Dental Journal
Majalah Kedokteran Gigi

Dental Journal
(Majalah Kedokteran Gigi)
2021 June; 54(2): 74–77

Original article

The severity and direction prevalence rate of patients with a mandible deviation compared to Cobb's angle

Kimberly Clarissa Oetomo[1], I Gusti Aju Wahju Ardani[1], Thalca Hamid[1] and Komang Agung Irianto[2]
[1]Department of Orthodontics, Faculty of Dental Medicine, Universitas Airlangga
[2]Department of Orthopaedics and Traumatology, Faculty of Medicine, Universitas Airlangga
Surabaya – Indonesia

ABSTRACT

Background: *Patients with mandible deviation often have idiopathic scoliosis, which might affect the result of orthodontic and orthopaedic treatment. Orthodontic treatment not only focuses on aesthetic and functional but also orthopaedic stability. A thorough examination is needed to obtain orthopaedic stability by evaluating the occlusion and posture to establish the best strategy of treatment and interdisciplinary approach.* ***Purpose:*** *This study was conducted to assess the correlation between mandible deviation and idiopathic scoliosis.* ***Methods:*** *This is a descriptive-analytic study with a cross-sectional approach. From 60 samples, 35 patients were chosen based on the inclusion criteria of the total sampling technique. Patients were referred to have skull posteroanterior (PA) and a thoracolumbar PA radiograph taken. Skull PA radiographs were analysed with Grummon's method using the Orthovision program. Cobb's angle analysis was used by the radiologist to analyse the thoracolumbar PA radiographs. The data gathered was then further analysed using the Spearman test and the Crosstabs test, using SPSS 23.0.* ***Results:*** *Correlation between mandible deviation and the severity of idiopathic scoliosis is not significant (p=0.866). The direction prevalence of mandible deviation towards Cobb's angle is 54.3% to the right and 45.7% to the left. All patients with mandible deviation have Cobb's angle.* ***Conclusion:*** *There is no correlation between mandible deviation and the severity of idiopathic scoliosis. However, many cases showed that the direction of mandible deviation and of idiopathic scoliosis is the same.*

Keywords: *Cobb's angle; idiopathic scoliosis; mandible deviation*

Correspondence: Kimberly Clarissa Oetomo, Department of Orthodontics, Faculty of Dental Medicine, Universitas Airlangga. Jl. Mayjen Prof. Dr. Moestopo No. 47 Surabaya, 60132 Indonesia. Email: kimi_ko7@yahoo.com

INTRODUCTION

Mandibular deviation is a craniofacial deformity with a lateral shift of its midline.[1] Mandibular deviation with a lateral shift may affect the oral function and body appearance. Individuals with lateral mandible deviation often have a temporomandibular joint disorder (TMD) because of the asymmetrical occlusion.[2] If this prolonged, more severe TMD, facial asymmetry, and an imbalance of musculature might occur, affecting the body's symmetrical coordination and balance. Previous studies have shown that patients with mandible deviation often have abnormal cervical vertebrae morphology.[3–5] A high prevalence of orthopaedic pathological findings is also reported in patients who need an orthodontic treatment because of the occurrence of mandible deviation; for example, 91% of the group examined by Hirschfelder and Hirschfelder, and 83% of patients of 420 patients investigated by Muller-Wachendorf.[6–8]

Scoliosis is the orthopaedic pathology that defines a three-dimensional deviation of the spinal axis. This might be linked indirectly to some mild forms of mandible deviation in the transversal dimension.[9] Idiopathic scoliosis is an orthopaedic condition characterised by inadequate posture, which is progressive and often revealed in childhood, common in children ten years or older.[10] Worsened scoliosis might occur during growth. Scoliosis management is often delayed by a lack of awareness among patients and parents.[11] The prevalence of idiopathic scoliosis is 0.47% to 5.20% around the world.[12] The prevalence rate of idiopathic scoliosis in Surabaya, Indonesia, is 2.94%.[10]

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.
 Available at https://e-journal.unair.ac.id/MKG/index
DOI: 10.20473/j.djmkg.v54.i2.p74–77

The possibility of mandible deviation and scoliosis being related offers a new perspective to the orthodontist and orthopaedist in examining patients. This study investigated the relationship between mandible deviation and idiopathic scoliosis.

MATERIALS AND METHODS

A total of 35 patients were chosen from 60 subjects from a private clinic and the Orthopaedic and Traumatology Hospital Surabaya, which fulfilled the inclusion criteria. The inclusion criteria were: 1) patient with mandible deviation, 2) no orthopaedic surgery procedures, 3) no orthodontic treatment, 4) age 9–35 years old, 5) no gender limitation. The exclusion criteria were: 1) have a history of facial trauma, 2) have a spinal trauma history, 3) had had orthognathic surgery. This study was ethically approved by Universitas Airlangga Faculty of Dental Medicine Health Research Ethical Clearance Commission (680/HRECC.FODM/X/2019), and written informed consent was obtained from the patients. Patients were asked to sign an informed consent form that included an agreement to allow their data to be used for research. They also agreed to have their thoracolumbar posteroanterior (PA) and skull PA x-rayed.

Tracing was performed using the Orthovision program's version of Grummon's (linear asymmetry) analysis (Figure 1).[13] The horizontal reference line (HRL) is a line connecting the right and left lateral orbital (LO). The vertical reference line (VRL) is defined as the perpendicular bisector of the right and left lateral orbital. Menton (Me) is the point of the chin. The direction of the mandible deviation can be seen from the Me's position towards the VRL.

Cobb's angle is formed between the upper-end plate on the superior end and the lower endplate on the spinal curve's inferior-end vertebrae. The curve's direction was also determined as to whether the endpoint of the curve's position is on the right or left of the midline of the vertebrae (Figure 2). When Cobb's angle is more than 10°, it can be concluded that the subject has scoliosis.[9,14]

All data were evaluated with a normality test. The Spearman test was performed to investigate the correlation between the severity of mandible deviation and Cobb's angle (scoliosis). The Crosstabs test was performed to investigate the prevalence of mandible deviation direction against Cobb's angle. The statistical package for social sciences (SPSS) (IBM, New York, USA) version 23.0 for Windows was used to conduct the statistical analysis.

RESULTS

This study was performed on a total of 35 patients chosen from 60 subjects (6 males and 29 females) aged 9–35 years old. A total of 14 subjects out of 35 have a mandible deviation to the right. The other 21 patients have a mandible deviation to the left. Of these, 19 patients have scoliosis to the right and 16 to the left. A one-sample Kolmogorov–Smirnov test was performed on the Me deviation degree (p=0.531; normal) and Cobb's angle (p=0.035; abnormal), to discover any correlation between the severity of the two variables. From the Spearman test, the correlation between Me deviation and Cobb's angle is not significant (p=0.866),

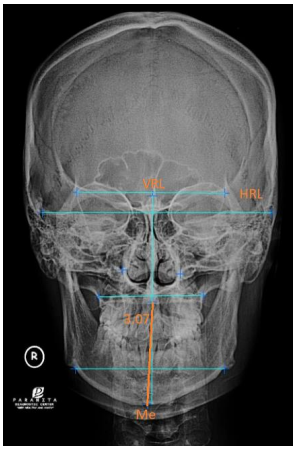

Figure 1. Skull PA analysis using Orthovision program (3.07° deviating to the right).

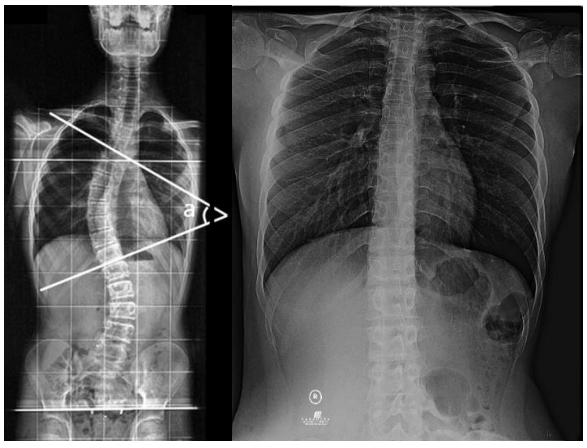

Figure 2. Thoracolumbar PA analysis with Cobb's angle method (left).[14] Subject's thoracolumbar PA (right) (10° Cobb's angle to the right).

Table 1. The direction prevalence rate of patients with Me deviation towards Cobb's angle

		Cobb's angle direction				Total
		Right	Percentage	Left	Percentage	
Me deviation towards VRL direction	Right	14	100%	0	0%	100%
	Left	5	23.8%	6	76.2%	100%
Total		19	54.3%	16	45.7%	100%

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.
 Available at https://e-journal.unair.ac.id/MKG/index
DOI: 10.20473/j.djmkg.v54.i2.p74–77

showing no correlation. Table 1 shows that 100% of the subjects with mandible deviation to the right have a right scoliosis curve direction. 23.8% of the patients with mandible deviation to the left have a right curve direction, and 76.2% of the subjects with mandible deviation to the left have a left curve direction.

DISCUSSION

Analysis of mandible deviation can be conducted using a skull PA. Mandible deviation may lead to temporomandibular joint disorders, imbalanced strength of craniofacial muscles, and the symmetry, coordination, and balance of other muscles.[15] A previous study reported by Sambataro et al.[16] revealed that patients with mandible deviation have abnormal cervical vertebrae and spine, as it interferes with upright posture stability on an unstable platform. This suggested that changes in the stomatognathic system affect posture and balance. Vertebrae and muscles work together to make the head posture stable and play a role in head movement.[16]

More female patients were considered as females are more prone to idiopathic scoliosis.[17,18] This phenomenon is caused by the fact that more of the oestrogen hormone can be found in females. Oestrogen significantly increases the incidence of the scoliotic curve and the curve severity, showing that oestrogen is a factor that contributes to idiopathic scoliosis.[17] Idiopathic scoliosis needs to be treated as soon as possible, as it progresses and becomes more severe.[12,19,20]

This study showed no significant correlation between mandible deviation and scoliosis (Cobb's angle). The correlation in this research could be positive between scoliosis and mandible deviation. Another possibility is that scoliosis is associated with the severity of mandibular deviation. Some patients had mild-to-moderate scoliosis, which then shows no apparent correlation between scoliosis and mandible deviation. It needs to be noted that in approximately 10% of subjects, Cobb's angle will get more severe as the individual grows and may reach 58–100%.[14,17] Scoliosis is a three-dimensional deformity, whereas the thoracolumbar PA that was used is a two-dimensional presentation. Thus, the spinal curve might be 20% more severe than the radiograph. A distortion of 2°–7° can be found.[21] To prevent this, elimination of the aetiologies needs to be conducted, as otherwise this progress cannot be avoided

This study also showed the direction prevalence where 100% of the patients with mandible deviation to the right have Cobb's angle to the right (curve direction). Many factors might affect this result. There is a possibility that the patient might have unilateral chewing habits where the masticatory muscles are often asymmetrical, producing asymmetrical stress distribution in the mandible. Evidence of this can be seen from the depth of the mandibular notch from the skull PA. This condition produces an asymmetrical stress distribution on the cervical spine and leads to the spine deformation.[22] The presence of a chewing side preference increases muscle misfit.[5] Cervical muscles, the sternocleidomastoid and the trapezius work together, connecting the spine, cervical spine, and mandible. Patients with right side dominance are more prevalent; they tend to chew on the right side and use the right limbs for activities, which result in the shortening of the muscles on the right side.[3,5,22] This condition produces Cobb's angle to the right.

The occurrence of an asymmetrical condyle may also play a role in mandible deviation. Imbalanced occlusion in patients with mandible asymmetry causes abnormal load distribution on articular surfaces and the remodelling of the condyle.[23] Thus, internal derangement and temporomandibular joint disorders might occur. Condyles play a significant role as the centre of the mandible's growth and as a pivot for mandible rotation. As the centre of growth, the condyle remodelling process occurs to respond to continuous stimulation during the mandible movement. Surface morphology and bone density are related to mandible asymmetry pathogenesis and imbalanced force distribution on both occlusal surfaces.[24] A study by Oh et al.[25] suggested a correlation between mandible deviation and condyles' asymmetry.

The possibility of occlusal cant occurrence in mandible deviation patients also leads to idiopathic scoliosis. Occlusal cant may also lead to mandible deviation, as asymmetrical occlusal guidance takes place. Occlusal cant causes a unilateral chewing habit. As a reaction, the side that is used more for chewing will receive higher occlusal force, preventing teeth eruption on that side.[25,26] This situation then causes cranial strain that results from unilateral muscle hypertrophy where compression on C1 (atlas) and C2 (axis) can be found. Formation of Cobb's angle or idiopathic scoliosis can be expected.[5,6]

Most of the patients have a mandible deviation in the same direction as Cobb's angle. This can be caused by damaging habits such as unilateral mastication during the growth period; thus, the mandible's side that received the greater load grows more and deviates to the opposite side. This corresponds to previous studies showing that abnormal morphology of vertebrae is related to mandible deviation.[3,22]

More patients have Cobb's angle formation to the right (54.3%). This corresponds to previous studies by Grauers et al.,[12] Choudhry et al.,[17] and Blom et al.[20], which suggested that the most common deformity is Cobb's angle to the right. Side dominance, a preference or hand-differences in task performance and represents an expression of the brain's motor cortex asymmetry, might play a role as right-handed patients are more prevalent. Stronger superficial extrinsic back muscles can be found on the dominant side. Here, right side dominance is more frequent and leads to a spinal curve to the right.[5] This study has limitations, such as the screening procedures used, which only use a radiographic approach, and only a small sample of patients

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.
 Available at https://e-journal.unair.ac.id/MKG/index
DOI: 10.20473/j.djmkg.v54.i2.p74–77

was involved. Further research involving muscle activity, sample grouping based on the severity of scoliosis, age, gender, type of scoliosis (using Lenke's classification), cone-beam computed tomography (CBCT) usage, and a larger sample size is suggested.

In conclusion, this study showed a positive correlation between the direction of mandible deviation and that of idiopathic scoliosis. The same direction between mandible deviation and Cobb's angle formation can be found. The more frequent direction of scoliosis and mandible deviation is to the right. There is no correlation between the severity of mandible deviation and idiopathic scoliosis.

REFERENCES

1. Lin H, Zhu P, Lin Y, Wan S, Shu X, Xu Y, Zheng Y. Mandibular asymmetry: a three-dimensional quantification of bilateral condyles. Head Face Med. 2013; 9(1): 42.
2. Thiesen G, Gribel BF, Freitas MPM, Oliver DR, Kim KB. Mandibular asymmetries and associated factors in orthodontic and orthognathic surgery patients. Angle Orthod. 2018; 88(5): 545–51.
3. de la Madrid Fajardo V, Morales Garfias F, Ondarza Rovira R, Justus Doczi R, García-López S. Influence of an occlusal imbalance in the deviation and alignment of the vertebral spine in rats: a controlled trial. Rev Mex Ortod. 2016; 4(1): e23–9.
4. Zhou S, Yan J, Da H, Yang Y, Wang N, Wang W, Ding Y, Sun S. A correlational study of scoliosis and trunk balance in adult patients with mandibular deviation. PLoS One. 2013; 8(3): e59929.
5. Arienti C, Buraschi R, Donzelli S, Zaina F, Pollet J, Negrini S. Trunk asymmetry is associated with dominance preference: results from a cross-sectional study of 1029 children. Brazilian J Phys Ther. 2019; 23(4): 324–8.
6. Pacella E, Dari M, Giovannoni D, Caterini L, Mezio M. The relationship between temporomandibular disorders and posture: a systematic review. Webmed Cent Orthod. 2017; 8(11): WMC005374.
7. Hirschfelder U, Hirschfelder H. Effects of scoliosis on the facial bones. Fortschr Kieferorthop. 1983; 44(6): 457–67.
8. Müller-Wachendorff R. Untersuchungen über die Häufigkeit des Auftretens von Gebißanomalien in Verbindung mit Skelettdeformierungen mit besonderer Berücksichtigung der Skoliosen. Fortschr Kieferorthop. 1961; 22(4): 399–408.
9. Cheng JC, Castelein RM, Chu WC, Danielsson AJ, Dobbs MB, Grivas TB, Gurnett CA, Luk KD, Moreau A, Newton PO, Stokes IA, Weinstein SL, Burwell RG. Adolescent idiopathic scoliosis. Nat Rev Dis Prim. 2015; 1: 15030.
10. Komang-Agung IS, Dwi-Purnomo SB, Susilowati A. Prevalence rate of adolescent idiopathic scoliosis: results of school-based screening in Surabaya, Indonesia. Malaysian Orthop J. 2017; 11(3): 17–22.
11. Peng Y, Wang S-R, Qiu G-X, Zhang J-G, Zhuang Q-Y. Research progress on the etiology and pathogenesis of adolescent idiopathic scoliosis. Chin Med J (Engl). 2020; 133(4): 483–93.
12. Grauers A, Einarsdottir E, Gerdhem P. Genetics and pathogenesis of idiopathic scoliosis. Scoliosis spinal Disord. 2016; 11: 45.
13. Grummons DC, Kappeyne van de Coppello MA. A frontal asymmetry analysis. J Clin Orthod. 1987; 21(7): 448–65.
14. Kim T-H, Kim J-H, Kim Y-J, Cho I-S, Lim Y-K, Lee D-Y. The relation between idiopathic scoliosis and the frontal and lateral facial form. Korean J Orthod. 2014; 44(5): 254–62.
15. Hwang S-A, Lee J-S, Hwang H-S, Lee K-M. Benefits of lateral cephalogram during landmark identification on posteroanterior cephalograms. Korean J Orthod. 2019; 49(1): 32–40.
16. Sambataro S, Bocchieri S, Cervino G, La Bruna R, Cicciù A, Innorta M, Torrisi B, Cicciù M. Correlations between malocclusion and postural anomalies in children with mixed dentition. J Funct Morphol Kinesiol. 2019; 4: 45.
17. Choudhry MN, Ahmad Z, Verma R. Adolescent idiopathic scoliosis. Open Orthop J. 2016; 10: 143–54.
18. Jada A, Mackel CE, Hwang SW, Samdani AF, Stephen JH, Bennett JT, Baaj AA. Evaluation and management of adolescent idiopathic scoliosis: a review. Neurosurg Focus. 2017; 43(4): E2.
19. Zheng S, Zhou H, Gao B, Li Y, Liao Z, Zhou T, Lian C, Wu Z, Su D, Wang T, Su P, Xu C. Estrogen promotes the onset and development of idiopathic scoliosis via disproportionate endochondral ossification of the anterior and posterior column in a bipedal rat model. Exp Mol Med. 2018; 50(11): 1–11.
20. Blom A, Warwick D, Whitehouse M. Apley & Solomon's system of orthopaedics and trauma. 10th ed. UK: CRC Press; 2018. p. 455–89.
21. Kim H, Kim HS, Moon ES, Yoon C-S, Chung T-S, Song H-T, Suh J-S, Lee YH, Kim S. Scoliosis imaging: what radiologists should know. RadioGraphics. 2010; 30(7): 1823–42.
22. Shimazaki T, Motoyoshi M, Hosoi K, Namura S. The effect of occlusal alteration and masticatory imbalance on the cervical spine. Eur J Orthod. 2003; 25(5): 457–63.
23. Moraes KJR de, Cunha DA da, Albuquerque LCA, Carvalho CC de, Silva HJ da. Chewing preference and its relationship with postural muscular electric potential. Rev CEFAC. 2018; 20(5): 648–56.
24. Okeson JP. Management of temporomandibular disorders and occlusion. 7th ed. St. Louis: Elsevier Mosby; 2012. p. 234–7.
25. Oh M-H, Kang S-J, Cho J-H. Comparison of the three-dimensional structures of mandibular condyles between adults with and without facial asymmetry: A retrospective study. Korean J Orthod. 2018; 48(2): 73–80.
26. Velásquez RL, Coro JC, Londoño A, McGorray SP, Wheeler TT, Sato S. Three-dimensional morphological characterization of malocclusions with mandibular lateral displacement using cone-beam computed tomography. Cranio. 2018; 36(3): 143–55.

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.

DOI: 10.20473/j.djmkg.v54.i2.p74–77