

Assessment of Alkaline Phosphatase in Crevicular Fluid of Adolescent Undergoing Rapid Maxillary Expansion



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OBJECTIVE: The objectives of this study were to observe the changes in enzyme behavior during Orthodontic tooth movement and Rapid Maxillary expansion to predict the exact timing for Commencement of treatment in young children. **METHODOLOGY:** We selected fifteen patients having age between 9-15 years. Periodontal protocols (Samples from buccal and palatal side) were observed and sample collection before initiation of treatment, during and after activation was done from patients requiring RME. The GCF and ALP activity was checked at the experimental location.

RESULTS: The initial enzyme activity in GCF and ALP was calculated between the buccal and Control sites during maxillary expansion. It was observed that during activation of the appliance and then after 3 months of retention period a significantly elevated enzyme levels were still noted at the experimental sites.

CONCLUSION: An Increase in osteoblastic activity during adolescence period can predict commencement of early or delayed intervention for most favorable treatment results.

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INTRODUCTION

In Orthodontics tooth movement and Rapid palatal expansion are beneficial and time tested procedures for correcting dento facial and orthopaedic anomalies. These procedures are carried out in growing as well as non growing patients. Many growing children are diagnosed with mal aligned teeth as well as narrow palate due to various reasons like thumb sucking, long use of pacifiers and some developmental anomalies.¹ Enzymes are highly specific complex proteins and they help to observe chemical changes in every part of the body. The enzymes which were analyzed

specifically are alanine transaminase, creatine kinase-MB, acid phosphatase, alkaline phosphatase and many more which are mainly involved in bone metabolism for their clinical applications.² Gingival crevicular fluid (GCF) is considered to be an inflammatory exudate. It is collected from periodontal tissues. Among so many enzymes present in human body, Alkaline phosphatase (ALP) is an enzyme which is a glycoprotein bound with membrane and its action is evident in cells of bone turn over and any change occur in the enzyme and its serum have been used as sign for examining bone metabolism in numerous diseases.⁶ It is proved that an increased level of alkaline phosphatase activity is largely related with active bone growth.⁸ If we know the exact status of bone growth we can start the orthopaedic treatment timely without wasting time and it has an important impact in the outcome of orthopedic treatment of growing patients with dental and skeletal defects.⁹ The assessment of skeletal maturation of growing patients can be done through different exceptional radiographic methods analysis like Hand and Wrist and cervical vertebrae maturation (CVM) method. Recently different options are getting available like biomarkers to get analysis of different stages of skeletal

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growth. Through these options we can benefit our patients from extra radiographic exposure. These biochemical markers are mainly involved in the growth of bone and its remodeling.¹⁰ During the analysis of GCF the most important enzyme of bone growth is ALP and its interaction has been an important diagnostic tool to suggest the commencement of early or delayed orthopedic intervention.^{6,10,11}

Therefore this study is designed to examine the changes in activities of ALP in GCF during preadolescence period and treatment with rapid palatal expansion to explore the relationship between active treatment phase and changes in periodontal tissue remodeling. That's why to predict the correct timing to start the treatment of skeletal problems as well as during the treatment phase of adolescent patients.

METHODOLOGY

This study was designed to evaluate the efficacy of enzyme Alkaline phosphatase and it was conducted in the department of Orthodontics de'Montmorency college of Dentistry, Lahore. The analysis of the collected samples was done by ELISA at University of Health Sciences, Lahore. We collected samples of 15 patients. They were selected and inclusion criteria was followed. Patients having any systemic disease were not included in the study. Good oral hygiene was observed during the study period. GCF was collected from the testing sites using paper points. The gingival massage was done to stimulate the GCF formation before the sample collection. The paper points were positioned lingually and buccally to obtain GCF. ALP level was calculated by ELISA technique.

STATISTICAL ANALYSIS

The data was collected was analyzed by SPSS (Statistical Package for Social Sciences) version 20. The mean level of enzyme alkaline phosphatase activity was calculated and the standard deviation of the mean values of the enzyme was determined. Multivariate ANOVA analysis was applied to calculate any significance of enzyme activity. The value of $P \leq 0.05$ was considered as a significant statistical value.

RESULTS

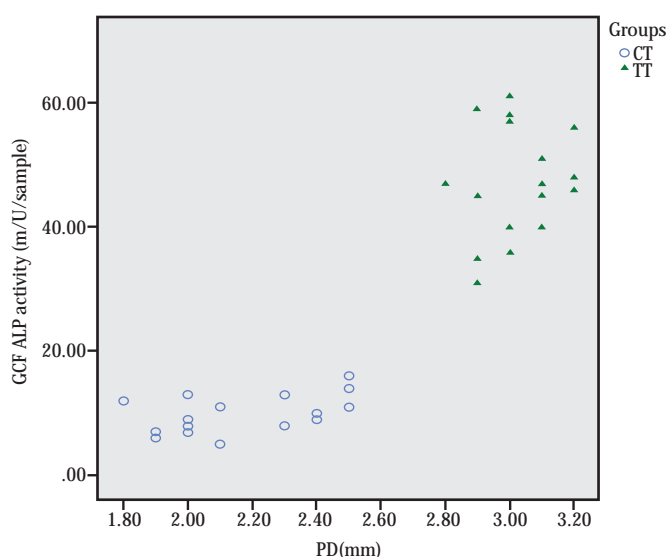
Among 15 patients, 9 male (60%) and 6 were females (40%). The average age of patients were calculated as 12.35 ± 1.57 . ANOVA test was applied to investigate the mean alkaline phosphatase levels between different groups. The statistically significant difference ($P < 0.05$) between different groups of alkaline phosphatase and palatal expansion during activation of appliance phase was noted

and it is shown in table.

Post Hoc concludes that among different days of expansion the mean alkaline phosphatase levels are statistically significant.

Groups			GCF ALP activity (mU/sample)
CT	PD(mm)	Pearson Correlation test	.42
		p-value	0.09
		N	1
TT	PD(mm)	Pearson Correlation test	.17
		p-value	0.50
		N	17

No significant correlations were seen between GCF ALP levels PD in the CT and TT, with Pearson correlation test Coefficients of 0.423 (p-value = 0.09) and 0.50 (p-value = 0.50), respectively.



DISCUSSION

The quantity of remaining growth of mandible during orthodontic treatment shows the success of many interventions. The chronological age of the patient is not trust worthy than skeletal age which is more accurate in assessing the advancement of an individual toward maturity.¹² When we start Orthodontic treatment inflammatory process starts in response to the movement of teeth. This response is seen in dental and as well as periodontal tissues. Similar case is with RME, as we start expanding the narrow palate inflammatory response begins and different inflammatory Cells start to release. This cellular activity leads to more osteoclastic activity.^{5,6} In Orthodontics, this natural inflammatory process lead to movement of teeth to resolve functional and esthetic problems which are linked to malocclusion of teeth. It is evident that without this inflammatory response movement of teeth cannot take place. However inflammatory mediators which are produced by

movement of teeth and during RME are not permanent. During the Movement of teeth there starts bone remodeling process in the adjacent tissues and periodontium.¹³ This bone remodeling process is basically characterized by bone deposition and bone resorption on the tension and stress side. It is observed that not many studies have paid attention on the analysis of GCF constituents who are involved in the process of bone remodeling during orthodontic tooth movement and RME. As the complex process of movement of teeth in response to forces applied during orthodontic treatment needs proper investigation.¹⁴ The biological reaction of teeth when we apply orthodontic forces can be checked by the investigation of different mediators of cell and enzymes present in GCF. By analyzing studies done it can be accomplished that the assessment of mediators of GCF shows biological activity present in the periodontium during orthodontic tooth movement.¹⁵ However, due to the inconsistency of the available studies and different procedures of GCF sampling, collection and their analysis, it is difficult to describe a firm conclusion. Therefore to prove that GCF can be a diagnostic tool to check clinical outcome in orthodontics more studies are required for improvement of GCF sample collection and then how to measure it. This will lead to create a relationship between GCF mediator production and reactivation of force for GCF diagnostic efficacy.¹⁴ The GCF ALP activity increases during inflammation of periodontium so the periodontal health of the patients should be brilliant.¹⁸ As the GCF ALP analysis is a very simple, quick, and non-invasive technique and sampling can be done in routine clinical setting without wasting enough time and other benefits are we can do many sample collections in case of insufficient sample.¹⁹ The ALP activity can be analyzed in laboratory as it is inexpensive and easily available. Biomarkers are evaluated as sign of normal biologic, pathogenic, or pharmacologic activity to a therapeutic interference. The main benefit of biomarkers evaluation is that we can protect our patients from extra radiologic exposure as well as they indicate such agents which are involved mostly in the growth of bone and process of remodeling.²⁰

As enzyme Alkaline phosphatase is involved in bone metabolism and is easily detectable in GCF.^{8,12} Also a raised level of ALP during adolescence shows active bone formation which indicate us exact commencement to start of treatment for orthopaedic intervention. A change in the level of alkaline phosphatase in GCF is a sign of remodeling process of bone during orthodontic movement of teeth and RME.

CONCLUSION

Many researchers have worked on GCF to verify changes

taking place in periodontium during orthodontic tooth movement and have related these changes and bone formation during adolescence period and active phase of treatment. An Increase in osteoblastic activity during adolescence and active phase of treatment can predict when to start early or delay intervention for most favorable treatment results. So Gingival crevicular fluid and ALP shows their interaction can be a reliable diagnostic means as a non-invasive biomarker of the pubertal growth spurt.

CONFLICT OF INTEREST

None declared

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