Comparative Contact Angle Analysis of 1% Chlorhexidine and 2% Metronidazole Mouthgel - An In Vitro Study

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Authors’ contributions

This work was carried out in collaboration between both authors. Authors AC and SBG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author SBG managed the analyses of the study. Both authors read and approved the final manuscript.

Article Information

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ABSTRACT

Introduction: Chlorhexidine is considered to be gold standard drug in treating various oral infections. Metronidazole is effective for treating various anaerobic infections, including dental abscess and periodontal abscess. In current technical applications and material sciences, contact angle is a thermodynamic characteristic that describes the wettability of solid surfaces. The aim of this study is to compare the contact angle of chlorhexidine and metronidazole mouth gel.

Materials and Methods: Total 10 samples of gel was used, involving 5 samples of 1% chlorhexidine gel and 5 samples of 2% metronidazole gel. The contact angles were measured with the Ossila Goniometer after each sample was dispensed from a microsyringe on the facial surface of the microtomed tooth. The obtained values from the samples were determined, and the data was statistically analysed using SPSS software version 20.0. The paired t test was used to analyse the data.
Results: From the data collected it was found that the average contact angle of the mouth gels that is chlorhexidine and metronidazole gel were 51.58 & 67.04 respectively. T test showed p value of 0.157, (p value < 0.05). Hence, it is statistically not significant. Chlorhexidine gel had a lower average mean of contact angle than metronidazole gel, which means chlorhexidine gel had got better wettability when compared to metronidazole gel.

Conclusion: Thus, it can be concluded that chlorhexidine gel has a better tendency to wet the tooth or oral cavity surfaces when compared to metronidazole gel, thereby it can have better action in treating various oral conditions.

Keywords: Chlorhexidine; Metronidazole; contact angle; wettability; gel; innovative measurement.

1. INTRODUCTION

Gingivitis is one of the most common diseases, affecting 82 percent of the world's adult population [1]. Gingivitis and periodontitis are caused by dental plaque, which is an etiological factor [2]. Plaque is mostly made up of bacteria encased in a matrix of salivary glycoprotein and extracellular matrix, and removing this bacterial biofilm is essential for treating gingivitis and periodontitis [3]. Scaling and root planing destroy bacterial biofilms mechanically, although various studies have shown that mechanical debridement alone is sometimes insufficient in removing flora responsible for periodontal disorders [4].

Chemical plaque removal agents have gained popularity as an adjuvant to mechanical therapy as a result of this. As an adjuvant to mechanical plaque removal, antimicrobials such as Chlorhexidine and Metronidazole have been utilised. The gold standard mouthrinse for gingivitis treatment is chlorhexidine. Several studies have shown that using Chlorhexidine as an adjuvant treatment for periodontitis has no significant benefits. It possesses a wide antiseptic range as well as substantivity [5]. Because of its specific antibacterial efficacy against obligate anaerobes, metronidazole has been used by a number of researchers. Gingivitis and periodontitis have both been successfully treated with it.

In current technical applications and material sciences, contact angle is a thermodynamic characteristic that describes the wettability of solid surfaces [6]. Many factors influence contact angles, including surface geometry, roughness, contamination, deformation, and so on. Because of this sensitivity, this very macroscopic test can detect extremely small-scale impacts [7]. It is described as an angle empirically measured on the liquid side (denser liquid side in the case of two liquids) between the tangent to the solid surface and the tangent to the liquid-fluid interface at the contact line between the three phases, according to its terminology. The contact point is defined as the place where two tangent lines connect. In the sense that it applies to all equilibrium and non-equilibrium circumstances, the preceding definition is generic [8]. Our team has extensive knowledge and research experience that has been translated into high quality publications [9–28]. The aim of this study is to compare the contact angle of 1% chlorhexidine and 2% metronidazole mouth gel.

2. MATERIALS AND METHODS

This in vitro study was conducted in white lab, Saveetha Dental College, Chennai, India. Total 10 samples of gel was used, involving 5 samples of 1% chlorhexidine gel and 5 samples of 2 % metronidazole gel. The contact angles were measured with the Ossila Goniometer after each sample was dispensed from a microsyringe on the facial surface of the microtomed tooth. The obtained values from the samples were determined, and the data was statistically analysed using SPSS software version 20.0. The paired t test was used to analyse the data. P value was set as 0.05 as level of significance.

3. RESULTS AND DISCUSSION

Gels are fascinating materials that can act as either solids or liquids due to a three-dimensional cross-linked network that is enlarged across their entire volume by a fluid [29,30]. The sessile drop or static contact angle is the most basic contact angle. When a liquid drop sits stationary on a surface, it is said to be in this state. Dynamic advancing and receding contact angles are measured to capture the entire range of angles for a given surface. The discrepancy between the advancing and retreatting angles is known as contact angle hysteresis [31,32]. Gels have various pharmacological functions and other unique properties. Sissle-drop goniometry can be
Table 1. Mean, standard deviation and significance values between groups

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. deviation</th>
<th>Std. error mean</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorhexidine</td>
<td>5</td>
<td>51.58</td>
<td>29.150</td>
<td>13.036</td>
<td>0.157</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>5</td>
<td>67.04</td>
<td>13.924</td>
<td>6.227</td>
<td>0.157</td>
</tr>
</tbody>
</table>

used to determine the gels' contact angle. The sessile drop or static contact angle is the most basic contact angle. When a liquid drop sits stationary on a surface, it is said to be in this state. Dynamic advancing and receding contact angles are measured to capture the whole range of angles for a given surface. The discrepancy between the advancing and retreating angles is known as contact angle hysteresis. Hysteresis is caused by a surface's chemical and topographical heterogeneity, solution contaminants absorption on the surface, or the solvent swelling, rearranging, or altering the surface [33].

Wetability is inversely proportional to contact angle. The sessile drop or static contact angle is the most basic contact angle. When a liquid drop sits stationary on a surface, it is said to be in this state. According to a previous study, low contact-angle values indicate a tendency for water to spread and attach to the surface, whereas high contact-angle values indicate a tendency for the surface to resist water. Yan used the sessile drop method to figure out how contact angle hysteresis and progressive contact angle work. The geometric approach (sessile drop method) provides for various assumptions and models of the measuring liquid drops for determining the contact angle. The models of liquid drops are classified into the spherical droplet model, the drop curve model (the Bashforth method), and the ellipsoidal method [34].

Chlorhexidine has a broad spectrum of action, making it effective against both Gram-positive and Gram-negative bacteria, as well as fungi. It exerts a bactericidal effect, increasing the permeability of bacterial cell membranes and changing protein properties. Chlorhexidine is considered to be gold standard drug in treating various oral infections. Metronidazole is effective for treating various anaerobic infections, including dental abscess and periodontal abscess. A systematic evaluation found that subgingival application of chlorhexidine gel as an addition to nonsurgical periodontal treatment for chronic periodontitis is very effective [35]. From the data collected it was found that the average contact angle of the mouth gels that is chlorhexidine and metronidazole gel were 51.58 & 67.04 respectively. T test showed p value of 0.157, (p value < 0.05). Hence, it is statistically not significant. Chlorhexidine gel had a lower average mean of contact angle than metronidazole gel, which means chlorhexidine gel had got better wettability when compared to metronidazole gel. The limitations of the study was less sample size and only static contact angle analysis for the mouthgels was done.

4. CONCLUSION

The average contact angle of chlorhexidine gel is lower than the average contact angle of metronidazole. Thus, it can be concluded that chlorhexidine gel has a better tendency to wet the tooth or oral cavity surfaces when compared to metronidazole gel, thereby it can have better action in treating various oral conditions.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.
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