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Original Article

Comparative Study of Occlusal Contact Marking Indicators

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Abstract

Background: A variety of indicators to register occlusal contacts are used in the daily dental practice. One of the most frequently used qualitative occlusal indicators is the articulating paper. Its reliability is often disputed because this indicator could produce false positive results or fail to register any occlusal contacts.

Aim: To compare the number and size of the recorded contacts on a tooth surface obtained with articulating paper and foil.

Materials and methods: Typodonts of upper and lower jaw with intact dental arches Frasaco A-3Z were fixed in a Girbach arcon articulator. Articulating contacts were marked with 12-micron Bausch articulating foil and 200-micron Bausch articulating paper under the same load. For each study a new sheet of the occlusal indicators was used, and 10 repetitions were made for each one. After every marking, the lower jaw was dismounted from the articulator and the distribution of the markings was videographed using a camera. The number of occlusal contacts was entered in a table. We analysed the markings on the first maxillary and first mandibular molars.

Results: We found that fewer and bigger contacts were recorded using the 200-micron articulating paper in comparison with the contacts obtained using the foil.

Statistical analysis showed that there is significant difference in the number of the occlusal contacts registered with articulating paper, since $p < 0.05$.

Conclusions: The type of occlusal contact indicator has an effect on the number and the size of the occlusal contact markings.

Keywords

articulating foil, articulating paper, occlusal contacts

INTRODUCTION

Occlusion is the static relationship between the incising or masticating surfaces of the maxillary or mandibular teeth or tooth analogues.[1] Qualitative and quantitative occlusal contact indicators are commonly used to assess these occlusal-articulating relations.[2] Articulation paper is the most frequently used indicator due to its lower price and easy application.[3,4]

It has been found in dental practice that the size of markings obtained with articulation paper indicates the load of the occlusal contacts.[5,6] The data in the available literature regarding the relationship between the thickness of the articulation paper and the area of the markings is rather contradictory.[7] According to some authors the size of the area

of the marking shows how heavy the load with the small mark areas showing less load.[8-10]

Thicker occlusal contact indicators have been found to register marks that are greater in number and area than those thinner indicators can obtain.[11]

In 2008 Millstein questioned this finding. He found that fewer contacts were recorded with 200-μ articulation paper than with the 40-μ paper.[12]

Saracoglu et al.[13] have reported that using repeatedly one and the same sheets of paper and foil can results in registering fewer contacts.

It has been established that there is no direct connection between the size of the mark areas and the applied occlusal load.[14]

The reliability of the articulation paper often is disputed due to the possibility of registering false occlusal contacts.[15]

AIM

Comparison of the results obtained with articulating foil and paper by number and size of the contacts.

MATERIALS AND METHODS

Typodonts of upper and lower jaw with intact dental arches Frasaco A-3Z were fixed in an arcon semi-adjustable Girbach articulator, model AR218710 (**Fig. 1**). We mounted the models fixed previously in maximum intercuspation position onto the occludator according to the manufacturer instructions.

For registration of the occlusal contacts we used two different indicators - articulation paper Bausch 200 μ and articulation foil Bausch 12μ. A new sheet of paper was used after every registration round with the help of Bausch excalibur articulating paper forceps (**Fig. 2**).

Ten repetitions were made with every one of the occlusal indicators. Models were closed in bite till maximum intercuspation, without any additional loading. The distribution of the occlusal contacts of the both dental arches were recorded with digital camera Sony model DSC-W530. Photos were obtained according to standard distance of 10 cm between the models and the fixed camera.

The area of registered occlusal contacts was measured using a free program "Image J". The program allows the outlined contour (area) to be measured. Thus, the area of the occlusal surface and the contacts for each tooth were measured in pixels. In this way, numerical values were obtained, respectively, of the total area of the tooth and of the occlusal contacts recorded for each occlusal indicator thickness.

We used the data obtained from the first maxillary molars and first mandibular molars due to their role as masticatory center. After every round we cleaned the occlusal surfaces with spirit soaked cotton roll. The obtained results were statistically analyzed with special software SPSS (SPSS Inc. IBM SPSS Statistic) v. 19.

RESULTS

During the comparison of the results obtained with articulation paper Bausch 200 μ (**Fig. 3**) and articulation foil Bausch 12μ (**Fig. 4**) we noticed differences in the number and size of the contacts. At least 4 contacts were registered on the maxillary first molars with both indicators. With articulation foil the maximum number of registered contacts was 5 and with paper - 4. On the occlusal surfaces of the mandibular molars were registered minimum 4 and maximum 5 contacts. The minimum marks registered with articulation paper were 3 and maximum 5.

The results after the statistical analysis of the number of occlusal contacts are displayed in **Table 1**.

The results from the statistical analysis show statistically significant difference in the number of the registered contacts with articulation paper and foil due to $p<0.05$.

On the maxillary first molars we had at least 4 contacts registered with both indicators. With articulation foil the maximum were 5 and with paper - 4. On the occlusal surfaces of the mandibular molars were registered minimum 4 and maximum 5 contacts. The minimum marks registered with articulation paper were 3 and maximum 5.

The minimum area of the registered occlusal contacts with the articulation foil was 0.66 pixels and with the articulation paper - 6.59 pixels. The maximum area of the foil contacts was 2.33 pixels, and with paper - 12.77 pixels.

The results after the statistical analysis of the size of these occlusal contacts are shown in **Table 2**.

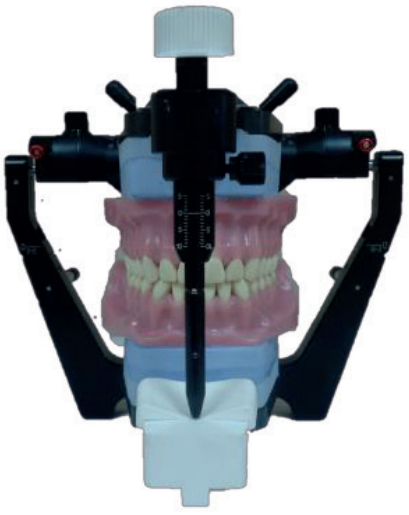

Figure 1. Models mounted in an occludator.

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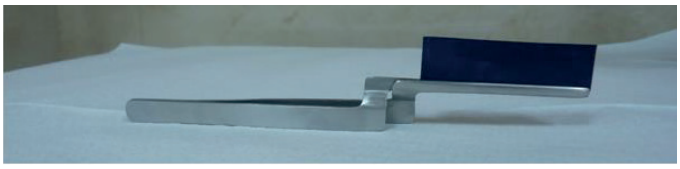

Figure 2. Excalibur articulating paper forceps.

Figure 3 A.

Figure 3 B.

Figure 3. Occlusal contacts registered with articulating paper. **A.** maxillary molars; **B.** mandibular molars.

Figure 4 A.

Figure 4 B.

Figure 4. Occlusal contacts registered with articulating foil. **A.** maxillary molars; **B.** mandibular molars.

Table 1. Numbers of occlusal contacts

Type of occlusion indicators	Articulation foil Bausch 12 µ			Articulation paper Bausch 200 µ		
Tooth	**Minimum**	**Maximum**	**Mean**	**Minimum**	**Maximum**	**Mean**
First maxillary molars	4	5	4.7	4	4	4
First mandibular molars	4	5	4.7	3	4	3.9

Table 2. Size of occlusal contacts in pixels

Type of occlusion indicators	Articulation foil Bausch 12 µ	Articulation paper Bausch 200 µ
Size of contacts in pixels	**Minimum**	**Maximum**
Minimum area	0.66	2.33
Maximum area	6.59	12.77

The results from the statistical analysis show statistically significant difference in the size of the registered contacts with articulation paper and foil due to $p<0.05$.

We determined that the thicker occlusal paper left fewer in number and larger in size markings, whereas the thinner paper left smaller in size, but bigger in number markings.

DISCUSSION

Our survey shows that articulation foil identifies more occlusal contacts and of smaller size. With articulation paper we registered less in number and bigger in size marks.

The formula force/size = load shows that the force is a constant value and when the marking area size increases, the load decreases. Resultant marks from thicker paper are larger in size, but contain less individual load and vice versa. The marks obtained from the thinner paper have smaller size and bigger individual load.[12]

Therefore, we can conclude that the small area markings contain heavier load and the large area markings have lesser load.

We confirm the statement that the thicker articulating paper leaves bigger in size and fewer in number marks.[5,15] But our results don't match the results of from other authors.[11] The assessment of occlusal contacts obtained from

articulation paper or articulation foil are inaccurate and subjective due to the possibility of registering false positive contacts.[10,14]

CONCLUSION

The type of occlusal contact indicators has an effect on the false registration marks and on the size and number of the occlusal contacts as well.

The results from the survey prove the link between the thickness of the occlusal indicator and the form of the marks on the occlusal surface.

REFERENCES

1. The Glossary of Prosthodontic Terms. J Prosthet Dent 2005; 94(1): 10-92.
2. Viram U, Arora A, Kapur DS, et al. T-scan: occlusion demystified. Unique Journal of Medical and Dental Sciences, 2015; 03 (01):1-5.
3. Kerstein R. Missing the mark: accurate observation of occlusal forces. Advances in CAD/CAM Dentistry 2008; 1(1): 11-3.
4. Babu R, Nayar S. Occlusion indicators: A review. Journal of Indian Prosthodontic Society 2007; 7(4): 170.
5. Carossa S, Lojacono A, Schierano G, et al. Evaluation of occlusal contacts in the dental laboratory: influence of strip thickness and operator experience. Int J Prosthodont 1999; 13(3): 201-4.
6. Asazuma Y, Isogai Y, Watanabe K, et al. Changes in gnathosonic and tooth contact characteristics induced by experimental occlusal interferences created using a full-cast double crown. J Oral Rehabil 1995; 22(3): 203-11.
7. Qadeer S, Kerstein R, Kim RJY, et al. Relationship between articulation paper mark size and percentage of force measured with computerized occlusal analysis. J Adv Prosthodont 2012; 4(1): 7-12.
8. Cabral CWLF, Silva FA, Silva WAB, et al. Comparison between two methods to record occlusal contacts in habitual maximal intercuspation. 2007. TSpace.
9. Harper K, Setchell D. The use of shimstock to assess occlusal contacts; a laboratory study. Int J Prosthodont 2002; 15(4): 347-52.
10. Saad M, Weiner G, Ehrenberg D, et al. Effects of load and indicator type upon occlusal contact markings. J Biomed Mater Res B Appl Biomater 2008; 85(1): 18-22.
11. Schelb E. Thickness and marking characteristics of occlusal registration strips. J Prosthet Dent 1985; 54: 122-6.
12. Millstein P. Know your indicator. J Mass Dental Soc 2008; 56: 30-1.
13. Saracoglu A, Ozpinar B. In vivo and in vitro evaluation of occlusal indicator accuracy. J Prosthet Dent 2002; 88: 522-6.
14. Carey J, Craig M, Kerstein RB, et al. Determining a relationship between applied occlusal load and articulation paper mark area. The Open Dentistry Journal 2007; 1: 1-7.
15. Millstein P, Maya A. An evaluation of occlusal contact marking indicators. J Am Dent Assoc 2001; 132: 1280-6.

Сравнительное исследование показателей окклюзионной маркировки контактов

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Абстракт

Введение: В повседневной стоматологической практике используются различные индикаторы для установления окклюзионных контактов. Одним из наиболее часто используемых качественных окклюзионных индикаторов является артикуляционная бумага. Его надёжность часто вызывает споры, потому что этот индикатор может давать ложные положительные результаты или не устанавливать окклюзионный контакт.

Цель: Сравнить количество и размеры отмеченных контактов на поверхности зуба, установленных с помощью артикуляционной бумаги и плёнки.

Материалы и методы: Модели верхней и нижней челюсти с интактными зубными дугами Frasaco A-3Z были зафиксированы в артикуляторе Girbach arcon. Артикуляционные контакты были зафиксированы с помощью 12-микронной артикуляционной плёнки Bausch и 200-микронной артикуляционной бумаги Bausch с одинаковой нагрузкой. Новый лист для окклюзионных показателей был использован для каждого исследования, и 10 повторов были сделаны для каждого исследования. После каждой маркировки нижняя челюсть удалялась из артикулятора, и распределение маркировки регистрировалось видеокамерой. Количество окклюзионных контактов зафиксировано в таблице. Мы проанализировали маркировку первых верхнечелюстных и нижнечелюстных моляров.

Результаты: Было установлено, что большее количество и более крупные маркировки были зафиксированы с использованием 200-микронной артикуляционной бумаги по сравнению с контактами, зафиксированными на плёнке.

Статистический анализ показал, что существует значительная разница в количестве окклюзионных контактов, установленных с помощью артикуляционной бумаги. $p < 0,05$.

Вывод: Тип индикатора окклюзионного контакта влияет на количество и размер окклюзионных маркировок контакта.

Ключевые слова

Окклюзионные контакты, артикуляционная плёнка, артикуляционная бумага.