COMPARISON OF LINEAR DIMENSIONAL STABILITY OF TWO ELASTOMERIC BITE REGISTRATION MATERIALS FOLLOWING CHEMICAL AND MICROWAVE DISINFECTION – AN INVITRO STUDY


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Abstract:
Purpose: The objective of this investigation was to evaluate and compare the effect of microwave disinfection and chemical disinfection on linear dimensional stability of vinylpolysiloxane (VPS) and polyether (PE) bite registration materials.

Materials and Methodology: Following American Dental Association (ADA) specification 19 protocols, 33 specimens from stainless steel master die were made with each material. Eleven specimens of each material were assigned to a treatment group: (1) No disinfection; (2) 10-minute immersion in 2% glutaraldehyde; (3) Microwave disinfection at 700W for 6 min. The test samples were washed under water for 15 seconds, dried and measured using a stereomicroscope at 0.7X magnification. One- way ANOVA and unpaired t-test with significance level of 5% were used to assess the statistical data.

Results: All the test specimens showed dimensional changes when compared to the control group. There was no statistical significant difference in both intra group and inter group comparisons. Addition silicone showed less dimensional change compared to polyether.

Conclusion: Disinfection using microwave can be used as an effective alternative method to chemical disinfection.

Key words: Addition silicone, polyether, bite registration materials, dimensional stability, microwave disinfection, interocclusal record.

Introduction:
The interocclusal relationship should be recorded and accurately transferred to the articulator by means of bite registration records during prosthetic rehabilitation[1,2]. Polyether and polyvinylsiloxane based bite registration materials are widely used considering their favorable physical properties[3,4]. Bite registration materials exposed to blood and saliva may act as significant source of cross contamination for infectious diseases like tuberculosis, herpes, hepatitis B and AIDS[5]. ADA guidelines has stated, spraying or immersion in 2% glutaraldehyde and

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sodium hypochlorite solutions are accepted methods of disinfection [6,7]. Two important factors should be considered when choosing a disinfectant, ability to eliminate microbial contamination and its effect on the resultant material [8,9]. Recently the use of domestic microwave oven to disinfect complete dentures, dental casts, hard chair side reline resins and elastomeric impression materials has been proposed[10]. Studies have proven that disinfection of elastomeric impression materials through microwave have shown dimensional changes < 0.5% which was clinically not significant according to ADA specification no.19 criteria[11]. No studies were found in the literature to evaluate the dimensional stability of elastomeric bite registration materials after microwave disinfection. The present study was formulated to evaluate linear dimensional accuracy of polyether and polyvinylsiloxane bite registration materials after microwave and chemical disinfection.

Materials and methodology:
Two commercially available bite registration materials- Polyether bite registration material – Ramitec (3M ESPE, Germany), Polyvinylsiloxane bite registration material - Jetbite (COLTENE, Switzerland) were selected. A stainless steel master die apparatus consisting of a ruled block, a ring mold and riser was fabricated [fig-1]. The ruled block consists of three horizontal lines X,Y,Z and two vertical lines CD and CI. The width of lines X, Y, Z and for CD and CI were 75 µm. The lines CD and CI were separated from each other by 25mm. The ring mold was a cylinder of inner diameter 30 mm and depth of 6 mm to place the bite registration material. The riser was a stainless disk of diameter 29.9 mm and thickness of 3 mm. [fig-2;fig-3]

Preparation of specimens using polyvinylsiloxane (PVS):
The material (Jetbite, COLTENE, Switzerland) was automixed and dispensed into the ring mold, assembled on the ruled block. A glass plate covered with polyethylene sheet was placed on the assembly and a 500 grams weighing stone was kept and allowed to set for 4 - 5 min in order to simulate the clinical impression seating force[16].

A Total of 33 specimens were prepared following the similar procedure and categorized as Group-I.[fig-4]

Group – I specimens were further divided into three subgroups G – I, M – I, O - I.

G – I (n=11) : specimens were immersed in 2 % glutaraldehyde for 10min.

M – I (n=11) : specimens were subjected to microwave disinfection by placing the specimens in a 300 ml microwavable plastic container with lid having an aperture for escape of water vapour. The container was filled with 200 ml distilled water till the specimens were completely immersed. The power was set to 700 W for 6 min.

O – I (n=11) : Specimens were not subjected to disinfection and were considered as control group.

Preparation of specimens using polyether(PE):
The required amount of equal length of pastes were dispensed on glass slab and mixed for 45 sec to get homogenous streak free mix. The mix was loaded into a plastic syringe provided by the manufacturer. The mix was injected into the ring mold, assembled on the ruled block. Glass plate covered with polyethylene sheet was placed on the assembly and a 500gms weighing stone was kept and allowed to set.

Total 33 specimens were prepared following the similar procedure and categorized as Group – II.[fig-5]
Group – II specimens were further divided into 3 subgroups G – II, M – II, O - II.

G – II (n=11) : Specimens were immersed in 2 % glutaraldehyde for 10 min.

M – II (n=11) : Specimens were subjected to microwave disinfection by placing the specimens in a 300 ml microwavable plastic container with lid having an aperture for escape of water vapour. The container was filled with 200 ml distilled water till the specimens were completely immersed. The power was set to 700 W for 6 min. O – II (n=11) : Specimens were not subjected to any disinfection and were considered as control group. Following disinfection, the specimens were rinsed under tap water for 15 sec, allowed to dry in the open air and stored in a sealed polyethylene bag. The specimens were observed under stereomicroscope at 0.7X magnification and images were captured using Olympus DP 17 camera [fig-6]. The images were analysed using image proplus version- 6.2 software. Dimensional changes were evaluated by measuring the horizontal distance between the two vertical lines CD and C'D' [fig-7]. A total of three measurements were recorded at PP1, QQ1, RR1 for each specimen and the mean was calculated. The collected data was tabulated and subjected to statistical analysis using One-way ANOVA test and Unpaired t-test.

Results:
Mean linear dimensional change values of subgroups of PVS – chemical, microwave and Control were 24.73 mm (±0.11), 24.67 mm (±0.06), 24.75 mm (±0.19) respectively. Comparison of linear dimensional change values by using One-way ANOVA test showed F value of 1.098. The difference was statistically not significant (p=0.346). [Table-1] Mean linear dimensional change values of subgroups of PE – chemical, microwave and Control were 24.65 mm (±0.68), 24.66 mm (±0.05), 24.71 mm (±0.07) respectively. Comparison of linear dimensional change values by using One-way ANOVA test showed F value of 3.028. The difference was statistically not significant (p=0.06). [Table-2] Comparison of linear dimensional change values between chemically disinfected – PVS group and chemically disinfected – PE group showed a mean and standard deviation of 24.73mm(±0.11) and 24.65mm(±0.68), respectively. The differences were statistically insignificant (p=0.052). Comparison between microwave disinfected – PVS group and microwave disinfected – PE group showed a mean and standard deviation of 24.67 mm (±0.06) and 24.66 mm (±0.05), respectively. The difference was not significant (p=0.717). Comparison between control – PVS group and control – PE group showed a mean and standard deviation of 24.75 mm (±0.19) and 24.71 mm (±0.07) respectively. The differences considered to be statistically insignificant (p=0.573) [Table-3]

Discussion:
Prosthetic rehabilitations frequently require an interocclusal record to fabricate a successful restoration. Traditionally the elastomeric bite registration materials were rinsed under running water after removal from the mouth to visibly eliminate saliva and blood[5]. To prevent cross contamination, bite registration materials must be disinfected either by spray or by immersion method[7]. In spray method disinfectant tends to pool and all surfaces are not uniformly disinfected for required length of time. Immersion disinfection is considered to be a more reliable method which ensures even contact between the disinfectant and the material[12]. Most commonly used disinfectant is 2% glutaraldehyde. It acts by fixing cell membranes, blocking the release of cellular components and consequently killing the microorganisms. However, the chemical disinfection procedures are inefficient in removing spore form of microbes and also time consuming[13]. Heat sterilization was found to be more efficient than chemical disinfection. In case of microwave oven, the temperature was increased because substances with high dielectric constant such as water...
absorb microwaves and convert the energy to heat. As the temperature of the material increases, its ability to absorb microwaves also goes up, increasing the temperature. Microbial lethality of microwave radiation may be due to the penetration of electromagnetic waves into a biological wet material, heating up the intra and extra cellular fluids by the transfer of energy from polar water molecules and dissolved ions. This results in the generation of heat within the material itself due to molecular activity. Microwave treatment has been reported to cause protein denaturation and aggregation in cytoplasm as well as to induce heat shock proteins, which may cause microbial inactivation\[14,15\]. Disinfectants used should be as effective as antimicrobial agents, and should not affect the dimensional accuracy of the materials. Loss of volatile substances could lead to weight loss, has been correlated to linear dimensional changes used for bite registration\[16\]. The present study was formulated to evaluate the linear dimensional accuracy of microwave and chemical disinfected bite registration materials. Elastomeric bite registration records must be used to mount the casts to the articulator as soon as possible. In the present study, to avoid any climatic effects on the records, the specimens were examined under the stereomicroscope within 3 to 5 hrs. In the current study, mean linear dimensional change values of polyvinylsiloxane bite registration material after chemical and microwave disinfection were reduced by 0.07% and 0.3% respectively, when compared with the control group PVS. This indicates that, there was a mild contraction of the material following microwave disinfection, however the difference was not statistically significant. The mean dimensional change values of polyether bite registration material after chemical and microwave disinfection were reduced by 0.25% and 0.22% respectively, when compared with control group PE. This infers that, there was only mild contraction of the material following disinfection and the difference was statistically insignificant. The mean dimensional changes observed in both polyvinylsiloxane and polyether bite registration materials after disinfection were less than 0.5% which were clinically not significant according to ADA specification no. 19. On comparison of linear dimensional change values between chemically disinfected PVS group (24.7364) and chemically disinfected PE group (24.6545), the PVS group showed higher mean. Similar results were obtained on comparison of linear dimensional change values between microwave disinfected PVS group (24.6727) and microwave disinfected PE group (24.6636). The differences were not significant statistically. Contraction of the bite registration material was found in all the specimens after disinfection, which was in accordance with the previous studies\[17\]. This might be due to the loss of volatile substances due to rise in temperature. Polyvinylsiloxane bite registration material was found to be dimensionally more stable than Polyether bite registration material, although there was no statistically significant difference. Cook\[18\] reported a more abrupt transition between the gel (initial) and the final set stages of polyether than of the polyvinylsiloxane. This could have accounted for the increased dimensional change of the polyether. In the present study microwave disinfection didn’t show any significant change in the dimensional stability of the bite registration materials. In order to prevent cross contamination among dental personnel, microwave disinfection of elastomeric bite registration materials can be safely used as an alternative method to chemical and autoclave disinfection, as microwave disinfection is simplest, fast, and less cumbersome.

**Conclusion:**

Significant dimensional changes were not observed between chemically disinfected polyvinylsiloxane bite registration material and Microwave disinfected polyvinylsiloxane bite registration material, compared with the control group. No significant dimensional changes were observed between chemically disinfected polyether bite registration material and Microwave disinfected polyether bite registration material, compared with the control group. Microwave oven,
can be used as an alternative for chemical disinfection without affecting the linear dimensional stability in both polyvinylsiloxane and polyether elastomeric bite registration materials.

References:


Tables

Table 1: Comparison of mean linear dimensional change values (in mm) between the subgroups of PVS using One way ANOVA test

<table>
<thead>
<tr>
<th>Group - I</th>
<th>Sub group</th>
<th>Sample Size</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>F-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVS</td>
<td>G - I</td>
<td>11</td>
<td>24.7364</td>
<td>.11201</td>
<td>1.098</td>
<td>0.346</td>
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<tr>
<td></td>
<td>M - I</td>
<td>11</td>
<td>24.6727</td>
<td>.06467</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>O - I</td>
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<td>24.7545</td>
<td>.19679</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Comparison of mean linear dimensional change values (in mm) between the subgroups of PE using One way ANOVA test
### Table 3: Comparison of mean linear dimensional change values (in mm) between the Groups using unpaired t – test

<table>
<thead>
<tr>
<th>Type of Disinfection</th>
<th>Material</th>
<th>Sample Size (n)</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Unpaired T</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>Chemical (G)</td>
<td>PVS</td>
<td>11</td>
<td>24.7364</td>
<td>.11201</td>
<td>2.065</td>
<td>0.052</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>11</td>
<td>24.6545</td>
<td>.06876</td>
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<tr>
<td>Microwave (M)</td>
<td>PVS</td>
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<td>24.6727</td>
<td>.06467</td>
<td>0.368</td>
<td>0.717</td>
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<tr>
<td></td>
<td>PE</td>
<td>11</td>
<td>24.6636</td>
<td>.05045</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (O)</td>
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<td>24.7545</td>
<td>.19679</td>
<td>0.573</td>
<td>0.573</td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>11</td>
<td>24.7182</td>
<td>.07508</td>
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<td></td>
</tr>
</tbody>
</table>

**Figures**
Fig 1: Master die apparatus

Fig 2: Schematic diagram of block reproduction
Fig 3: Schematic diagram showing ruled surface of die

Fig 4: Polyvinylsiloxane specimens
Fig 5: Polyether specimens

Fig 6: Measurement of specimens under stereomicroscope
Fig: Stereomicroscopic image showing measurement of specimen