**Journal of Advanced Medical and Dental Sciences Research**

@Society of Scientific Research and Studies

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr UGC approved journal no. 63854

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

*Review Article*

# Drug Induced Orthodontic Tooth Movement

Sejal Sidhu

BDS Sri Guru Ram Das Institute of Dental Sciences & Research, Amritsar, Punjab, India

***ABSTRACT:***
Orthodontic tooth movement largely depends on paradental tissue remodeling, and optimal force application is thought to elicit optimal responses. Orthodontists, treating these patients should be aware of the disease process as well as any effects of the drugs on the tooth movement process. Hence; we aim to summarize some of the important aspects of orthodontic tooth movement.

**Key words:** Drug, Orthodontic, Tooth

Received: 8 February, 2019 Revised: 27 February, 2019 Accepted: 28 February, 2019

**Corresponding Author:** Dr. Sejal Sidhu , BDS Sri Guru Ram Das Institute of Dental Sciences & Research, Amritsar, Punjab, India, Email: Sejal_sidhu@yahoo.com

**This article may be cited as:** Sidhu S. Drug Induced Orthodontic Tooth Movement. J Adv Med Dent Scie Res 2019;7(4): 5-7.

## INTRODUCTION

Remodeling of the paradental tissues facilitates orthodontic tooth movement in response tomechanical forces. Recent research has demonstrated, or rather outlined the sequence of events occurring as part of the tooth movement process.[1] The synthesis, release, as well as the role of various inflammatory mediators, neurotransmitters, growth factors and other cytokines in response to applied mechanical forces were elucidated, and have become targets of thorough reviews in recent times. These endogenous molecules have been found to play important roles in the initiation, maintenance, and cessation of tooth movement.[2- 4] However, some of these ligands can also cause unwanted side effects, such as pain and root resorption. Current orthodontic research aims at developing methods to increase the tissue concentrations of molecules promoting tooth movement, while simultaneously decreasing the concentration of unwanted elements, which can produce harmful side effects. Orthodontists often prescribe drugs to manage pain from force application to biological tissues, manage temporomandibular joint problems, and tackle fungal and viral infections throughout the course of treatment.[5]Hence; in the present review, we aim to highlight some of the important aspects of drug induced orthodontic tooth movement.

## ORTHODONTIC TOOTH MOVEMENT (OTM)

OTM is mainly a biological response towards mechanical force. It is induced by the prolonged application of controlled mechanical force on the tooth, which eventually causes remodelling of the tooth socket by creating pressure and tension zones in the alveolar bone and periodontal ligament. Strains of periodontal cells, bone-related cells, and extracellular matrix play a key role in orthodontic tooth movement (OTM). This strain forms changes in gene expression in the cells by interactions between the cells and the extracellular matrix, whereby integrins play an important role. Various cell-signaling pathways are activated, ultimately leading to stimulation of periodontal ligament metabolism, and localized boneresorption and bone deposition. These interactions are regulated by local factors such as cytokines ( IL-1), and growth factors, as well as by systemic factors such as parathyroid hormone, vitamin D, estrogen, or caicitonin. Drugs that alter or interfere with the inflammatory process will therefore have an effect on the tooth movement. Several studies have proposed the effect of

short and long term administration of medication on orthodontic tooth movement. Davidovitch et al. and Yamasaki et al. concluded in their study that the rate of orthodontic tooth movement can be altered by administrating certain drugs locally or systemically. The drugs used in orthodontics can be broadly classified into two major groups, promoter drugs and suppressor agents. Promoter drugs are agents that act with the secondary and primary inflammatory mediators and enhance the tooth movement, examples being; Prostaglandin, Leukotrienes, Cytokines, Vitamin D, Osteocalcin, and Corticosteroids. Suppressor agents are drugs which reduces bone resorption examples are; Nonsteroidal anti-inflammatory agents and bisphosphonates.[5- 9]

## PHARMACOLOGICAL ACCELERATION OF OTM

### ARACHIDONIC ACID METABOLITES

Among the arachidonic acid metabolites, PGE2 is by far the most widely tested substance in terms of its capacity to modify OTM. Evidence, mainly derived from animal studies, points toward a positive effect of PGE2 with respect to enhancing bone resorption and accelerating tooth movement. The few available clinical studies are of low quality and involve repeated injections of PGE2 and follow-up times of a maximum of 60 days. The mode of application of PGE2 is a major limitation as it involves repeated injection (due its short half-life) in combination with an anaesthetic solution to alleviate the hyperalgesia caused by injection of PGE2. Potential adverse effects (e.g., root resorption) linked to long-term administration of PGE2, as required in the context of orthodontic treatment, are possible given its mode of action but have not been evaluated so far.[10- 12]

Specific synthases are involved in the pathway of the synthesis of each type of prostaglandins (e.g., PGE and PGD synthases) and many of them have been cloned and could provide drug targets for the regulation of the synthesis of specific prostaglandins, such as PGE2 in the case of OTM. In addition, it is possible that other PGs such as PGI2 may be involved in bone resorption providing further targets for drugs. Another obvious group of drug targets are the identified receptors of specific prostaglandins (such as the receptors EP1, EP2, or EP4 of prostaglandin PGE2) and the design of selective agonists can provide pharmacological methods of modifying OTM through these receptors.[13]

Intravenous immunoglobulin (IVIg) preparations are polyspecific and polyclonal immunoglobulin therapeutic preparations used as a replacement therapy in immunodeficient patients. These IVIg preparations were shown to induce COX-2 mediated PGE2 synthesis and cytokine production. It is possible that local administration of these IVIg preparations could be used to modulate bone modeling through PEG2 induction and bypass some of the limitations of PEG2 injections.[14, 15]

### ACETAMINOPHEN

Paracetamol (acetaminophen) was first identified in the late nineteenth century and it was available in the UK on prescription in 1956, and over-the-counter in 1963. Since then, it has become one of the most popular antipyretic and analgesic drugs worldwide, and it is often also used in combination with other drugs. The lack of a significant anti-inflammatory activity of paracetamol implies a mode of action which is distinct from that of the non-steroidal antiinflammatory drugs. Yet, the Cochrane Systematic Review, 2004 concluded that paracetamol was effective against the postoperative pain in adults. Acetaminophen (paracetamol) is effective for controlling pain and discomfort associated with orthodontic treatment.[16]

### VITAMIN-D

Vitamin D and its active metabolite, 1,25,2(OH)D3, together with parathyroid hormone (PTH) and calcitonin, regulate the amount of calcium and phosphorus levels. Vitamin D receptors have been demonstrated not only in osteoblasts but also in osteoclast precursors and in active osteoclasts. In 1988, Collins and Sinclair demonstrated that intraligamentary injections of vitamin D metabolite, 1,25-dihydroxy cholecalciferol, caused increase in the number of osteoclasts and amount of tooth movement during canine retraction with light forces.[17- 19]

### RELAXIN

The first clinical trial is a randomized double-blinded study in which 39 adults who required a minor maxillary alignment received a series of 4 maxillary aligners, each subject received a weekly 0.2ml injection of Relaxin or placebo over 8 weeks period to the target teeth. Tooth movement was calculated weekly on a PVS impression that was scanned and digitalized. After completing 8 weeks of orthodontic treatment, there was no statistical significance between both the groups. Similarly, there was no statistically significant difference with regard to the relapse of orthodontic treatment over 4 weeks post-treatment between the Relaxin and placebo groups.[20]

### TENOXICAM

Another double-blinded RCT investigated the effect of Tenoxicam in controlling pain and its influence on orthodontic movement of the upper canine in 36 patients who had an orthodontic indication for bilateral retraction of the upper canine teeth. Group A patients received one tablet of 20 mg of Tenoxicam 45 minutes before the orthodontic activation process and one tablet of placebo after activation. Group B patients received the opposite treatment, and Group C received one tablet of placebo 45 minutes before the procedure and one tablet of placebo just afterward. Subsequently, after 30 days interval, there was no statistically significant difference in orthodontic tooth movement between the 3 groups, but patients in groups A and B had lower pain intensity than in those in group C. Thus, Tenoxicam used only once daily was shown to be effective for pain control, without having a significant influence on orthodontic tooth movement.[21, 22]

**NITRIC OXIDE:**

In one of the previous study, authors evaluated the role of nitric oxide in orthodontic tooth movement in Spraguedawley rats. They concluded that multinuclear osteoclasts, Howship's lacunae, capillary vascularization, and orthodontic tooth movement were significantly increased in nitric oxide synthase precursor group as compared to nitric oxide synthase inhibitor.[23]

**CORTICOSTEROIDS**

The increasing use of glucocorticoid therapy for many inflammatory and autoimmune diseases should alert clinicians to the variations from normal bone turnover that may be caused by this steroid. In animal experiments, high doses of glucocorticosteroids have actually made the animals osteoporotic. One of the previous author evaluated the rate of tooth movement in rats during short and long term corticosteroid therapy. They demonstrated that bone remodeling seemed to slow down in acute administrations, whereas the rate of tooth movement increased in chronic treatment. Clinically these results suggest that it is possible to treat patients undergoing corticosteroid therapy with minimum adverse effects. Patients who are within the short term phase of drug use may be advised to postpone orthodontic treatment or because their bone turnover will be delayed, should be scheduled for appliance adjustments at long intervals and clinicians should expect a faster rate of tooth movement with more alveolar bone loss in patients with a long-term steroid therapy, as in chronic asthmatics.[24]

**CONCLUSION**

Human beings, in every culture and community on earth, consume a large variety of molecules in the form of food ingredients, medications, drugs, and remedies. It is imperative that the orthodontist should obtain a comprehensive list of all the medications consumed by every patient, both before and during the course of orthodontic treatment.

**REFERENCES**


1. Schoutens A, Laurent E, Markowicz E, Lisart J, De-Maertelaer V. Serum triiodothyronine, bone turnover and bone mass changes in euthyroid pre and postmenopausal women. Caleif Tissue Int 1991;49:95-100.
2. Roodman GD. Role of cytokines in the regulation of bone résorption. Calcif Tissue lnt. 1993;53:94-98
3. Shirazi M, Dehpour AR, Jafari F. The effect of thyroid hormone on orthodontic tooth movement in rats. J ClinPediatr Dent 1999;23:259-64
4. Varónos D. Ormonesthyroidous-anti thyroidika [in Greek]. In Parisianos (ed). latrikiPharmakologia. Athens: Parisianos, 1987;429-437
5. Chambers TJ, Chambers JC, Symonds J, Darby JA. The effect of human calcitonin on the cytoplasmic spreading of rat osteoclasts. J ClinEndoerinolMetab 1986;63:1080-1085
6. Davidovitch Z, Finkelson MD, Steigman S, Shanfeld JL, Montgomery PC, Korostoff E. electric currents ,bone remodeling and orthodontic tooth movement Am J OrthodDentofacialOrthop 1980;77(1):33-47.
7. Yamasaki K, Shibata Y, Imai S, Tani Y, Shibasaki Y, Fukuhara T. Clinical application of prostaglandin E1 (PGE1) upon orthodontic tooth movement. Am J Orthod 1984;85:508-510.
8. Klein D. C, Raisz L.G. Prostaglandins: stimulation of bone resorption in tissue culture. Endocrinology 1970;86:1436–1440.
9. Raisz, L. G, Sandberg A. L, Goodson J. M, Simmons H. A, Mergenhagen S. E, Complement-dependent stimulation of prostaglandin synthesis and bone resorption. Science 1974;185:789–791.
10. Liu L, Igarashi K, Haruyama N, Saeki S, Shinoda H, Mitani H. Effects of local administration of clodronate on orthodontic tooth movement and root resorption in rats. Eur J Orthod 2004;26:469-473.
11. Igarashi K, Mitani H, Adachi H, Shinoda H. Anchorage and retentive effects of a bisphosphonate (AHBuBP) on tooth movements in rats. Am J OrthodDentofacialOrthop 1994;106:279-289
12. Zahrowski JJ. Bisphosphonate treatment: an orthodontic concern calling for a proactive approach. Am J OrthodDentofacialOrthop 2007;131:311-320.
13. Chumbley AB, Tuncay OC. The effect of indometacin (an aspirin-like drug) on the rate of orthodontic tooth movement.Am J Orthod 1986;89:312-400.
14. de Carlos F, Cobo J, Diaz-Esnal B, Arguelles J, Vijande M, Costales M. Orthodontic tooth movement after inhibition of cyclooxygenase-2. Am J OrthodDentofacialOrthop 2006;129:402-406.
15. Vayda P, Loveless J, Miller R, Theroux K. The effect of short term analgesic usage on the rate of orthodontic tooth movement. J Dent Res 2000;79:614.
16. Storey, E., The nature of tooth movement. Am J Orthod, 1973. 63(3): p. 292-314
17. Robert WE, Garetto LP, Katona TR. Principles of orthodontic biomechanics: metabolic and mechanical control mechanisms. In: Carlson DS, Goldstein SA, editors. Bone biodynamics in orthodontic and orthopedic treatment. Monograph 27. University of Michigan: Center for Human Growth and Development,AnnArbor; 1992:189- 255.
18. Cockran, G. V., Pavvluk, R. J. & Bassett, C. A. L. Stress generated electric potentials in the mandible and teeth. Arch Oral Biol, 1067;12, 917- 20.
19. Grimm, F. M. Bone bending, a feature of orthodontic tooth movement. Am J Orthod, 1972;62, 384-94
20. Arantes GM, Arantes VM, Ashmawi HA, Posso IP. Tenoxicam controls pain without altering orthodontic movement of maxillary canines. OrthodCraniofac Res 2009; 12(1): 14-9.
21. Al-Hasani N, Glares G, Albustani A, Hussain S. Clinical efficacy of locally injected calcitriol in orthodontic tooth movement. Int J Pharm PharmSci 2011; 3(5): 139-43.
22. Yamasaki K, Shibata Y, Imai S, Tani Y, Shibasaki Y, Fukuhara T. Clinical application of prostaglandin E1 (PGE1) upon orthodontic tooth movement. Am J Orthod 1984; 85(6): 508-18.
23. Akin E,GurtonU,Olmez H. Effects of nitric oxide in orthodontic tooth movement in rats. Am J OrthodDentofacialOrthop 2004;126:608-14. 15. Kalia S, Melsen B, Verma C. Tissue reaction to orthodontic
24. Yamasaki K, Miura F, Suda T. Prostaglandin as a mediator of bone resorption induced by experimental tooth movement in rats. J Dent Res 1980;59:1635-42.