



## Clinical Assessment of the effects of Prostaglandin E1 on Orthodontic Tooth Movement in Maxillary Arch: An In vivo Split Mouth Study

**Dr. Swati Jain**

Post graduate student, Department of Orthodontics and Dentofacial Orthopaedics, V S Dental College and Hospital, Bangalore

**Dr. Nishitha C. Gowda**

Senior Lecturer, Department of Orthodontics and Dentofacial Orthopaedics, V S Dental College and Hospital, Bangalore

**Dr. Vennila N. Swamy**

Reader, Department of Orthodontics and Dentofacial Orthopaedics, V S Dental College and Hospital, Bangalore

**Dr. Santosh Ramegowda**

Professor and Head of the department, Department of Orthodontics and Dentofacial Orthopaedics, V S Dental College and Hospital, Bangalore

### ABSTRACT

Clinical Assessment of the effects of Prostaglandin E1 on Orthodontic Tooth Movement in Maxillary Arch: An In vivo Split Mouth Study

**Introduction:** Prostaglandins are one of the chemical mediators influencing the orthodontic tooth movement. (OTM)

**Aim:** To study the effect of exogenous application of Prostaglandin E1 (PGE1) gel on OTM in routine patients.

**Methodology:** Fifteen patients were selected who required extraction of first premolars for the correction of malocclusion. After routine banding, bonding, initial alignment, en-mass retraction using appropriate appliances, they were treated with topical application of 3 microgram of PGE1 gel on test side and placebo gel on control side in four sessions. The OTM was measured clinically on patients and models.

**Results:** There was statistically significant increase in OTM on test side as compared with control side.

**Conclusion:** PGE1 gel is an effective method for faster OTM.

**KEYWORDS :** Prostaglandin E1 (PGE1), Orthodontic tooth movement (OTM)

### Introduction:

Orthodontic treatment is an expensive procedure partly because of long duration of treatment required. Orthodontic tooth movement (OTM) is triggered by prolonged application of controlled mechanical forces. Various cell signalling pathways are activated, ultimately leading to stimulation of periodontal ligament (PDL) metabolism resulting in localized bone resorption and deposition.<sup>(1,2)</sup> Therefore, OTM is dependent on bone metabolism being influenced by chemical mediators causing bone resorption and deposition. Hence mediators causing bone resorption can be used for faster retraction and on the other hand mediators causing bone formation can be used to increase the stability. There are various ways and means by which we can influence the rate of orthodontic tooth movement such as mechanically, chemically or electro physiologically.<sup>(3)</sup> Current clinical systems still mainly use mechanical forces to induce bone remodeling; while several studies have suggested that there might be ways to increase cellular activities with agents more potent than mechanical forces alone<sup>(4)</sup> Though various studies have concluded the importance of Prostaglandins, most studies have been done on local injection of prostaglandin for retraction of canine post first premolar extraction. The disadvantages are painful procedure for the patient and limited clinical application. Local route of gel administration having good biocompatibility and stability characteristics is an effective means of delivering the drug at specific target site with prolonged release. The goal of this study is to determine the dose, timing and efficacy of local prostaglandin gel in OTM.

### Aim:

The aim of this study is to determine the amount of canine distalisation with local administration of prostaglandin E1 and placebo gel in maxillary arch and compare their significance.

### Objectives:

The objectives of the study include

1. To assess canine distalisation using pre and post model
2. To assess and measure the rate of the canine cusp tip movement in relation to the median rugae line and mid-

palatine raphe on both the sides using electronic vernier caliper.

3. To compare the mean value of tooth movement between the prostaglandin E1 side (study side) and control side.

### Inclusion criteria:

1. Both male and female patients between the ages of 13 to 25yrs.
2. Patients with need for orthodontic treatment requiring 1<sup>st</sup> Premolar extraction in maxillary arch.
3. Patients with adequate bone support and good periodontal health
4. All subjects with Class I or Class II malocclusion indicated for bilateral maxillary first premolar extraction.
5. Extraction space of minimum 3mm should be available before maxillary permanent canine distalization
6. Patients who have completed levelling and aligning stage
7. Patients who were willing to participate in this study

### Exclusion criteria:

1. Patients with previous history of fixed or removable orthodontic treatment.
2. Patients with missing teeth in the maxillary arch.
3. Craniofacial abnormalities
4. Systemic diseases like hyperthyroidism, diabetes and periodontal compromise
5. Pregnant and lactating women
6. Chronic drug intake like Phenytoin
7. Class III malocclusion

### Materials and methods:

Armamentarium for the study

1. Diagnostic instruments
2. Orthodontic armamentarium
3. Impression trays
4. Applicator or tucker
5. Nickel titanium (NiTi) coil spring
6. Preparation of PGE1 ge

7. Alginate impression material
8. Type III dental stone
9. Digital vernier caliper
10. Force measuring Gauge

**Figure 1- Orthodontic armamentarium**



**Methodology:**

Fifteen patients who visited department of orthodontics, V. S. dental college and hospital seeking orthodontic treatment were selected based on the inclusion and exclusion criteria. They underwent fixed orthodontic treatment using pre-adjusted edgewise appliance after explanation of the proposed procedure and written informed consent. Also, clearance from ethical board of institution was obtained before commencing the study.

**Method of data collection**

The study was conducted from beginning of space closure of fixed orthodontic treatment, for duration of 2 months. A split mouth study was used in which the maxillary arch of each subject was divided into right (test) side and left (control) side.

**Orthodontic Appliance**

Firstly, the extractions of maxillary first premolars were carried out. Secondly, bonding was done using 0.022 slot system pre adjusted edgewise appliance with MBT prescriptions. Thirdly, alignment was initiated utilizing continuous arch wires (0.014/0.016 NiTi). Fourthly, torque was applied by using 0.019X0.025 inch stainless steel wire for one month. Finally, retraction started using 9mm medium force NiTi retraction coil spring with application of gel at each interval. Light continuous force of 150 gm (as measured from a dynamometer) was applied from canine hook to molar hook.

**Method of gel application**

The prostaglandin E1 Gel (3 microgram) was applied on the test side [as shown in figure 2(a)], while placebo on control side [as shown in figure 2(b)] by using applicator. It was repeated once in 15days for duration of 2 months.

**Figure 2(a) Test side (Prostaglandin E1 gel)**



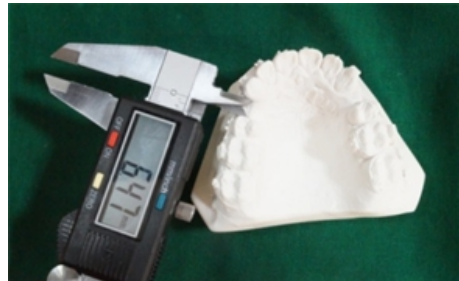
**Figure 2(b). Control side (Placebo gel)**



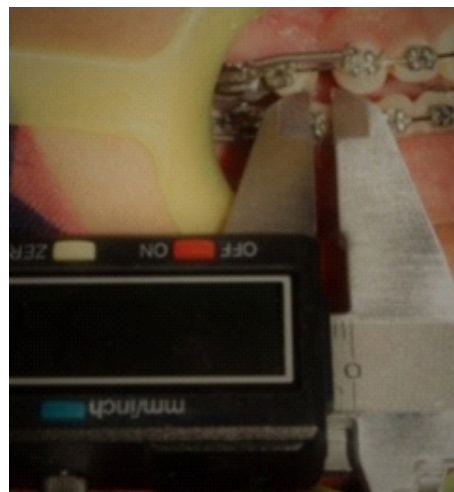
**Measurement of canine movement**

The movement of the upper canines was recorded by measuring the distance between the distal surface of canine to the mesial surface of second premolar using digital vernier caliper bilaterally on the model [as shown in Figure 3(a)] and patients' mouth [as shown in Figure 3(b)] at T0 (baseline), T1 (15 days), T2 (30 days), and T3 (45 days).

**Figure 3 (a) Measurements done on the model**



**Figure 3 (b) Measurements done inside the mouth**



The rate of amount of movement was obtained by calculating the differences between sequential measurements (T0-T1-T2-T3). The total amount of movement was considered to be the difference between the values of T0 and T3.

**Anchorage consideration**

Transpalatal arch in the maxilla was soldered to the first molar band from the beginning of the aligning stage and was continued throughout the treatment and second molars were also banded.

**Statistical analysis:**

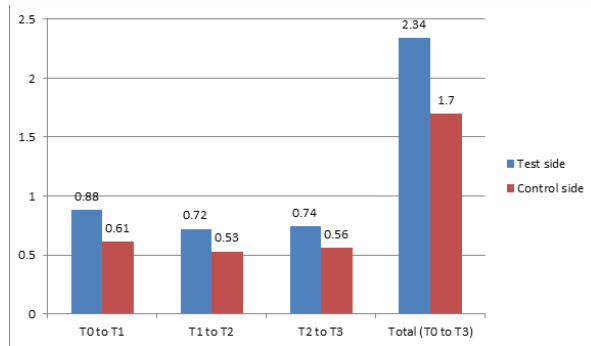
Split plot ANOVA test was done for testing difference between measurements of pre and post gel application.

**Results**

There was statistically significant difference in orthodontic tooth movement between test and control group. Around 36.38% faster tooth movement was recorded from baseline to end of T3 in test group. (p value<0.005) and confidence interval of 95%) as shown in Table 1.

**Table 1 Measurements of mean canine movement at different intervals (in mm)**

	T0-T1	T1-T2	T2-T3	T0-T3
Test side	0.88	0.72	0.74	2.34
Control side	0.61	0.53	0.56	1.70
Difference	0.27	0.19	0.18	0.64
% increase in OTM	30.68%	26.40%	24.32%	27.35%

**Graph 1: Measurements of mean canine movement at different intervals (in mm)**

### Discussion

Many studies have tried to increase the rate of tooth movement by various methods broadly categorized into biological, physical, mechanical and surgical approaches.<sup>(5)</sup> Some of the biologicals used were prostaglandins, vitamin D where studies<sup>(6)(7)(8)(9)(10)(11)(14)(12)</sup> were conducted to show the relationship between applied forces, prostaglandins, and the acceleration of tooth movement. Prostaglandins (PGs) are inflammatory mediators and a Paracrine hormone that acts on nearby cells which stimulates bone resorption by increasing the number of osteoclasts directly.<sup>(5)</sup> Prostaglandin solution prepared in a gel form is a feasible method, due to its ease of administration and improved patient compliance with no systemic side effects. In our study, maxillary canine is considered instead of the mandibular canine since the maxilla is more frequently included in orthodontic treatment. Few decades ago,<sup>(13)</sup> investigated the effect of local administration of prostaglandin on animals and humans while we evaluated the effect of local PGE1 on the amount of canine distalisation in human subjects. A split mouth design was adopted to eliminate the confounding effects on the rate of tooth movement. The dose of PGE1 used in one of the previous study<sup>(7)</sup> is almost 0.1 to 0.3 of the biosynthesis levels of PGE1 and PGE2 while it is 0.001 to 0.002 of the per diem biosynthesis amount of all PGs in a physiological state of human beings.<sup>(14)</sup> In previous studies, the effect of PGE1 on orthodontic tooth movement was observed at dose of 10 micro gram by injection,<sup>(7)</sup> and also at 1 micro gram by injection<sup>(3)</sup> while we considered 3 microgram for local application due to uncertainty of bioavailability of drug in the gel form. In accordance with previous authors where they stated 1.6 fold increase in OTM in one study<sup>(7)</sup>, 1.7 fold increase in OTM in another study.<sup>(3)</sup> In our study, the rate of canine distalisation was more and faster on the test side and it was statistically significant ( $P < 0.005$ ) when compared to the control side where the percentage of accelerated tooth movement was 31% in first, 26% in second and 24% in third visit on the test side. Lesser bioavailability of drug in the gel form might be one reason for variation in OTM. Also, as previous authors used the injection form where trauma due to the invasive process might cause added concentration of inflammatory mediators increasing the Prostaglandin levels at the target site and henceforth more OTM. Some limitations were, duration of study being inadequate for space closure and limited knowledge on bioavailability of the drug in its gel form. No serious side effects or root resorption was noted in any patient.

### Conclusion

There is a significant increase in the rate and amount of canine distalisation with administration of PGE1 gel. Thus, it could be used effectively as an adjuvant, along with other mechanical forces, in fixed orthodontic mechanotherapy to accelerate OTM.

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