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ORIGINAL RESEARCH


# Comparative Evaluation of Myeloperoxidase Enzymatic Activity in Gingival Crevicular Fluid of Subjects having Orthodontic Treatment by Different Aligning Arch Wires

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## ABSTRACT

**Introduction:** There exist a number of factors that affect the outcome of orthodontic treatment. These factors can be assessed by various gingival markers. One such maker is myeloperoxidase (MPO). Hence, we planned the present study to assess and compare the MPO activity in the gingival crevicular fluid (GCF) of subjects undergoing orthodontic treatment by different aligning arch wires.

**Materials and methods:** The present study included assessment of patients who underwent orthodontic treatment for crowding of anterior teeth. Diagnostic cast models of all the subjects were made for recording the irregularity index. All the subjects were randomly divided into three study groups with 15 patients in each group based on the type of nickel–titanium (NiTi) arch wires used. A collection of GCF samples was done in all the patients at various time intervals and it was sent to the laboratory for assessment of MPO activity. Activity of the MPO enzyme was expressed in terms of number of units per 100 µL. All the results obtained were compiled and analyzed by Statistical Package for the Social Sciences (SPSS) software.

**Results:** We observed that nonsignificant results were obtained while comparing the mean age and mean gingival score in all the study groups. However, significant results were obtained on comparing the mean MPO enzymatic activity in all the study groups at different time intervals.

**Conclusion:** Both superelastic NiTi and heat-activated NiTi generate optimal forces, which are necessary for higher metabolic response of the periodontal ligament.

**Clinical significance:** In the intimal stages of orthodontic treatment, both superelastic NiTi and heat-activated NiTi wires are superior in leveling and aligning the crowded teeth.

**Keywords:** Gingival crevicular fluid, Myeloperoxidase, Nickel–titanium.

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## INTRODUCTION

Numerous factors affect the success and prognosis of orthodontic treatment. These factors include periodontal health, amount of orthodontic forces delivered, type of orthodontic forces used, and oral hygiene of the subjects.[1-3] New methods have been developed from time to time with the purpose of accelerating the orthodontic tooth movement, which has resulted in shortening of the clinician's time along with reduction in associated adverse effects, such as pain, discomfort, dental caries, and periodontal diseases and minimizing iatrogenic damages.[4-6] An inflammatory process is often generated by the orthodontic treatment. Inside the neutrophil granules, MPO enzyme is found. The degree of inflammation is reflected by the MPO levels. It has been shown in the past literature that higher force is exerted by traditional

NiTi wires of same cross-section in comparison with the heat-activated arch wires.[7-11] Hence, we planned the present study to assess and compare the MPO activity in the GCF of subjects undergoing orthodontic treatment by different aligning arch wires.

## MATERIALS AND METHODS

The present study was conducted in the Department of Orthodontics of the dental institution and included assessment of patients who underwent orthodontic treatment for crowding of anterior teeth from June 2014 to July 2016. Ethical approval was taken from the Institutional Ethical Committee, and written consent was obtained after explaining in detail the entire research protocol. In the present study, we included only those patients who belonged to three groups of Angle's classification and underwent treatment of crowding of approximately 4 to 6 mm in anterior teeth. Inclusion criteria for the present study included:

- Patients without history of any systemic illness
- Patients without any known drug allergy
- Patients with negative history of any type of antibiotic or anti-inflammatory therapy in the past 6 months
- Nonsmokers
- Patients with healthy periodontal tissue with diffuse periodontal depth of <3 mm
- Patients with absence of bone loss on radiographic examination
- Patients with absence of supragingival plaque on teeth.

Diagnostic cast models of all the subjects were made for recording the irregularity index. Vernier caliper was used for measuring the values on the case. Vernier caliper was kept in a direction parallel to the occlusal plane. All the subjects were randomly divided into three study groups with 15 patients in each group as shown in Table 1. Complete oral hygiene instructions were given to all the patients in the present study before the start of all the procedures. About 2 hours before the start of the examination procedure, all the patients were instructed not to eat or drink anything. At the following time intervals, collection of GCF samples was done: Baseline, 2 hours, 1 week, and 2 weeks after the activation of orthodontic treatment. Placement of superior and inferior bands formed the activation procedure of orthodontic treatment. Full engagement of archwire in each bracket was done. In all the patients, placement of strips was done in the identical crevicular location of lower anterior teeth and was done for the collection of GCF samples. Twice collection of samples was done from the same site. Drying of the collection site in all the patients was done with an air syringe after isolation of the tooth with cotton pellets. Absorbent Periopaper strips were used for the collection of the GCF samples in all the subjects. Strips were placed in the gingival cervix for 30 seconds for collecting the GCF. Placement of all the individual Perio strips in the Eppendorf tube containing buffer solution was done and was transported to the central laboratory for further processing. In the laboratory, all the samples were centrifuged at 13,000 gm for 10 minutes at 4°C. Collection of the supernatants was done and was stored at –70°C. Bradley–Bozeman modified technique was used for assessing the MPO activity.[12] Activity of the MPO enzyme was expressed in terms of number of units/100 µL. All the results obtained were compiled and analyzed by SPSS software. Chi-squared test, Student's t-test, and one-way analysis of variance were used for assessment of the level of significance; $p < 0.05$ was considered statistically significant.

**Table 1:** Distribution of subjects into various groups

| *Groups* | *Parameter* |
|---|---|
| I | Heat-activated NiTi |
| II | Superelastic NiTi |
| III | Multistranded NiTi |

## RESULTS

Comparative evaluation of the mean age and gingival index in all the subjects of the present study is shown in Table 2. Mean age of the subjects in the groups I, II, and III was found to be 6.25, 5.60, and 6.10 years respectively. Mean gingival index score in the subjects of groups I, II, and III was found to be 0.69, 0.65, and 0.60 respectively. Nonsignificant results were obtained while comparing the mean age and mean gingival score in all the study groups ($p > 0.05$). The MPO activity in the subjects of group I at baseline, 2 hours time, 1 week time, and 2 weeks time, was found to be 807.2, 2084.3, 971.1, and 560.5 units/100 µL respectively. We observed statistically significant results on comparing the mean MPO enzymatic activity in all the study groups at different time intervals ($p < 0.05$; Table 3). Table 4 shows the intergroup comparison of mean MPO activity. Significant results were obtained while comparing the mean MPO activity in between groups II and III subjects at different time intervals ($p < 0.05$).

## DISCUSSION

The use of orthodontic constraint brings about tooth movement inside the alveolar bone. This is because of

**Table 2:** Comparative evaluation of mean age of the subjects and gingival index

| | *Groups* | | | |
|---|---|---|---|---|
| *Parameter* | *I* | *II* | *III* | *p-value* |
| Mean age (years) | 6.25 | 5.60 | 6.10 | 0.25 |
| Mean gingival index | 0.69 | 0.65 | 0.60 | 0.30 |

**Table 3:** Myeloperoxidase enzymatic activity (units/100 µL) in GCF of all the subjects at different time intervals

| | *Groups* | | |
|---|---|---|---|
| *Time interval* | *I* | *II* | *III* |
| Baseline | 807.2 | 803.8 | 810.7 |
| 2 hours time | 2084.3 | 2100.5 | 1890.7 |
| 1 week time | 971.1 | 981.0 | 925.0 |
| 2 weeks time | 560.5 | 596.1 | 560.2 |
| p-value | 0.02* | 0.03* | 0.01* |

*Significant

**Table 4:** Intergroup comparative evaluation of mean MPO activity

| | *p-value* | | | |
|---|---|---|---|---|
| *Groups* | *Baseline* | *2 hours time* | *1 week time* | *2 weeks time* |
| Group I *vs* group II | 0.5 | 0.62 | 0.48 | 0.23 |
| Group II *vs* group III | 0.25 | 0.01* | 0.04* | 0.03* |
| Group I *vs* group III | 0.52 | 0.03* | 0.25 | 0.17 |

*Significant

the way that any change in the organic framework, due to mechanical stacking, brings about strain inside the natural framework. This, in turn, prompts arrival of different neurotransmitters bringing about renovation and adjustment of the natural framework to the more up-to-date condition.[13,14] Due to this rule, renovating of the periodontal tendon and the alveolar bone around a tooth happens amid orthodontic drive application. Research is continually being done and refreshed consistently on the science of orthodontic tooth development and the tissue-level reaction inside the cell level on utilization of orthodontic constraint. The MPO is a chemical found in polymorphonuclear neutrophil (PMN) granules and can be utilized to appraise the quantity of PMN granules in tissues. Mean MPO action was expanded in both the GCF and salivation of orthodontic patients 2 hours after treatment initiation. The MPO may be a fairly good biomarker to evaluate aggravation in orthodontic development.[15,16] Hence, we planned the present study to assess and compare the MPO activity in the GCF of subjects undergoing orthodontic treatment by different aligning arch wires.

In the present study, we observed significant results on comparing the mean MPO enzymatic activity in all the study groups when compared at different time intervals ($p < 0.05$; Table 3). Furthermore, on comparing MPO values between groups II and III, we observed statistically significant results ($p < 0.05$; Table 4). Our results were in correlation with the results obtained by Fatima et al[17] who reported similar findings in their study. In the GCF of 20 patients undergoing fixed orthodontic treatment, Navarro-Palacios et al[18] assessed the gingival MPO activity. Only those patients were included in their study that were at stages of dental crowding alignment phase with same arch wires. They classified all their subjects broadly into two study groups. One group included subjects with severe crowding, whereas another group included subjects with minimum crowding. They evaluated the salivary MPO activity at baseline, 2 hours, 7 days, and 2 weeks after the activation of orthodontic appliance. Modified Bradley–Bozeman technique was used by them for the measurement of MPO activity. The maximum activity of the enzyme was observed by them at 2 hours. Elevation of the MPO activity was seen until 1 week's time. At 2 weeks, the MPO values were found to be similar to those of baseline values. No significant difference was observed in the MPO enzyme activity between the two study groups. They concluded that MPO activity is unaffected by amount of crowding in permanent dentition. Fatima et al[17] assessed MPO enzymatic movement amid starting arrangement with orthodontic arch wires of various alloy types. The MPO action was resolved in GCF from a specimen of 60 patients isolated into three gatherings amid starting orthodontic arrangement with three sorts of arch wire. The MPO action was evaluated at initial time, 2 hours, 7 days, and 14 days after activation of the appliance. The MPO action was altogether elevated in GCF at various time intervals in all categories in comparison to the baseline values. Enzymatic action was most elevated in the super elastic (SE) NiTi mass taken after by heat-activated (HANT) and multistranded stainless steel group, yet no noteworthy contrast between SE NiTi and HANT group was observed. Super elastic and HANT NiTi arch wires delivered an expanded incendiary reaction in the light of MPO movement amid introductory leveling and arrangement contrasted with multistranded stainless steel. Sandhu et al[19] investigated the effectiveness and properties of NiTi and multistranded stainless steel wires in patients with severe crowding. A total of 96 patients who were suffering from moderate-to-severe crowding were studied. All the patients were broadly divided into four study groups: Superelastic NiTi preadjusted edgewise appliance (PEA), superelastic NiTi Begg, multistranded stainless steel PEA, and multistranded stainless steel Begg. In a 0.022-inch slot PEA and Begg appliance, 0.16 inch and 0.175 inch Superelastic NiTi and multistranded stainless steel wires were used respectively. Follow-up record of 6 weeks was evaluated. They did not observe any statistically significant results on comparing the reduction of crowding between superelastic NiTi PEA and multistranded stainless steel PEA groups. However, they observed a significantly greater reduction in crowding in subjects of superelastic NiTi Begg group in comparison with multistranded stainless steel Begg group.

From the results, they concluded that in comparison to multistranded stainless steel wire in the Begg appliance, performance of NiTi was significantly better.

## CONCLUSION

Optimal forces are generated by both superelastic NiTi and heat-activated NiTi, which are necessary for higher metabolic response of the periodontal ligament.

## REFERENCES


1. Cardaropoli D, Gaveglio L. The influence of orthodontic movement on periodontal tissues level. Semin Orthod 2007 Dec;13(4):234-245.
2. Krishnan V, Davidovitch Z. Cellular, molecular, and tissue-level reactions to orthodontic force. Am J Orthod Dentofacial Orthop 2006 Apr;129(4):469.e1-469.e32.
3. Bartzela T, Türp JC, Motschall E, Maltha JC. Medication effects on the rate of orthodontic tooth movement: a systematic literature review. Am J Orthod Dentofacial Orthop 2009 Jan;135(1):16-26.
4. Taba M Jr, Kinney J, Kim AS, Giannobile WV. Diagnostic biomarkers for oral and periodontal diseases. Dent Clin North Am 2005 Jul;49(3):551-571, vi.
5. Brooks PJ, Nilforoushan D, Manolson MF, Simmons CA, Gong SG. Molecular markers of early orthodontic tooth movement. Angle Orthod 2009 Nov;79(6):1108-1113.
6. Low E, Zoellner H, Kharbanda OP, Darendeliler MA. Expression of mRNA for osteoprotegerin and receptor activator of nuclear factor kappa beta ligand (RANKL) during root resorption induced by the application of heavy orthodontic forces on rat molars. Am J Orthod Dentofacial Orthop 2005 Oct;128(4):497-503.
7. Lacey DL, Timms E, Tan HL, Kelley MJ, Dunstan CR, Burgess T, Elliott R, Colombero A, Elliott G, Scully S, et al. Osteoprotegerin ligand is a cytokine that regulates osteoclast differentiation and activation. Cell 1998 Apr;93(2):165-176.
8. Garlet TP, Coelho U, Silva JS, Garlet GP. Cytokine expression pattern in compression and tension sides of the periodontal ligament during orthodontic tooth movement in humans. Eur J Oral Sci 2007 Oct;115(5):355-362.
9. Haynes DR, Atkins GJ, Loric M, Crotti TN, Geary SM, Findlay DM. Bidirectional signaling between stromal and hemopoietic cells regulates interleukin-1 expression during human osteoclast formation. Bone 1999 Sep;25(3):269-278.
10. Natt AS, Sekhon AK, Munjal S, Duggal R, Holla A, Gandhi P, Gandhi P, Sarin S. A comparative evaluation of static frictional resistance using various methods of ligation at different time intervals: an *in vitro* study. Int J Dent 2015 Apr;2015:407361.
11. Parvizi F, Rock WP. The load/deflection characteristics of thermally activated orthodontic archwires. Eur J Orthod 2003 Aug;25(4):417-421.
12. Bozeman PM, Learn DB, Thomas EL. Assay of the human leukocyte enzymes myeloperoxidase and eosinophil peroxidase. J Immunol Methods 1990 Jan;126(1):125-133.
13. Kanzaki H, Chiba M, Sato A, Miyagawa A, Arai K, Nukatsuka S, Mitani H. Cyclical tensile force on periodontal ligament cells inhibits osteoclastogenesis through OPG induction. J Dent Res 2006 May;85(5):457-462.
14. Yamaguchi M, Ozawa Y, Mishima H, Aihara N, Kojima T, Kasai K. Substance P increases production of proinflammatory cytokines and formation of osteoclasts in dental pulp fibroblasts in patients with severe orthodontic root resorption. Am J Orthod Dentofacial Orthop 2008 May;133(5):690-698.
15. Yam LT, Janckila AJ. Tartrate-resistant acid phosphatase (TRACP): a personal perspective. J Bone Miner Res 2003 Oct;18(10):1894-1896.
16. De La Peña VA, Diz Dios P, Tojo Sierra R. Relationship between lactate dehydrogenase activity in saliva and oral health status. Arch Oral Biol 2007 Oct;52(10):911-915.
17. Fatima A, Talapaneni AK, Saleh A, Sana S, Hussain A. An evaluation and comparison of myeloperoxidase enzymatic activity during initial orthodontic alignment: an *in vivo* study. J Orthod 2017 Jul;13:1-5.
18. Navarro-Palacios A, García-López E, Meza-Rios A, Armendariz-Borunda J, Sandoval-Rodríguez A. Myeloperoxidase enzymatic activity is increased in patients with different levels of dental crowding after initial orthodontic activation. Am J Orthod Dentofacial Orthop 2014 Jul;146(1):92-97.
19. Sandhu SS, Shetty VS, Mogra S, Varghese J, Sandhu J, Sandhu JS. Efficiency, behavior, and clinical properties of superelastic NiTi versus multistranded stainless steel wires: a prospective clinical trial. Angle Orthod 2012 Sep;82(5):915-921.