Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i7.7223

UNDERSTANDING & EVALUATION OF MIDLINE DISCREPANCIES IN ORTHODONTIC PATIENTS: A COMPREHENSIVE APPROACH CONCERNING FACIAL HARMONY

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ABSTRACT

A considerable proportion of the attractiveness of a smiling face is attributed to the smile. A person's smile, which is often the first feature of their personality to be noticed, can be impacted by any dentofacial midline discrepancy. This study sought to determine the prevalence of dentofacial midline discrepancies in orthodontic patients in order to establish the stability, esthetics, and functional occlusion of treatment outcomes following orthodontic treatment. A descriptive cross-sectional study encompassing 138 patients of Pakistani origin were included in the study. All subjects with permanent teeth, with the possible exception of third molars, underwent evaluation. Further to the clinical assessment, extraoral pictures and dental casts were analyzed as well. The data was collected using study proforma. The mean age of the patients was 22.11±5.425 years, with 76.01% being female and 23.91% being male. Non-coincident dental midline and mandibular midline deviation from facial midline had the largest prevalence among research subjects (54.3%), while maxillary midline deviation from facial midline (33.3%) was less common. The findings underscore that discrepancies between maxillary/mandibular dental midline and mandibular dental midline deviation from facial midline were more prevalent than maxillary midline deviation from facial midline.

Keywords: Dentofacial Discrepancies, Midline, Orthodontic Patients

INTRODUCTION

Dentofacial discrepancy refers to any deviation from normal facial and dental proportions (1-3).

Midline discrepancies are the most noticeable dental asymmetries. Orthodontists make the most discriminating assessments of midline position, followed by dentists (4). Orthodontic treatment focuses on smile, esthetics, and one of the most significant factors in achieving an esthetic smile is the coincidence of the maxillary and mandibular midlines with each other as well as the facial midline (5, 6). Dentofacial discrepancies are the most distressing non-syndromic anomalies for patients. Severe facial asymmetry can be caused by craniofacial abnormalities, diseases, trauma, or any other aberrant growth, and it can have an impact on appearance, self-esteem, and overall well-being (7-9).
According to a study conducted at Aga Khan University Hospital in Karachi, Pakistan, the most common dentofacial discrepancy among orthodontic patients was non-coincidental dental midline, which occurred in 78.2% of patients, followed by mandibular midline deviation from facial midline (67.5%) and maxillary midline deviation from facial midline (14.3%) (2). To measure the patient's facial midline, various soft tissue landmarks and structures are employed as references. During clinical assessment, a common approach is using a piece of dental floss is stretched from the glabella to the lower chin, passing over the nasal bridge and philtrum (10).
The alignment of the dental and facial midlines is a crucial consideration in esthetic opinions. The importance of integrating the maxillary and mandibular midlines has been emphasized, as it creates a harmonious dental appearance and optimizes face proportions, thereby improving esthetics. Several studies have been conducted on midline discrepancies of approximately 2-3 mm across various populations (11).
Minor asymmetries are deemed clinically acceptable but major skeletal and dental deviations from the facial midline can have a severe impact on esthetic outcomes. It could be skeletal or dental asymmetry. Skeletal asymmetry can be caused by misalignment of the maxilla and/or mandible in relation to the face skeleton. Dental asymmetries are caused by asymmetric crowding, spacing, tooth size differences, tooth rotations, or displacement/distortion of the upper or lower dental arches. Symmetrical teeth alignment is essential for an aesthetically pleasing smile. Maxillary teeth are prominently exposed when smiling, therefore the coordination of the maxillary dental midline with the facial midline is more important than the mandibular dental midline. It is vital to coordinate upper and lower dental midlines for aesthetic and functional reasons, but it can lengthen and complicate orthodontic treatment situations. The decision of extracting tooth for correction is critical in determining whether the cause of asymmetry is skeletal, dentoalveolar, or a mix of the two. It is also critical to determine whether a dental midline deviation is caused by buccal segment asymmetry or uneven crowding in dental arches (3, 12, 13).
In most orthodontic patients, the dental midline does not coincide with the facial soft tissue midline. It is difficult to determine the cause of non-coincidence between dental and facial midlines, especially if there is a tiny difference between the two (14).
Orthodontists and dentists have substantially lower tolerance for midline deviation than patients. The findings of various research attempting to define the threshold of acceptability for dental midline deviation are inconsistent (15). The importance of midline asymmetries in orthodontic diagnosis and treatment planning is highlighted by numerous cases of this malocclusion handled by orthodontists. As a result, various research has been done to diagnose and cure facial and dental asymmetry (16). When possible, the maxillary dental midline ought to align with the facial midline; otherwise, it should be parallel to the facial midline. An inclined maxillary midline would be more noticeable and less appealing (17).
Keeping in mind the utmost importance of facial symmetry and dentofacial discrepancies, this study was conducted to investigate the prevalence of dentofacial midline discrepancies in orthodontic patients.

MATERIAL AND METHODS

Study Design, Setting & Duration

This research employed a cross-sectional design conducted at Orthodontics department, Institute of Dentistry, Liaquat Medical and Health Sciences, Jamshoro /Hyderabad. The duration of study was six

months and total sample of 138 patients from Department of Orthodontics, Institute of Dentistry, LUMHS, Jamshoro /Hyderabad were screened.

Technical and Ethical Approval

The study received technical approval from the Institutional Research Ethical Review Committee of LUMHS and REV department of CPSP.

Population & Sampling

One hundred thirty-eight patients requiring orthodontic treatment at the Department of Orthodontics LUMHS Jamshoro/Hyderabad and meeting the selection criteria were recruited as a study participant.

Statistical package for Social Sciences (SPSS) Version 26 was used to compile and analyze data. Quantitative variables such as age was determined using mean and standard deviation. Qualitative variables like gender, ethnicity, co-incidence of dental midline, maxillary midline shift from facial midline and mandibular midline shift from maxillary midline were summarized as frequency and percentage. Descriptive statistics were employed to assess the frequency of dentofacial discrepancies. Effect modifiers like age, gender, and ethnicity was controlled through stratification. A *P*-value of 0.05 or less was regarded as statistically significant.

Inclusion & Exclusion Criteria

The inclusion criteria comprised patients of Pakistani origin visiting dental OPD for orthodontic treatment and patients having permanent dentition excluding third molars.

The exclusion criteria included Patients with previous history of orthodontic treatment, patients with midline diastema, congenital or acquired craniofacial deformity.

Data Collection

The Department of Orthodontics, Institute of Dentistry, Liaquat University of Medical and Health Sciences, Jamshoro/Hyderabad, conducted this cross-sectional study. All study participants and their parents provided verbal and written informed consent at the time of recruitment, after which each participant received a thorough explanation of the study. The diagnostic records of patients receiving orthodontic treatment were used to gather data.

Data was obtained via non-probability consecutive sampling, which includes dentofacial discrepancies, although patients with craniofacial deformities were dropped. Data for the evaluation of dental and facial asymmetry in patients was gathered from initial clinical evaluations and diagnostic workup. Symmetry was evaluated using the following dentofacial variables: a. Inconsistent midline alignment; b. Mandibular midline shift from mandibular midline; c. Maxillary midline shift from facial midline.

These variables were examined via clinical examinations and dental casts. Clinical assessment of the facial midline was performed by drawing a straight line through the nasal bridge, nasal tip, philtrum, and chin point, and any deviation from the straight path was called asymmetric facial midline.

Line constructed between mesial surfaces of mandibular central incisors should coincide with straight facial midline, Line deviating from facial midline was considered *as mandibular midline discrepancy*.

Contact between mesial surfaces of maxillary and mandibular central incisors should align in a straight line. If no straight line, it was called non coincident and regarded as *maxillomandibular midline discrepancy.*

Alginate impression material and impression trays were used to take impressions of the patient's dentition in order to make dental castings. Orthodontic plaster was poured into it following the obtaining of an impression. After orthodontic plaster had had time to dry, the resulting dental casts were taken out of the impression trays and examined for symmetry.

RESULTS:

The mean age of the patients was 22.11± 5.425 years (Table 1). There were 76.1% females and 23.9% were males (figure 1). Most of the study subjects 95.7% were Muslims and 4.3% were non-Muslims (figure 2).

Table 1- Descriptive Statistics of Age

Descriptive Statistics		Age (Years)
Mean		22.11
Std. Deviation		3.52
95% Confidence Interval for Mean	Lower Bound	21.52
	Upper Bound	22.70
Median		22
Interquartile Range		5
Minimum		15
Maximum		34

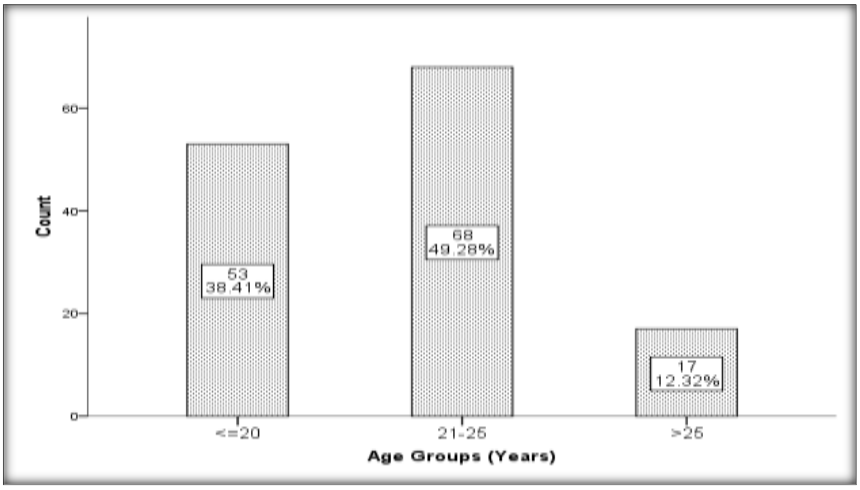

Figure 1: Age Distribution Of The Patients

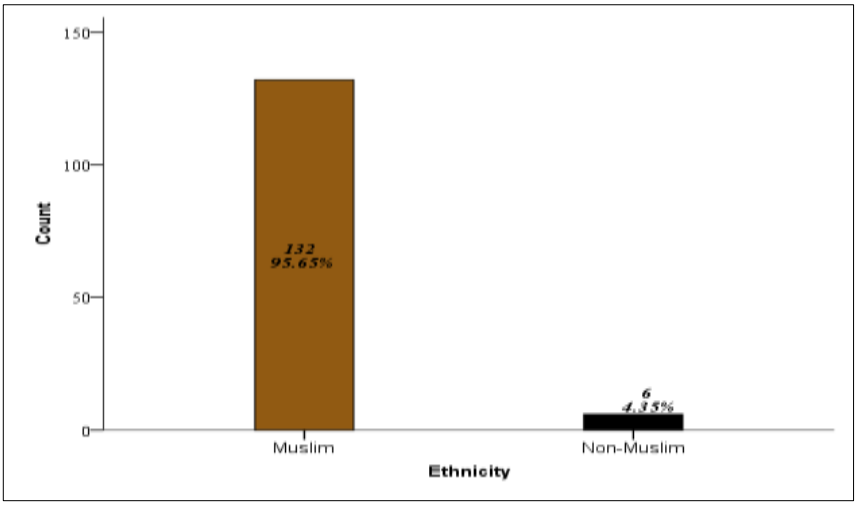

Figure 2. Patient Distribution According To Ethnicity

Frequency of dentofacial asymmetries in orthodontic patients is presented in table 2. Non co-incident dental midline and mandibular midline discrepancy from facial midline is the most common dentofacial asymmetry among study subjects i.e. 54.3% and maxillary midline deviation from facial

midline 33.3% is less prevalent (table 2). Stratification analysis was performed with respect to gender, age groups and ethnicity. Frequency of dentofacial asymmetries were not statistically significant between the male and female, it was also not statistically significant between age groups (table 3 & 4).

Table 2: Frequency of Dentofacial Midline Discrepancies in Orthodontic Patients

Dentofacial Midline Discrepancy	Frequency	Percentage
Coincidence of dental midline	75	54.3%
Maxillary midline shift from facial midline	46	33.3%
Mandibular midline shift from maxillary midline	75	54.3%

Table 3: Frequency of Dentofacial Midline Discrepancies in Orthodontic Patients Stratified by Gender

Dentofacial Midline Discrepancy	Gender		P-Value
	Male n=33	Female n=105	
Coincidence of dental midline	19(57.6%)	56(53.3%)	0.670
Maxillary midline shift from facial midline	11(33.3%)	35(33.3%)	0.999
Mandibular midline shift from maxillary midline	19(57.6%)	56(53.3%)	0.670

Table 4: Frequency of Dentofacial Midline Discrepancies in Orthodontic Patients Stratified by Ethnicity

Dentofacial Midline discrepancy	Ethnicity		P-Value
	Non-Muslim n=6	Muslim n=132	
Coincidence of dental midline	5(83.3%)	70(53%)	0.219
Maxillary midline shift from facial midline	4(66.7%)	42(31.8%)	0.077
Mandibular midline shift from maxillary midline	5(83.3%)	70(53%)	0.145

DISCUSSION

The study aimed to investigate the frequency of dentofacial asymmetries in orthodontic patients (mean age 22.11±5.425 years) with permanent dentition (excluding third molars) of both genders.

In a Pakistani study conducted at Aga Khan University, 78.5% (219) of patients had noncoincident midlines, 67.5% (189) had mandibular midline asymmetry, 43.2% (122) had molar asymmetry, 15.7% (44) had mandibular arch asymmetry, 14.3% (40) had maxillary midline asymmetry, 13.6% (38) had maxillary arch asymmetry, 6.1% (17) had nose deviation, and 12.1% (34) had facial asymmetry and chin deviation (2).

In Iranian research, 44.6% of girls and 46.4% of boys exhibited some sort of asymmetry. In girls, skeletal, dental, and functional asymmetry were 20%, 21%, and 10%, respectively, but in boys, they were 23.6%, 20.9%, and 7.6%. There was a positive correlation between a history of trauma (r=0.39) and unilateral mastication (r=0.22) with asymmetry (r=0.95).

Asymmetry with midline shift is a prevalent clinical issue, affecting 46% of orthodontic patients and 21% of untreated young adolescents. Furthermore, 62% of midline disparity cases affected the lower midline, whereas 39% affected the upper midline. To accurately assess and quantify asymmetry, the following resources may be used: clinical facial assessment, cephalograms in oblique (45°) or anteroposterior view (AP), submental vertex radiographs, and computed tomography scans. One of the most powerful methods used to determine asymmetry is clinical evaluation performed directly on the patient (1).

In the current study, 76.1% of patients were girls and 23.9% were men; according to ethnicity, 95.7% of the study subjects were Muslims and 4.3% were non-Muslims. Non-coincident dental midline is the most common dentofacial asymmetry among research individuals, accounting for 54.3%, while

maxillary midline deviation from facial midline (33.3%) is the least common dentofacial difference. There is no relationship between ethnicity and the prevalence of dentofacial asymmetry. The importance of balanced facial, maxillary, and mandibular midlines in achieving a successful orthodontic result and maintaining facial harmony cannot be overstated. The point at which 'normal' asymmetry becomes 'abnormal' is difficult to define and is frequently determined by the clinician's and the patient's sense of balance (11).
Your smile is the first perception of your personality (14). The balancing smile is highly significant as it is determined by the coincidence of the facial and dental midlines (16). The facial midline is determined by landmarks such as the nose, philtrum, and chin, which are all aligned straight(18). It should be in the center of the face and align with the dental midline (19). The dental midline is the mid sagittal line of the maxillary and mandibular arches when the teeth are fully intercusped (19). Dental midline is the crucial element in smile design and should be parallel to the long axis of the face. In addition, it should be perpendicular to Incisal plane and perpendicular to papilla (20).. Establishing dental midline parallel to that of face is the initial step while constructing fixed or removable prosthesis (21). If it is in harmony with facial component, it markedly contributes to the aesthetics of the face (22). This will give patient a feeling of harmony and balance (19). Of all the dental and occlusal asymmetries, midline discrepancies might be the most evident to the patient (23). The prevalence of facial asymmetry in orthodontic patients is an important element for clinicians in their earlier identification of deviations in advance of any orthodontic treatments. This may guide clinicians towards providing the correct orthodontic treatment (9, 18)

The two strategies to transverse decompensation are:
(a) asymmetric extraction, so that the incisors are retracted more on one side than on the other and the midline shifts to the preferred direction, and
(b) asymmetric elastics (usually anterior diagonal elastics).

With the desired extractions, the midline can be shifted several millimeters. Without extraction, elastics can only cause minor changes (3). For optimal aesthetics, the maxillary dental midline should be near the face's midline. If just mandibular surgery is scheduled, the orthodontist must perform the maxillary midline correction. If maxillary surgery is still necessary, the surgeon can easily rotate the jaw and alter the midline by 3 to 4 mm. This rotation will cause some occlusal discrepancies posteriorly, but they will not prevent orthodontic teeth alignment during post-surgical orthodontics. For individuals requiring maxillary surgery, it is recommended to reduce pre-surgical orthodontics and allow the surgeon to correct the maxillary midline. Orthodontics can cure dental asymmetries and functional shifts, but substantial face asymmetries may necessitate orthopedic correction throughout the developing age period and/or surgical therapy once growth is completed (11).
When planning orthodontic treatments, one should proceed carefully because transversal asymmetry of dental arches is not always corrected after orthodontic treatment, and orthodontic cases result in dental arches that are beyond the non-extraction approach (24, 25). The clinical examination begins with the patient's principal complaint and an assessment of their medical history. Clinical examinations include a visual assessment of the complete face, palpation to discern between soft tissue and bone abnormalities, and balancing the dental and facial midlines (26-28).

CONCLUSION

Non coincident dental midline and mandibular dental midline discrepancy from facial midline was the most common dentofacial discrepancy. Maxillary midline deviation from facial midline was less frequent. No statistically significant difference between age and gender groups were found. No statistically significant difference based on ethnicity was found.

Declarations

Data Availability

The corresponding author can provide the data used to support study's findings upon request.

Conflict of Interest

The authors declare no conflict of interest.

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