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ORIGINAL RESEARCH

Effect of orthodontic fixed appliances on salivary flow and viscosity

Efecto de la aparatología ortodóntica fija sobre el flujo y viscosidad salival

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ABSTRACT

Objective: To determine the effect of orthodontic fixed appliances on salivary flow and viscosity. **Material and methods:** Saliva samples from 44 patients between 10-34 years old of both genders were assessed in Trujillo, Peru. Twenty-two of them received orthodontic fixed appliances and the other 22 did not receive then and served as control. Samples for the evaluation of salivary flow and viscosity before and one month after orthodontic fixed appliances placement were obtained. To quantify salivary flow, 5 minutes was clocked to obtain saliva in a test tube and then make measurements using a 10 mL test tube millimeter. To measure viscosity, 5 mL of saliva was collected and calculated by the formula of the relative viscosity (VR = time of 5 mL saliva/time to 5 mL of water) using a viscometer. For comparison of salivary flow and viscosity before and a month after the Wilcoxon test was used because the data did not exhibit a normal distribution. A significance level of 5% was considered. **Results:** Statistically significant differences ($p < 0.05$) in salivary flow and viscosity were found before orthodontic fixed appliances placement and one month after, showing an increase in salivary flow and a decrease in salivary viscosity. **Conclusion:** The use of orthodontic fixed appliances affects salivary flow and viscosity month after placement.

RESUMEN

Objetivo: Determinar el efecto de la aparatología ortodóntica fija sobre el flujo y viscosidad salival. **Material y métodos:** Se evaluaron muestras salivales de 44 pacientes de ambos sexos entre 10 a 34 años de edad; de Trujillo, Perú, 22 de ellos recibieron aparatología ortodóntica fija y los otros 22 no la recibieron y sirvieron como control. Se obtuvieron muestras para la evaluación del flujo y viscosidad salival antes y al mes de instalada la aparatología ortodóntica fija. Para cuantificar el flujo salival se cronometraron cinco minutos para obtener saliva en un tubo de ensayo y luego hacer la medición empleando una probeta milimetrada de 10 mL. Para medir la viscosidad se recolectaron 5 mL de saliva y luego fue calculada mediante la fórmula de la viscosidad relativa (VR = tiempo de 5 mL de saliva/tiempo para 5 mL de agua) usando un viscosímetro. Para la comparación entre y flujo y viscosidad salival antes y al mes se empleó la prueba de Wilcoxon debido a que los datos no siguieron distribución normal; se consideró un nivel de significancia del 5%. **Resultados:** Se encontraron diferencias estadísticamente significativas ($p < 0.05$) en el flujo y la viscosidad salival entre antes y al mes de instalada la aparatología ortodóntica fija, apreciándose un aumento del flujo salival y una disminución de la viscosidad salival. **Conclusión:** El uso de aparatología ortodóntica fija afecta el flujo y viscosidad salival al mes de su instalación.

Key words: Salivary flow, salivary viscosity, fixed orthodontic appliances.

Palabras clave: Flujo salival, viscosidad salival, aparatología ortodóntica fija.

INTRODUCTION

Patients with orthodontic fixed appliances may be more susceptible to changes in some specific salivary characteristics due to certain conditioning factors.[1-3] Saliva is a complex secretion[4] that has as its main function the maintenance and protection of the soft and hard tissues of the oral cavity,[5,6] where flow and viscosity plays a relevant role.[3]

The quantity of saliva is defined by salivary flow rate, while its quality is defined by its content of salivary protein and its viscosity.[3] Salivary flow is calculated by dividing the volume of saliva between time of collection.[6] There are 2 types of salivary flow, at rest and stimulated. Salivary flow under normal conditions is 0.25 and 0.40 mL/min, while the normal stimulated salivary flow is 2 mL/min.[7,8] Salivary viscosity is the property of the saliva that opposes its flow when a force is applied. The glycoprotein mucin is responsible for salivary viscosity. It has been suggested that viscosity primarily influences the origin of caries.[1,9,10] It plays a very important role in the cleaning of bacterial substrates: if the saliva is highly viscous, then it is less effective in cleaning thus favoring demineralization and caries.[11,12]

Orthodontic fixed appliances may affect salivary secretion and viscosity due to the fact that there is an increase in bacterial plaque accumulation and a

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higher level of difficulty for oral hygiene thus leading to changes in saliva characteristics which produce as a consequence enamel demineralization and white lesions.[13-15]

Koch et al.[1] found that one month after orthodontic appliances placement, an increase in salivary flow and a decrease of its viscosity occurred. Li and col[15] found an increase in salivary flow rate 1 month after orthodontic appliance placement. Likewise, Lara et al.,[14] Romero et al.[5] Ulukapi H et al.[16] and Peros et al.[17] reported that there was an increase in stimulated salivary flow 12 to 18 weeks after treatment with fixed orthodontic appliances. Chang et al[18] reported an increase in the rate of stimulated salivary flow at 3 months orthodontic appliances use.

There is no clear relationship between the use of orthodontic appliances and changes in salivary flow and viscosity. At the same time, it is necessary to determine whether the salivary changes are similar or different in different populations after orthodontic appliances placement. Better understanding of these changes could induce the clinician to take preventive measures during the orthodontic treatment.

This research was aimed to determine the effect of orthodontic fixed appliances over salivary flow and viscosity.

MATERIAL Y METHODS

Study sample

This study was conducted with 44 patients, divided into 2 groups of 22 patients each, with an age range between 10 and 34 years *(Table I)*, who attended several dental clinics in the city of Trujillo, Peru seeking orthodontic treatment. The minimum sample size per group was calculated by considering a power test of 80% and a confidence level of 95%. Before considering the patient as suitable for the investigation an interview that served for sample selection phase was conducted. The inclusion criteria were: patients with normal nutritional status, without tooth decay or periodontal disease, without systemic diseases or anomalies, not under any medication, not pregnant and without smoking habits. Saliva samples were collected prior to orthodontic fixed appliance placement and a month after. For the implementation of this project, the authors received approval from the Committee of Research of the School of Dentistry in the Universidad Privada Antenor Orrego with the corresponding resolution from the dean.

Determination of salivary flow

The saliva sample collection was carried out between 9 am and 12 pm with the aim of reducing as far as possible the circadian rhythm. The patient was asked not to eat one hour prior to sample collection. At the time of collection, the patients were asked to rinse with water, without moving their heads and not passing saliva for 2 minutes. Later, stimulation was induced with orthodontic elastic bands (30 seconds). The chronometer was set at 5 minutes and stimulated saliva collection was conducted in a straight and relaxed posture. The collected saliva was placed in glass test tubes. To measure salivary flow a 10 mL measuring cylinder was used.

Determination of salivary viscosity

In order to measure salivary viscosity, the same procedure for saliva collection to meaure salivary flow was performed. Five milimeters of saliva were collected. For the meaurement of viscosity, an Ostwald Cannon Fesked Mod. 100 viscosimeter was used. To determine the final viscosity, the relative viscosity formula was employed (RV = time for 5 mL of saliva/ time for 5 mL of water).

Group formation

a. Experimental group

It was formed by 22 patients, 10 to 34 years of age (17.27, SD: 5.81) who were programmed for orthodontic fixed appliance placement. The patients selected for this study signed an informed consent form. The collected samples for flow and viscosity

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Table I. Sample distribution by gender and age.

Groups	Gender	n	Mean age	SD	Minimum	Maximum
Experimental	Female	13	19.23	6.35	10	34
	Male	9	14.44	3.57	10	22
	Total	22	17.27	5.81	10	34
Control	Female	8	22.13	4.05	13	27
	Male	14	17.14	4.50	11	25
	Total	22	18.95	4.90	11	27

were taken prior to appliance placement the same day and a month after.

b. Control group

It was formed by 22 patients, 11 to 27 years of age (18.95, SD: 4.90) who did not receive fixed orthodontic appliances until one month after the first saliva sample. The patients selected for this study signed an informed consent form. The collected samples for salivary flow and viscosity were obtained in two moments with a one month waiting time wihout any apppliance placed in the mouth during that period of time.

Statistical analysis

The obtained data was analyzed through the SPSS program, 2.2 version. For the comparison of flow and viscosity before and one month after appliance placement, the Wilcoxon test was used. This non-parametric test was selected beacuse the data obtained from the assessed groups did not follow a normal distribution after the Shapiro-Wilk test was applied. The significance leveal was set at 5%.

RESULTS

Statistically significant differences were found between the flow and viscosity values before and one month after fixed appiances placement in the experiment L group ($p < 0.05$) but not in the control group. In the experimental group, the initial salivary flow was 1.12 mL/min (SD: 0.23) and one month after, it was 1.36 mL/min (SD: 0.28); while for viscosity, the initial value was 1.16 (SD: 0.11) and after one month, it was 1.01 (DE: 0.10) *(Table II)*.

In relation to genders, both in the male and female group statistically significant differences were found in the experimental group ($p < 0.05$) but not in the control group. Values for salivary flow were higer than those for viscosity one month after orthodontic fixed appliances placement *(Table III)*.

DISCUSSION

Orthodontics has become one of the most desirable dental treatments nowadays to enhance the smile; however it is possible that placement of orthodontic appliances may lead to changes in the saliva that may put at risk dental and periodontal health. This study shows e changes that are produced in salivary flow and viscosity after orthodontic fixed appliances placement.

Salivary flow and viscosity were compared before and one month after bracket placement in order to observe the effect it produced. Statistically significant differences were found which coincides with reports from other authors.[1,14,15]

The increase in salivary flow after fixed orthodontic appliances placement would be considered as a protection factor due to the fact that any foreign body in the oral cavity causes stimulation by increasing salivary flow.[2] In consequence, an increase in salivary flow would be favorable for patients because there will be more lubrication and substrate and oral cavity micro-organisms elimination with good oral hygiene.[9]

The decrease in salivary viscosity is consistent with the results reported by Koch et al.[1] Such a decrease is considered a response to an increase in salivary flow.[1] When there is an increase in salivary flow a greater amount of water is generated in its biological content which causes a decrease in mucin, the viscous glycoprotein, therefore the relative viscosity also decresaes.[9] This interaction is important in the process of caries formation.[13]

A decrease in salivary flow and an increase in viscosity would be a negative aspect because it has more influence on the formation of dental caries.[1-3,12] Another negative aspect is the effect on periodontal

Table II. Salivary flow (mL/min) and viscosity before and after orthodontic fixed appliance placement.

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Group	Variables	Period	n	Mean	SD*	Before-after difference	p**
Experimental	Flow	Before	22	1.12	0.23	-0.24	0.000
	Flow	After	22	1.36	0.28		
	Viscosity	Before	22	1.16	0.11	0.15	0.000
	Viscosity	After	22	1.01	0.10		
Control	Flow	Before	22	1.07	0.21	-0.01	0.762
	Flow	After	22	1.08	0.14		
	Viscosity	Before	22	1.14	0.15	0.01	0.138
	Viscosity	After	22	1.13	0.14		

*Standard deviation; **Wilcoxon's test.

Table III. Salivary flow (mL/min) and viscosity before and after orthodontic fixed appliances placement by gender.

Gender	Group	Variables	Period	n	Mean	Before and after difference	p*
Female	Experimental	Flow	Before	13	1.16	-0.22	0.001
		Flow	After	13	1.38		
		Viscosity	Before	13	1.18	0.14	0.002
		Viscosity	After	13	1.04		
	Control	Flow	Before	8	1.00	0.13	0.101
		Flow	After	8	0.87		
		Viscosity	Before	8	1.07	0.01	0.618
		Viscosity	After	8	1.06		
Male	Experimental	Flow	Before	9	1.06	-0.25	0.017
		Flow	After	9	1.31		
		Viscosity	Before	9	1.14	0.17	0.000
		Viscosity	After	9	0.97		
	Control	Flow	Before	14	1.16	0.05	0.162
		Flow	After	14	1.11		
		Viscosity	Before	14	1.17	0.01	0.180
		Viscosity	After	14	1.16		

* Wilcoxon test.

disease because if saliva were to be more viscous there would be more risk of periodontal disease which would be totally unfavorable for patients with orthodontic fixed appliances because they experience more difficulty in keeping a good oral hygiene.[1,9,12]

In the control group not statistically significant differences were found, therefore there is no significant change in flow and viscosity. Such results were due to the absence of a stimulus on the oralcavity.[1]

The clinical significance of these results lies in the fact that salivary flow and viscosity are elements of great importance in the origin of caries and periodontal disease during orthodontic treatment so it is necessary to understand the changes it causes.

CONCLUSIONS

- There is an effect of orthodontic fixed appliances on salivary flow and viscosity one month after bracket placement causing an increase in salivary flow and a decrease in the relative viscosity.
- By gender, the effect of fixed appliances on salivary flow and viscosity was similar for men and women with an increase in salivary flow and a decrease in viscosity.

REFERENCES

1. Koch KE, Collantes CL, Lewintre MI, Latyn K. Influencia de la aparatología ortodóntica fija en la viscosidad y flujo salival. *Rev Fac Odontol UNNE*. 2010; 3 (11): 48-51.
2. Lombardo L, Yildiz YÖ, Gorgun Ö, Panza C, Scuzzo G, Siciliani G. Changes in the oral environment after placement of lingual and labial orthodontic appliances. *Prog Orthod*. 2013; 14: 28.
3. Alesandri G, Incerti S, Garulli G, Gatto MR, Checchi L. Effect of fixed orthodontic appliances on salivary properties. *Prog Orthod*. 2013; 14: 13.
4. Llena-Puy C. The rôle of saliva in maintaining oral health and as an aid to diagnosis. *Med Oral Patol Oral Cir Bucal*. 2006; 11: E449-55.
5. Romero HM, Hernández Y. Modificaciones del Ph y flujo salival con el uso de aparatología funcional tipo Bimler. *Revista Latinoamericana de Ortodoncia y Odontopediatría*. 2009;1-26.
6. Caridad C. El pH, flujo salival y capacidad buffer en relación a la placa dental. *ODOUS Científica*. 2008; 9 (1): 25-32.
7. Loyo K, Balda R, Gonzales O, Solorzano AL, Gonzales M. Actividad cariogénica y su relación con el flujo salival y la capacidad amortiguadora de la saliva. *Acta Odontol Venez*. 1999; 37 (3): 10-17.
8. Laurence JW. Aspectos clínicos de biología salival para el clínico dental. *J Minin Interv Dent*. 2008; 1 (1): 5-22.
9. Ahmed B, Jafer N. Salivary viscosity in relation to oral health status among a group of 20-22 years old dental students. *Iraqi J Comm Med*. 2013; 1 (3): 219-224.
10. Carda C, Mosquera N, Salom L, Gomez ME, Peydró A. Structural and functional salivary disorders in type 2 diabetic patients. *Med Oral Patol Oral Cir Bucal*. 2006; 11: E309-E314.
11. Ortega ME, Calzado M, Pérez M. Evaluación del flujo y viscosidad salival y su relación con el índice de caries. *Medisan*. 1998; 2 (2): 33-39.
12. Cedillo L, Martinez D, Varela F, Villa T, Zepeda T. *La Saliva como método de diagnostico para determinar la incidencia de caries en alumnos de la facultad de estudios superiores Iztacala*. Revisado el 15 de abril del 2014. Disponible en: http://odontologia.iztacala.unam.mx/memorias15col/contenido/oral/lasalivacomometode04.htm
13. Viazis AD. *Atlas de ortodoncia*. Buenos Aires: Panamericana; 1995.

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14. Lara E, Montlel NM, Sanchez L, Alanis J. Effect of Orthodontic treatment on saliva, plaque and the levels of *Streptococcus mutans* and *Lactobacillus*. *Med Oral Patol Oral Cir Bucal*. 2010; 15 (6): 924-929.
15. Li Y, Hu B, Liu Y, Ding G, Zhang C, Wang S. The effects of fixed orthodontic appliances on saliva flow rate and saliva electrolyte concentrations. *Journal of Oral Rehabilitation*. 2009; 36 (11): 781-785.
16. Ulukapi H, Koray F, Efes B. Monitoring the caries risk of orthodontic patients. *Quintessence Int*. 1997; 28 (1): 27-29.
17. Peros K, Mestrovic S, Anic S, Slaj M. Salivary microbial and nonmicrobial parameters in children with fixed orthodontic appliances. *Angle Orthod*. 2011; 81 (5): 901-906.
18. Chang HS, Walsh LJ, Freer TJ. The effect of orthodontic treatment on salivary flow, pH, buffer capacity, and levels of mutans streptococci and lactobacilli. *Aust Orthod J*. 1999; 15 (4): 229-234.

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