

# Effects of Fixed Orthodontic Appliances on Salivary Conditions

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**Keywords:** Edgewise, Straight Wire, Fixed Orthodontic, Saliva.

**Abstract:** Fixed orthodontic can increase salivary flow rate because of its mechanical stimuli and as the body's physiological response that regard as a foreign in the body. The aim of this research is to know the effects of the fixed orthodontic techniques to salivary flow rate and calcium. This study used observational analytic with cross sectional design using samples of saliva stimulated from 66 young subjects (18-25 years old), divided into groups of controls, edgewise technique and straight wire technique. The subjects obtained by consecutive sampling method based on inclusion and exclusion criteria. The salivary flow rate and saliva's calcium had significantly difference ( $p=0.001$ ) for all groups. Salivary flow rate and calcium showed significant differences between subjects with fixed orthodontic of edgewise technique and straight wire technique ( $p < 0.05$ ). This study concludes that fixed orthodontic with edgewise technique and straight wire technique influences the salivary flow rate and calcium. Mechanical stimulation process in patients with edgewise technique is higher than straight wire technique.

## 1 INTRODUCTION

Fixed orthodontic appliance is a device placed on the surface of teeth which cannot be removed by the patient (Coburne and DiBiase, 2010). Both fixed and removable orthodontic appliances are widely used in orthodontic treatment with the increasing knowledge of the importance of oral and dental health. Thus, fixed orthodontic appliances are more widely used than removable orthodontic appliances (Lau and Wong, 2006). Orthodontic treatment may also cause changes in the oral cavity, such as bacterial concentration, salivary buffer capacity, salivary acidity (pH), salivary protein level and salivary flow rate (Carillo, 2010). Many techniques of fixed orthodontic treatment are to be developed to overcome the previous techniques technical weaknesses. The fixed orthodontic treatment technique that is still used in the Orthodontic clinic in Dentistry Hospital (RSGM), University of Sumatera Utara, such are edgewise, straight- wire technique and self-ligature bracket technique.

The use of fixed orthodontic appliances increase salivary flow rate as a form of physiological

response of the body by recognizing the fixed orthodontic appliance as a foreign object in the oral cavity. The placement of fixed orthodontic appliance improves the mechanical stimulation process in the oral cavity (Carillo, 2010).

Saliva is a complex liquid produced in the oral cavity by several salivary glands which consists of water and other contents. Based on the function, saliva has several properties such as lubricating, cleansing, neutralizing, and protecting the oral cavity against demineralization. This protective function of saliva is strongly related to the salivary flow, composition, pH, buffer capacity, and ionic arrangement of salivary proteins (Teixeira, 2012), (Motamayel, 2013). Based on the description, researchers are interested to observe the salivary flow rate and saliva's calcium in fixed orthodontic patients with edgewise and straight wire techniques. So that we will know the effect of fixed orthodontic in salivary conditions.

## 2 MATERIAL AND METHOD

This is an observational analytic study with cross sectional design and this study has obtained permission from the health research ethics committee of the Faculty of Medicine, University of

Sumatera Utara. Samples of stimulated saliva collected from 66 young subjects (18-25 years old) with spitting method. This research was conducted on April 2018 to August 2018 at Orthodontic Residency’s clinic, RSGM, University of Sumatera Utara. The population of this study were patients from the clinic. This research consist of a control group and two study groups, with edgewise and straight wire techniques of fixed orthodontic appliances. Subjects that match the inclusive criteria were obtained as many as 22 people in each group. General inclusive criteria: 18-25 years old, male and female. Inclusive criteria of control group: without orthodontic appliances. Inclusive criteria for experimental group: subjects with fixed orthodontic appliances; edgewise and straight wire placement technique, and patients with 4-6mm crowding. Exclusive criteria: smokers, alcohol drinkers, intake of medications, systemic diseases, women that undergoes menstruation, pregnancy, breastfeeding, dental caries, and patient with prosthesis.

Saliva collection was done at 09.00-12.00 WIB by spitting method. Saliva was collected in mouth with closed lip position, then was spitted into a salivary pot every 1 minute. The saliva collection performed for 5 minutes. Subjects were initially instructed to rest for 1 minute, then every 1-minute subjects were asked to spit the accumulated saliva into a measuring cup. The total amount of saliva collected then divided by the collection time of 5 minutes to obtain the salivary flow rate ml/min. Saliva’s calcium data was obtained by using Atomic Absorption Spectrophotometer (SAA) at the Pharmaceutical Research Laboratory of University of Sumatera Utara.

### 3 RESULT

This research was conducted to observe the effect of fixed orthodontic placement technique on salivary flow rate and saliva’s calcium at Orthodontic Clinic, Faculty of Dentistry, University of Sumatera Utara using consecutive sampling method. All the data were then processed and analyzed by Annova and Spearman Test.

Table 1 shows the distribution of salivary flow rate on control group, subjects with edgewise and straight wire fixed orthodontic placement techniques. The minimum salivary flow rate in the control group is 0.60 ml/min with maximum rate of 2.00 ml/min. In the edgewise placement technique group, the minimum salivary flow rate is 1.60 ml/min with maximum rate of 5.20 ml/min, while in

the straight wire placement technique group the minimum salivary flow rate is 0.60 ml/min with the maximum rate of 2.00 ml/min. There is a significant difference of salivary flow rate between study groups (group with edgewise and straight wire placement technique) ( $p=0.001$ ).

Table 1. Distribution of salivary flow rate on control group, edgewise and straight wire placement technique.

	Salivary Flow Rate (ml/minute)			p
	Min	Max	Median	
Control	0,60	2,00	1,00	0,001 *
Edgewise	1,60	5,20	2,60	
Straight wire	0,60	2,00	1,20	

\*significance  $p<0,05$

Table 2 shows the distribution of saliva’s calcium in control group, subjects with edgewise and straight wire fixed orthodontic techniques. The minimum saliva’s calcium value in the control group is 0.00 m mol/l while the maximal value is 0.90 m mol/l. In the edgewise placement technique group, the minimum salivary calcium value is 0.90 m mol/l while the maximum value is 2.10 m mol/l. In the straight wire placement technique group, the minimum salivary calcium value is 0.30 m mol/l while the maximum value is 1.50 m mol/l. The test shows that saliva’s calcium has a value of  $p=0.001$  which indicates that there is a significant difference between the study groups (group with edgewise and straight wire placement technique) ( $p <0,05$ ).

Table 2. Distribution of salivary calcium on control group, edgewise and straight wire placement technique

	Saliva’s calcium (m mol/l)			p
	Min	Max	Median	
Control	0,00	0,90	0,60	0,001*
Edgewise	0,90	2,10	1,30	
Straight wire	0,30	1,50	0,90	

\*significance  $p<0,05$

Table 3 shows the relationship between salivary flow rate with saliva’s calcium. Spearman’s test of correlation showed a significant relationship

( $p=0,001$ ) with  $r$  value of 0.835 which indicates a perfect relationship between salivary flow rate and saliva's calcium.

Table 3. Relationship of salivary flow rate with saliva's calcium.

Variable	(r)	P
Salivary Flow Rate	0, 83	0,001*
Saliva's calcium		

\*significance  $p<0,05$

## 4 DISCUSSION

Fixed orthodontic treatment can be done with several techniques such as edgewise and straight wire techniques to obtain an ideal occlusion. Orthodontic treatment can cause environmental changes in the oral cavity, such as changes in saliva. Aim of this study is to observe the effect of fixed orthodontic placement technique on the flow rate, and saliva's calcium. Table 1 shows the distribution of salivary flow rates in the control group, subjects with edgewise and straight wire fixed orthodontic placement techniques. The results showed a significant difference in the three study groups with the highest salivary flow rate is on the edgewise fixed orthodontic placement technique group. The placement of fixed orthodontic appliances in a malocclusion patient improves the mechanical stimulation process in the oral cavity. After the placement of orthodontic appliances, the body will start to recognize the placed appliances as a foreign object and causes stimulation that increases the salivary flow rate (Carillo, 2010). In Edgewise technique, a wider bracket is usually used.

A study by Crincoli on frictional forces in some brackets found that conventional brackets produce frictional forces 5-6 times higher than other brackets (Singh, 2007), (Crincoli, 2013). The presence of large frictional force of edgewise and the use of wide bracket causes a larger pressure and also the bracket used on the edgewise technique has multiple loops which cause discomfort feeling to the patients, thus increases the salivary flow rate (Rasyid, 2014). Changes occurring in the oral cavity are considered as physiological responses to mechanical stimulation due to the high pressure caused by the edgewise technique while the straight-wire technique causes the salivary flow rate, pH and saliva's calcium to be lower due to the negated wire bending (Samawi, 2011).

Salivary secretions may be enhanced by two types of salivary reflexes, simple salivary reflex (unconditioned) and acquired salivary reflex (conditioned). In fixed orthodontic appliance users there is an increase in salivary flow rate through simple or unconditioned saliva reflex that occur through a chemoreceptor or pressure receptor. This pressure may come from the fixed orthodontic appliance placement. When the appliances are activated, the receptors initiate an impulse in the afferent nerve fibers that carry information to the salivary centre in the medulla brainstem. The salivary centre then sends an impulse to the salivary glands through the extrinsic autonomic nerves to stimulates the parasympathetic nervous system that plays a major role in salivary secretion that causes much and enzyme-rich dilute saliva secretion. The presence of brackets and wires in the teeth encourage the saliva secretion in the absence of food due to manipulation of pressure receptors located in the mouth (Sherwood, 2011). The nerves responsible for saliva secretion include facial and glosso pharyngeal nerves. Facial nerve is directly related to sublingual and sub mandibular salivary glands, while the glosso pharyngeal nerve is directly related to the parotid gland (Neil, 2007).

Table 2 shows the distribution of saliva's calcium in the control group, subjects with of edgewise and straight wire fixed orthodontic placement techniques. The results showed a significant difference between the three study groups with the highest saliva's calcium value in the edgewise fixed orthodontic placement technique. Studies by Bhavsar, state that saliva's calcium is higher in patients undergoing orthodontic treatment compared to patients without orthodontic treatment. The results of this study lead to the fact that saliva's calcium value is affected by changes in the oral environment due to orthodontic brackets in the oral cavity. Increased salivary calcium concentration is due to dental demineralization and fixed orthodontic treatment. The presence of great pressure and friction in edgewise techniques leads to an increase in salivary flow rate and salivary calcium ions. The concentration of calcium ions depends on the pH and salivary flow rate. Saliva containing calcium acts as an important source of ions. Thus the balance between re mineralization and demineralization depends on the concentration of saliva's calcium (Bhavsar, 2017).

Table 3 shows the relationship between salivary flow rate and saliva's calcium. The results showed a significant correlation between salivary flow rate and saliva's calcium. The results showed that the

higher the pressure of fixed orthodontic placed, the greater the saliva secretion will be and it will increase the amount of calcium ions in the saliva, with r value of 0.83 which means that the increase of calcium in saliva is related perfectly with the salivary flow rate. The results showed a perfect relationship between saliva secretion and the amount of calcium ion in the saliva which also means that the calcium ions level in saliva are affected by the saliva flow rate. As reported by Indriana, increased salivary flow rate affects the amount of calcium ion concentration in saliva (Indriana, 2011).

## 5 CONCLUSION

A fixed orthodontic placement with both edgewise and straight wire techniques affect the salivary flow rate and saliva's calcium. There were significant differences of salivary flow rate and saliva's calcium level between control and study groups ( $p < 0.05$ ). It can be concluded that fixed orthodontics appliances affects the condition of the patient's saliva

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