Effects of Nd:YAG laser irradiation on the growth of *Candida albicans* and *Streptococcus mutans* – in vitro study


**Introduction:** *Streptococcus mutans* is one of the main bacterial strains colonizing the oral cavity and a major contributor of tooth decay, which in turn may affect the overall health of the host. Research shows that glucosyltransferases from *S. mutans* (Gtfs) are a key factor in the development of virulent dental plaque. The fungal species of *Candida albicans* is by far the most commonly detected fungal organism in humans, part of the healthy human microbiota, but in immunocompromised hosts it may cause a number of infections, ranging from superficial infections of the mucosa and skin, to life-threatening systemic infections.

**Study design**

The following parameters were applied in two experimental groups: Cultures of *Streptococcus mutans* (ATCC 25175) and *Candida albicans* (ATCC 90028) were exposed to irradiation with Nd:YAG laser (LightWalker, Fotona) with flat-top Genova handpiece with the following parameters:

- 100 microsec/puls (MSP),
- spot area 1 cm²,
- energy distribution profile: flat-top,
- L1 group: 0.25 W, 10 Hz, 15 s, 3 J/cm²,
- L2 group: 1 W, 10 Hz, 60 s, 60 J/cm².

Control group: non irradiated. Quantitative analysis of the pathogenic cultures was performed directly after the application and 24 hours after.

*C. albicans* cells are frequently found along with *S. mutans*, derived plaque biofilms. Recent studies indicate high prevalence of *S. mutans* in dental biofilm where the fungal pathogen *C. albicans* resides, suggesting that this association is involved in the enhancement of biofilm virulence. *C. albicans* coadheres with *S. mutans* in the presence of sucrose. Such bacterium-fungus association may enhance *S. mutans* infection and augment fungal carriage and infectivity of mucosal disease. Management

**Fig. 1:** Macroscopic image of the effect of laser on the quantity of *Streptococcus mutans*. 

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of infections caused by bacteria and fungi is a viable challenge in various medical fields, including dentistry.

**Results**

The analysis of the effects of laser irradiation revealed a statistically significant reduction (p < 0.0001) of both and \( S. \) mutans cultures for both sets of parameters of laser application. In both cases (lower fluence (L1) and higher fluence (L2) the number of pathogens was reduced by 95%.

**Conclusions**

We suggest that laser-based antimicrobial treatment using fluence of 3 J/cm\(^2\) (0.25 W) and 60 J/cm\(^2\) (1 W) can significantly reduce the quantity of \( S. \) mutans and \( C. \) albicans in biofilm.

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**Fig. 2:** Macroscopic image of the effect of laser on the quantity of \( C. \) albicans.

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<thead>
<tr>
<th></th>
<th>( S. ) mutans</th>
<th>( C. ) albicans</th>
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<tbody>
<tr>
<td></td>
<td>L1 (0.25W, 1Hz, 50s, 50/cm(^2))</td>
<td>L2 (1W, 10Hz, 60s, 60/cm(^2))</td>
</tr>
<tr>
<td>control</td>
<td>3.25 x10^8 cfu/ml</td>
<td>3 x10^8 cfu/ml</td>
</tr>
<tr>
<td>directly after irradiation</td>
<td>4.4 x10^7 cfu/ml</td>
<td>2.7 x10^7 cfu/ml</td>
</tr>
<tr>
<td>control at 24h</td>
<td>9.3 x10^6 cfu/ml</td>
<td>9.25 x10^6 cfu/ml</td>
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<tr>
<td>at 24h after irradiation</td>
<td>3.7 x10^5 cfu/ml</td>
<td>2.37 x10^5 cfu/ml</td>
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<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>L1 (0.25W, 1Hz, 50s, 50/cm(^2))</td>
</tr>
<tr>
<td>control</td>
<td>3 x10^8 cfu/ml</td>
</tr>
<tr>
<td>directly after irradiation</td>
<td>2.5 x10^7 cfu/ml</td>
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<tr>
<td>control at 24h</td>
<td>8.96 x10^6 cfu/ml</td>
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<tr>
<td>at 24h after irradiation</td>
<td>1.1 x10^6 cfu/ml</td>
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**References:**


Opisana praca została zaprezentowana w formie plakatu i wyróżniona podczas podczas 2. Kongresu Polskiego Towarzystwa Stomatologii Laserowej (PTSL) w Krakowie 24-25 listopada 2017 r.