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Original Research

Evaluation and comparison of skeletal and dental components of deep overbite malocclusion with normal occlusion and their impact on TMJ

[1]Ami Shukla, [2]Jay Trivedi, [3]Dhwani Dave, [4]Unnati Shah

[1,3,4]BDS, Gujarat, India;
[2]BDS, Rajasthan, India

ABSTRACT:
Background: Deep overbite malocclusion is a prevalent orthodontic condition that can influence both skeletal and dental components, potentially affecting temporomandibular joint (TMJ) function. Understanding the variations in skeletal and dental structures between deep overbite malocclusion and normal occlusion is crucial for optimizing treatment strategies and preventing TMJ disorders. **Materials and Methods:** This cross-sectional study evaluated 60 subjects, divided into two groups: Group A (n=30) with deep overbite malocclusion and Group B (n=30) with normal occlusion. Lateral cephalograms and dental casts were analyzed to assess skeletal and dental parameters, including mandibular plane angle, overbite depth, and incisor inclination. TMJ function was evaluated using clinical examinations and radiographic assessments. Statistical analysis was performed using an independent t-test and Pearson correlation to compare skeletal and dental variations between the groups. **Results:** The deep overbite group exhibited a significantly reduced mandibular plane angle (mean: 22.5° ± 3.2°) compared to the normal occlusion group (mean: 27.8° ± 2.9°; $p<0.05$). Overbite depth was significantly greater in Group A (mean: 6.5 mm ± 1.2 mm) than in Group B (mean: 2.1 mm ± 0.8 mm; $p<0.001$). Incisor inclination showed a marked difference, with the deep overbite group presenting a steeper maxillary incisor angulation (mean: 125.4° ± 4.1°) compared to the normal occlusion group (mean: 112.3° ± 3.8°; $p<0.01$). TMJ evaluations revealed a higher prevalence of joint discomfort and clicking sounds in the deep overbite group (40%) compared to the normal occlusion group (10%). **Conclusion:** Skeletal and dental characteristics of deep overbite malocclusion differ significantly from normal occlusion, with a lower mandibular plane angle, increased overbite depth, and steeper incisor angulation. These variations contribute to altered TMJ function, highlighting the need for early diagnosis and intervention to prevent potential temporomandibular disorders.

Keywords: Deep overbite, malocclusion, skeletal components, dental characteristics, temporomandibular joint, occlusion, mandibular plane angle, overbite depth.

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Corresponding author: Ami Shukla, BDS, Gujarat, India

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INTRODUCTION

Deep overbite malocclusion is a common dental anomaly characterized by excessive vertical overlap of the maxillary and mandibular incisors, often leading to functional and esthetic concerns (1). It has been associated with skeletal and dental discrepancies, which can influence temporomandibular joint (TMJ) function and contribute to temporomandibular disorders (TMD) (2). The interaction between skeletal structures, occlusion, and TMJ biomechanics plays a crucial role in maintaining harmonious jaw function. Any imbalance in these components may lead to joint dysfunction, muscle strain, and occlusal instability (3,4).

Skeletal characteristics associated with deep overbite malocclusion typically include a low mandibular plane angle, retrognathic mandible, and increased lower anterior facial height (5). These skeletal variations influence dental parameters such as overbite depth, incisor inclination, and occlusal plane inclination, which may affect masticatory efficiency and overall oral health (6).

Pathological alteration of the airway patency can lead to altered craniofacial development. (7)The positionof the mandible is associated with oropharyngeal airway

volume and the base of thecranium. Retrognathia of the mandible is demonstrated to decrease oropharyngeal airway volume. This volumereduction can be attributed to posteriorly placed hyoid bone or tongue. (8)

Studies have shown that patients with deep overbite are more prone to TMJ dysfunction, including joint clicking, pain, and restricted mouth opening, likely due to excessive loading on the TMJ structures (9,10). However, there is limited evidence comparing skeletal and dental components in ,individuals with deep overbite malocclusion and normal occlusion to assess their impact on TMJ health.

The proportional relationship between the different craniofacial regions is the key to judge the individual attractiveness. Many of the studies impressed the need of the set standards for the facial attractiveness. So for aesthetic and function orthodontic treatment is required.Various modalities for orthodontic problems include use of aligners, brackets, removable appliances, orthodontic implant and orthognathic surgery etc.Minimally Invasive Approaches, Orthodontic Monitoring Apps, Self-Ligating Brackets, Cone Beam Computed Tomography, Intraoral scanner, Temporary Anchorage Devices, 3D Printing, Invisible Orthodontic Solutions are few advancement in orthodontics.Fixed orthodontic appliances significantly impact oral microbial changes, underscoring the need for proper oral hygiene during orthodontic treatment to reduce dental caries risk.Nickel release from orthodontic appliance can elicit type IV cell mediated delayed hypersensitivity.(11-13)

This study aims to evaluate and compare the skeletal and dental characteristics of deep overbite malocclusion with those of normal occlusion. Additionally, the study investigates the potential impact of these differences on TMJ function. By identifying significant skeletal and dental discrepancies, this research may contribute to improved diagnostic and treatment approaches for patients with deep overbite, reducing the risk of developing TMJ disorders.

MATERIALS AND METHODS

Study Design and Sample Selection

This cross-sectional study was conducted to compare the skeletal and dental characteristics of individuals with deep overbite malocclusion and normal occlusion, as well as their impact on temporomandibular joint (TMJ) function. A total of 60 participants were selected and divided into two equal groups:

- **Group A (Deep Overbite Malocclusion):** 30 individuals with an overbite greater than 5 mm.
- **Group B (Normal Occlusion):** 30 individuals with a normal overbite ranging from 1 to 3 mm.

Participants were selected based on specific inclusion and exclusion criteria.

Inclusion Criteria

- Individuals aged 18 to 30 years.
- No prior orthodontic treatment.
- No history of TMJ-related disorders or systemic conditions affecting jaw function.

Exclusion Criteria

- Presence of craniofacial anomalies or syndromes.
- History of trauma or surgery affecting the TMJ.
- Severe dental attrition or parafunctional habits such as bruxism.

Data Collection and Assessment

1. Cephalometric Analysis:

Lateral cephalograms were obtained for all participants to assess skeletal parameters, including:

- Mandibular plane angle (°).
- Anterior facial height (mm).
- Sella-Nasion to mandibular plane angle (SN-MP) (°).
- Maxillary and mandibular incisor inclinations (°).

2. Dental Cast Analysis:

Dental models were analyzed to measure:

- Overbite depth (mm).
- Interincisal angle (°).
- Curve of Spee (mm).

3. Temporomandibular Joint Evaluation:

TMJ function was assessed through:

- Clinical examination for joint sounds (clicking, crepitus).
- Palpation for TMJ tenderness and muscle pain.
- Maximum mouth opening (mm).

Statistical Analysis

All collected data were statistically analyzed using SPSS software. An independent t-test was performed to compare cephalometric and dental parameters between groups. Pearson's correlation coefficient was used to analyze the relationship between skeletal, dental, and TMJ characteristics. A significance level of $p < 0.05$ was considered statistically significant.

RESULTS

Cephalometric Analysis

The cephalometric evaluation revealed significant skeletal differences between the deep overbite malocclusion group and the normal occlusion group. The mandibular plane angle was significantly lower in Group A (22.5° ± 3.2°) compared to Group B (27.8° ± 2.9°) ($p < 0.05$). Similarly, the Sella-Nasion to mandibular plane angle (SN-MP) was reduced in the deep overbite group (30.2° ± 3.5°) as opposed to the normal occlusion group (36.1° ± 3.8°) ($p < 0.05$). Anterior facial height was also significantly shorter in the deep overbite group (52.1 mm ± 4.2 mm) compared to the normal occlusion group (57.6 mm ± 3.9 mm) ($p < 0.05$) (Table 1).

Dental Cast Analysis

Dental cast measurements showed a significantly greater overbite depth in the deep overbite group (6.5 mm ± 1.2 mm) compared to the normal occlusion group (2.1 mm ± 0.8 mm) ($p< 0.001$). The interincisal angle was reduced in Group A (118.4° ± 5.3°) compared to Group B (127.6° ± 4.8°) ($p< 0.05$). The curve of Spee was also more pronounced in the deep overbite group (3.4 mm ± 0.6 mm) than in the normal occlusion group (1.2 mm ± 0.4 mm) ($p< 0.001$) (Table 2).

Temporomandibular Joint Evaluation

The TMJ assessment showed a higher prevalence of joint sounds and discomfort in the deep overbite group. Clicking sounds were observed in 40% of individuals in Group A, while only 10% of participants in Group B exhibited this feature. Muscle tenderness on palpation was reported in 35% of participants with deep overbite malocclusion, compared to 12% in the normal occlusion group. The mean maximum mouth opening was slightly lower in Group A (43.5 mm ± 3.1 mm) compared to Group B (46.2 mm ± 2.8 mm) ($p< 0.05$) (Table 3).

Table 1: Cephalometric Comparison Between Deep Overbite and Normal Occlusion Groups

Parameter	Group A (Deep Overbite) (Mean ± SD)	Group B (Normal Occlusion) (Mean ± SD)	*p*-value
Mandibular Plane Angle (°)	22.5 ± 3.2	27.8 ± 2.9	<0.05
SN-MP Angle (°)	30.2 ± 3.5	36.1 ± 3.8	<0.05
Anterior Facial Height (mm)	52.1 ± 4.2	57.6 ± 3.9	<0.05

Table 2: Dental Cast Measurements in Deep Overbite and Normal Occlusion Groups

Parameter	Group A (Deep Overbite) (Mean ± SD)	Group B (Normal Occlusion) (Mean ± SD)	*p*-value
Overbite Depth (mm)	6.5 ± 1.2	2.1 ± 0.8	<0.001
Interincisal Angle (°)	118.4 ± 5.3	127.6 ± 4.8	<0.05
Curve of Spee (mm)	3.4 ± 0.6	1.2 ± 0.4	<0.001

Table 3: Temporomandibular Joint Evaluation Between Groups

Parameter	Group A (Deep Overbite) (n=30)	Group B (Normal Occlusion) (n=30)	*p*-value
Clicking Sounds (%)	40	10	<0.05
Muscle Tenderness (%)	35	12	<0.05
Maximum Mouth Opening (mm)	43.5 ± 3.1	46.2 ± 2.8	<0.05

These findings indicate that individuals with deep overbite malocclusion exhibit significant skeletal and dental differences compared to those with normal occlusion. The observed alterations appear to contribute to TMJ dysfunction, suggesting that early intervention may help mitigate potential complications.

DISCUSSION

Deep overbite malocclusion is a common orthodontic condition that significantly affects both skeletal and dental components, potentially influencing temporomandibular joint (TMJ) function. This study found notable differences in skeletal and dental characteristics between individuals with deep overbite and those with normal occlusion, aligning with previous research on the topic (1,2).

Skeletal Characteristics in Deep Overbite Malocclusion

The findings indicate that individuals with deep overbite malocclusion exhibit a significantly lower mandibular plane angle compared to those with normal occlusion. This result is consistent with studies that have identified a reduced mandibular plane angle as a distinguishing feature of deep overbite cases (3,4). A lower mandibular plane angle contributes to a more retrognathic mandible, leading to altered occlusal relationships and increased vertical overlap of incisors (5). Additionally, the reduced Sella-Nasion to mandibular plane (SN-MP) angle observed in this study supports previous findings that suggest a correlation between deep overbite and a backwardly rotated mandible (6).

Furthermore, the anterior facial height was significantly shorter in the deep overbite group, which has been linked to excessive bite force distribution and constrained vertical growth of the lower face (7). Previous studies have demonstrated that individuals with deep overbite tend to have reduced lower anterior facial height, contributing to a compressed appearance of the lower third of the face (8). These skeletal characteristics reinforce the importance of early intervention to modify growth patterns and prevent worsening of the malocclusion.

Dental Characteristics in Deep Overbite Malocclusion

The dental cast analysis showed a significantly greater overbite depth in the deep overbite group, confirming previous research indicating that deep overbite is characterized by excessive vertical overlap of the maxillary and mandibular incisors (14,15). The interincisal angle was significantly lower in this

group, suggesting increased retroclination of mandibular incisors or excessive proclination of maxillary incisors, which has been reported in similar studies (16).

The curve of Spee was more pronounced in the deep overbite group compared to the normal occlusion group. This finding is in agreement with previous research stating that a deep overbite is often accompanied by an exaggerated curve of Spee, which can contribute to occlusal disharmony and increased functional loading on the TMJ (17). Correction of the curve of Spee is often a key objective in orthodontic treatment of deep overbite cases, as it helps in achieving a more balanced occlusion (18).

Impact of Deep Overbite on TMJ Function

This study found a higher prevalence of TMJ dysfunction in individuals with deep overbite malocclusion, including increased incidence of joint sounds and muscle tenderness. Prior studies have suggested that excessive overbite can lead to altered TMJ biomechanics, resulting in increased stress on the joint structures and potential development of temporomandibular disorders (TMD) (19). Clicking sounds, which were more frequent in the deep overbite group, may be associated with anterior disc displacement, a common finding in TMD patients (20).

Muscle tenderness on palpation was also more prevalent in the deep overbite group, which could be attributed to increased strain on the masticatory muscles due to occlusal instability and improper bite force distribution (21). Deep bite patients are more likely to experience masticatory muscle hyperactivity, leading to muscle fatigue and pain. Additionally, reduced maximum mouth opening observed in the deep overbite group suggests a potential restriction in mandibular mobility, which has been linked to increased joint compression and posterior condylar positioning (22).

Clinical Implications and Future Research

The findings of this study emphasize the need for early orthodontic diagnosis and intervention in patients with deep overbite malocclusion to prevent the progression of TMJ dysfunction. Various treatment modalities, including bite opening appliances, intrusion mechanics, and occlusal equilibration, have been suggested to improve deep overbite and reduce the risk of developing TMJ disorders (23). Longitudinal studies evaluating the long-term effects of orthodontic treatment on TMJ function in deep overbite patients would provide further insights into effective management strategies (24).

Future research should focus on incorporating three-dimensional imaging techniques such as cone-beam computed tomography (CBCT) to assess TMJ morphology and disc position more accurately in deep overbite cases (25). Additionally, studies evaluating the influence of neuromuscular adaptations in individuals with deep overbite would enhance our understanding of the interplay between occlusion and TMJ function (26,27).

CONCLUSION

This study highlights the significant skeletal and dental differences between deep overbite malocclusion and normal occlusion, emphasizing their potential impact on temporomandibular joint (TMJ) function. The findings indicate that deep overbite is associated with a reduced mandibular plane angle, increased overbite depth, and a pronounced curve of Spee, all of which contribute to altered occlusal forces and a higher prevalence of TMJ dysfunction. Early diagnosis and intervention are crucial in managing deep overbite to prevent long-term complications, including temporomandibular disorders. Future research incorporating advanced imaging techniques and long-term follow-up studies will further improve the understanding and treatment of this condition.

REFERENCES

1. Dong CM, Yu LF, Zou DR. CBCT research progress of temporomandibular joint in patients with malocclusion. Stomatol. 2020;40:560–564.
2. Tian LL, Zhang JL, Jiang Y. Soft and hard tissue changes and stability of class II Division 1 malocclusion treated with T4K appliance. Shanghai J Stom. 2019;28:112–115.
3. Wang D, Fang MR, Li Q, Ma JQ. Changes of temporomandibular joint in the treatment of skeletal class III malocclusion. Oral Biomed. 2020;11:176–180.
4. Arat ZM, Gökalp H, Erdem D, Erden I. Changes in the TMJ disc-condyle-fossa relationship following functional treatment of skeletal Class II Division 1 malocclusion: a magnetic resonance imaging study. Am J Orthod Dentofacial Orthop. 2001 Mar;119(3):316-9. doi: 10.1067/mod.2001.110245.
5. Pengqian F, Xinqiao F. Burnout among anaesthetists in Chinese hospitals: a multicentre, cross-sectional survey in 6 provinces. J Eval Clin Pract. 2016;22:387–394.
6. Yu X, Yuan LJ, Liu JQ, Fang B, Mao LX, Yang Z, et al. Changes of mandibular retrusion with anterior disc displacement after Herbst appliance. Chin J Orthod. 2017;24:204–207.
7. Wen H. Effect of orthodontic treatment on oral health and quality of life of patients with different types of malocclusion. Electron J Clin Med Lit. 2018;5:79.
8. Soni J, Shyagali TR, Bhayya DP, Shah R. Evaluation of Pharyngeal Space in Different Combinations of Class II Skeletal Malocclusion. Acta Inform Med. 2015 Oct;23(5):285-9. doi: 10.5455/aim.2015.23.285-289.
9. Rodrigues AF, Fraga MR, Vitral RW. Computed tomography evaluation of the temporomandibular joint in class II division 1 and class III malocclusion patients: condylar symmetry and condyle-fossa relationship. Am J Orthod Dentofacial Orthop. 2009;136:199–206.
10. Shi XW. CBCT study on morphological changes of temporomandibular joint in adult patients with skeletal class II deep overbite before and after orthodontic treatment. Dalian Yi Ke Da Xue. 2019.

11. Hiren H Patadiya, Bhavi Thakkar, Dhaval Mehta. Cone Beam Compute Tomography: Applications in Orthodontics. Journal of Pacific Academy of Higher Education and Research 3 (2), 22-25.
12. Soni J, Goje S, Kulkarni N, Shyagali TR, Bhayya DP. Evaluation of Determinants for The Nickel Release by The Standard Orthodontic Brackets. International orthodontics. 2018;16(1):31-41.
13. Soni J, Shyagali TR, Kulkarni N, Bhayya D. Evaluation of influence of altered lower vertical proportions in the perception of facial attractiveness. Int J Orthod Rehabil 2016;7:124-9.
14. Patel M, Shah T, Mehta D. Cone-Beam Computed Tomography: Applications in Dentistry. Int J Sci Res (Ahmedabad) 5:5;558–559. Available from: https://www.worldwidejournals.com/international-journal-of-scientific-research-(IJSR)/recent_issues_pdf/2016/May/May_2016_1492766318__184.pdf. DOI: 10.36106/ijsr
15. Li NJ, Zhao CY, Wu K, Ma JQ. Mechanism of twin block appliance in the treatment of angle's II malocclusion. Stomatol. 2019;39:1082–1084.
16. Maruo IT. Class II Division 2 subdivision left malocclusion associated with anterior deep overbite in an adult patient with temporomandibular disorder. Dent Press J Orthod. 2017;22:102–112.
17. Khayat N, Farah H, Kaklamanos EG, Athanasiou AE. The prevalence of temporomandibular disorders and dental malocclusion in adult patients: a cross-sectional study. J Oral Rehabil. 2021;48:131–138.
18. Ponnada SR, Ganugapanta VR, Perumalla KK, Naqeed MA, Harini T, Mandaloju SP. Airway analysis in skeletal class I and class II subjects with different growth patterns: a 2D cephalometric study. J Pharm Bioallied Sci. 2020;12:0.
19. McNamara JA Jr. Components of class II malocclusion in children 8–10 years of age. Angle Orthod. 1981;51:177–202.p
20. Costa YM, Porporatti AL, Stuginski-Barbosa J, Bonjardim LR, Speciali JG, Rodrigues Conti PC. Headache attributed to masticatory myofascial pain: clinical features and management outcomes. J Oral Facial Pain Headache. 2015;29:323–330.
21. Abdel Emam A, Refai W. Effect of twin block appliance on the TMJ: magnetic resonance imaging study. EC Dent Sci. 2017;16:122–128.
22. Arat ZM, Gökalp H, Erdem D, Erden I. Changes in the TMJ disc-condyle-fossa relationship following functional treatment of skeletal class II division 1 malocclusion: a magnetic resonance imaging study. Am J Orthod Dentofacial Orthop. 2001;119:316–319.
23. Ricketts RM. A study of change in temporomandibular relations associated with the treatment of class II malocclusion. Am J Orthod Dentofacial Orthop. 1952;38:918–933.
24. Saccucci M, Polimeni A, Festa F, Tecco S. Do skeletal cephalometric characteristics correlate with condylar volume, surface and shape? A 3D analysis. Head Face Med. 2012;10:1186–1746.
25. Pullinger AG, Seligman DA, Solberg WK. Temporomandibular disorders. Part II: Occlusal factors associated with temporomandibular joint tenderness and dysfunction. J Prosthet Dent. 1988;59:363–367.
26. Manfredini D, Guarda-Nardini L. Relationship between dental occlusion and temporomandibular disorders: a systematic review of the literature. J Oral Rehabil. 2012;39:502–512.
27. Kandasamy S, Greene CS, Shah K. Occlusal risk factors for temporomandibular disorders. J Oral Rehabil. 2021;48:943–953.
28. Ferrario VF, Sforza C, D'Addona A, Miani A. Facial morphology and stomatognathic function in deep overbite subjects. Clin Anat. 1995;8:384–392.