Volume-6, Issue-2, February - 2017 • ISSN No 2277 - 8160 IF : 3.62 | IC Value 80.26

Original Research Paper Orthodontology

Effects of estrogen on orthodontic tooth movement in post-menopausal women: A clinical outlook from animal studies

Dr. Khalid Ashraf MDS JR 3, Dept. of Orthodontics, Saraswati Dental College, Lucknow.

Dr. Ragni Tandon M.D.S, Professor & Head, Dept. of Orthodontics, Saraswati Dental College, Lucknow.

Dr. Kamlesh Singh Professor, M.D.S, Dept. of Orthodontics, Saraswati Dental College, Lucknow.

Dr. Sueeba Shabir M.B.B.S, JR, Dept. of Obstetrics and Gynecology, Mayo Institute of Medical Sciences, Lucknow.

ABSTRACT Menopause is not just cessation of menstruation it is "depletion of ovarian follicle" leading to decrease of ovarian hormones. Women all over world now have to spend almost one-third of their lives in menopausal years because average life expectancy is increasing and so is the concern about the lifestyle managements of menopausal women. Estrogen is an inhibitor of bone turnover and is used to treat osteoporosis. Various studies have demonstrated how the estrogen therapy to prevent osteoporosis in post-menopausal females cause variations in the orthodontic tooth movement. An insight from the animal studies shows how variations in estrogen level cause variation in orthodontic tooth movement. The orthodontist should be aware about the consequences of estrogen therapy, subsequent molecular changes and the increased treatment time in postmenopausal females.

KEYWORDS :

INTRODUCTION:

Menopause is not just cessation of menstruation it is "depletion of ovarian follicle" leading to decrease of ovarian hormones. Until mid 1960's not much was known about menopause, but after the first International Menopause Society was formed in 1978 research on menopause gained pace. It is not only the quantity of life but also the quality of life of menopausal women which is important. With the awareness in clinicians and menopausal women, concern about the lifestyle managements of menopausal women has increased [1].

Women all over world now have to spend almost one-third of their lives in menopausal years because average life expectancy is increasing. The menopausal transition occurs on average at 46 years with a range from 34–54 years, while the average age of menopause is 51 years with a range from 40–60 years [2].

Estrogens are female sex hormones that occur naturally in three forms. The first and most prominent form of estrogen is estradiole (E2), which is produced from menarche to menopause and is important in the regulation of the estrous cycle. The second form is estrone (E1), produced after menopause, when the total amount of estrogens has decreased. The third form, estriole (E3), is expressed primarily during pregnancy.

The relationship between the decrease of estrogens after menopause and the development of osteoporosis is well established. Estrogen supplementation is used to overcome postmenopausal problems of osteoporosis [3]. Animal studies of Haruyama et.al [4] and Yamashiro T et.al [5] and others suggest that estrogen supplementation might slow Orthodontic Tooth Movement (OTM).

MATERIAL AND METHODS:

Our search strategy included the Pubmed, covering the literature of studies on estrogen and its effect on orthodontic tooth movement in post-menopausal females, by using the search terms and their combinations. All the relevant animal studies were included. The references from the retrieved articles were perused to identify additional relevant publications.

REVIEW FROM ANIMAL STUDIES:

Estrogen is an inhibitor of bone turnover and is used to treat osteoporosis. Estrogen also directly promotes collagen synthesis in osteoblast-like cells [6], and transforming growth factor-b, insulin like growth factor and procollagen in osteoblasts[7]. Thus it may be reasonable to find that estrogen decrease the rate of tooth movement.

Bone mineral content and bone mineral density (Figure 1), increase with age until reaching a peak at 30 to 40 years in women, after that it decrease by 1 to 2 percent a year[8]. Throughout their lives women tend to have lower bone mass than men, and they lose bone more rapidly with aging [9]. Women lose 30% to 50% of trabecular bone tissue and 25% to 35% of cortical bone mass around the time of menopause [10-11].

BONE MINERAL DENSITY LEVELS FOR OSTEOPAENIA & OSTEOPOROSIS RECOMMENDED BY WORLD HEALTH ORGANIZATION:

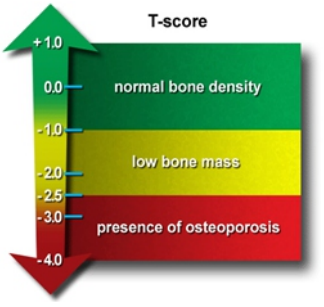

Figure 1: (Data from principles of gynaecology, Norman Jefcott)

Wronski [12] et al. observed trabecular bone loss in ovariectomized rats. They found that it was accompanied by accelerated bone resorption. Since tooth movement is involved in bone metabolism, all the metabolic and hormonal changes affecting bone turnover may affect tooth movement. An increase of bone turnover, caused by a reduced level of estrogen in the postmenopausal period, affected the bone morphology [13-14] and orthodontic treatment.

A case report presented by Miyajima K et al. [15] after orthodontic treatment of a post-menopausal female, 61 years old, who was on

estrogen therapy for three years revealed that tooth movement was very slow in this patient. This is in concordance with the conclusions drawn from various animal studies.

Yamashiro T et al. [5] in a study on rats with bilateral ovariectomy or sham operation, in which orthodontic tooth movement was initiated on NiTi wire with 10gms of force, showed that the tooth movement increased rapidly. Further bone histomorphometry demonstrated that ovariectomy significantly elevated the osteoblast surface, osteoclast surface, and number of osteoclasts ($p < 0.05$) in the alveolar bone. These findings showed that estrogen deficiency results in rapid orthodontic tooth movement, and that the acceleration of tooth movement could be due to the further activation of alveolar bone turnover.

Megumi Hashimoto et.al [16] in his study on Wistar rats found that ovariectomy accelerated Orthodontic tooth movement (OTM). After OVX and the sham operation under general anesthesia, 25gms of force using nickel-titanium closed-coil springs were applied to the left maxillary first molar. The amount of OTM in the OVX group was two-fold greater than that in the control group.

Ahmet Arif Celebi et al. [17] in a study on 18 female cats found that the ovarian activity can affect the orthodontic tooth movement; he used closed coil spring with 80gms of force on canines and found that the OTM increased in ovariectomized cats with decreased estrogen levels.

In ovariectomized rats, osteogenesis and also chondrogenesis are decreased because estrogen deficiency causes alteration in the production of osteoinductive proteins like osteogenin and bone morphogenetic protein, which results in the disruption of bone matrix formation [18]. This finding suggests that the effect of ovariectomy was related to the bone turnover rate caused by the reduction of estrogen levels in the OVX group [19-20].

Irin Sirisoontorn et al. [21] in his study on rats found that tooth movement in the ovariectomized group was more rapid than in the non-ovariectomized group. The ovariectomy might have increased bone turnover and led to the acceleration of tooth movement. Deep resorption craters were observed in the roots not only at the cervical and middle portions of the roots but also at the apical portion in the OVX group indicating that estrogen deficiency leads to osteoporosis.

Bone resorption and formation are closely associated with each other and normally the rate of bone formation and resorption are essentially the same. In osteoporotic post menopausal women the estrogen action on bone is mediated by direct effects on bone through the estrogen receptor and by its effects on collagen. The accentuated decline in bone mass that occurs because of estrogen deficiency is mediated by a variety of mechanisms, but the primary event is increased resorption (osteoclastic activity), which becomes uncoupled from bone formation (osteoblastic activity).

Korse CM et al [22] have demonstrated that drop in serum estradiol level is more rapid in oophorectomized women than those in natural menopause. Significantly they found that mean estradiol levels declined 1.4 pmol/l per year in menopausal women, but the estradiol level declined at the rate of 11.1 pmol/l in women with surgical menopause. In a study on women, circulating estradiol level decreased significantly ($p<0.05$) from 161pg/ml pre-operatively to 108 pg/ml on the ninth day after surgical menopause [23].

CONCLUSION:

Treatment of osteoporosis in postmenopausal females with the estrogen therapy can inhibit the orthodontic tooth movement, but if estrogen therapy is not used in patients during the course of orthodontic treatment it can lead to resorption of alveolar bone and possibly root resorption. Before orthodontic treatment is initiated in postmenopausal females undergoing estrogen therapy the type of osteoporosis should be included as a part of medical history and the patient informed about the increased time duration of treatment.

REFERENCES:

1. Principles of Gynaecology; 5th Edition, Norman Jeffcoate.
2. Broekmans FJ, Soules MR, Fauser BC. Ovarian aging: mechanisms and clinical consequences. Endocr Rev.2009;30(5):465–493.
3. Theodosia Bartzela, Jens C. Turp, Edith Motschall, and Jaap C. Maltha. Medication effects on the rate of orthodontic tooth movement: A systematic literature review. Am J Orthod Dentofacial Orthop 2009;135:16-26.
4. Haruyama N, Igarashi K, Saeki S, Otsuka-Isoya M, Shinoda H, Mitani H. Estrous-cycle-dependent variation in orthodontic tooth movement. J Dent Res 2002;81:406-10.
5. Yamashiro T, Takano-Yamamoto T. Influences of ovariectomy on experimental tooth movement in the rat. J Dent Res. 2001;80:1858–1861.
6. Ohashi T, Kusahara S. Effects of estrogen on the proliferation and differentiation of osteogenic cells during the early stage of medullary bone formation in cultured quail bones. J. Bone Miner Met, 1991;9(3):253-258.
7. Orimo H. Preventive treatment of involutional osteoporosis. J. Bone Miner Met, 1993:11(Suppl 1)S59-S64.
8. Morse CA et al. the treatment seeking woman at menopause. Maturitas, 1994;18:161-173
9. Kaufert P, Syrotuik J. Symptom reporting at menopause. Soc Sc Med, 1981;15E:173-84
10. Kanis JA et al. treatment of osteoporosis. J Bone Miner Met, 1993;11(Suppl 2): S17-S24.
11. Gorai I et al. the effect of ipriflovone on osteopenia in ovariectomized women. J Miner Met, 1993; 11(Suppl 1):S46-S50.
12. Wronski TJ, Cintro´n M, Doherty AL, Dann LM. Estrogen treatment prevents osteopenia and depresses bone turnover in ovariectomized rats. Endocrinology. 1988;123:681–686.
13. Hsieh YD, Devlin H, McCord F. The effect of ovariectomy on the healing tooth socket of the rat. Arch Oral Biol. 1995;40:529–531.
14. Tanaka M, Ejiri S, Toyooka E, Kohno S, Ozawa H. Effects of ovariectomy on trabecular structures of rat alveolar bone. J Periodontal Res. 2002;37:161–165.
15. Miyajima K, Nagahara K, Iizuka T. Orthodontic treatment for a patient after menopause. Angle Orthod. 1996;66:173–180.
16. Megumi Hashimoto et.al. The effect of bone morphometric changes on orthodontic tooth movement in an osteoporotic animal model. Angle Orthod. 2013;83:766–773.
17. Ahmet Arif Celebi; Serhat Demirer; Bulent Catalbas; Sevket Arikan. Effect of ovarian activity on orthodontic tooth movement and gingival crevicular fluid levels of interleukin-1b and prostaglandin E2 in cats. Angle Orthod. 2013;83:70–75.
18. Cesnjaj M, Stavljenic A, Vukicevic S. Decreased osteoinductive potential of bone matrix from ovariectomized rats. Acta Orthop Scand. 1991;62:471–475.
19. Hsieh YD, Devlin H, McCord F. The effect of ovariectomy on the healing tooth socket of the rat. Arch Oral Biol. 1995;40: 529–531.
20. Tanaka M, Ejiri S, Toyooka E, Kohno S, Ozawa H. Effects of ovariectomy on trabecular structures of rat alveolar bone. J Periodontal Res. 2002;37:161–165.
21. Irin Sirisoontorn et al. Tooth movement and root resorption; The effect of ovariectomy on orthodontic force application in rats. Angle Orthod. 2011;81:570–577.
22. Korse C.M., Bonfrer J.M., Von Beurden M. et al. — Estradiol and testosterone levels are lower after oophorectomy than after natural menopause – Tumour Biol. 2009; 30(1) : 37-42 E pub. 2009 Feb. 5.
23. Subrata Samanta and Karabi Baral. Study of Estradiol, Testosterone and DHEA-S Status in Women After Surgical Menopause. Indian Medical Gazette — March 2015.