Crevicular Alkaline Phosphatase Activity During The Application Of Two Patterns Of Orthodontic Forces

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Introduction
The early phase of orthodontic tooth movement involves an acute inflammatory response characterized by the release of inflammatory mediators and various enzymes in the gingival crevicular fluid. Currently, no evidence-based force level has been described for optimal efficiency in clinical orthodontics. \(^1\)

The use of an initially light and then gradually increasing force can result in the smooth recruitment of osteoclasts and less hardening in rats. \(^2\)

Alkaline phosphatase is considered the most promising reliable marker for bone formation. Alkaline phosphatase is a specific marker for osteoblastic activity. Osteoblastic cells produce high levels of alkaline phosphatase during the process of differentiation. \(^3\)

Previous studies revealed that alkaline phosphatase activity in the GCF increases at sites where bone formation predominates during orthodontic tooth movement. For instance, an increase in alkaline phosphatase activity has been identified at the mesial sides of distalized molars and distally retracted canines. \(^4,5\)

Aim of the Study
The objective of this study was to test the hypothesis that using a gradually increasing orthodontic force would induce an increased activity of osteoblasts compared to a relatively constant orthodontic force.

Materials and Methods
Twelve healthy orthodontic patients, requiring the extractions of the maxillary first premolars and distal retraction of canines with the need of minimum anchorage requirements, were included in the study.

Split mouth design was used in all subjects. One maxillary quadrant was randomly selected to receive a relatively constant orthodontic force. The contralateral maxillary quadrant received a gradually increasing orthodontic force.

<table>
<thead>
<tr>
<th>Group</th>
<th>Force (cN)</th>
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<tbody>
<tr>
<td>1st Week</td>
<td>50</td>
</tr>
<tr>
<td>2nd Week</td>
<td>100</td>
</tr>
<tr>
<td>3rd Week</td>
<td>150</td>
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Nickel titanium coil springs, stretched between the maxillary canines and maxillary first molars, were used to deliver the specified force levels.

Corex gauges were used to adjust the force levels to the required levels.

Oral hygiene requirements were reinforced throughout the entire experimental period to minimize the influence of gingival inflammation on crevicular alkaline phosphatase levels.

Gingival crevicular fluid samples were harvested at a weekly interval from the mesial side of the maxillary canine and the distal side of the maxillary first molar.

Samples were placed in endodontic tubes containing 100µl of phosphate-buffered saline. Gingival crevicular fluid samples were analyzed using a spectrophotometer to investigate the activity of alkaline phosphatase enzyme. The enzyme level in the gingival crevicular fluid was used as a biological marker for osteoblastic activity within the periodontium.

One-way ANOVA test was conducted to test the presence of significant differences between each group means, followed by post-hoc tests to investigate the difference between each group means. Paired-samples test was used to compare enzyme levels at different points in the two experimental groups.

Results
With the exception of the maxillary first molar receiving gradually increasing orthodontic force, the results revealed a consistent pattern of alkaline phosphatase activity. This pattern included an initial rise from baseline to the first week, then a peak in the second week. This peak was followed by a reduction in enzyme activity on the third week.

Conclusion
The use of a gradually increasing orthodontic force could induce an increase in osteoblastic activity during the initial stage of orthodontic tooth movement compared to that induced by a relatively constant orthodontic force.

If future research evaluating the influence of using a gradually increasing force on bone resorption yielded positive results, then coupled with the results of the present study, gradually increasing force systems could be recommended for clinical use in orthodontics.

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References