

ROLE OF DRUGS IN ORTHODONTIC TOOTH MOVEMENT:A REVIEW

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ABSTRACT

Orthodontic treatment is based on the premise that when force is delivered to a tooth and thereby transmitted to the adjacent investing tissues and contribute to the movement of that tooth. Orthodontic tooth movement is triggered by the prolonged application of controlled mechanical forces activating various cell-signalling pathways ultimately leading to stimulation of periodontal ligament metabolism resulting in localized bone resorption and deposition. Any pharmacologic agent or supplement consumed by a patient can reach the periodontal tissues through the circulation and thus interacts with and influence a cell's response to orthodontic forces. These drugs may have dual effect on orthodontic tooth movement. They may either potentiate or inhibit tooth movement as well as exacerbate or reduce tooth resorption. This article reviews various drugs and its effect on orthodontic tooth movement.

KEYWORDS : Orthodontics, Tooth movement, Drugs, bone resorption, Bone deposition.

Orthodontic tooth movement is defined by Proffit as "the result of a biological response to interfere in the physiologic equilibrium in the dentofacial complex by an externally applied force." (Proffit WR) Orthodontic treatment is based on the premise that when force is delivered to a tooth, it gets transmitted to the adjacent investing tissues and leads to the movement of that tooth (Kamatchi Diravidamani et al., 2012). Orthodontic tooth movement is triggered by the prolonged application of controlled mechanical forces activating various cell-signalling pathways ultimately leading to stimulation of periodontal ligament metabolism resulting in localized bone resorption and deposition (Reitan K., 1985). It is well documented that a precondition for this remodelling is an inflammatory response. Inflammatory mediators, neurotransmitters, and growth factors, in addition to numerous other cytokines such as IL-1, play a vital role in orthodontic tooth movement. The main mediators involved in this complex process are hormones and systemic factors, growth factors, cytokines, colony stimulating factors, prostaglandins (Eenal Bhambri et al., 2013).

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These drugs can be classified as drugs that potentiate or increase tooth movement and drugs that inhibit or decrease tooth movement. Drugs that increase tooth movement are eicosanoids, Vit.D, nitric Oxide, diazepam, opioids, calcium and calcium regulators, alcohol and nicotine whereas drugs that decrease tooth movement are NSAIDs, leukotriene antagonists, oestrogens, bisphosphonates, corticosteroids, echistatin, parathyroid and thyroid hormones, immunosuppressant, relaxin and antihistamines.

Drugs Affecting Tooth Movement

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 (Kamatchi Diravidamani et al., 2012). Collins and Sinclair demonstrated in their study, that, intraligamentary injections of vitamin D metabolite, caused increase in the number of osteoclasts and amount of tooth movement during canine retraction with light force (Collins MK, Sinclair PM, 1988). Kale et al substantiated this finding by observing in his study that, local applications of vitamins enhanced the rate of tooth movement in rats due to the well-balanced bone turnover induced by vitamin D (Kale S et al., 2004)

Bran and colleagues showed increased bone formation on the pressure side of the periodontal ligament after application of orthodontic forces and in 2004, Kawakami observed an increase in the mineral appositional

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Table 1: Effect on Tooth Movement on Drugs

Drugs	Effect on Tooth Movement
NSAIDs	Decrease the rate of tooth movement
Vitamin D	Increase the rate of tooth movement
prostaglandins	Increase the rate of tooth movement
Corticosteroids	Increase the rate of tooth movement
Bisphosphonates	Decrease the rate of tooth movement

rate on alveolar bone after orthodontic force application (Kawakami M, Takamo-Yamamoto T, 2004) in table 1.

NSAIDs

NSAIDs are a group of drugs that have analgesic, antipyretic and anti inflammatory action. They are most commonly used in orthodontics for control of pain(Krishnan V, Davidvitch Z,2006), (Gameiro GH et al.,2007), (Krishnan V,2007). NSAIDs act by inhibiting the production of prostaglandins. Knop et al suggest that prostaglandin inhibition by NSAIDs leads to a reduction in the numbers of osteoclast-like cells, Howship lacunae, and blood vessels throughout all treatment periods(Knop LA et al.,2011). Retamoso et al demonstrated lower rate of collagen maturation in the PDL with both NSAID's and steroidal drugs, with a more pronounced effect with latter drugs(Retamoso L et al.,2011).

Ngan et al.1989 were the first to compare the effectiveness of various drugs for the management of orthodontic pain, concluding that ibuprofen is more effective than aspirin in controlling pain(Ngan P et al.,1989). De Carlos et al compared the effect of a selective COX-2 inhibitor, rofecoxib, with a conventional NSAID, diclofenac, on tooth movement in rats. They found that both inhibited tooth movement but inhibition was only partial in the use of rofecoxib(Felix de Carlos, Juan Cobo, 2006). Chumbley and Tuncayfound that indomethacin reduced orthodontic tooth movement in cats by half and also asserted that tooth movement is inhibited in patients taking NSAIDs(Chumbley A. B., Tuncay, 1986) in table 1.

Corticosteroids

Increased amount of glucocorticoids have been used for the treatment of inflammatory and autoimmune diseases. In a recent study, verna et al compared the effect of acute and chronic corticosteroid therapy on orthodontically induced root resorption. He found more root resorption in acute group compared to chronic group (Verna C et al., 2006). In 2004, kalia et al also demonstrated that bone remodeling seemed to slow down in acute administrations, whereas the rate of tooth movement increased in chronic treatment (Kalia S. et al., 2004) in table 1.

Bisphosphonates

These analogues of pyrophosphate are commonly used in the treatment of bone metabolism disorders such as osteoporosis, bone diseases and bone pain from some types of cancer. Several studies have demonstrated that orthodontic tooth movement can be inhibited by the topical application of bisphosphonates.

In 2005, Schwarz reported an important case of female orthodontic patient who was being medicated with Zometa to control bone metastases related to breast cancer. At the time the patient began treatment with this drug, when the premolar spaces were about one-third closed, all orthodontic movement stopped (Schwartz J. E., 2005). Igarashi et al evaluated the anchorage and retentive effects of bisphosphonates on tooth movements in rats and concluded that it could be useful in enhancing anchorage and retaining teeth(Igarashi K et al.,1994).

Among the drugs investigated, risedronate appears to be the most effective in reducing orthodontic

tooth movement, followed by 4-amino-1-hydroxybutylidene-1,1-bisphosphonate, and then clodronate(Iglesias-Linares A et al.,2010) in table 1.

Antihistamines

Antihistamines are a group of drugs attributed to the treatment of respiratory disorders like asthma. Meh et al demonstrated increased alveolar bone density in rats after administration of cetirizine along with orthodontic force application and observed a reduction in tooth movement(Abbash Mohamed,1989).

CONCLUSION

All the drugs have therapeutic effects, as well as side effects, that may influence the cells targeted by orthodontic forces. Drug-consumption history must be an integral part of every orthodontic diagnosis and treatment plan. An orthodontist must be aware of these drugs so that the the treatment best suited for a patient is provided in a simpler way.

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