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Original Research Article

Measurements of Pressure Area for Different Pressure Indicating Materials

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Abstract

Pressure indicator during insertion of removable prosthesis can help identify potential areas of discomfort resulting from different errors during prosthetic work, correct diagnosis of specific problem relies on proper application of pressure indicator. A study was therefore, undertaken to measure pressure area of upper and lower complete dentures using different types of pressure indicating materials.

Thirty two processed dentures were examined. All of them had a clear tissue surface with no sharp projections to minimize patient discomfort. Three different pressure indicating materials ; zinc oxide, alginate, and extra light silicon were used, surface area measurements were evaluated for each material. Setting time, ease of remove, no. of sites, and coast of the materials were also evaluated.

The results of this study showed that there was a significant difference in pressure area measurements between the three different pressure indicating materials, while there was no difference between alginate and silicon- alginate and zinc oxide materials, while there was a significant difference between silicon and zinc oxide pressure materials. Setting time appreciation showed that silicon set in shorter time than alginate and zinc oxide materials, while for cost variable discussion silicon material revealed a higher cost means than both alginate and zinc oxide materials.

In the present investigation data collected showed a significant difference in pressure area measurements between silicon and zinc oxide materials. Silicon, and alginate pressure materials showed no difference in pressure area readings between them.

Key words: Pressure indicating material, Surface area, Silicon, Zinc oxide.

الخلاصة

الالم للطقم المواد التي تكشف مناطق العلو والالم اثناء ارتداءالطقم المتحرك تساعد في التعرف على مناطق الالم الناتجة عن عدة اخطاء اثناء صنع الطقم.التشخيص الصحيح لمشكلة معينة تعتمدعلى الاستعمال الصحيح لهذه المادة. اجريت دراسة لهذا الغرض لقياس منطقة الالم للطقم الكامل العلوي والسفلي باستخدام مواد ذات انواع مختلفة والمقارنة بينهم.

الكلمات المفتاحية : ارتداء الطقم المتحرك ، الالم للطقم.

Introduction

Pressure indicating materials have been used to detect denture problems during insertion and adjustment appointments [1,2],the use of such materials is an important step to locate an accurate means of excessive pressure that may locate in the tissue surface area[3,4]. Pressure indicators used to investigate denture problems like; overextension, sore spots, and even over thickness of denture material[5].

Patients sometimes are capable of localizing offending areas on their dentures after

insertion, but that becomes sometimes adjustment for the patient suggestions and desire rather than investigation for the accurate diagnosis and treatment of the denture problems [6,7].

Different types of pressure indicators were used by many clinicians, most have used zinc oxide and polymerizing silicone[5,8,9],while others used the disclosing wax as indicator for denture adjustment[10]. Alginate also have been accomplished as a simple material to relieve denture high spot [10,11].

Although many types of pressure indicating materials advocated by many authors, but the number of articles that discuss the difference in material properties still limited till now, this study was therefore undertaken to evaluate surface area between three different pressure indicators; zinc oxide, polyvinyl siloxane, and alginate. Setting time, cost of the materials, and no. of displacement sites have been also discussed.

Materials and Methods

Sample:

Seventy five readings for twenty five processed dentures were evaluated ,each denture should have a smooth tissue surface with no obvious spicules or sharp projections that affect patient discomfort during insertion[5,10].Three different pressure indicating materials were applied for each single denture; extra-lite body silicon(vinyl polysiloxane impression material)(Bisco,Twinzvps),

alginate(Tropicalgin), and zinc oxide powder mixed with olive oil (2.2:2) parts ratio give an acceptable results[12]. Zinc oxide was used after 24 hr of mixing[9,12].

Dry the denture before applying pressure indicators so that material will adhere to the tissue surface of the denture[10,11].We should apply the material with correct amount for each type; as for zinc oxide material the base appear as the color of the media, we use a brush to apply the material with streaks in tissue surface[11,13].For silicon and alginate we use a thin layer as possible that the color of the underlying denture will not appear[5].

Each material was mixed and manipulated according to manufacture s specific for each one. For alginate when used as pressure indicating material, it mixed with (2:4) powder: water ratio that give more viscous consistency rather than mixing as an usually used impression material[10,16].Insert the denture with attention that material not wrapped away by reflecting lip and cheek during insertion[10]Instruct the patient to close on cotton roll at the molar region to apply a firm pressure[14,15].

Digitalization and Mathematical Equation

After identifying areas with high spots and over extentions, These areas were measured as surface area, the method was derived from the original description made by Ferrario et al[17], for each material lines were drawn as fellow landmarks; straight line along the length of the pressure area parallel to the length of the denture representing (L);width(W) is a line represent width of the pressure area parallel to the width of the denture and intersect with the line of (L); and(H) is the line represent thickness or the height of the pressure area.(for large area we take an average of about four readings for both (L),(W) lines) Fig(1).

With the current technology of computerized digitizers measuring directly metriccordinates of selected land marks. In this study we use the ordinary scanner to take a picture with its original dimensions of the materials without any change in the optimization or resolution readings of any indirect optical photo device, these pictures were directly evaluated and measured through data analyzed in the computer[17,18].

Approximation formula derived that represent denture-supporting area(A_D) as a function of three distances between

landmarks[17]: $A_{D=} \mu LW/6 + 5L [(\mu H/4)^2 + (W/6)^2]^{½}$

Statistical analysis

Statistical measurements were analyzed to assess the results of the present study; descriptive statistics: mean(M) ,standard deviation(SD), standard of error(SE),and coefficient of variation(CV) were assessed for three different types of pressure indicators for digitalized computer method. The analysis of variance (ANOVA) and multiple comparisons, with p=0.05 as a significant level of difference were performed.

Results

Table (1) and Fig(2) were shown the descriptive mean and standard deviation of the digitalized method for silicon, alginate, and zinc oxide pressure materials in surface area measurements. Table (2) with(ANOVA) test analysis showed that there was a significant differences between the three different pressure indicating materials($P \leq 0.05$).

Table (3) with p- value measurement showed that there was a nonsignificant difference between the alginate and silicon and between the alginate and zinc oxide materials($P \geq 0.05$), while there was a significant difference between the silicon and zinc oxide materials.

Table (4) showed the no. of sites for each patient with denture discomfort and the actual painful sites of denture area, table(5) discussed the cost of 1gm for each of the three materials used.

Discussion

The dental indicating material used to detect high areas of contact or pressure spots of denture base which may cause irritation or soreness to the mouth tissues, as pressure indicator has been displaced so the size and location of high spots can be easily determined [12,14,15].

In this study measurements of pressure area of complete finished denture were evaluated by using mathematic equation and measuring the corresponding data directly on the processed denture using the digitalized scanner device and three different pressure indicating materials were used; zinc oxide powder,

alginate, and extra light silicon to compare the difference in measurements of pressure area between these materials. The use of newly digitalized area measurement method was improved as a direct, accurate, less time consuming, with less error accumulation than direct distance measurements[20,21].

Data obtained from this study showed that both zinc oxide powder and alginate materials were of high mean pressure area readings than silicon material, but the difference between three groups was significant this results revealed the fact that these materials had a different surface properties specific for each[12,16,19].

There was a significant difference in pressure area measurements between the extra silicon material and zinc oxide pressure material, this results revealed the fact that zinc oxide powder when mixed with vegetable oil becomes a high viscous cream based media in compares with elastomers silicon material[5,12,19]

Pressure area measurements between both silicon and alginate as a pressure indicators showed that there was a nonsignificant differences in mean readings, this result expressed the properties of these two materials as both of them have almost the same properties of elastomeric materials [5,10]. For alginate and zinc oxide materials the difference in measurements was a nonsignificant, this result agreed with the fact that when we use alginate as a pressure indicating material the mixing should be as a more viscous property than the usual mixing when used as impression material[16].

Setting time for these three materials was also discussed, as each material mixed and manipulated according to the manufacture specific for each, except for zinc oxide which mixed and manipulated in ratio to the

olive oil according to the most accepted and proved one[9,12], all these materials mixed at the same room temp.(25^0)and hum.(22%), for silicon material setting time showed shorter time mean value than alginate, this result revealed that the mixing of ultrasilicon type with the gun instrument give an even amounts of catalyst and base cartridges and so on accurate reaction of polymerization process[22,23] in comparison to the manual mixing of alginate material. For zinc oxide it took a longer time(about 28 hr.) to set, this fact revealed that zinc oxide material when mixed with olive oil become almost anon setting creamy type due to the fillers composition[12].Tab(6).

In this study we discuss the ease of remove for each material; for silicon it was much easier to remove from the processed denture than alginate, while for zinc oxide it was difficult and need a soap and water to remove and this results agreed with the findings of Shetty,Shenoy, and Loney et al who found that the elastomeric properties of silicon and alginate make it easier to remove from the dental tray and finished denture[5,10].

Cost of the materials used in this investigation was determined according to cost unit of 1 gm calculation for each of the three materials ,the results indicated that homemade zinc oxide material was the cheapest material in compare to the alginate and silicon cost unit materials calculation, alginate and silicon showed almost an equal cost values. Tab(7).These results agreed with the cost unite calculations found by Bookhan and Owen[24].

No. of sites also discussed in this study; by examining the tissue surface of denture for each of the silicon, alginate , and zinc oxide pressure materials that used to determine discomfort complain for each patient we found that no. of sites appeared in tissue surface for zinc oxide material were more than both alginate and silicon materials Fig[3,4,5], and after removal of patient discomfort pressure area the no. of site for this material were also more than both alginate and silicon pressure indicators, this material behavior may due to the highly viscosity of zinc oxide after mixing with olive oil and so on give many tissue displacements spots rather than the actual sites of denture discomfort [6,8].

Conclusion

Denture adjustments are more effective and accurate by using pressure indicators to improve diagnosis of denture problems rather than patients desire, ultrasilicon material showed that although of benign an expensive material but with accurate mixing procedure, ease of remove, shorter setting time, accurate details of pressure area and no. of actual sites than alginate and zinc oxide materials.

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Table 1: Descriptive of three pressure materials groups

	S	*A*	*Z*
Mean	**166.0276**	**204.4223**	**241.5197**
SD	**77.80851**	**103.718**	**100.8993**
SE	**15.5617**	**20.74361**	**20.17985**
Min	**14.24481**	**35.03174**	**56.5697**
Max	**348.9654**	**414.5641**	**421.5907**
C.V	**46.86481**	**50.73714**	**41.77682**

Figure 2 : Descriptive means of the materials group

Table 2 : ANOVA between groups

	F-test	**P-value**	**Sig**
Between groups S,A,Z	**3.959**	**0.023**	**S**

***p<0.05 Significant**

.

Table 3: LSD of pressure area measurements for three pressure indicators

	Mean difference	**P-value**	**Sig**
S&A	**-38.8947**	**0.157**	**NS**
S&Z	**-75.4921**	**0.006**	**S**
A&Z	**-37.0974**	**0.171**	**NS**

***p<0.05 Significant**
****P>0.05 Non significant**

Table 4 : No. of sites for each material and actual sites to be adjusted

patients	No. of sites			Actual sites of pt. discomfort need to be adjusted
	S	A	Z	
1	5	5	8	4
2	2	2	3	2
3	5	4	4	2
4	1	3	5	1
5	3	0	6	3
6	5	4	5	4
7	4	3	7	3
8	6	4	6	2
9	5	4	9	4
10	6	5	7	4
11	2	0	4	1
12	4	4	5	4
13	3	3	3	3
14	4	3	5	4
15	2	1	3	2
16	5	2	6	5
17	4	4	7	3
18	5	1	5	4
19	4	4	8	4
20	1	1	1	1
21	5	3	5	4
22	6	5	6	6
23	2	2	5	2
24	3	2	5	3
25	4	4	7	4

Table 5 : cost for each 1 gm unit calculation for three materials

	Cost for 115 gm	Cost for 1 gm
S	200 $	1.739 $
A	170 $	1.481 $
Z	8.410 $	0.073 $

Table 6: Mean value setting time for each material

	S.T (min)	Mean value
S	4 min	3.25 min
A	4.5 min	4 min
Z	30 hr	28 hr

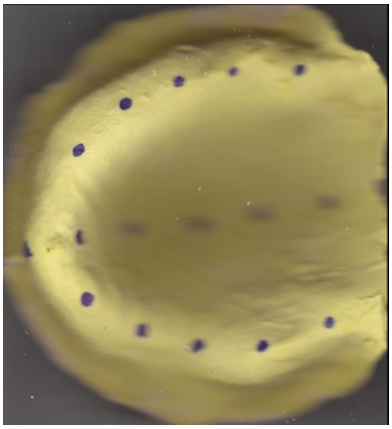

Figure 1: Digitalization of the cast

Figure 3: silicon pressure indicator

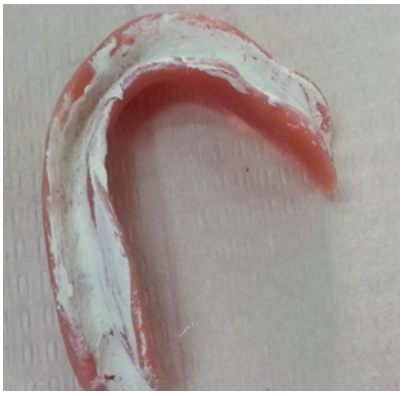

Figure 4: zinc oxide pressure indicator

Figure 5: alginate pressure indicator