Aim
The objective was to evaluate whether pulse heating thermal images could quantify natural sound enamel and non-cavitated lesions.

Materials and Methods
1) The premolars on the approximal surfaces were visually assessed. Simulated biting X-rays were taken to evaluate lesion extension. The lesions were divided into three groups: lesions within outer half of enamel (D1), lesions within inner half of enamel (D2), and lesions that reached to the dentin-enamel junction (DEJ; D3).

2) Among these lesions, total of nine non-cavitated lesions that were surrounded by sound enamel was selected (three for each group).

3) A xenon flash lamp was employed as the heat source (1600×4J/excitation-time: 1/1200s). The distribution of the infrared radiation energy was acquired by the infrared camera (113 images/s).

4) The temperature descent curve between $I_r$ (intensity of the infrared radiation energy) and $t$ (elapsed time after the pulse heating) was fitted on the logarithmic curve expressed by the following equation with coefficients $A$ and $B$: $I_r = -A \ln(t) + B$. One-way ANOVA was used to compare the coefficient $A$ estimates between the areas (sound enamel and lesion).

Results

Figure 1. Schematic of study procedure and areas of interest.

Figure 2. Example of thermal profiles (D2) obtained at two regions, sound enamel and lesion after pulse heating.

Figure 3. Average and Standard Deviations of Coefficient $A$ for Sound enamel and Lesion Regions. Superscript letters indicate there is no significantly difference ($p>0.05$).

Table 1. Average and standard deviations of coefficient $A$ for all groups.
Superscript letters indicate there is no significantly difference ($p>0.05$).

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Region</td>
<td>23.1 ± 5.0</td>
<td>18.7 ± 2.7</td>
<td>18.6 ± 6.2</td>
<td></td>
</tr>
<tr>
<td>Lesion Region</td>
<td>34.5 ± 7.3</td>
<td>39.7 ± 7.4</td>
<td>34.4 ± 4.6</td>
<td></td>
</tr>
</tbody>
</table>

**D1**: Lesions within outer half of enamel  
**D2**: Lesions within inner half of enamel  
**D3**: Lesion that extended to the dentin-enamel junction (DEJ)

Conclusion
Thermal images under pulse heating have the potential to quantify non-cavitated enamel caries from sound enamel.