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ORIGINAL ARTICLE

Vertical Mandibular and Trunk Symmetry in Indonesian Orthodontic Patients

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Abstract

Objective: To analyze differences in vertical mandibular and trunk symmetry in orthodontic patients. **Material and Methods:** This was a cross-sectional study of 129 growing orthodontic patients who sought orthodontic treatment at the Dental Hospital Universitas Sumatera Utara, Indonesia. Mandibular symmetry index was observed with pre-treatment panoramic radiography based on Kjellberg's technique and trunk symmetry was evaluated based on questionnaires and visual observation. Vertical mandibular asymmetry was decided if the index of asymmetry was lower than 93.7%. The bivariate analysis used the chi-squared and Fisher's exact tests, with a significance level of 5%. **Results:** There was a significant association between vertical mandibular and trunk symmetry ($p<0.05$). The prevalence odds ratio for the association with vertical mandibular asymmetry was 3.007 (95% CI = 1.016-8.905) for trunk asymmetry. **Conclusion:** The necessity to consider trunk symmetry could be included in orthodontics treatment of any malocclusion with vertical mandibular asymmetry that might require a multidisciplinary approach in the future.

Keywords: Orthodontics; Facial Asymmetry; Radiography, Panoramic.

Introduction

Bilateral differences occur everywhere in vertebrae naturally and mark asymmetry in the anatomy of the body. Even though a small amount of asymmetry in the maxillofacial region is common, a critical threshold distance is considered clinically asymmetric [1-3]. In dentistry, the classification of asymmetries according to the involving structures includes dental, skeletal, muscular, and soft tissue and functional parameters. These slight facial asymmetries are acceptable esthetically. However, more significant asymmetry may cause functional as well as esthetic problems [1,3,4].

The etiology of mandibular asymmetry is vast and might be a combination of genetic and environmental influences. The causes of mandibular asymmetry can be stratified as developmental, pathological, traumatic, and functional [4,5]. Some previous studies have hypothesized that postural disorders are involved in the stomatognathic system [6-8]. A similar theory about the development of the craniocervical complex based on individual muscular balances [9] associated with regional imbalances has been deemed a contributory factor in facial asymmetry and shoulder imbalance in adolescent subjects. Morphological features of the odontoid process may serve as valuable predictive markers in interdisciplinary orthopedic–orthodontic diagnostics [10,11].

Considering the role of the myofascial system associated with TMD, occlusal changes, and tooth loss have wisely been recommended in any muscular-skeletal disorder treatment. This, related to postural alterations, may reflect a general lack of equilibrium in the individual [6]. According to Alghadir et al. [12], jaw clenching can enhance postural stability during standing on an unstable surface in both conditions of the presence and absence of visual input in healthy adults. In treatment and rehabilitation planning for patients, postural instability should be considered. Segatto et al. [13] suggested that mandibular asymmetry measurements could substitute disease-marker measurements obtained during the evaluation of the lateral cephalograms and, similarly to rasterstereography, further reduce the radiation load of the involved orthopedic subjects [12,13].

The mystery of asymmetry was still unsolved due to developmental facial asymmetry that is idiopathic and gradually develops over the years after birth, which might become prominent during the adolescent period. In young adults, visual perception control is most important in orienting the head in the frontal plane and related to the standing surface and postural control in adaptation efforts to maintain the head position [14]. Otherwise, the explanations of why most asymmetries cannot be treated with single-jaw surgery include occlusal canting in the planning and management of dentofacial deformities of the complexity of some malocclusions related to imbalanced mandibular function and development.

Since some previous studies have reported on the growth and development of skeletal postural and mandibular aspects in a similar period, the objective of this study was to analyze the differences in vertical mandibular and trunk symmetry in young adult subjects who sought orthodontic treatment at the Dental Hospital Universitas Sumatera Utara, Medan, Indonesia.

Material and Methods

Study Design and Ethical Clearance

This cross-sectional study was conducted at the Dental Hospital Universitas Sumatera Utara between June 2016 and March 2017 and was approved by the Health Research Ethical Committee of the Universitas Sumatera Utara Medical Faculty (100/DATE/KEPK FK USU-RSUP HAM/2017). In compliance with the

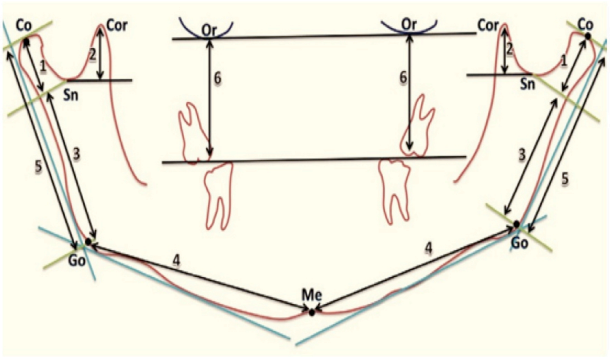
Declaration of Helsinki, subjects who consented as participants were included in a survey and provided written informed consent.

Sample and Data Collection

Patients aged between 11 and 25 years old who willing to participate in this study were included. Participants had no history of congenital disease or previous orthodontics treatment. The mandibular symmetry index was analyzed based on Kjellberg's technique using the pre-treatment panoramic radiograph [15,16]. A trunk symmetry assessment was conducted using the visual observation method and by answering the modified questionnaires under spinal orthopedic surgeon supervision [17,18] (Table 1). If any of the questions in the modified questionnaires and visual observation method of trunk symmetry assessment was positive, it was categorized as suggesting trunk asymmetry. Vertical mandibular asymmetry was decided if the asymmetry index was lower than 93.7% (Figure 1).

Table 1. Modified questionnaires and visual observation method of trunk symmetry.

No.	Questionnaires related to trunk symmetry assessment (position while standing straight in front of the mirror)	Category	
		Yes	No
1.	Are your left and right shoulders at the same height?		
2.	Is either side of your shoulders more forward than the other side?		
3.	Are your left and right ears at the same level?		
4.	Are your left and right hips on the same level when standing in an upright position?		
5.	Are the left and right of your sleeves of your right and left arms at the same level when wearing a short-sleeved shirt?		
6.	Are the left and right legs of your pants at the same height on both sides when wearing tight pants?		
7.	Is your body posture similar to one of these following positions? 		



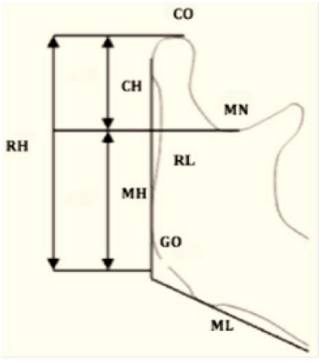


Figure 1. Vertical mandibular symmetry determined based on Kjellberg's technique.

Data Analysis

The significance of association between the trunk and vertical mandibular symmetry was evaluated using the chi-squared and Fisher's exact tests, with assumed significance at $p<0.05$. All statistical analyses were performed using the Statistical Package for the Social Sciences version 18.0 software program (IBM Corp., Armonk, NY, USA) [19].

Results

The validity and reliability vertical mandibular symmetry used 20 panoramic radiographs measured using Cohen's κ and displayed moderate agreement for inter-rater measurements (κ = 0.538) between a dentomaxillofacial radiologist and orthodontist and intra-rater measurements (κ = 0.674) as conducted by an orthodontist. The modified questionnaires' validity during trunk symmetry assessment by Pearson correlation coefficient showed a critical value of r = 0.422 (ES and TB). The reliability of the modified questionnaires used in trunk symmetry assessment by Cronbach's alpha was 0.800 ($r \geq 0.6$). There were 129 growing orthodontics subjects (mean age: 20.7 ± 3.2 years old) who attended the Dental Hospital Universitas Sumatera Utara involved in this cross-sectional study. Among these studied subjects, Table 2 indicates that there was no significant difference ($p>0.05$) of vertical mandibular symmetry between early adolescents (11–18 years) and late adolescents (19–25 years).

Table 2. Characteristics of age-based vertical mandibular symmetry.

Age	Vertical Mandibular Symmetry		p-value
	Symmetry N (%)	Asymmetry N (%)	
Early Adolescence	7 (5.42)	22 (17.05)	0.136
Late Adolescence	43 (33.33)	57 (44.18)	

Table 3 presents that 34.88% of the total study population had trunk symmetry and 3.88% had trunk asymmetry. Broken down further, 43.41% of the study population with vertical mandibular asymmetry had trunk symmetry and 17.83% had trunk asymmetry. There was thus a significant difference ($p=0.047$) in trunk symmetry based on vertical mandibular symmetry. The final multivariate analysis model using the backward stepwise method showed that the prevalence odds ratio for the association with vertical mandibular asymmetry was 3.007 (95% CI: 1.016–8.905) for trunk asymmetry.

Table 3. Characteristics of trunk symmetry based on vertical mandibular symmetry.

Trunk	Vertical Mandibular Symmetry		p-value	Odds Ratio
	Symmetry N (%)	Asymmetry N (%)		
Symmetry	45 (34.88)	56 (43.41)	0.047*	3.007
Asymmetry	5 (3.88)	23 (17.83)		(1.016–8.905)

*Statistically Significant.

Discussion

This study sought to analyze the difference in vertical mandibular and trunk symmetry in orthodontic patients. Even though abnormal body posture has long been hypothesized as responsible for various malocclusions and dentofacial deformity development, some literature still does not support these assumptions. Although facial asymmetry and malocclusion are treated as focal pathological states, these deformities can originate from a faulty posture of the trunk [11].

Previous studies on idiopathic scoliosis have been mainly focused on examining abnormal body posture as it relates to malocclusion, facial asymmetry, and skeletal problems due to issues with balancing of the stomatognathic system [9-11,13]. In this study, vertical mandibular asymmetry was 85.69% ± 6.48%, whilst the asymmetry was 97.15% ± 1.97% based on the Kjellberg technique. There was no significant difference between early adolescents and late adolescents ($p>0.05$) despite late adolescent walk-in patients being more prevalent than early adolescents in this cross-sectional study (Table 2). However, one must consider the skeletal age in addition to the chronological age while treating any malocclusion with asymmetry.

Table 3 indicates that the prevalence odds ratio for the association with vertical mandibular asymmetry was 3.007 (95% CI: 1.016–8.905) for trunk asymmetry. The hypothesis of compensatory spine curvature inducement might lead to compensatory head posture in three dimensions. Then, the phenotype of asymmetric posture can be used to help with early detection to avoid complex orthodontic treatment related to malocclusion with mandibular asymmetry.

Early identification of developmental skeletal asymmetry to obtain homeostasis in vertebrae, associated with fluctuating asymmetry derived from deviations in ideal symmetry, is possible. This functions as a bioindicator to reflect the level of adaptive genetic and environmental stress experienced by individuals or populations [3,15]. Observation of the development of mandibular asymmetry as related to mandibular condyle suggested that postural balance and occlusion pertaining to the adaptation process in the stomatognathic system include tooth, muscles, and joints [6-8].

The significant relationship of our finding in Table 3 was also supported by Harila et al. [20] that suggested asymmetric growth of occlusion and the development of crossbite are commonly found in children with congenital hip dislocation. A correlation was noted between mandibular deviation and shoulder imbalance related to the degree of scoliosis in adult subjects, presenting a linear trend [21]. Thus, the presence of mandibular and postural asymmetry in vertical and transversal assessments showed reciprocal relationships. These deformities should be clinically evaluated in the management of mandibular deviation [11,13,22]. The phenomenon of head position adaptation due to the shift of the mandible was identical to the phenomenon of body posture compensation in maintaining the balance function. The temporomandibular joint as a center growth point of the mandibular area affects body posture relative to other craniofacial parameters.

The evaluation of body posture is a special investigation parameter nowadays since the goal of orthodontic treatment includes achieving good stability in addition to aesthetics and function. Even though Algadhir et al. [12] suggested that jaw positions should be considered in treatment and rehabilitation planning for healthy patients with postural instability, a different study reported postural parameters found not to be accurate in the juvenile population with unilateral posterior crossbite [23].

The present study suggested how, overall, the body can compensate for this asymmetry phenomenon. However, our results differed from those of Arienti's study that stated trunk and facial asymmetry only based on clinical examinations were not associated with one another in the cross-sectional study of 1,029 healthy adolescents in Italy. Also, there was no apparent relation between the severity of scoliosis based on a coronal view of the spine and facial form variations based on skeletal type in idiopathic female scoliosis patients in Korea [24]. There was plausible evidence supporting an increased prevalence of unilateral angle class II malocclusions, lateral crossbite risk, and midline deviation in children affected by scoliosis [3]. Hong et al. [10] suggested that ramus length difference of right and left that reflected midsagittal line showed a possible correlation with the coracoid height difference, clavicular angle, radiographic shoulder height, and clavicle-rib intersection difference based on frontal cephalometric data ($p<0.05$).

In understanding the growth and development of malocclusion subjects, scientific validation to date the development of mandibular asymmetry will help in diagnosing sociodemographic complexity. Information about the morphological aspect related to the measurement and degree of mandibular symmetry will help dental clinicians diagnose malocclusion to form a comprehensive treatment plan [12,21,25].

In a clinical setting, body posture could be considered when dental occlusion is developed. Vertical mandibular asymmetry closely related to the temporomandibular joint could determine the adaption of balancing the stomatognathic system through constant force of the cervical to spinal area. Mandibular shifts characterized by midline differences between the maxilla and mandible have a close relationship with the postural disorder [13]. In a clinical setting, body posture should be taken into account when dental occlusion is developing [6-8,12,26]. The assessment of asymmetrical phenotype in the trunk and facial symmetry should consider three-dimensional mandibular growth and development.

Since the complexity of asymmetry is not just evaluated in the dentomaxillofacial areas but also the whole body, future studies should conduct a comprehensive analysis, such as examining locomotor organs, due to the developmental process of asymmetry. However, the present early detection of asymmetry symptoms by questionnaires that has never before been done in any previous studies indicated that asymmetry should be considered. Longitudinal investigations will be required to achieve stability of the stomatognathic system. Since the stomatognathic system is a complex issue nowadays, further study should consider skeletal malocclusion variance, which is related to the adaptation process.

Conclusion

The bilateral symmetry of the mandibular area might influence the body equilibrium and vice versa in treatment malocclusion with mandibular asymmetry by panoramic radiograph analysis for early orthodontic and orthopedic prevention. The necessity to consider trunk symmetry could be advised during orthodontics treatment of any malocclusion with vertical mandibular asymmetry that might require a multidisciplinary approach in the future.

Authors' Contributions

ES	https://orcid.org/0000-0002-0144-4397	Conceptualization, Methodology, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review and Editing and Visualization.
EIA	https://orcid.org/0000-0002-5680-7925	Conceptualization, Writing - Review and Editing, Supervision and Project Administration.
TB	https://orcid.org/0000-0002-8369-7696	Validation, Formal Analysis, Data Curation and Visualization.
BMS	https://orcid.org/0000-0003-0310-0990	Methodology and Supervision.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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