Dental Journal
Majalah Kedokteran Gigi
Volume 47, Number 4, December 2014

Research Report

The differences of orthodontic tooth movement on menstrual and ovulation cycle

Sonya Grecila Susilo,[1] Rahmi Amtha,[2] Boedi Oetomo Roeslan[3] and **Joko Kusnoto[1]**
[1]Department of Orthodontics
[2] Department of Oral Medicine
[3]Department Biochemistry
Faculty of Dentistry, Universitas Trisakti
Jakarta - Indonesia

ABSTRACT

Background: *Estrogens are sex hormon that play an important role in bone metabolism, including in bone remodeling during orthodontic treatment. Women has a monthly cycle which is affected by fluctuations of estrogen that is menstruation and ovulation.* ***Purpose:*** *The study was aimed to determine the differences of orthodontic tooth movement during menstrual an ovulation cycle.* ***Methods:*** *Five women were given ± 100 g orthodontic force using fixed orthodontic appliance with straight wire technique at the time of menstruation and ovulation with an interval of 1.5 months. Orthodontic tooth movement and levels of estrogen were measured during menstruation and ovulation.* ***Results:*** *Statistical results showed a significant differences between estrogen levels and orthodontic tooth movement ($p < 0.05$). When estrogen levels decline as in menstruation, tooth movement as results of orthodontic force would increase, whereas when estrogen levels increase as the time of ovulation, tooth movement would decrease.* ***Conclusion:*** *The estrogen level in menstruation and ovulation cycle may affect the tooth movement on ortodontic treatment.*

Key words: *Estrogen level, tooth movement, orthodontic force, menstruation, ovulation*

ABSTRAK

Latar belakang: *Estrogen merupakan hormon seks yang mempunyai peran penting dalam metabolisme tulang termasuk dalam remodeling tulang selama perawatan ortodonti. Wanita memiliki siklus bulanan yang dipengaruhi oleh fluktuasi estrogen yaitu menstruasi dan ovulasi.* ***Tujuan:*** *Penelitian ini bertujuan untuk mengetahui perbedaan pergerakan gigi akibat gaya ortodonti pada siklus menstruasi dan ovulasi.* ***Metode:*** *Lima orang wanita diberikan gaya ortodonti ±100 gr menggunakan alat orthodontik cekat dengan teknik straight wire pada saat menstruasi dan ovulasi dengan selang waktu 1,5 bulan. Selain itu subyek juga diukur kadar estrogennya saat menstruasi dan ovulasi.* ***Hasil:*** *Hasil statistik menunjukan kadar estrogen berbanding terbalik dengan pergerakan gigi ortodonti ($p < 0,05$). Saat kadar estrogen menurun seperti pada menstruasi, maka pergerakan gigi akan meningkat, sedangkan pada saat kadar estrogen meningkat seperti saat ovulasi, maka pergerakan gigi akan menurun.* ***Simpulan:*** *Kadar estrogen pada siklus menstruasi dan ovulasi dapat mempengaruhi pergerakan gigi pada perawatan ortodonti.*

Kata kunci: *Kadar estrogen, pergerakan gigi, gaya ortodonti, menstruasi, ovulasi*

Correspondence: Sonya Grecila Susilo, c/o: Departemen Ortodonsia, Fakultas Kedokteran Gigi Universitas Trisakti. Jl. Kyai Tapa No. 1 Grogol Jakarta 11440, Indonesia. E-mai: sonya.grecila@yahoo.com

INTRODUCTION

Orthodontic tooth movement begin when the remodeling occurs on alveolar bone. On the pressure side, activity of osteoclasts will produce a resorption, whereas on the tension side, activity of osteoblasts will make the apposition.[1,2] One of the hormones which can affect bone remodeling is estrogen. Estrogen influences the composition and degradation of collagen fibers in the periodontal ligaments and the remodeling of the alveolar bone.[3]

Currently, patients who come to the orthodontic clinic is dominate by teenage girls and adult womens.[4] Women has a monthly cycle that is influenced by estrogen fluctuations called menstruation and ovulation. Estrogen will increase when women had ovulation cycle and will decrease when had the menstrual cycle. The menstrual cycle is characterized by periodic vaginal bleeding that had occurred because release of the uterine mucosa.[5] Menstruation cycle averages 28 days in length.[6] Ovulation is the rupture of mature follicle and the release of ovum.[7] In average 28-day cycle, ovulation occurs on day 14 and is followed 2 weeks later by start of the menstrual flow.

Although the role of estrogen on bone remodeling has been known, but until now the effect of menstruation and ovulation to orthodontic tooth movement is still questionable. To ensure the differences orthodontic tooth movement during the menstrual and ovulation cycle should be done further research. The purpose of this study was to determine the differences of orthodontic tooth movement during menstrual and ovulation cycle.

MATERIALS AND METHODS

Five female subjects in range of age 18-25 years old were selected to participated in this study. The Local Research Biomedic and Ethics Committee (No: 73/KE/FKG/12/2012) approved the research protocol. The entire of subjects are patients who come and seek orthodontic treatment that performed by resident of department ortodontic Trisakti University. Woman who present good general and oral health with regular menstrual cycle of 26-32 days each month with skeletal maloclussion class I that needs bilateral first premolar extractions will fulfill the inclusion criteria. Women who were pregnant, breast-feeding, treated with contraseptive drugs or estrogen therapy, diagnosed with systemic disease or periodontal disease were excluded from the study. The study was conducted at Universitas Trisakti and Biomedical Laboratory.

The study began by giving an explanation to the subject about study procedures and they were asked to signed an informed consent as an agreement to be participating in this study. After that the subjects were asked about their history of menstrual cycle to estimate when will the next menstruation and ovulation. Menstrual phase is determined at the time the subject were experiencing the first day of bleeding, while the ovulation phase is determined approximately 14 days after first day menstruation and proved by ovulation test kits.

In addition, subjects also performed fixed orthodontic treatment by using a straight wire technique. Bracket used is Roth perscription 0.018 slots (Forestadent, Germany). Molar bands was cemented on the first molar, and brackets were bonded from left to right second premolars. Leveling and aligning phase begins with 0.014 nickel-titanium (NiTi) wire on the upper and lower arches. After leveling and aligning phase was completed, then started the canine retraction using 0.016 stainless steel wire. Retraction canines performed using NiTi closed coiled spring with a force of approximately 100 grams were measured using dontrix gauge.

The data was collected in three sessions. First, when the subject was having first day period of menstruation, a ± 100 gr of orthodontic force was given on the canine with NiTi closed coiled spring. The level of estrogen menstruation were measured and also impression was taken to determine the range of tooth movement. Second session was collected in 1.5 month later when subject were having period of ovulation, a ± 100 gr of orthodontic force was given on the canine with NiTi closed coiled spring and the level of estrogen ovulation were measured. Also performed imprression to determine the range of tooth. The third session was collected when the subject had menstrual cycle next 1.5 month later. This session only performed impression to determine the range of tooth. The work flow can be seen on Figure 1..

Determination of estrogen level was done by taking 10 mL blood with venous puncture, then blood was put into vacutainer tubes. Blood samples were immediately sent to the laboratory for processing using the ELISA method. Whereas determination range of tooth movement was done by taking impression for study model. The range of menstruation tooth movement was calculated with digital calliper from the difference between the linear distance (mm) from right distal canine to the second mesial

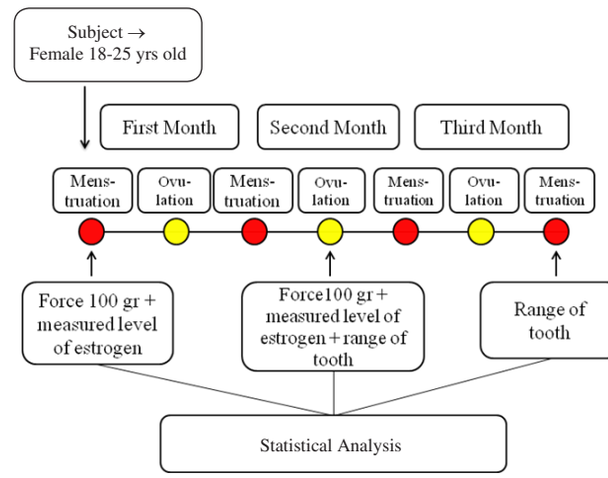

Figure 1. Work flow diagram on differences orthodontic tooth movement on menstrual and ovulation cycle.

Table 1. Summary of statistical analysis

	Rate	Standart deviation	T-test		Pearson correlation	
			t	P-value	R	p-value
Menstruation estrogen level	28.66	11.61	7.66	0.000*	-0.823	0.003*
Ovulation estrogen level	143.9	62.88				
Mentrustion range of tooth	1.71	0.324				
Ovulation range of tooth	0.66	0.2				

*significant $p < 0.05$

premolar on right between session I and II, while the range of ovulation tooth movement was calculated from the difference between the linear distance (mm) of right distal canine to second right mesial premolar between session II and III. This measurement was also performed on the left side in the same way.

Kolmogorov Smirnov test was used to analyze the normality of range of tooth movement and level of estrogen. If the sample distribution was normal, then T-Test was used to analyze differences between level of estrogen and range of tooth movement. The Pearson's correlation test was used to assess the correlations between range of tooth movement and estrogen level during menstruation and ovulation.

RESULTS

This study collected sample from 5 subject with average age of subjects was 22±2.44 years and Body Mass Index (BMI) was 21.28 ± 1.29. The outcome data were tested for normality with Kolmogorov-Smirnov test and showed normal data distribution ($p > 0.05$). The results measurement of estrogen level during menstruation and ovulation can be seen in Table 1. The measurement showed that estrogen levels was lower during menstruation (28.66 ± 11.61 pg/ml) than ovulation (143.9 ± 62.68 pg/ml) cycle. The mean and standard deviation of the range of tooth during menstruation was 1.71 ± 0.324 mm and when ovulation was 0.66 ± 0.2 mm (Table 1). The mean range of tooth increase during the menstruation cycle than ovulation.

The T-Test was used to identify differences between level of estrogen and range of tooth movement. T-Test result showed there were significant differences between two groups (T-value = 7.66, P-value = 0,000). Pearson's correlation test result showed a negative correlation between estrogen levels and orthodontic tooth movement ($r = -0.823$, $p < 0.05$) (Table 1). It means when estrogen level decline, it will increase the tooth movement and conversely.

DISCUSSION

This study was done by activating orthodontic force during peak of estrogen level on ovulation and during the lowest estrogen level during menstruation. The force that applied to canine distalization was approximately 100 grams to generate translation movement. Type of force is a continuous force that generated from the Ni-Ti closed coil spring.[8] The result showed that fluctuations in estrogen levels during menstruation and ovulation cycle can affect tooth movement due to ortodontic force. When estrogen levels decline as in menstruation, tooth movement will increase, whereas when estrogen levels increase as the time of ovulation, tooth movement will decrease. This opinion is in accordance with Sirisoontorn *et al.*[3] research which revealed that lack of estrogen may increase the orthodontic tooth movement. That results is same as some previous studies such as Haruyama *et al*.,[9] Ghajar *et al*.,[10] and Olyaee *et al*.,[11] which said that estrogen level inversely related to orthodontic tooth movement.

Orthodontic tooth movement occurs because the presence of osteoblast and osteoclasts that stimulate remodeling of alveolar bone. Estrogen is a hormone that is known to inhibit the activity of osteoclasts in a direct or indirect manner. Estrogen directly inhibits bone remodeling by decrease osteogenesis and chondrogenesis. Estrogen can also work indirectly on osteoclasts by increasing the production of calcitonin. Increased secretion of calcitonin by estrogen would inhibit the action of osteoclasts in bone resorption.[12]

Limited amount of estrogen will increased remodeling process so that bone density will be increased too.[12] This hormone also inhibits cytokine products such as interleukin 1β (IL-1β), Interleukin 6 (IL-6), and tumor necrosis factor-alpha (TNF-α), a macrophage colony-stimulating factor (M-CSF) that is involved in the activity of osteoclasts that makes the process of bone remodeling will be also inhibited.[4,13] During menstruation estrogen levels will decrease, thus when orthodontic force was given, the activity of osteoclasts will increase. The remodeling process will also be faster. This is what causes the orthodontic tooth movement became more rapid. In contrast during ovulation, estrogen levels will rise that makes osteoblast activity is inhibited and tooth movement will be slower.

Effects of estrogen to orthodontic tooth movement can be used in orthodontic treatment especially in order to shorten the duration of treatment. The duration of treatment is not only often complained by the patient but also can cause negative effects on teeth.[14] Prolonged orthodontic treatment often causes demineralization email, root resorption and periodontal disease. Several methods have been developed to accelerate ortodontic tooth movement such as selective alveolar decortication, gingival fiberotomy, reduce friction between bracket and

wire, physical or mechanical stimulation such as by using a low-energy laser and injection several drugs both locally and systemically such as prostaglandin, corticosteroid and vitamin D.[4,15] But there is no single method that is actually received by the experts.

This study may suggest an option for orthodontists to accelerate the tooth movement by performing activation of orthodontic force during menstruation, This method will be safer and more comfortable for the patient and the orthodontic treatment will be also more effective and efficient, even though this option is only can be done by female patients and sometimes there are psychological barries that women feel embarrassed to tell their sexual cycle. Therefore futher studies with bigger sample and longer observation period should be performed to prove the validity and consistency.

The study at 5 women showed that there was a significant differences in orthodontic tooth movement during the menstrual and ovulation cycle. Estrogen levels were tend to inversely related to orthodontic tooth movement, which means decreased estrogen levels such as during menstruation would increase tooth movement. Meanwhile, when estrogen levels increase as at the time of ovulation, tooth movement would decrease; orthodontic tooth movement would be faster if during menstruation the orthodontic force was activated. The estrogen level in menstruation and ovulation cycle may affect tooth movement on orthodontic treatment.

REFERENCES

1. Qing Z, Zhen T, Jie G, Yang-xi C. Influences of applying force during the different stages of estrous cycle on orthodontic tooth movement of rats. Hua Xi Kou Qiang Yi Xue Za Zhi 2005; 23(6): 480-2.
2. Henneman S, Von den Hoff JW, Maltha JC. Mechanobiology of tooth movement. Eur J Orthod 2008; 30(3): 299-306.
3. Sirisoontorn I, Hotokezaka H, Hashimoto M, Gonzales C, Luppanapornlarp S, Darendeliler MA, Yoshida N. Tooth movement and root resorption: the effect of ovariectomy on orthodontic force application in rats. Angle Orthod 2011; 81(4): 570-7.
4. Xu X, Zhao Q, Yang S, Fu G, Chen Y. A new approach to accelerate orthodontic tooth movement in women: orthodontic force application after ovulation. Med Hypotheses 2010; 75(4): 405-7.
5. Benson R, Pernoll M. Buku saku obstetri dan ginekologi. 9th ed. Wijaya S, editor. Jakarta: Penerbit Buku Kedokteran EGC; 2010. h. 46-47, 56.
6. Cunningham F, Gant N, Leveno K, Gilstrap L, Hauth J, Wenstrom K. Obstetri williams. 21th ed. Andri H, editor. Jakarta: Penerbit Buku Kedokteran EGC; 2012. h. 68.
7. Saladin K. Anatomy and physiology: the unity of form and function. 5th ed. New York: Mc Graw Hill; 2010. p. 1092-4.
8. Proffit W, Fields H, Sarver D. Compemporary orthodontics. 4th ed. St. Louis: Mosby Elsevier; 2007. p. 332-5.
9. 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(6): 406-10.
10. Ghajar K, Olyaee P, Mirzakouchaki B, Ghahremani L, Garjani A, Dadgar E. The effect of pregnancy on orthodontic tooth movement in rats. Med Oral Patol Cir Bucal 2013; 18: e 351-5.
11. Olyaee P, Mirzakouchaki B, Ghajar K, Seyyedi S, Shalchi M, Garjani A. The effect of oral contraseptives on orthodontic tooth movement in rat. Med Oral Patol Cir Bucal 2013; 18: 146-50.
12. Derek S, Kalangi S, Wangko S. Kerja osteoklas pada perombakan tulang. BIK Biomed 2007; 3: 97-107.
13. Ames MS, Hong S, Lee HR, Fields HW, Johnston W, Kim D. Estrogen deficiency Increases variability of tissue mineral density of alveolar bone surrounding teeth. Arch Oral Biol 2010; 55(8): 599-605.
14. Krishnan V, Davidovitch Z. Biological mechanisms of tooth movement. Oxford: Blackwell Publishing Ltd; 2009. p. 9, 155, 173-4.
15. Baloul S, Gerstenfeld L, Morgan E, Carvalho R, van Dyke T, Kantarci A. Mechanism of action and morphologic changes in the alveolar bone in response to selective alveolar decortication–facilitated tooth movement. Am J Orthod Dentofacial Orthop 2011; 139: S83-101.