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Original Article

The correlation between back posture and sagittal jaw position in adult orthodontic patients

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الملخص

أهداف البحث: لا يزال هناك نقاش في الطب القائم على البراهين عن التبادل المتبادل بين إطباق الأسنان وعلاج الجسم الوضعي. وارتبط تشوه وضعية الظهر بعدم تناسق الجذع كأحد خصائص الجنف، التي تم الإبلاغ عنها بشكل شائع في موضوع نمو الإطباق. تهدف هذه الدراسة لتحديد الارتباط بين وضعية الظهر ووضع الفك السهمي عند مرضى تقويم الأسنان الكبار الذين تم علاجهم في مستشفى الأسنان بجامعة سوماتيرا أوتارا.

طرق البحث: أجريت هذه الدراسة على الملاحظة على مرضى تقويم الأسنان الذين لديهم التحكم الروتيني لتقويم الأسنان بين أكتوبر ٢٠١٩ وفبراير ٢٠٢٠. تم عمل علاقة الفك السهمي بالمعالجة المسبقة لقياس الرأس الجانبي بناء على تحليل شتاينر بواسطة برنامج تقويم العظام البصري. وتم عمل قياسات وضعية الظهر المرتبطة بالعنق والصدر، والقطنية باستخدام مقياس الجنف البلاستيكي الاقتصادي.

النتائج: من بين ١٢٨ مريضا، أعمارهم ١٨-٣٠ عاما، وجدنا ٧٢ مريضا من النوع ١، و٤١ مريضا من النوع ٢ و١٥ مريضا من النوع ٣ لعدم إطباق الهيكل العظمي، ولم يكن هناك اختلاف كبير في عدم تناسق الجذع بناء على علاقة الفك السهمي. بالإضافة إلى ذلك، لم يكن هناك ارتباط كبير بين وضعية الظهر عند مرضى النوع ٢ والنوع ٣.

الاستنتاجات: في هذه الدراسة، كانت علاقة الفك السهمي ضعيفة بوضعية الظهر عند مرضى تقويم الأسنان الكبار بسبب آلية التعويض. ووجود خلل وظيفي في الفك، نقطة بـ-سيلا-نازيون، ووضعية الرأس هي متغيرات محددة في نوع معين من العظام الهيكلية للأسنان التي يجب أخذها في الاعتبار في الدراسات المستقبلية.

الكلمات المفتاحية: عدم التناسق؛ الفك السهمي؛ الجذع؛ عدم الإطباق؛ الجنف

Abstract

Objective: A debate remains in evidence-based medicine about the reciprocal interchange between dental occlusion and body postural therapy. Back posture deformity has been found to be related to trunk asymmetry as one characteristic of scoliosis that is commonly reported in occlusal development issue. This study aims to determine the correlation between back posture and sagittal jaw position in adult orthodontic patients treated at the dental hospital of Universitas Sumatera Utara.

Methods: This observational study was conducted on orthodontic patients who had routine orthodontic control between October 2019 and February 2020. The sagittal jaw relationship on pre-treatment cephalometry lateral-based on Steiner analysis was done with Ortho-Vision software. The back posture that related to cervical, thoracic, and lumbar measurement was performed using scoliometer plastic economy (Baseline®).

Results: From 128 patients, aged between 18 and 30 years, we found 72 patients with Class I, 41 patients with Class II, and 15 patients with Class III skeletal malocclusion. There were no significant differences of trunk asymmetry based on sagittal jaw relationship ($p = 0.651$). Additionally, there was no significant correlation between back posture and sagittal jaw position in Class II and Class III patients ($r = 0.112$, $p > 0.05$).

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Conclusion: In this study, the sagittal jaw relationship had poor correlation to back posture in orthodontic adult patients due to a compensatory mechanism. The presence of temporomandibular dysfunction, sella-nasion-B point, and head posture are specific variables in a particular dento-skeletal type that should be considered in further studies.

Keywords: Asymmetry; Malocclusion; Sagittal jaw; Scoliosis; Trunk

Introduction

Both malocclusion and scoliosis are physical conditions that may cause significant issues and injuries during adolescent development. The balancing of body posture in scoliosis development has been shown to have an association with dentofacial problems or malocclusion.[1,2] According to health care professionals, basic and clinical research projects about the validity of reciprocal interchanges between postural and dental occlusion therapy are important in evidence-based medicine.[1,3,4] The malocclusion gradually extends from dental to skeletal jaw relationships and the pattern of dentocraniofacial growth. In addition to adaptive asymmetries of postural control, spinal deformity in scoliosis has also been associated with a specific dento-skeletal type.[4]

Previous studies have reported that assessment of general body growth and development in different stages has also shown a specific growth pattern in the dentocraniofacial region. Understanding the development pattern and implementation in dentocraniofacial treatment is an issue that is reliant not only on the development of better appliances. Thus, the evaluation of comprehensive individualised treatment at different ages should be considered to achieve better function, aesthetics, and structural balance.[5–7]

Anomalies that include volume and proportion differences of morphology in human dentocraniofacial are called skeletal malocclusions. The correlation between genetics and their response to environmental factors show phenotypic expressions that lead to growth and development problems.[6] Discrepancies in jaw relationships will affect primary and permanent dental health conditions, alignment, and position of the deciduous and permanent teeth. This condition is due to skeletal malocclusion that includes sagittal jaw relationship as one of the phenotypes; it is a developmental anomaly with life-long morbidity.[7]

One characteristic of scoliosis is three-dimensional or rotational spine deformity in all three planes (sagittal, vertical, and transversal). If the presence of an abnormal curvature of the spine begins to develop before birth, it is called congenital scoliosis. If the aetiology of the scoliosis is unknown, it is called idiopathic scoliosis. Thus, trunk asymmetry is also commonly associated with idiopathic scoliosis.[8] Under the forward-bending movement, a scoliometer is a protractor that can measure the rib humping and vertebral rotation. A physician uses an x-ray as a screening tool for scoliosis to measure the degree or severity of scoliosis. According to Coelho et al. (2013), there were perfect inter-rater and very good intra-rater reliability values (r = 0.7) between scoliometers and radiographic measurements. The highest sensitivity value was 5° at 87° for a trunk rotation.[9] The Baseline® Body Level/Scoliometer might provide valid transversal measurements and reliable cervical, thoracic, and lumbar measurements in horizontal and anterior posterior positions in situations with mild to moderate scoliosis deformities.[10] The two-parameter scoliometer values for thoracic and lumbar values could also predict the scoliosis Cobb angle.[11]

Previous studies have reported that the incidence of malocclusion in Caucasians was higher and demonstrated asymmetric features in an idiopathic scoliosis group compared to a control group.[12,13] Altogether, 27.1% patients with scoliosis among patients with lateral displacement of mandibular based on postero-anterior radiographs and chest X-rays in cross-sectional study of Japan population.[14] Clinical evaluation of mandibular deviation in three dimensional, scoliosis-related, and trunk imbalance required a comprehensive assessment in clinical management of malocclusion with mandibular asymmetry.[14,15]

The static and dynamic postural body stability showed variation based on a sagittal skeletal relationship with the American Board of Orthodontics (ABO) discrepancy index in Indian orthodontic patients.[16] However, there was a significant association between degree of mandibular position to basis cranial in antero-posterior (SNB angle) and kyphotic posture of orthodontics for pre-adolescents. This kyphotic posture was common in patients with nasopharyngeal obstruction.[17] In contrast, another study suggested that any occlusal and/or orthodontic treatment should not be performed to prevent or treat spinal deformity, especially if it were irreversible and expensive[18] and the beneficial effects on spinal deformity with orthodontic treatment have not been examined with sufficient require high-quality studies.[19] Due to the complexity of dentofacial aspects and the fact that postural asymmetry requires developing investigations, this study aimed to determine the correlation between back posture and sagittal jaw position in adult orthodontic patients who were treated at the dental hospital of Universitas Sumatera Utara. We hypothesised that back posture in adult orthodontic patients is associated with sagittal jaw position discrepancy.

Materials and Methods

This study was approved by the Medical Faculty of Universitas Sumatera Utara/H. Adam Malik General Hospital review board (378/DATE/KEPK FK USU-RSUP HAM/2019). This observational study began with a skeletal analysis based on the sagittal jaw relationship of orthodontic patients between 18 and 30 years of age who came

to the clinic for routine orthodontic control during the period from October 2019 to February 2020 at the dental Hospital Universitas Sumatera Utara. The inclusion criteria for participants are as follows: aged between 18 and 30 years old, no history of congenital deformity or facial, spine, or chest trauma history. All cephalometric radiographs in dental records were taken using x-ray radiographic equipment at Pramita laboratory, Medan. After the sample was collected and the participants provided consent, there were 128 participants in this study, including 100 female patients (78.2%) and 28 male patients (21.8%). Those patients who were selected using simple random sampling and who provided consent to participate in this study were referred to the orthopaedic and traumatology division at Universitas Sumatera Utara Hospital.

This retrospective observational study of sagittal jaw relationship used the Steiner method in landmark identification for Sella (S), Nasion (Na), A-point (maxilla), and B-Point (mandibular)[20] and were digitised with OrthoVision software (No. licence: t580r-1E659-rZa3s-3kW76-TODKf-9NC01). The sagittal jaw relationship (ANB angle) is the difference between mandibular and maxilla relationship in anterior-posterior measurements. The classification is as follows: Class I if the ANB angle is between 0° and 4°, Class II if more than 4°, and Class III if less than 0° (Figure 1).[20,21]

The participants were called back to have back postural assessments using scoliometer plastic economy (Baseline®) by an orthopaedic specialist at the Department of Orthopaedic and Traumatology, Universitas Sumatera Utara Hospital during March 2020. Scoliosis screening with Adam's Forward Bending Test in the given position was as follows: body parallel to the floor, palms closed and arms straightened down to form an angle perpendicular to the body, then the scoliometer is moved along the patient's spine (Figure 2).[11] In general, the scoliometer measures the angle of trunk rotation (ATR) with a cut-off criteria of

Figure 2: Measurement of ATR with Bunnell scoliometer (±0.1°) in standing position with forward bending.

Figure 1: Analysis of skeletal classification based on Steiner Analysis with OrthoVision (documentary of private collection).

ATR value between 0° and 3° considered normal back posture, while an asymmetry posture was considered if the ATR was in the range of 4°−6° and scoliosis if the ATR was above 7°.

Descriptive data were expressed as frequencies and percentages and the data analysis was performed using the Chi-square test SPSS version 22.0. In order to obtain the correlation between back posture and sagittal jaw position, normality tests were used. Since there was no normal distribution among sex, age, sagittal jaw position, and back posture in the participants, the analysis was conducted with Spearman's nonparametric correlation.

Table 1: Description of sagittal jaw position and sex based on Classes I to III.

Sex	Sagittal Jaw Position						Total
	Class I		Class II		Class III		
	N	%	n	%	n	%	N
Male	14	50.0	7	25.0	7	25.0	28
Female	58	58.0	34	34.0	8	8.0	100
Total	72	56.3	41	32.0	15	11.7	128

Table 2: Differences of back posture based on sagittal jaw position with chi-square Analysis.

Sagittal Jaw Position	Back Posture							
	Normal		Asymmetry		Scoliosis		Total	p
Class	F	%	F	%	F	%	F	
I	63	87.5	8	11.1	1	1.4	72	
II	34	82.9	6	14.6	1	2.4	41	0.651
III	11	73.3	3	20	1	6.7	15	

Note: $p > 0.05$: non-significant difference.

Result

Of 128 patients with a mean age of 22.1 ± 3.01 years old, the prevalence of sagittal jaw position sequentially from skeletal Classes I, II, and III were as follows: 72 (56.25%), 41 (32.03%), and 15 (11.72%) patients (Table 1).

There were 63 participants (87.5%) without trunk asymmetry, eight participants (11.1%) with trunk asymmetry, and one participant (1.4%) with scoliosis from the Class I sagittal jaw position. From the Class II sagittal jaw position, there were 34 participants (82.9%) without asymmetry, six participants (14.6%) with trunk asymmetry, and one participant (2.4%) with scoliosis. From the Class III skeletal malocclusion, there were 11 participants (73.3%) without trunk asymmetry, three participants with trunk asymmetry (20%), and one person with scoliosis (6.7%). Overall, there were a total of 108 patients without trunk asymmetry, 17 patients with trunk asymmetry, and 3 patients with scoliosis. Based on the Chi-square analysis, there were no significant differences ($p = 0.651$) between sagittal jaw position and back posture in 128 adult orthodontic patients who were treated at the dental hospital of Universitas Sumatera Utara (Table 2). There was also no significant correlation (r = 0.441, p > 0.05) between back posture and sagittal jaw position in 56 adult orthodontic patients with a mean age of 22.36 ± 3.024 who had Class II and Class III sagittal jaw positions according to Spearman's analysis.

In 56 participants with Class II and Class III sagittal jaw positions, there was a significant correlation and a weak negative relationship between sex and sagittal jaw position, while other variables showed no significant correlation (Table 3). There was also a significant correlation and a strong positive correlation among back posture and thoraco-lumbar degree in Class II and Class III sagittal jaw position participants (Table 4). However, there was no significant correlation and a weak positive correlation between back posture and sagittal jaw position.

Table 3: Correlation of sagittal jaw position with sex, age, spinal degree, and back posture in Class II and Class III participants.

Sagittal Jaw Position	Sex	Age	Cervical	Thoracic	Lumbar	Back Posture
Correlation Coefficient	−0.303*	−0.100	0.054	0.109	0.184	0.112
Sig. (2-tailed)	0.023	0.464	0.691	0.426	0.175	0.411

Note:* = significant correlation.

Table 4: Correlation of back posture to sex, age, spinal degree, and sagittal jaw position in Class II and Class III participants.

Back Posture	Sex	Age	Cervical	Thoracic	Lumbar	Sagittal Jaw Position
Correlation Coefficient	−0.135	−0.334*	0.127	0.567*	0.671*	0.112
Sig. (2-tailed)	0.322	0.012	0.351	0.000	0.000	0.411

Note:* = significant correlation.

Discussion

The postural assessment that was correlated with the final analysis of craniofacial defect and malocclusion could further improve assessment, prognosis, and therapeutic approaches of dentofacial asymmetry. In this study, sagittal jaw position was determined based on digital radiography analysis with a digital method based on Steiner Analysis.[21] In addition, the assessment of mandibular deviation, trunk imbalance, and degree of scoliosis should be clinically evaluated from all three planes.[15] The scoliometer plastic economy (Baseline®) reading is a good baseline measurement and cost-effective, and it makes it easy to screen the trunk asymmetry related to back posture in three anatomical planes during follow-ups.[10] Several studies on malocclusion, spinal posture abnormalities, and thoracic, lumbar, and pelvic tilt have shown significant relationships between them. Children with idiopathic scoliosis showed higher frequency in facial and dental asymmetry, such as: Class II subdivision, lateral cross bites, and lower midline deviations.[1,12] Accordingly, when the postero-anterior radiograph of a patient aged between 11 and 42 years old shows jaw deformity, the prevalence of scoliosis (approximately 27.1%) was obtained.[14] However, there were no significant differences ($p = 0.651$) between sagittal jaw position and back posture in 128 adult orthodontics patients who were treated at the dental hospital of Universitas Sumatera Utara in this study (Table 2). Even though there was no significant correlation ($p > 0.05$), there was a poor positive correlation ($r = 0.112$) between sagittal jaw position and back posture in Class II and Class III.

The results are in good agreement with a previous study that reported the absence of clinical relevance between malocclusion traits and posturography parameters at mandibular rest position and dental intercuspal position among 122 healthy adolescent participants.[22] Similarly, the rasterstereography result was in good agreement with craniofacial and cervical vertebrae assessment using lateral cephalograph.[23] It is noteworthy that the degree of cervical measurement demonstrated poor correlation and low positive correlation with sagittal jaw position and back posture in Class II and Class III subjects as summarised in Tables 3 and 4. This finding is correlated with a previous report where the horizontal skeletal pattern (ANB angle) parameters in the lateral cephalometric measurements showed no significant difference among idiopathic scoliosis in female patients between 14 and 28.5 years old.[24] These findings were related to previous reports for the postural compensatory mechanism, which might have minimised the effects of one area due to jaw position and body posture. Cervical spine measurements were significantly correlated, rejecting the association between trunk and back. Mild scoliosis might be a negative factor in the evaluation of temporomandibular joint mobility of scoliosis patients between 20 and 30 years old.[25,26]

The changes of surface area can be ascribed to the motions of the corporal centre pressure with occlusal splint, which could increases the postural stability in temporomandibular disorder subjects.[27,28] Several aspects of dentition phases such as dental or skeletal malocclusion, mandibular position, and temporomandibular disorders could affect the postural balancing and stomatognathic system.[22,29] Furthermore, it is essential to consider the jaw sensory-motoric system while diagnosing a patient with postural instability, since that might modulate postural control mechanism.[30] In addition, previous research also reported that the Lithuanian orthopaedic patients (11.9 ± 2.1 year old) depicted kyphotic posture and nasopharyngeal obstruction, showing a significant decrease in the SNB angle.[17]

This approach will reinforce the multi-disciplinarity among healthcare collaborations due to the probable assessment of postures that can avoid boxing treatment into remote and ineffective components, especially in growing patients.[4] Both malocclusion and scoliosis screening provide information about the sense of security, even if evidence-based medicine considered a situation to be false scoliosis. In 120 mixed dentition subjects with orthopaedically normal, false scoliosis, and scoliosis, there was a correlation with cross-bite and abnormal mandible position.[31] However, a retrospective study of 120 patients (median age 14 years old) demonstrated that functional problems were the most relevant variables influencing temporomandibular joint (TMJ) symptoms, while anatomical variables were not. It seems that occlusal functional variables and scoliosis severity were associated with temporomandibular dysfunction (TMD).[32]

Based on these findings, an agreement was made for both multidisciplinary parties not to perform irreversible and expensive occlusal and/or orthodontic treatment due to postural imbalances correction.[18] There was no beneficial effects of orthodontic treatment in treating spinal deformities without the cobb angle radiograph.[19] Due to the multifactorial nature of particular dento-skeletal malocclusion and scoliosis, this study suggests that the particular type of dento-mandibular formation should be emphasised in dentocraniofacial analysis for the further investigation of postural asymmetry. A scoliosis diagnosis with rasterstereography and sample selection should be based on more stringent inclusion criteria, such as idiopathic scoliosis or certain malocclusion. Compared to other craniofacial parameters, a mandibular posture that is related to the SNB angle will have greater impact on sagittal jaw relationship.[17,33] In that case, a scoliometer might also not be sufficiently reliable in detecting mild trunk asymmetry in adult orthodontic patients.

The limitation of this study was that there was an inadequate distribution of patients with sagittal jaw position and back posture issues. The use of a scoliometer was more precise in thoracic and lumbar hump assessment than in the cervical area, which connects directly to the craniofacial area. There are genetic variance factors in asymmetry development that can influence the skeleton, nerves, and joints. Thus, these factors should be considered due to the complexity of the jaw relationship and back posture deformity.

Conclusion

This study reported a poor correlation between sagittal jaw relationship in craniofacial and back posture

assessment with a scoliometer. This finding suggests that jaw movement related to the TMJ function might cause an effect on the postural disorder rather than on the anatomical structure.

Recommendations

The presence of temporomandibular dysfunction, sella-nasion-B point, and head posture are some specific variables in particular dento-skeletal situations that should be considered in further study.

Source of funding

Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

The ethical committee of Medical Faculty of Universitas Sumatera Utara/H. Adam Malik General Hospital (NO: 378/DATE/KEPK FK USU-RSUP HAM/2019) has ethically approved this study. The purpose and methods that were used in this study were explained to the participants. Collected data were kept confidential. The patients gave consent for the publication of their data.

Authors' contributions

ES conceptualised and designed the study, and also the funding acquisition. ARNS conducted the research and organised the data. Both ES and ARNS provided resources, and TB and ARNS analysed and interpreted the data. ES, TB, and ARNS wrote the original draft and did the reviewing and editing. All authors critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

Acknowledgement

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