70
Hamid et al. (2020)	Iraq (Erbil)	506 orthodontic patients	13-40	49.41

1.6 Evaluation of dental midline:

Dental midline position relative to the facial midline is an important diagnostic feature in orthodontic treatment planning. Evaluation of dental midline position may be complicated because sometimes other midline facial structures are not well aligned (**Anistoroaei et al., 2018).**

The dental midlines can be evaluated at mouth open, at centric relation, at initial contact and at centric occlusion. Dental midline shifts more than 2 mm are usually considered a matter of concern, it can be detected easily and more compromise the attractiveness of the face as compared to 1-2 mm and ~1 mm midline shifts (Figure 1.5**),** (**Kharbanda, 2019).**

In orthodontic diagnosis the extent to which the maxillary midline deviates from the facial soft tissue midline is commonly recorded, presumably because an objective will be for the two midlines and the mandibular midline to be coincident after the treatment. **(Brunetto, 2015).**

Figure (1.5): A perfect coincidence of maxillary and mandibular midlines is desirable though rare. Up to 1 mm of midline deviations is acceptable. Note slight shift of maxillary midline to right in a girl following orthodontic treatment. The occlusion is perfect with class I molar and canine relationship. Bold white line: refers to MSR (midsagittal reference line) ; red line: maxillary midline; yellow line: mandibular midline. (**Kharbanda, 2019).**

The correction of the dental midline deviation through orthodontic treatment often requires complex biomechanics, difficult to achieve in the final stages of treatment, especially for an inexperienced orthodontist. (**Anistoroaei, et al., 2018**) Accurate early diagnosis will enable the clinician to formulate a proper treatment plan otherwise it may be gotten worse during treatment **(Jain et al., 2015**).

1.6.1 Reference planes:

The midline shift can evaluate under the following reference planes (**Kharbanda, 2019):**

1. Mid-sagittal reference (MSR) plane. Mid-sagittal reference plane of the face/head is also called MSR plane. It corresponds to a median plane that divides the body into two halves. It is mainly constructed or follows the average of mid-sagittal structures of the skull. MSR extends down from the head, in natural head position (NHP) or when a subject is sitting upright or standing vertically. The face is bisected by a mid-sagittal vertical line running through the head, the centre of nose, lips and chin. The pupils are

equidistant to this line in the horizontal plane, vertical to mid-sagittal line. MSR plane can be visualised as an imaginary vertical, or vertical line outside the face dropped at glabella **(Naini and Gill, 2008)**. The vertical line also bisects dorsum of the nasal tip equidistantly unless there is an asymmetrical nose. In dental clinical settings MSR plane is easily visualized with a piece of long dental floss or a ruler (Figure 1.6).

Figure (1.6): Evaluation of midline in a clinical setting
(A) Using long dental floss (B) Using a ruler

2. Philtrum of the upper lip: Most patients are more concerned about their facial midline in reference to upper lip or the corners of the mouth. Therefore, the center of the philtrum is a good guide to the placement of the maxillary dental midline. The 'V' at the vermillion border forms a suitable landmark that is much easily appreciated by orthodontists and patients (Figure 1.7). **Arnett and Beggman (1993)** noted that the philtrum is usually a reliable midline structure and can in most instances, be used as the basis for midline assessment. According to **Miller (1979)** the maxillary midline is situated exactly in the middle of the mouth (using the philtrum as a guide) in approximately 70% of individuals, but that the maxillary and mandibular midlines coincide in only one-fourth of the population (**Kharbanda, 2019).**

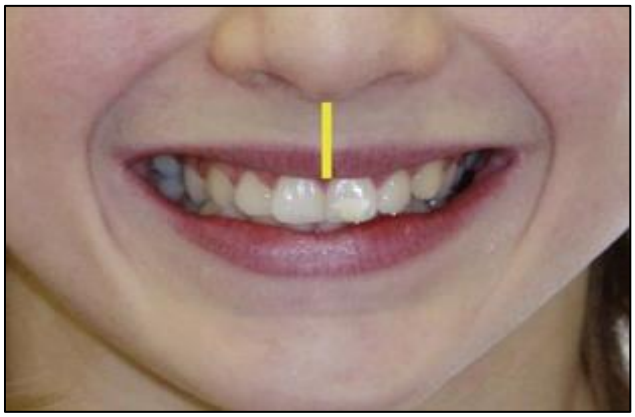

Figure (1.7): The center of the philtrum as a guide to the placement of the maxillary dental midline

3. Corners of mouth: Another guide for assessment of midline is to look at the distance between the canine or first premolar and the corner of the mouth. If the midline is properly positioned, the patient will see the same amount of tooth exposure on the right and left side. The patient looks at soft-tissue guides, such as the philtrum and the corners of the mouth, in evaluating the dental midline, more than any arbitrary string such as a vertical line or dental floss that is placed in front of the face (**Kharbanda, 2019).**

4. Mid palatal raphe: Mid palatine raphe and incisive papillae used as reference points in cases of the normal shape of the arch. Marking points usually determine the maxillary model midline over the mid palatal suture, from the incisive papilla to the most visible posterior landmark **(Maurice and Kula, 1998).**

5. Symphysis of the mandible: Mandibular dental midline is evaluated in reference to MSR and relation to symphysis of the mandible.

6. The base of dentoalveolar structures: Midlines are evaluated on their respective skeletal bases, that is maxillary and mandibular bases at A point and B point respectively (Figure 1.8).

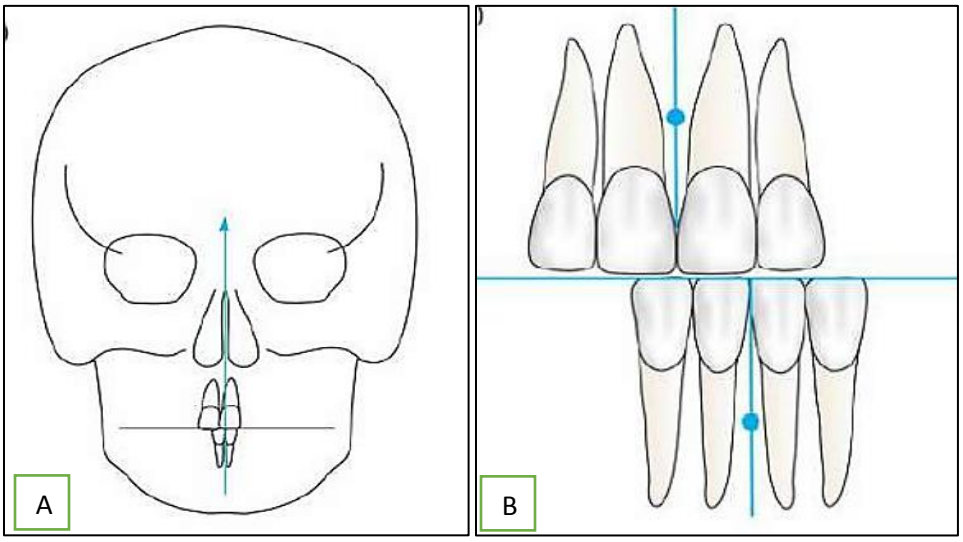

Figure (1.8) A: The dental and skeletal midlines are evaluated in relation to MSR. Incisor apical base discrepancy between upper and lower arches. **B:** Upper dental midline to the right of the lower midline. Skeletal problem with apical base discrepancy

7. Angulation of the incisors: A diligent appraisal of the dental casts and clinical evaluation is performed to assess the axial inclinations of the incisors which may either be contributing to midline discrepancy or alternatively these may have inclined in compensation to underlying dento-alveolar or apical base discrepancy. Under these situations, a mental graphic picture needs to be created for the positions of incisors by placing them in a correct mesio-distal angulation (tip) and visualizing where the centers of the roots might be so located that a perpendicular can be dropped to the occlusal plane. In certain situations, altered angulations may compensate for underlying dentoalveolar or mild forms of skeletal asymmetry (Figure 1.9).

In other instances, alteration in angulations may reflect as a midline shift. A discrepancy of 10° change in incisors angulations could compromise facial aesthetics and are therefore considered unacceptable by the orthodontists **(Kharbanda, 2019).**

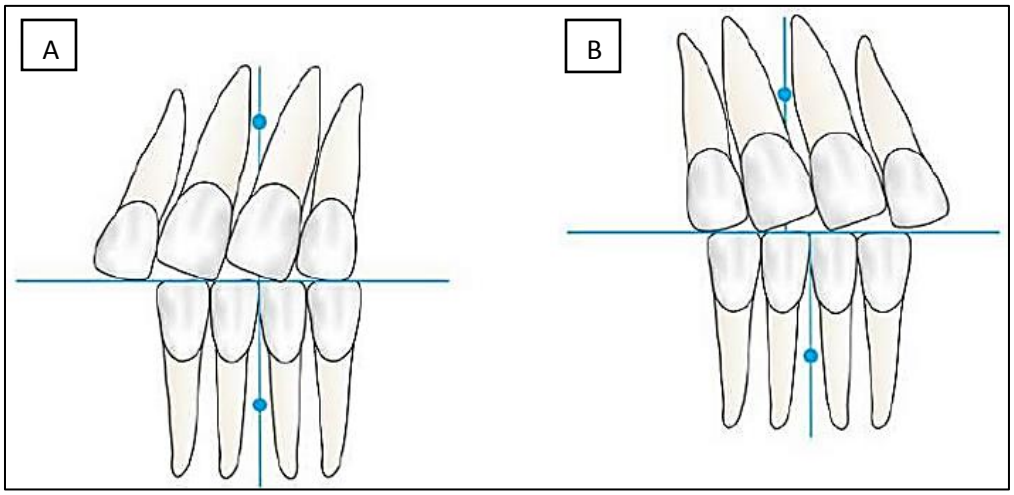

Figure (1.9) (**A**) Upper midline shift to the right without an apical base discrepancy. Upper incisors are tipped towards the right. (**B)** Dental midlines correspond. Apical base discrepancy is masked by compensatory tipping of the upper incisors to the left side

1.7 Aetiology of the midline deviation :

One of the common etiologic factor for the deviation of midline, irrespective of the type of the midline shift is genetic due to the genetic imperfections in the mechanism which was meant to create symmetry and environmental factors producing decided right and left differences for examples: multiple neurofibromatosis, familial incidence associated with dominant gene, hemifacial microsomia, cleft lip and palate (**Bishara et al., 1994).**

Lundstorm et al. (1961) classified the etiological factors as: Genetic and Non genetic or combination.

Another classification of the etiology of the midline shift as: (**Kharbanda, 2019).**

A- Dental: several dental factors can cause asymmetry of the dental arches and midline shift include:

1- **Side differences in the pattern of exfoliation**: A midline shift in the mandible is often seen with the premature shedding of the deciduous canine leading to shifting of midline to the same side. Also, Unbalanced loss of 1st molar and possibly deciduous

2nd molar can cause midline shift, however, the more anterior tooth loss, the greater the effect on the extent of midline shift, Figure (1.10).

Figure(1.10) The lower centreline has shifted to the right following early loss of the lower right canine.

2- **Supernumerary tooth:** Position and orientation of the developing successor tooth buds in the eruptive phase. Eruption pathways can be disturbed due to the physical obstruction such as a presence of a supernumerary tooth, (Figure 1.11)

Figure (1.11): Midline shift associated with a mesiodens

3- **Differences in the site of tooth emergence**: the sequence of eruption and position of the antagonist. A premature extraction of the deciduous molar leading to drift of permanent molar teeth compromising arch length leading to dental arch asymmetry including midline shift.

4- **Tooth rotations:** occur consequently to lack of space in the arch or due to the physical obstruction caused by root stumps of the deciduous teeth, retained deciduous teeth or in association with supernumerary teeth.

5- **Crowding:** If anterior crowding results in an infra-position of canine or a palatally positioned lateral incisor on one side, this leads to an upper midline shift towards the crowded side, (Figure 1.12, 1.13).

Figure (1.12) Midline shift with severe crowding

Figure (1.13) Midline shift with palatally placed lateral incisor.

6- **Ankylosis and retained primary teeth**: as in cases of unilateral retained primary incisor, canine or molar.

7- **Congenitally missing teeth/ partial hypodontia**: as the missing maxillary lateral incisors/missing second premolars, (Figure 1.14).

Figure (1.14) Midline shift with congenitally missing lateral incisor.

8- **The tooth-size discrepancy:** unusually large teeth, such as macrodontia or microdontic teeth leading to migration of adjacent teeth as in situation of microdontic laterals (Figure 1.15).

Figure (1.15) Midline shift due to microdontic laterals.

9- **Transverse problems in the dental arch or its bases:** leading to crowding of the anterior segment are associated with midline shift (Figure 1.16).

Figure (1.16) Midline shift due to transverse problems.

10- **Habits**: Deleterious oral habits, influencing facial morphology, such as thumb sucking, tongue thrusting, pacifier use, mouth breathing.

B- Skeletal: (Figure 1.17)

1- Early unilateral condylar fracture leading to deficient growth on the affected side.

2- Rheumatoid arthritis of TMJ.

3- Hemifacial macrosomia, Hemimandibular hypertrophy (condylar hyperplasia). Most likely in females between age of 15 – 20 yrs.

4- Neurofibromatosis

5- Pathological state in the form of cysts and tumors.

6- Cleft lip and cleft palate especially unilateral clefts.

Figure (1.17) Midline shift in**:** (**A)** patient with condylar hyperplasia, (**B**) patient with unilateral condylar fracture, **(C)** in a cleft patient.

C- **Functional:**

Mandibular functional shift or deflective contacts may result from the lateral deflection of mandible due to presence of occlusal interferences which prevent proper intercuspation in the centric position or may be caused by a constricted maxillary arch or a local factor such as a malpositioned tooth, anterior cross bite, posterior cross bite or in compensation of a skeletal discrepancy, (Figure 1.18).

Figure (1.18): Midline shift due to premature functional contacts. (**A**) maxillary and mandibular midline coinciding during closure of mandible with first initial contact (**B**) Midline shift in centric occlusion

1.8 Clinical presentation of dental midline deviations:

Jerrold and Lowenstein (1990) described following major possible clinical situations on midline deviations.

Group A: Local/dentoalveolar type of midline shift when the face is symmetric, and there are no major skeletal deviations. Four clinical situations can exist:

1. When maxillary midline is off to the right or left side.

2. A clinical situation in which both maxillary and mandibular midlines are coincident but both are off from the centre line of the face in the same direction. Both have moved to the right or left side.

3. A clinical situation when face, maxilla, mandible and maxillary midlines are coincident however mandibular midline is off to centre line or midsagittal reference line of the face. This clinical situation is seen during the late mixed dentition stage. Unilateral loss of deciduous canine in the lower arch can lead to a slight shift of the incisors towards lost tooth side. Once detected, it is advised to perform the extraction of deciduous canine of the contralateral side which usually leads to spontaneous correction of the midline.

4. While facial midline is correctly centered, the maxillary midline and mandibular midlines are not in alignment due to the shift of each of them in their respective jaws in a direction opposite to each other. Maxillary midline may shift to the right side the midline

of the mandibular dental arch has moved to left side, thus compounding the severity of the problem.

Group B: Dental asymmetry comprises clinical situations of facial asymmetry functional or true skeletal deviations. The dental midline deviations may or may not be present. A major cause of such asymmetries in otherwise normal faces involves a lateral functional shift of the mandible.

1.9 Diagnosis of midline deviation:

In each patient an appropriate database for detection of midline asymmetries should be assembled to aid in making an appropriate diagnosis of the nature; extent; and location of the midline asymmetry. This should include**: (Nanda et al., 1996; Narmada et al., 2015)**

1- Patient history: involve history of exfoliation of the primary teeth, extractions, trauma, familial tendencies.

2- Detailed facial and intra-oral clinical examination: the facial and intraoral examination aids in the visualization of the facial and dental midlines, as well as their inter-relationship. Axial inclinations of the incisors and their relationship to the facial midline should be noted at the clinical examination. The clinical examination should also include a functional analysis of mandibular movements in an attempt to determine both centric relation (CR) and centric occlusion (CO) and to record any significant discrepancies between them. Anterior and posterior cross bites should alert the clinician to the possibility of a functional shift and a significant CO-CR discrepancy.

3- Intra and extra oral photographs or video: clinical photographs or a video should record any observations made at the clinical examination, but are not an adequate substitute for a comprehensive clinical examination.

4- Dental models trimmed to centric relation occlusion: it allows for an examination for dental abnormalities that may contribute to midline discrepancies. These may include missing or premature loss of teeth with resultant drifting of teeth, tooth size discrepancies, crowding, and posterior occlusion discrepancies.

5- An occlusogram: it is a representation of the occlusal view of the maxillary and mandibular arches, oriented transversely on the midpalatal raphe, it is helpful in graphically determining the location and extent of the midline discrepancies.

6- Radiographs: particularly the posteroanterior (PA) cephalogram, are invaluable aids in the diagnosis of midline discrepancies. The PA cephalogram should be taken whenever facial or midline asymmetries are detected on clinical examination. A tracing, combined with construction of skeletal and apical base midlines, as well as horizontal reference lines will assist the clinician in determining the extent and location of midline asymmetries.

A panoramic radiograph is useful for the detection of missing or ectopically erupting teeth which may contribute to a midline discrepancy and also gives an adequate screening view of the condyles to help detect gross skeletal left/right asymmetries. The panoramic radiograph can also be used in determining axial inclinations of posterior teeth.

Finally, a submental vertex radiograph is an excellent way of confirming and quantifying mandibular asymmetries.

The assessment of molar occlusion asymmetry must be performed. Data from the clinical examination, the dental models, and the radiographs are used to assess axial inclinations of posterior teeth and are combined to determine the extent of molar occlusion asymmetry. In asymmetric Angle Class II subdivision malocclusions, maxillary molars should be evaluated for forward crown tip on the Class II side, a

condition that may result from premature loss of primary second molar teeth. Combinations of midline and molar asymmetry often imply skeletal or apical base asymmetry and are problems that may be beyond the scope of correction by conventional orthodontic treatment alone and that may require a combined orthognathic surgical approach where these asymmetries are significantly great (**Narmada et al., 2015).**

1.10 Management of dental midline shifts:

Appropriate use of biomechanically oriented appliances will minimize undesirable side effects the following are recommended mechanics can be used to correct midline shift: **(Narmada, et al., 2015)**

1- **Bracket placement**: in patients with apical base midline discrepancies; the incisor brackets can be angulated at the time of bonding. In such a way the placement of a straight wire would change the axial inclinations of the incisors towards the desired midline this method results in tipping of the incisors **(Nanda and Margolis, 1996).**

2- **Cantilevers:** it is ideal for uprighting tipped incisors. It can also be used to change axial inclinations in patients with apical base discrepancies. The use of cantilevers is ideal because the side effects are minimal and the application of the force is localized. The cantilever also delivers small forces due to the long inter attachment distance and a low load deflection rate **(Pair, 2011).**

3- **Asymmetric mechanics:** such as retraction on only one side in extraction patients is sometimes an option used to correct midlines. The use of elastics with a continuous wire is often the most popular method to place asymmetric forces to correct the midlines. This method is satisfactory for minor midline problems restricted to tipped teeth **(Shroff and Siegel, 1998).**

4- **Asymmetric extraction:** one creative approach for managing dental asymmetry is to extract a combination of teeth that will simplify inter-arch and intra-arch mechanics.

5- **Correction of functional midline deviation**: The functional midline shift can be corrected by **(Narmada, et al., 2015):**

   a. Unlocking the mandible.

   b. Removal of the occlusal prematurities.

   c. Expansion of the upper arch.

   d. Functional appliances.

   e. Inter arch elastics.

6-Surgical options: (Narmada, et al., 2015)

   a. Rhinoplasty.

   b. Camouflaging grafting.

   c. Maxillary dental midline subapical procedure to rotate midlines.

   d. Mandibular dental midline to symphysis -Subapical procedures to rotate the mandible.

   e. Two or three-piece maxillary expansion via Le fort I osteotomy.

   f. Surgically assisted maxillary expansion.

7- **Mini screw anchorage for the correction of midline discrepancies** can allow seemingly impossible midline discrepancies to be easily corrected without the use of compliance-dependent intermaxillary elastics or adverse side effects. The mini screws can be implanted either unilaterally or bilaterally, in one or both the arches, depending on the midline deviation **(Chung et al., 2009; Feng et al., 2014).**

8- Clear aligner: Invisalign is another essential treatment option for correcting mild to moderate teeth midline shift in adults. If the deviated midline is accompanied by crossbite or other bite issues, Invisalign can be paired with additional dental appliances to correct the dental midline misalignment.

Chapter Two
Materials and Methods

2.1 Material

2.1.1 Sample:

A total of 250 dentate children (119 males, 131 females) aged between 7-15 years were randomly selected from population attended department of prevention, orthodontics and pedodontics, College of Dentistry /University of Babylon. No fixed proportion between male and female was proposed. The subjects came from different environmental areas (162 urban and 88 rural areas subjects).

Subjects excluded from the study were those with history of previous orthodontic treatment or undergone any orthodontic treatment, prosthetic treatment in the anterior teeth, trauma, surgery, major local/systemic problems that affect the growth and development of facial structures or body for example; cleft lip and palate. acute traumatic injury, facial palsy, neuropathy craniofacial syndromes, neoplasia.

An informed written consent was obtained from all participants after explaining the nature of the study in detail.

2.1.2 Clinical examination Instruments:

1. Disposable dental mirrors.
2. Gloves, medical masks, disinfectant.
3. Dental Vernier**.**
4. Cheek retractor.
5. Dental floss.

Figure (2.1) Clinical examination instruments
(1) Cheek Retractor (2) Dental Mirror (3) Vernier (4) Dental floss

2.2 Method:

A cross-sectional study was conducted in department of prevention, orthodontics and pedodontics at College of Dentistry /University of Babylon. A special case sheet was filled to register information and clinical examination for each participant.

The data collected included: age of subject, residency, classification of malocclusion, the presence/absence of dental midline deviation, the magnitude of deviation.

2.2.1 Method of midline determination

During the examination, the participant was seated in the dental chair and instructed to look forward with back straight in sitting posture without using the headrest. The participants were asked to close the mouth in maximum intercuspation.

The midline evaluation form of each participant was filled by a single investigator included in the study. All midlines were checked by taking philtrum as a guide. The evaluation includes maxillary dental midline and mandibular dental midline concerning

facial midline. The facial midline was determined by stretching a piece of dental floss vertically between soft tissue nasion till pognion including center of philtrum. The shifting of the maxillary and mandibular dental midlines was observed (Figure 2.2) Any shift in the dental midline either to right or left was evaluated and quantified by using a vernier as greater than or equal to, or less than, 2 mm

Each recording was checked twice by the same investigator to eliminate the intra-observer error.

Figure (2.2) Midline Determination

Chapter Three
Results

3.1 Results:

In the studied group, the dental midline deviation was observed in 31.2%, (n=78) patients in the mandible and 17.2% (n=43) patients in the maxillary arch, and 8.4% (n=21 both in maxilla and mandible resulting in 56.8% (n=142) of the patients having the dental midline deviation.

In females, the deviation of dental midline was more frequent (30.4%, n =76) than in males (26.4%, n=66) (Figure 3.1, Table 3.1)

Table (3.1) The correlations between dental midline deviation of children and statistical variables

Variable	Dental midline deviation		Normal		Total		Pearson Chi-Square test	P- value
	No.	%	No.	%	No.	%		
Gender	142	56.8	108	43.2	250	100	0.165	0.684
Male	66	26.4	53	21.2	119	47.6		
Female	76	30.4	55	22	131	52.4		
Age stage	142	56.8	108	43.2	250	100	3.08	0.022*
7-9 years	25	10	32	12.8	57	22.8		
10-12 years	57	22.8	46	18.4	103	41.2		
13-15 years	60	24	30	12	90	36		
Residency	142	56.8	108	43.2	250	100	0.29	0.59
Urban	94	37.6	68	27.2	162	64.8		
Rural	48	19.2	40	16	88	35.2		
Angle classification	142	56.8	108	43.2	250	100	11.373	0.003**
Class I	117	46.8	75	30	192	76.8		
Class II	21	8.4	18	7.2	39	15.6		
Class III	4	1.6	15	6	19	7.6		

*Statistically significant differences when p≤0.05.
**Statistically high significant differences when p<0.01.

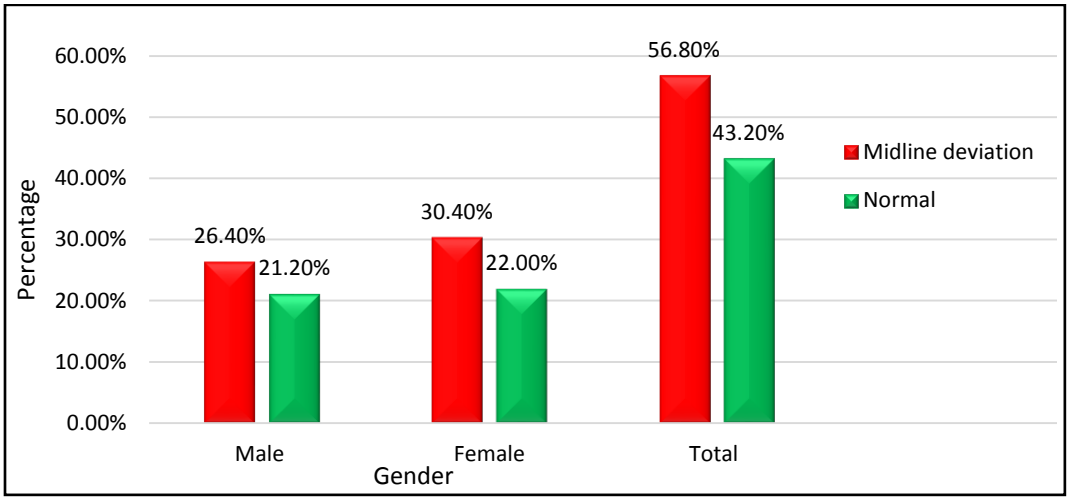

Figure (3.1) The prevalence of dental midline deviation according to gender

The subjects from urban area were more affected (37.6%, n=94) compared to those in rural area (19.2%, n=48) (Figure 3.2 and Table 3.1).

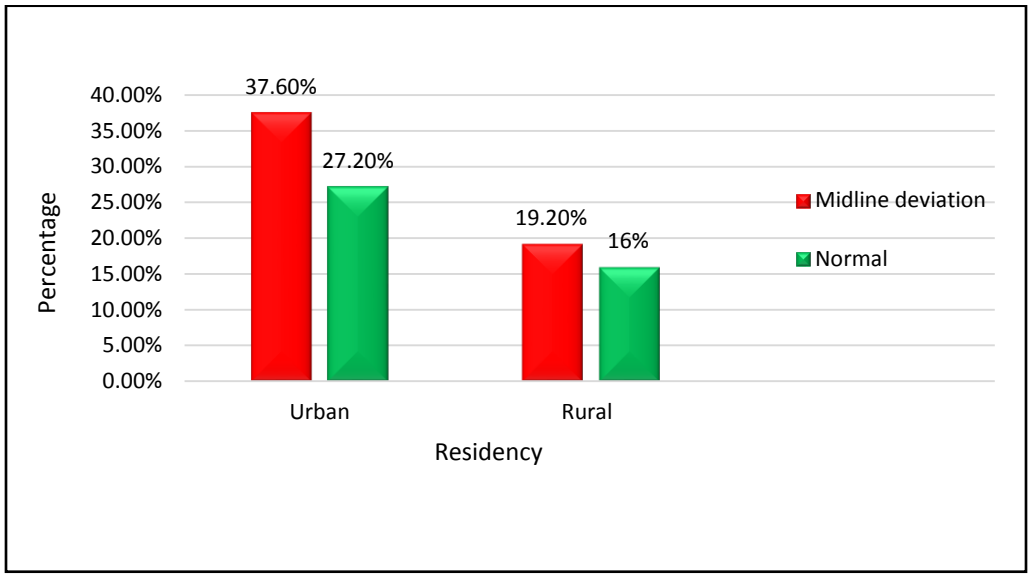

Figure (3.2) The prevalence of dental midline deviation according to residency

In study group, the deviation of dental midline in the dental arch changed with age: at 7-9 years old were 10% (n=25) of the children who had this anomaly, 22.8% (n=57) of the children at 10-12 years old, and 24% (n=60) of age13-15 years (Figure 3.3 and Table 3.1).

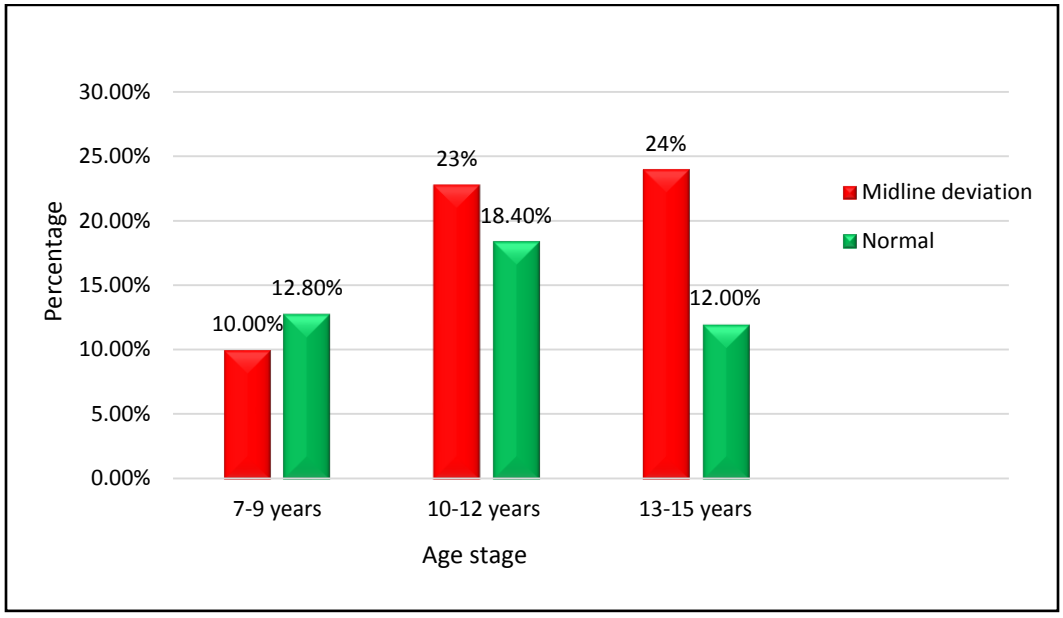

Figure (3.3) The prevalence of dental midline deviation according to age stage

The dental midline deviation was observed in 46.8% (n=117) of children with Angle Class I malocclusion, 8.40% (n=21) of children with Angle Class II malocclusion and 1.60% (n=4) of those with Angle class III malocclusion as shown in (Figure 3.4, Table 3.1).

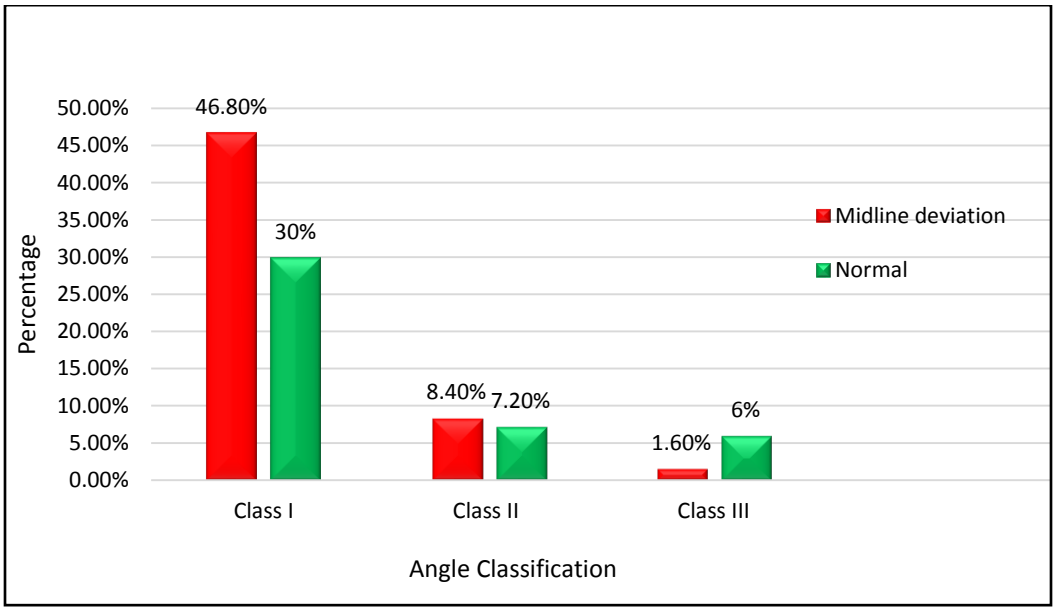

Figure (3.4) The prevalence of dental midline deviation according to Angle classification of malocclusion

In study group, the deviation of dental midline which is greater than or equal to 2mm were 66.9% (n=95) of the children who had this anomaly while 33.1% (n=47) of the children have a deviation of dental midline less than 2mm (Table 3.2).

Table (3.2) Counts and percentages of children with midline deviation greater than or equal to, or less than, 2 mm

Midline deviation	No.	Percentage
Greater than or equal to 2mm	**95**	**66.9 %**
Less than 2mm	**47**	**33.1 %**
Total of subjects with midline deviation	**142**	**100%**

Pearson Chi-square test showed no statistically significant results between the deviation of the dental midline with gender and residency ($p>0.05$) as shown in (Table 3.1). Statistically significant correlation was observed between dental midline deviation and age stages ($p=0.022$).

Statistically significant high correlation was found between the deviation of the dental midline and Angle classes of malocclusions ($p=0.003$) (Table 3.1)

Chapter Four

Discussion

4.1 Discussion

This study was statistically evaluated a group of children aged (7-15 years) in order to determine the prevalence of dental midline deviation, according to gender, age stages, residency, and Angle classes of malocclusions.

Based on the data collected, around half of the total participants (56.8 %) had dental midline shifting or deviation, which was relatively greater in the mandible than the maxilla. **Thilander et al. (2012)** conducted a study on children from different developmental stages, resulting in (13.2%) midline deviation in the sample of their study. **Jayalakshmi et al. (2013)** observed maxilla-mandibular dental midline discrepancy in almost 80% of the Indian students. A study by **Khan et al. (2014)** observing midline deviation in a Pakistani population was 17.2%. **Bhateja et al. (2014)** also reported that 32.6% of their sample did not have coinciding dental midlines. In a study done by **Jain et al. (2015),** it was found that orthodontic patients showed midline deviation in about 77% in routine clinical examination, and 21% of patients showed maxillary dental midline shift and 43% of patients showed mandibular dental midline shift which is nearly twice of maxillary dental midline shift.

While a study done by **Anistoroaei et al. (2018**) and **Hamid et al. (2020)**, reported that midline deviation in a sample of orthodontic patient was 20.70% and 49.41 % respectively. and it was greater slightly in the maxilla than the mandible.

The reason for these vast differences in the result of current study with other previous studies is probably because of differences in the size, criteria of sample, methods of examination, and racial differences.

However, this study highlights the results of other studies that show the lack of maxillary and/or mandibular dental midlines coincidence with each other or with the facial soft-tissue midline. **Bishara (1994)** and **Nanda (1996)** revealed that this may be due to skeletal asymmetries in which the maxilla or mandible is in malposition relative to the facial skeleton, or due to dental asymmetries resulting from displacement or distortion of the upper or lower dental arches, congenital missing tooth, early loss of deciduous teeth and habits such as thumb sucking.

In females the deviation of the dental midline was more frequent than in males with no statistically significant difference (p=0.684). This finding agrees with the studies of **Anistoroaei et al. (2018)** and **Hamid et al. (2020).**

This study agrees with study done by **Anistoroaei et al. (2018),** in that the subjects from urban area show more frequent dental midline deviation than those from rural area with statistically insignificant differences (p=0.59).

The deviation of dental midline changed with age, the prevalence of midline deviation increased after age 12 years with statistically significant correlations.

This may be related to the fact that after age of 12 years, dental anomalies of the number, shape, dental size, position, dental crowding, spacing and the consequences of premature loss of primary teeth causing the establishment of deviation of the maxillary and mandibular dental midlines (**Anistoroaei et al. (2018).**

Prevalence of dental midline shifting was higher in subjects with Angle class I and class II than those with Angle class III malocclusion with statistically high significant difference. Also, a study done by (**Anistoroaei et al. 2018)** showed that the prevalence of midline shifting is seen mostly in patients with Class I and Class II malocclusions with statistically significant high correlations. Patients with class III

Angle malocclusion were found to have a maximum midline shift as reported by **Jain et al. (2015).** This is in disagreement with the present study.

In this study, the deviation of dental midline which is greater than or equal to 2mm was 66.9% (n=95) of the children who had this anomaly while 33.1% (n=47) of the children have a deviation of dental midline less than 2mm. In contrast the study of **Al-Huwaizi et al. (2003),** reported midline shift in 44.8% of the sample mostly of 1mm while midline shifts of 2mm or more were found in 18.7% of the sample. People consider dental midline discrepancies a factor in reducing smile attractiveness; discrepancies of 2 mm or more have 56% chance of being noticed by laypeople(non-professionals) **(Johnston et al. 1999),** but also It is considered that minor discrepancy in the midlines is acceptable (**Bhateja et al., 2014**).

4.2 Limitation of study:

The limitation of this study is that it included a relatively smaller sample size. Subjects of other geographic locations were not able to be added in this study.

4.3 Recommendations:

This study could be repeated on a larger scale on children transitioning from primary dentition to permanent dentition stage in order to further identify the cause of midline deviation. Another recommendation for future research is to observe the occlusal changes that occur upon transitioning from the mixed dentition stage to the permanent dentition stage and find if the existing problems resolves or persists.

It is important for dentists to recognize any malocclusion early so they can intervene or refer to a specialist.

Conclusions

Within the limitation of the current study:

1- Coincident midlines are an important component of functional occlusion and can be used as a clinical guide to establish ideal intercuspation.
2- More than half of 250 dentate children (56.8%) have midline shift.
3- Midline shift in mandible more than maxilla.
4- The deviation of midline in female is more frequent than male
5- Urban area were more affected than rural area.
6- no statistically significant results between the deviation of the dental midline with gender and residency
7- Statistically significant correlation was observed between dental midline deviation and age stages
8- Statistically significant high correlation was found between the deviation of the dental midline and Angle classes of malocclusions.

References

- **Al-Dailami MMY. (2000).** Occlusal features in a sample of Yemeni students aged (10-15) years. Master Thesis, College of Dentistry, Baghdad University, Iraq.
- **Al-Huwaizi, A. F., Al-Alousi, W. S., & Al-Mulla, A. A. (2003).** The Dental Midline at 13 Year of Age. *Journal of the College of Dentistry*,
- **Al-Naddawi, F. A., & Shereef, B. T. (1989).** A study of the prevalence of maxillary diastema and dental midlines deviation in Iraqi adults. *Iraqi Dent J*, *14*, 128-36.
- **American Academy of Pediatric Dentistry (2021)** . Policy on the role of pediatric dentists as both primary and specialty care providers. The Reference Manual of Pediatric Dentistry. Chicago, American Academy of Pediatric Dentistry:158.
- **Anistoroaei, D., Zegan, G., Saveanu, I. C., Sodor, A., & Golovcencu, L. (2018).** The prevalence of dental midline deviation in a group of orthodontic patients. *Romanian Journal of Oral Rehabilitation*, *10*(3), 176-82.
- **Arnett, G. W., & Bergman, R. T. (1993).** Facial keys to orthodontic diagnosis and treatment planning. Part I. *American journal of orthodontics and dentofacial orthopedics*, *103*(4), 299-312.
- **Beyer, J. W., & Lindauer, S. J. (1998, September).** Evaluation of dental midline position. In *Seminars in orthodontics* (Vol. 4, No. 3, pp. 146-152). WB Saunders.
- **Bhateja, N. K., Fida, M., & Shaikh, A. (2014).** Frequency of dentofacial asymmetries: A cross-sectional study on orthodontic patients. *Journal of Ayub Medical College Abbottabad*, *26*(2), 129.
- **Bishara, S. E., Burkey, P. S., & Kharouf, J. G. (1994).** Dental and facial asymmetries: a review. *The Angle Orthodontist*, *64*(2), 89-98.
- **Borzabadi-Farahani, A., Borzabadi-Farahani, A., & Eslamipour, F. (2009).** Malocclusion and occlusal traits in an urban Iranian population. An epidemiological study of 11-to 14-year-old children. *The European Journal of Orthodontics*, *31*(5), 477-484.
- **Brunetto, A. R. (2015).** Orthodontic retreatment of a Class III patient with significant midline asymmetry and bilateral posterior crossbite. *Dental Press Journal of Orthodontics*, *20*, 118-126.
- **Cheong, Y. W., & Lo, L. J. (2011).** Facial asymmetry: etiology, evaluation, and management. *Chang Gung Med J*, *34*(4), 341-51.

- **Chung, K. R., Kim, S. H., Kook, Y. A., Kang, Y. G., & Sinclair, P. M. (2009).** Dental midline correction using two component C-orthodontic mini-implant. *Progress in Orthodontics*, *10*(2), 76-86.
- **Daskalogiannakis, J., Miethke, R. R., & McNamara, J. A. (2000).** *Glossary of orthodontic terms* (p. 79). Batavia, IL, USA: Quintessence Publ..
- **Feng, X., Yang, Z. H. E. N. H. U. A., Dai, J., & Li, R. (2014).** Miniscrew anchorage for the correction of midline discrepancies. *J Clin Orthod*, *48*(3), 169-79.
- **Ferro, K. J., Morgano, S. M., Driscoll, C. F., Freilich, M. A., Guckes, A. D., Knoernschild, K. L., ... & Twain, M. (2017).** The glossary of prosthodontic terms.
- **Fu, A. S., Mehta, N. R., Forgione, A. G., Al-Badawi, E. A., & Zawawi, K. H. (2003).** Maxillomandibular relationship in TMD patients before and after short-term flat plane bite plate therapy. *CRANIO®*, *21*(3), 172-179..
- **Hamid, D.H., Hamad, T.S. and Rahman, A.Q. (2020)** Prevalence of Dental Midline Shifting in a Sample of Orthodontic Patients in Erbil City. *Journal of University of Raparin*, *7*(1), pp.545-555.
- **Jain, S., Jain, V., & Gupta, A. (2015).** Prevalence of midline shift in orthodontic patients. *International Journal of Current Innovation Research*, *1*(10), 287-290.
- **Jain, S., Sharma, N., Patni, P., & Jain, D. (2018)**. Association of midline discrepancy with tempromandibular joint disorder. A systematic review. Clujul Medical, 91(2), 151.
- **Jayalakshmi, N. S., Ravindra, S., Nagaraj, K. R., Rupesh, P. L., & Harshavardhan, M. P. (2013).** Acceptable deviation between facial and dental midlines in dentate population. *The Journal of Indian Prosthodontic Society*, *13*(4), 473-477.
- **Johnston, C. D., Burden, D. J., & Stevenson, M. R. (1999).** The influence of dental to facial midline discrepancies on dental attractiveness ratings. *The European Journal of Orthodontics*, *21*(5), 517-522.
- **Khan, M. F., Qamar, K., & Naeem, S. (2014)**. Coincidence Of Facial Midline With Dental Midline. *Pakistan Oral & Dental Journal*, *34*(2).
- **Kharbanda, O. P. (2019).** *Orthodontics: Diagnosis and Management of Malocclusion and Dentofacial Deformities, E-Book*. Elsevier Health Sciences.
- **Lewis, P. D. (1976).** The deviated midline. *American Journal of Orthodontics*, *70*(6), 601-616.
- **Lundström, A. (1961)**. Some asymmetries of the dental arches, jaws, and skull, and their etiological significance. *American Journal of Orthodontics*, *47*(2), 81-106.
- **Maurice, T. J., & Kula, K. (1998).** Dental arch asymmetry in the mixed dentition. *The Angle Orthodontist*, *68*(1), 37-44.

- **Mehta, N., Maloney, G. E., Scrivani, S. J., & Bana, D. S. (Eds.). (2011).** *Head, face, and neck pain science, evaluation, and management: An interdisciplinary approach*. John Wiley & Sons.
- **Miller, E. L., Bodden Jr, W. R., & Jamison, H. C. (1979).** A study of the relationship of the dental midline to the facial median line. *The Journal of prosthetic dentistry*, *41*(6), 657-660.
- **Mohlin B. (1982).** Need and demand for orthodontic treatment in a group of women in Sweden. Eur J Orthod; 4, 231-42.
- **Murshid, Z. A., Amin, H. E., & Al-Nowaiser, A. M. (2010).** Distribution of certain types of occlusal anomalies among Saudi Arabian adolescents in Jeddah city. *Community dental health*, *27*(4), 238-241.
- **Naini, F. B., & Gill, D. S. (2008).** Facial aesthetics: 2. Clinical assessment. *Dental update*, *35*(3), 159-170.
- **Nanda, R., & Margolis, M. J. (1996, June).** Treatment strategies for midline discrepancies. In *Seminars in orthodontics* (Vol. 2, No. 2, pp. 84-89). WB Saunders.
- **Narmada, S., Senthil Kumar, K., & Raja, S. (2015)**. Management of mid-line discrepencies: A review. *J Indian Acad Dent Spec Res*, *2*(2), 45-8.
- **Pair, J. (2011).** Movement of a maxillary central incisor across the midline. *The Angle orthodontist*, *81*(2), 341-349.
- **Rhodes, G., Zebrowitz, L. A., Clark, A., Kalick, S. M., Hightower, A., & McKay, R. (2001).** Do facial averageness and symmetry signal health?. *Evolution and Human Behavior*, *22*(1), 31-46.
- **Severt, T. R., & Proffit, W. R. (1997).** The prevalence of facial asymmetry in the dentofacial deformities population at the University of North Carolina. *The International journal of adult orthodontics and orthognathic surgery*, *12*(3), 171-176.
- **Sheats, R. D., McGorray, S. E., Musmar, Q., Wheeler, T. T., & King, G. J. (1998, September).** Prevalence of orthodontic asymmetries. In *Seminars in orthodontics* (Vol. 4, No. 3, pp. 138-145). WB Saunders.
- **Shroff, B., & Siegel, S. M. (1998, September).** Treatment of patients with asymmetries using asymmetric mechanics. In *Seminars in Orthodontics* (Vol. 4, No. 3, pp. 165-179). WB Saunders.

- **Simmons, L. W., Rhodes, G., Peters, M., & Koehler, N. (2004).** Are human preferences for facial symmetry focused on signals of developmental instability?. *Behavioral Ecology*, *15*(5), 864-871.
- **Thilander, B., & Bjerklin, K. (2012**). Posterior crossbite and temporomandibular disorders (TMDs): need for orthodontic treatment?. *European Journal of Orthodontics*, *34*(6), 667-673.
- **Turp, J. C., Greene, C. S., & Strub, J. R. (2008).** Dental occlusion: a critical reflection on past, present and future concepts. *Journal of oral rehabilitation*, *35*(6), 446-453.
- **Wieckiewicz, M., Paradowska-Stolarz, A., & Wieckiewicz, W. (2014).** Psychosocial aspects of bruxism: the most paramount factor influencing teeth grinding. *BioMed Research International*, *2014*..
- **Zhang, Y. F., Xiao, L., Li, J., Peng, Y. R., & Zhao, Z. (2010).** Young people's esthetic perception of dental midline deviation. *Angle Orthodontist*, *80*(3), 515-520.