

A RETROSPECTIVE INVESTIGATION OF BONE LOSS IN PANORAMIC RADIOGRAPHS OF PRE AND POST ORTHODONTICALLY TREATED INDIVIDUALS IN DIFFERENT AGE GROUPS UTILIZING DIGITALIZED SOFTWARE

Dr. Nivedha Menon ¹, Dr. Hema ², Dr. Bhuvanesarri ³,
Dr. Anitha Balaji ⁴, Dr. Krishna Prasanth ^{5*}

^{1,2} Post Graduate, Department of Periodontics, Sree Balaji Dental College and Hospital.

³ Professor, Department of Periodontics, Sree Balaji Dental College and Hospital.

⁴ Professor and Head, Department of Periodontics, Sree Balaji Dental College and Hospital.

⁵ Assistant Professor, Department of Community Medicine, Sree Balaji Medical College and Hospital.

Email: ¹nivedha.menon@gmail.com, ²hema.natalie@gmail.com, ³dr.bhuvana22@gmail.com,

⁴anithab.pd@sbdch.bharathuniv.ac.in, ⁵mail2kristain@gmail.com (*Corresponding Author)

DOI: [10.5281/zenodo.11369130](https://doi.org/10.5281/zenodo.11369130)

Abstract

Aim and Objective: This study aims to evaluate the effects of orthodontic treatment on the periodontal health of patients by estimating the prevalence and severity of alveolar bone loss in orthodontic patients.

Material and Methods: 30 patients visiting a Dental Hospital were enrolled in this study. All patients in the age group of 13 -45 years were included. Pre and post panoramic radiographs were collected. The intraoral bone loss in the molar region was assessed using Digimizer tool and primary details were collected. Data has been gathered and statistical analysis has been done. **Results:** An evident relationship between the progress of periodontal disease and orthodontic treatment was identified. Correlation between bone losses with age will be implemented for periodontal assessment and further planning of orthodontic treatment. **Conclusion:** The efficiency of orthodontic therapy is also evaluated by the response of the periodontal tissues, therefore oral hygiene maintenance and periodontal management is vital.

INTRODUCTION

Awareness for orthodontic treatment has risen among adults probably for a boost in confidence with an attractive smile and treatment affordability. However, the treatment modality greatly differs between young orthodontic patients and adults as growth modification procedures are not possible in adults.

Bone loss after orthodontic treatment, particularly in the alveolar bone surrounding the teeth, has been a topic of interest and research in the field of orthodontics. While orthodontic treatment aims to align teeth and improve occlusion, it can potentially lead to some changes in the surrounding bone structures.

The extent of bone loss after orthodontic treatment can vary among individuals. Factors such as age, genetics, oral hygiene, systemic conditions, and treatment mechanics can influence the bone response. It is essential for orthodontists to consider these factors when planning and monitoring treatment to minimize potential adverse effects. ⁽¹⁾

Orthodontic treatment involves the application of forces to teeth, which can potentially affect the surrounding bone tissues. It is essential to determine the long-term effects of orthodontic treatment on bone health to ensure optimal treatment outcomes. To stop further periodontal disease, oral hygiene is always more crucial for orthodontic patients. Plaque buildup on orthodontic appliance components is causing periodontal tissues to be destroyed in the absence of oral hygiene maintenance.

Maintaining oral hygiene during orthodontic treatment will help in good gingival health, which reflects in final orthodontic treatment outcome. However, orthodontic patients do not have adequate knowledge of gingival health. Poor maintenance of oral hygiene is due to either lack of knowledge or negligence by patients themselves. It is always needed to assess the knowledge of orthodontic patients on gingival health. ⁽²⁾⁽³⁾

Proper oral hygiene practices, regular dental visits, and maintenance of periodontal health are crucial during and; after orthodontic treatment to minimize the risk of any periodontal complications. Digitalized software provides a valuable tool for accurately measuring bone levels in panoramic radiographs. This study aims to evaluate bone loss in panoramic radiographs of pre- and post-orthodontically treated individuals across different age groups using digitalized software.

MATERIALS AND METHODS

Anonymized pre and post orthodontic digital orthopantomogram (OPG) of 30 patients in the age group of 13 - 45 years were selected from the Department of Orthodontics, Sree Balaji Dental College and Hospital, Chennai. The subjects were randomly divided into 2 groups based on age group.

| | Group A | Group B |
|------------|---------|---------|
| Age group: | 14-25 | 26-45 |

Each orthopantomogram was divided into sextants and one tooth per sextant was chosen to evaluate overall bone loss with **Digimizer software**. Subjects with an ongoing orthodontic treatment, systemic disease or medications were excluded from the study.

By comparing pre and post-treatment OPGs (Figure 1 and 2), we were able to assess the effect of orthodontic treatment on the alveolar bone and detect any potential bone loss or changes in bone structure. These findings can help evaluate treatment outcomes, identify any complications, and guide further treatment planning if necessary.



Figure 1



Figure 2

The linear distance between crestal bone and Cemento-enamel junction (CEJ) on mesial/distal aspect of the tooth (whichever was greater) is denoted as Bone loss (BL)(Figure 3). Age and gender of the patients were noted and Digimizer software was used to mark the points and perform measurements in the digital orthopantomogram at 60% magnification.



Figure 3

Statistical analysis was performed. Association between age and Bone Loss (BL) was calculated using Pearson's correlation. From the sample ($n = 25$), a regression equation was derived using linear regression. The difference between the actual and calculated bone loss was calculated using Paired t test and noted as error. A $P < 0.05$ was considered to be statistically significant. ⁽⁶⁾

DISCUSSION

Crestal bone loss, which can occur due to periodontal disease or other factors, can impact the position of the center of resistance of the tooth. This change in the center of resistance affects the distribution of forces applied during orthodontic tooth movement. Orthodontists need to consider this when planning treatment to ensure appropriate force application and tooth movement.

Orthodontic patients may experience gingivitis or changes in periodontal health during treatment. The use of fixed appliances in orthodontics can create an environment that promotes the growth of certain microorganisms, such as anaerobic rods, spirochetes, and motile microorganisms, which are associated with periodontal disease. These changes in the oral microbiota can contribute to the development of gingivitis or other periodontal conditions.

The association between bone loss and orthodontic treatment is an important aspect to consider. However, determining the ideal bone level for orthodontic treatment is complex, and there is limited research available on this specific topic. Each patient's bone level and response to orthodontic forces may vary, depending on various factors such as age, genetics, systemic health, and oral hygiene. ⁽⁴⁾⁽⁵⁾

- ❖ Statistically female patients were noted to have significantly higher bone loss when compared to men.[Figure 4, Table 1]

Table: 1

Male Vs Female - Pre Vs Post Treatment Bone Loss (in mms)

| Sl.No | PRT-16 | POT-16 | PRT-11 | POT-11 | PRT-26 | POT-26 | PRT-36 | POT-36 | PRT-31 | POT-31 | PRT-46 | POT-46 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| MALE | 0.31 | 0.44 | 0.30 | 0.45 | 0.25 | 0.43 | 0.29 | 0.45 | 0.24 | 0.37 | 0.29 | 0.44 |
| FEMALE | 0.33 | 0.45 | 0.32 | 0.46 | 0.27 | 0.44 | 0.31 | 0.47 | 0.24 | 0.38 | 0.30 | 0.44 |

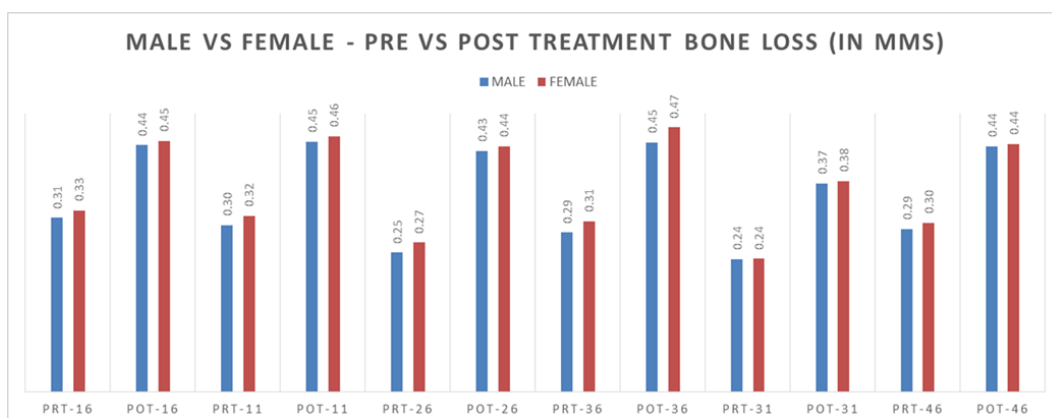


Figure 4

- ❖ An increase in bone loss was seen in group A when compared to group B.

Table 2

| GROUP | GROUP A | GROUP B |
|------------------|---------|---------|
| Age Group | 14-25 | 26-45 |
| PRT-16 | 0.351 | 0.312 |
| PRT-11 | 0.334 | 0.300 |
| PRT-26 | 0.300 | 0.250 |
| PRT-36 | 0.301 | 0.286 |
| PRT-31 | 0.255 | 0.239 |
| PRT-46 | 0.294 | 0.292 |
| POT-16 | 0.477 | 0.443 |
| POT-11 | 0.483 | 0.449 |
| POT-26 | 0.483 | 0.433 |
| POT-36 | 0.487 | 0.448 |
| POT-31 | 0.401 | 0.370 |
| POT-46 | 0.450 | 0.441 |

Table 2 [With Average Bone Loss Measurement in centimetres (cms)]

- ❖ When a comparison of frequency distribution of bone loss was done, it was noted that <1mm bone loss was most frequent. [Table 3, Figure 3]

Table 3

| Frequency distribution of absolute difference between Pre-Treatment and Post-Treatment Bone Loss (in mm) | | | | | | |
|--|-----------------|-----|-----|-----|-----|-----|
| Bone Loss in mm | Total Frequency | | | | | |
| | D16 | D11 | D26 | D36 | D31 | D46 |
| <1 mm | 11 | 11 | 11 | 9 | 16 | 13 |
| 1-2 mm | 14 | 12 | 8 | 10 | 7 | 9 |
| 2-3 mm | 4 | 5 | 5 | 8 | 4 | 5 |
| 3-4mm | 1 | 1 | 2 | 2 | 0 | 2 |
| 4-5mm | 0 | 1 | 3 | 0 | 2 | 1 |
| >5mm | 0 | 0 | 1 | 1 | 1 | 0 |

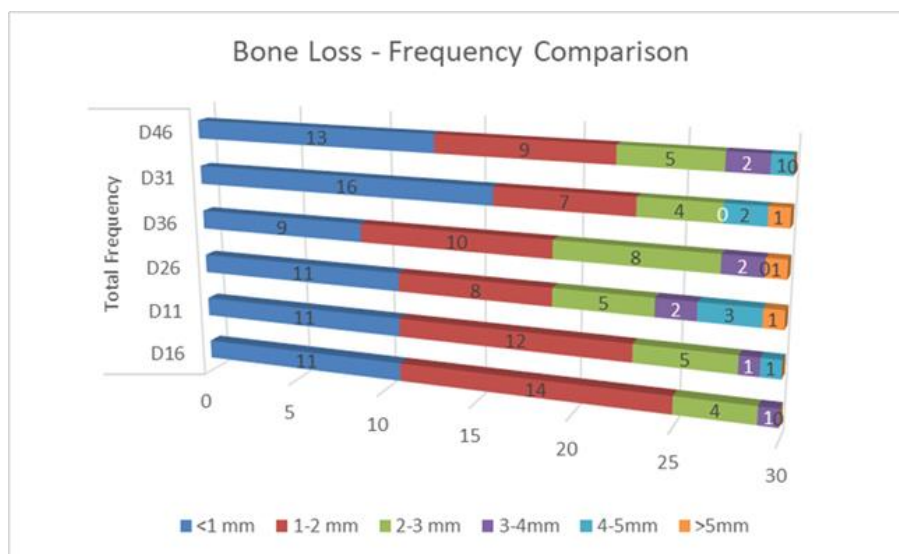


Figure 5

Nasir et al in 2011, suggested that there is a strong relationship between the progress of periodontal disease and orthodontic treatment. The presence of orthodontic appliances, particularly fixed appliances, can create challenges in maintaining optimal oral hygiene, which can potentially contribute to the progression of periodontal disease. Factors such as difficulty in cleaning around brackets and wires, plaque retention, and changes in the oral microbiota may increase the risk of gingivitis and periodontal inflammation during orthodontic treatment. ⁽⁷⁾

Mehta et al in 2021, conducted a similar study where this method of correlating bone loss with age can be applied for periodontal assessment and plan orthodontic treatment. As individuals age, changes in bone metabolism and density can occur, which can impact the response to orthodontic forces and the overall treatment outcomes. However, considering age-related changes in bone levels, orthodontists and periodontists can better assess the potential risks and benefits of orthodontic treatment in relation to periodontal health. This information can aid in treatment planning, including the selection of appropriate orthodontic techniques, force levels, and treatment duration ⁽⁸⁻²⁵⁾

In this study, we have attempted to establish a solution or prediction model that could help assess the association between bone loss and orthodontic treatment in a particular age group. This type of research is valuable in providing insights into the effects of orthodontic treatment on bone levels and can help guide treatment planning decisions. By understanding the relationship between bone loss and orthodontic treatment, orthodontists can apply appropriate force levels and implement strategies to minimize potential complications. It is important to note that individualized treatment planning and monitoring are essential in orthodontics. Each patient's specific circumstances and factors should be taken into account to ensure optimal treatment outcomes and maintain periodontal health throughout the orthodontic process. ⁽⁹⁾⁽¹⁰⁾

CONCLUSION

The hypothesis of study was that there is a change in the periodontal status of the patients receiving fixed orthodontic treatment. The study results supported the hypothesis and showed a significant and definitive bone loss pre and post orthodontic treatment among younger and older age group individuals.

A multidisciplinary approach to orthodontic treatment will allow better management of the most complex and unique demands the patient. Orthodontic forces represent a physical agent capable of inducing an inflammatory reaction in the periodontium hence goal of orthodontics should also be to complete the orthodontic treatment with the least effects on the root and periodontium.

References

- 1) Zachrisson BU. Clinical implications of recent orthodontic-periodontic research findings. In Seminars in orthodontics 1996 Mar 1 (Vol. 2, No. 1, pp. 4-12). WB Saunders.
- 2) Nelson PA. Alveolar bone loss of maxillary anterior teeth in adult orthodontic patients. American journal of orthodontics and dentofacial orthopedics. 1997 Mar 1;111(3):328-34.
- 3) Kaimenyi JT, Ashley FP. Assessment of bone loss in periodontitis from panoramic radiographs. Journal of clinical periodontology. 1988 Mar;15(3):170-4
- 4) Sam G. Horizontal and Vertical Bone loss After Active Orthodontic Treatment: A Clinical Retrospective Study. European Journal of Molecular & Clinical Medicine.;7(11):2020.
- 5) Bagga DK. Adult orthodontics versus adolescent orthodontics: an overview. J Oral Health Comm Dent. 2010;4(2):42-7.
- 6) Maithri M, Ballal DG, Kumar S, Raghavendra U, Gudigar A, Chan WY, Macherla S, Vineetha R, Gopalkrishna P, Ciaccio EJ, Acharya UR. Development of a Computational Tool for the Estimation of Alveolar Bone Loss in Oral Radiographic Images. Computation. 2022 Jan 12;10(1):8.
- 7) Nasir N, Ali S, Bashir U, Ullah A. Effect of orthodontic treatment on periodontal health. Pakistan Oral and Dental Journal. 2011 Jun 30;31
- 8) Mehta S. Age Related Assessment of Bone Loss of Orthodontic Patients with Panoramic Radiograph. EC Dental Science. 2019;18:1109-13.
- 9) Zardawia FM, Aboud AN, Khursheed DA. A retrospective panoramic study for alveolar bone loss among young adults in Sulaimani City, Iraq. The Sulaimani Dental Journal. 2014;1:94-8.
- 10) Kasaj A, Vasiliu C, Willershausen B. Assessment of alveolar bone loss and angular bony defects on panoramic radiographs. European journal of medical research. 2008 Jan 23;13(1):26.
- 11) Mandal S, Vishvakarma P. Nanoemulgel: A Smarter Topical Lipidic Emulsion-based Nanocarrier. Indian J of Pharmaceutical Education and Research. 2023;57(3s):s481-s498.

- 12) Mandal S, Jaiswal DV, Shiva K. A review on marketed Carica papaya leaf extract (CPLE) supplements for the treatment of dengue fever with thrombocytopenia and its drawback. *International Journal of Pharmaceutical Research*. 2020 Jul;12(3).
- 13) Bhandari S, Chauhan B, Gupta N, et al. Translational Implications of Neuronal Dopamine D3 Receptors for Preclinical Research and Cns Disorders. *African J Biol Sci (South Africa)*. 2024;6(8):128-140. doi:10.33472/AFJBS.6.8.2024.128-140
- 14) Tripathi A, Gupta N, Chauhan B, et al. Investigation of the structural and functional properties of starch-g-poly (acrylic acid) hydrogels reinforced with cellulose nanofibers for cu²⁺ ion adsorption. *African J Biol Sci (South Africa)*. 2024;6(8): 144-153, doi:10.33472/AFJBS.6.8.2024.141-153
- 15) Mandal S, Bhumika K, Kumar M, Hak J, Vishvakarma P, Sharma UK. A Novel Approach on Micro Sponges Drug Delivery System: Method of Preparations, Application, and its Future Prospective. *Indian J of Pharmaceutical Education and Research*. 2024;58(1):45-63.
- 16) Mishra, N., Alagusundaram, M., Sinha, A., Jain, A. V., Kenia, H., Mandal, S., & Sharma, M. (2024). Analytical Method, Development and Validation for Evaluating Repaglinide Efficacy in Type II Diabetes Mellitus Management: a Pharmaceutical Perspective. *Community Practitioner*, 21(2), 29–37. <https://doi.org/10.5281/zenodo.10642768>
- 17) Singh, M., Aparna, T. N., Vasanthi, S., Mandal, S., Nemade, L. S., Bali, S., & Kar, N. R. (2024). Enhancement and Evaluation of Soursop (*Annona Muricata* L.) Leaf Extract in Nanoemulgel: a Comprehensive Study Investigating Its Optimized Formulation and Anti-Acne Potential Against *Propionibacterium Acnes*, *Staphylococcus Aureus*, and *Staphylococcus Epidermidis* Bacteria. *Community Practitioner*, 21(1), 102–115. <https://doi.org/10.5281/zenodo.10570746>
- 18) Khalilullah, H., Balan, P., Jain, A. V., & Mandal, S. (n.d.). Eupatorium Rebaudianum Bertoni (Stevia): Investigating Its Anti-Inflammatory Potential Via Cyclooxygenase and Lipooxygenase Enzyme Inhibition - A Comprehensive Molecular Docking And ADMET. *Community Practitioner*, 21(03), 118–128. <https://doi.org/10.5281/zenodo.10811642>
- 19) Mandal, S. Vishvakarma, P. Pande M.S., Gentamicin Sulphate Based Ophthalmic Nanoemulgel: Formulation and Evaluation, Unravelling A Paradigm Shift in Novel Pharmaceutical Delivery Systems. *Community Practitioner*, 21(03), 173-211. <https://doi.org/10.5281/zenodo.10811540>
- 20) Mandal, S., Tyagi, P., Jain, A. V., & Yadav, P. (n.d.). Advanced Formulation and Comprehensive Pharmacological Evaluation of a Novel Topical Drug Delivery System for the Management and Therapeutic Intervention of Tinea Cruris (Jock Itch). *Journal of Nursing*, 71(03). <https://doi.org/10.5281/zenodo.10811676>
- 21) Mishra, N., Alagusundaram, M., Sinha, A., Jain, A. V., Kenia, H., Mandal, S., & Sharma, M. (2024). Analytical Method, Development and Validation for Evaluating Repaglinide Efficacy in Type II Diabetes Mellitus Management: a Pharmaceutical Perspective. *Community Practitioner*, 21(2), 29–37. <https://doi.org/10.5281/zenodo.10642768>
- 22) Singh, M., Aparna, T. N., Vasanthi, S., Mandal, S., Nemade, L. S., Bali, S., & Kar, N. R. (2024). Enhancement and Evaluation of Soursop (*Annona Muricata* L.) Leaf Extract in Nanoemulgel: a Comprehensive Study Investigating Its Optimized Formulation and Anti-Acne Potential Against *Propionibacterium Acnes*, *Staphylococcus Aureus*, and *Staphylococcus Epidermidis* Bacteria. *Community Practitioner*, 21(1), 102–115. <https://doi.org/10.5281/zenodo.10570746>
- 23) Gupta, N., Negi, P., Joshi, N., Gadipelli, P., Bhumika, K., Aijaz, M., Singhal, P. K., Shami, M., Gupta, A., & Mandal, S. (2024). Assessment of Immunomodulatory Activity in Swiss Albino Rats Utilizing a Poly-Herbal Formulation: A Comprehensive Study on Immunological Response Modulation. *Community Practitioner*, 21(3), 553–571. <https://doi.org/10.5281/zenodo.10963801>
- 24) Mandal S, Vishvakarma P, Bhumika K. Developments in Emerging Topical Drug Delivery Systems for Ocular Disorders. *Curr Drug Res Rev*. 2023 Dec 29. doi: 10.2174/0125899775266634231213044704. Epub ahead of print. PMID: 38158868.
- 25) Abdul Rasheed. A. R, K. Sowmiya, S. N., & Suraj Mandal, Surya Pratap Singh, Habibullah Khallullah, N. P. and D. K. E. (2024). In Silico Docking Analysis of Phytochemical Constituents from Traditional Medicinal Plants: Unveiling Potential Anxiolytic Activity Against Gaba, *Community Practitioner*, 21(04), 1322–1337. <https://doi.org/10.5281/zenodo.11076471>