THICKNESS, STRENGTH, PLASTIC DEFORMATION AND MARKING CHARACTERISTICS OF OCCLUSAL REGISTRATION STRIPS

Osman T. Altay, DDS, MS, PhD;* A. Ergin, DDS, MS;**
E. Buyukkilic, DDS, MS, PhD;*** A. Bilge, DDS, MS, PhD****

لقد استخدم أطباء الأسنان تقنيات ومواد مختلفة لتحديد وتوضيح التماس الإطباقي مثل الأوراق الملونة والشرائط البلاستيكية، شرائط الحرير والشموع، وأصبغة خاصة بمواد الطبع المطاطية المرنة التصوير الفوتوغرافي للأطباق والأفلام الإطباقية لكن تبقى أوراق العض خصوصاً الشرائط البلاستيكية والشموع من أكثر المواد المستعملة.

إن تسجيل التماس الإطباقي مهم جداً للتشخيص والمعالجة كما أن دقته من العوامل الضرورية لنجاح المعالجة. فمثلاً اختلاف ثخانة أوراق الإطباق يظهر علامات مزيفة، كما يؤدي إلى الحيرة. إن ثخانة شرائط التسجيل المنتجة من مختلف المعامل غير متطابقة، يمكن أن تكون رقيقة جداً أو سميكة، وعلى كل حال تعتبر ثخينة مقارنة بثخانة الشرائط الواقعية.

الهدف من هذه الدراسة إجراء مقارنة تحت ظروف مخبرية جافة لـ(١١) نوعاً من شرائط تسجيل الإطباق وذلك من حيث الثخانة والمتانة ودرجة التشوه وتسجيل التماس (ثمانية منها ورقية وثلاثة بلاستيكية) أوضح هالستين بأنه يمكن للمريض ذو الأسنان الطبيعية أن يشعر بالثخانة الإطباقية عندما تكون بحوالي ٥٨ ميكرون وعلى هذا فثخانة مواد تسجيل الإطباق يجب أن تكون أقل من عينة إدراك المريض، لذلك فإن اختيار الأوراق الإطباقية الرقيقة مهم جداً للحصول على تسجيل دقيق للأطباق والشرائط الخمسة التي استعملت في هذه الدراسة كانت ضمن المواصفات المطلوبة من ناحية الثخانة.

هناك سيئتين رئيسيتين لاستعمال شرائط إطباقية ثخينة:

١ ـ تظهر لطاخات وعلامات مزيفة.

٢ ـ يشعر المريض بوجود جسم أجنبي بين أسنانه وهذا يؤدي إلى تداخل حدبي مزيف.

إن متانة الشد وهي المقاومة بالكيلوغرام تجاه تمزق شرائط تسجيل الإطباق لذلك فهي غير متعلقة بالثخانة وإنما متعلقة بليونة المادة. وقد أظهرت نتائج هذه الدراسة أن أرق ثلاث شرائط تتمتع بمتانة شد قصوى. لقد أبدت الشرائط نسب متفاوتة من التشوهات اللينة. ومع أن معدل تشوه الشرائط اللينة يتراوح بين ٥٢ ـ ١٢٤٪ لكن بالنسبة لأوراق تسجيل الإطباق كان ١٠٪ فقط. شرائط تسجيل الإطباق التي تشوهاتها اللينة أقل من ذلك تكون قصفة أكثر ويمكن أن تتمزق حتى قبل حدوث التماس الإطباقي.

جميع الشرائط الورقية قصفة الورق غير مستحب إذ يتمزق عندما يصبح رطباً وبالتالي فهو مادة غير عملية لتقدير الإطباق داخل الفم هناك ميزة أخرى للشرائط اللينة وهي لا تتأثر بالرطوبة.

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* Associate Professor, Department of Prosthetic Dentistry
** Research Assistant, Department of Prosthetic Dentistry
*** General Practitioner, Selanik Caddesi 33/1 Kizilay, Ankara
**** $p_{ro}f_{essor}$ and Head, Department of Prosthetic Dentistry, Faculty of Dentistry, Hacettepe University, Ankara, Turkey
Address reprint requests to Dr. O.T. Altay, Dis Hekimi Tunali Hilmi Caddesi, Bilir Sokak, 6/3, Kavaklidere 06700, Ankara, Turkey

تؤيد نتائج هذه الدراسة الدراسات التي بينت أن الزيادة في الثخانة تؤدي إلى زيادة إمكانية التعليم، لقد اختلفت العلامات كثيراً حتى في نفس الظروف ومعدل الاختلاف الأساسي كان بحدود ٢٠ ـ ٢٥٪ وأن علامات الأوراق الإطباقية غير صحيحة وكان لابد من التحري الدقيق خلال عملية التسجيل.

الاستنتاج:

إن اختيار وصحة استعمال الشرائط الإطباقية مهم جداً وثخانتها يجب أن تكون دوماً أقل من ٥٨ ميكرون إضافة إلى تمتعها بتشوه ليونة مقبول، المواد القصفة كالورق غير مرغوب بها.

إن ثخانة الشرائط تؤثر على حجم العلامات والانحراف الأساسي للعلامات بنفس المواد كان مهماً جداً لذلك حتى لو تم الاختيار الصحيح للشرائط فيجب أن تفحص العلامات الناتجة عدة مرات قبل البدء بعملية السحل.

في هذه الدراسة تم اختيار هائل ج. م. ح. (الأزرق والأحمر) وسينسيكولر كأفضل شرائط لتسجيل الإطباق.

Ink, silk paper, plastic strips and wax have been used for a long time in dentistry to determine occusal contacts. These materials indicate different thickness, tensile strength, plastic deformation and marking ability. The manufacturers have not standardized the specification of these materials. Moreover, the articulation strips sold in the market — be they thick, thin or extra thin, differ from each other due to the trademarks. Thus, properties of these materials should be known to the dentist. If the material is unsuitable, it may show contact areas inaccurately and thickness will affect the precision of the restoration. In this study, 11 articulation strips (3 plastics, 8 papers) have been tested and results are presented.

Introduction

Various techniques and materials are used to determine occlusal contacts. Dentists have used colored papers, plastic strips, silk ribbons, waxes, special dyes, elastomeric impression materials, photo-occlusion and articulating film techniques to visualize occlusal contacts,[17] but articulating papers, particularly plastic strips and waxes, are the most commonly used materials.

Registration of occlusal contact is very important for diagnosis and treatment because its accuracy is essential for the success of the treatment.[8] For example, the different thicknesses of articulating papers may display false markings and, thus, cause confusion.[2910]

Manufacturer's designation of registration strip thickness which is presently not standardized, such as micro thin, extra thin and thick, has only rough qualitative relationships to the true strip thickness or marking size.[7]

The purpose of this study was to compare the thickness, strength, plastic deformation and marking characteristics of 11 different occlusal registration strips under dry laboratory conditions.

Materials and Methods

In this study, 11 different occlusal registration strips (8 papers and 3 plastics) were tested for thickness, strength, plastic deformation and marking characteristics. These were Black-Check/[1] Ash Improved,[13] Polydental,[0] Bausch (blue and red),[d] Bausch Dental,[d] Betch,[e] Hanel GHM[f] (red and blue), David Scottlander§ and Sensicolor.[h]

Thickness:

Micrometer[1] and PassameteH were used to measure the thickness of the occlusal registration strips. Five measurements were made for each type and mean values were calculated.

[a] Dental Materials Manufacturers Bon Company.
[b] Amalgamated Dental Trade Distributors Ltd., London, England.
[c] Polydental, Switzerland.
[d] Dr. Jean Bauch KG, 5 Koln, 65-Germany.
[e] Alfred Betch, D-7600 Offenburg, Germany.
[f] Hanel-GMH-Medizinnal, D-740, Nurtingen, Germany.
[8] Scottlander and Davis Ltd., London, England.
[h] Bausch Dental KG, D-5000, Koln 60-Germany.
' Moore & Wright, England.
i Car-Zeiss, West Germany.

Strength:

An Instron[k] universal testing machine was used. The distance between the crossheads was 1.5 cm, loading was 10 kg, crosshead speeds for articulating papers were 10 mm/min and 100 mm/min for plastic strips. Four strips from each brand were tested to determine the mean values.

Plastic Deformation:

The percentage of plastic deformation was calculated by dividing the increase in length at tear

$$\text{Plastic deformation} = \frac{\text{Increase in length} \times 100}{\text{Original length}}$$

point by the original length of the strips.

$$\text{Plastic deformation} = \frac{\text{Increase in length} \times 100}{\text{Original length}}$$

Marking characteristics:

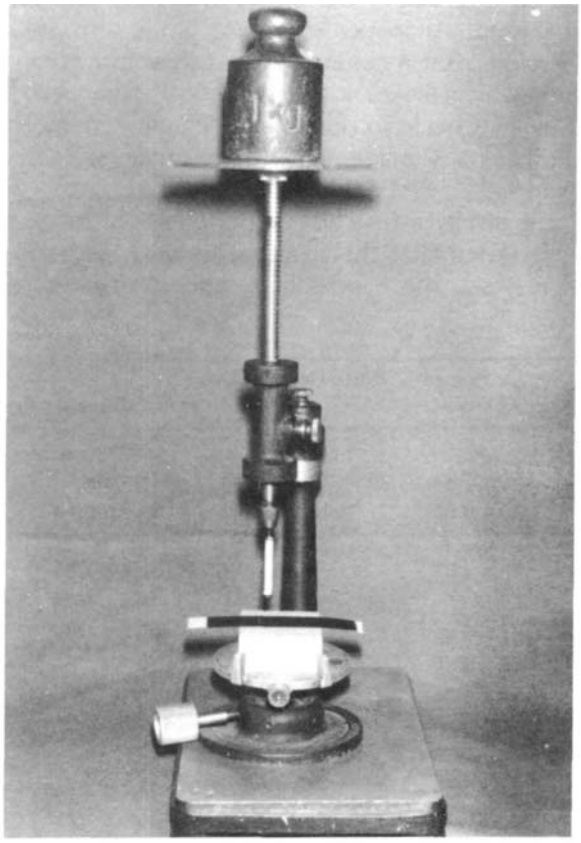

Figure 1. Load application with a parallelometer.

Approximately 10N of force was applied five times for each strip on the stone block, which was located on a parallelometer [Fig. 1]. The load was applied by a 1 cm diameter steel ball [Fig. *2]* which was tied to the parallelometers vertical arm [Fig. 3]. Photographs were taken and magnified (6x) to compare their sizes in mm^2 [Fig. 4]. The measurement was done by placing a transparent paper with millimeter squares onto the photographs, magnified to standard scales.

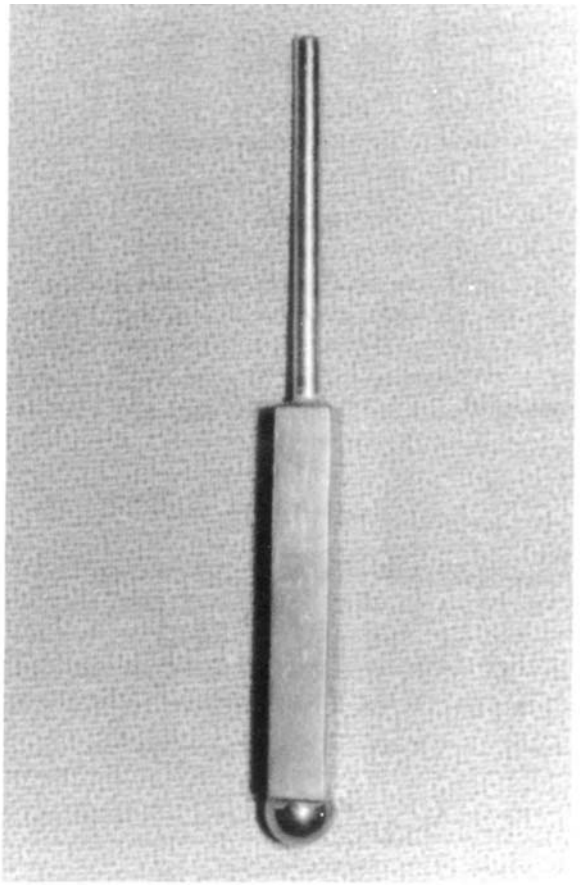

Figure 2. Special parallelometer tip through which the load is applied.

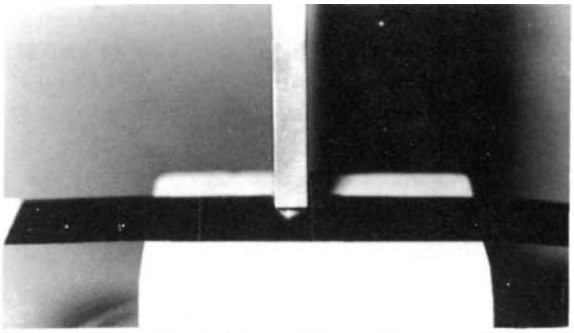

Figure 3. Stone block, strip and the parallelometer tip during loading.

[k] 1185 Universal Materials Testing Machine, England.

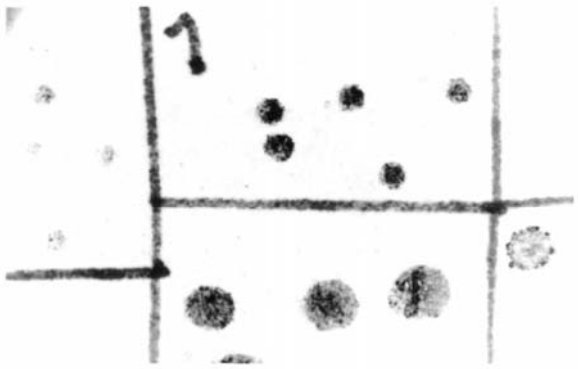

Figure 4. One of the markings after 6× magnification.

Results

The thickness of the tested materials ranged between 22- 203 microns and strength values ranged between 0.85-2.75 kg/cm^2; percentage of plastic deformation ranged between 3-124%, and marking characteristics ranged between 15-104 mm^2 as shown in Table 1.

Discussion

Hollstein[11] stated that the perception of occlusal thickness for a patient with natural teeth was 58 micron. The thickness of occlusal registration materials should be below the patient's perception. Therefore, selecting thinner articulating papers is important in producing accurate registration. Only five strips in this study met this demand.

Using a thicker articulating strip has two major disadvantages of which (1) it may display false markings and smears, and (2) the patient becomes astutely aware of the presence of a foreign substance between teeth, which may result in a false intercuspal relationship.

Tensile strength is the resistance in kilogram to the breakage of occlusal registration strip. Therefore, it is unrelated to thickness but is directly related to the plastic deformation of the material. In this study, the three thinnest strips showed the maximum tensile strengths.

The strips had varying percentages of plastic deformation. Although the deformation of plastic strips ranged between 52-124%, the plastic deformation of various articulating papers was only 10%. Occlusal registration strips that have lower plastic deformation are more brittle and, thus, they break long before the occlusal contact can be evaluated. All paper strips are brittle and are, therefore, not recommended as they tear when wet, which makes it an impractical material for evaluating occlusion intraorally.[9] Plastic strips have another advantage of being unaffected by wetness.[9]

The results of this study supported that of Shelb[7], who stated that the increase in thickness also increases the marking ability. Marking

Table 1. *Results of testing 11 occlusal registration strips.*

	Brand	Thickness (/tx.m)	Tensile Strength (Kg/cm^2)	Plastic Deformation (%)	Marking Area (mi
1.	Hanel GHM occlusion articulation test-foil (blue)	22 ±0.0	2.67±0.19	51	34.4 ±6.80
2.	Sensicolor Bausch Dental KG (red)	25 ±0.0	1.40 ±0.08	124.16	18.2 ± 4.14
3.	Hanel GHM occlusion articulation test-foil (red)	25.33 ±0.57	2.75 ±0.09	55.83	31.4±7.36
4.	Bausch occlusion paper (blue)	43.3 ±0.57	1 ±0.13	6.66	46.2 ±8.34
5.	Bausch occlusion paper (red)	54.67 ±0.57	0.85 ±0.06	7.33	69.9 ±7.85
6a.	Betch articulating paper (red)	70.67 ±0.57	1.63 ±0.07	10	30.2 ±3.34
6b.	Betch articulating paper (blue)	70.67 ±0.57	1.63 ±0.07	10	27 ±4.69
7.	Polydental articulating paper (black)	77 ±0.0	2.61 ±0.47	4.5	15±6.67
8.	David Scootlander articulating paper (blue)	86.33 ±0.57	2.24±0.14	3	38.2 ±9.44
9.	Foncomp. Black-Check articulating paper (black)	94 ±0.00	2.0 ±0.49	9.33	25.4 ± 1.51
10.	Ash improved articulating paper (blue)	175 ±0.0	1.51 ±0.07	9.166	104.2 ± 21.31
11.	Bausch Dental articulating paper (blue)	203.3 ±2.88	1.07 ±0.06	7.66	99±23.25

characteristics of the two strips, tested under the same conditions, were highly deviant with 20—25% standard deviations (Table 1). Such high standard deviations, with the same articulating strip markings, suggests limited reliability of these two materials and that careful checking during handling is needed.

Conclusions

The selection and appropriate handling of occlusal articulating strips are important. Their thickness should be below 58 micron, and they should have adequate plastic deformation. Brittle materials, such as paper, are not desirable.

The thickness of the strips affected the size of the markings. Standard deviation in the marking characteristics of some materials suggested large variation. Therefore, even if the most appropriate articulating strip is chosen, markings should be checked several times before grinding.

Based on this study, Hanel GHM (blue and red) and Sensicolor seemed to meet optimal requirements.

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