SCIENTIFIC REPORT

Structur 3 – Polymerisation heat

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Structur 3 is the new material from VOCO for producing temporary crowns and bridges. It is characterised by excellent aesthetics, longevity and user-friendly application. Besides strength and other physical properties, heat generation also plays a key role during polymerisation with temporary restorations as curing of the material sometimes takes place directly on the vital, prepared tooth. The knowledge about the increase in temperature in the pulp is very important, because devitalisation due to denaturing of proteins occurs with a temperature of 41°C or more. The increase in temperature in the pulps during the curing of temporary restorations was investigated by Hanover Medical School using four different c&b-materials.[1]

The study involved producing a five-unit bridge with the abutment teeth 23, 25 and 27 and a single crown on tooth 25. The extracted human teeth were prepared and maintained on a base at a constant temperature of 36 °C to create realistic conditions. Prior to use the materials for the temporary crowns and bridges were to be brought to room temperature, which was set at 23 °C here. Thanks to compliance with these temperatures differences in measured values could then be attributed to the material or the shape of the temporary restoration.

Details of the study

For the test set-up the extracted teeth 23, 25 and 27 were prepared to accommodate a five-unit bridge and embedded in a base of epoxy resin filled with copper powder which provided for temperature control. The pulp chambers of the teeth were each equipped with thermocouples to measure the difference in temperature in relation to the initial temperature. The measured results (see Fig. 1) were named according to the position of the thermocouples, i.e. tooth 23 is shown as “3 central”, tooth 25 as “5 central”, and tooth 27 as “7 lingual” and “7 buccal” due to the use of two thermocouples. The set-up was then heated to 36 °C in a heating chamber. The investigated materials, Luxatemp Star from DMG and Structur 2 SC, Structur Premium and Structur 3 from VOCO were brought to room temperature (23.0 ± 0.3 °C) prior to use. The materials were mixed, placed in the impression and then applied to the prepared teeth 25 s after the start of mixing. The chamber was then opened again 90 s after the start of mixing (120 s in the case of Luxatemp Star) to remove the impression with the temporary restoration. The elastic phase of the materials had come to an end by this time.

Results

The results first of all showed that a typical temperature sequence could be observed regardless of the material used and the individual tooth under examination. The stumps heated to a temperature of 36 °C firstly cool down a few degrees after the impression containing the material is applied, before the polymerisation heat causes the temperature of the pulp to slightly rise again.

Figure 1 shows the maximum temperatures reached inside the pulp chamber during the intraoral curing of the four provisional crown & bridge material. The extent of the change in temperature also depends on the quantity of material surrounding the tooth. This can be seen more clearly if the central abutment tooth is considered. Independently of the material used, tooth 25 reached the highest temperatures due to its position between two bridge units which applied polymerisation heat from both sides. Nonetheless neither the critical temperature of 41 °C nor the initial temperature of 36 °C (red line in figure 1) was attained by the end of measurement.

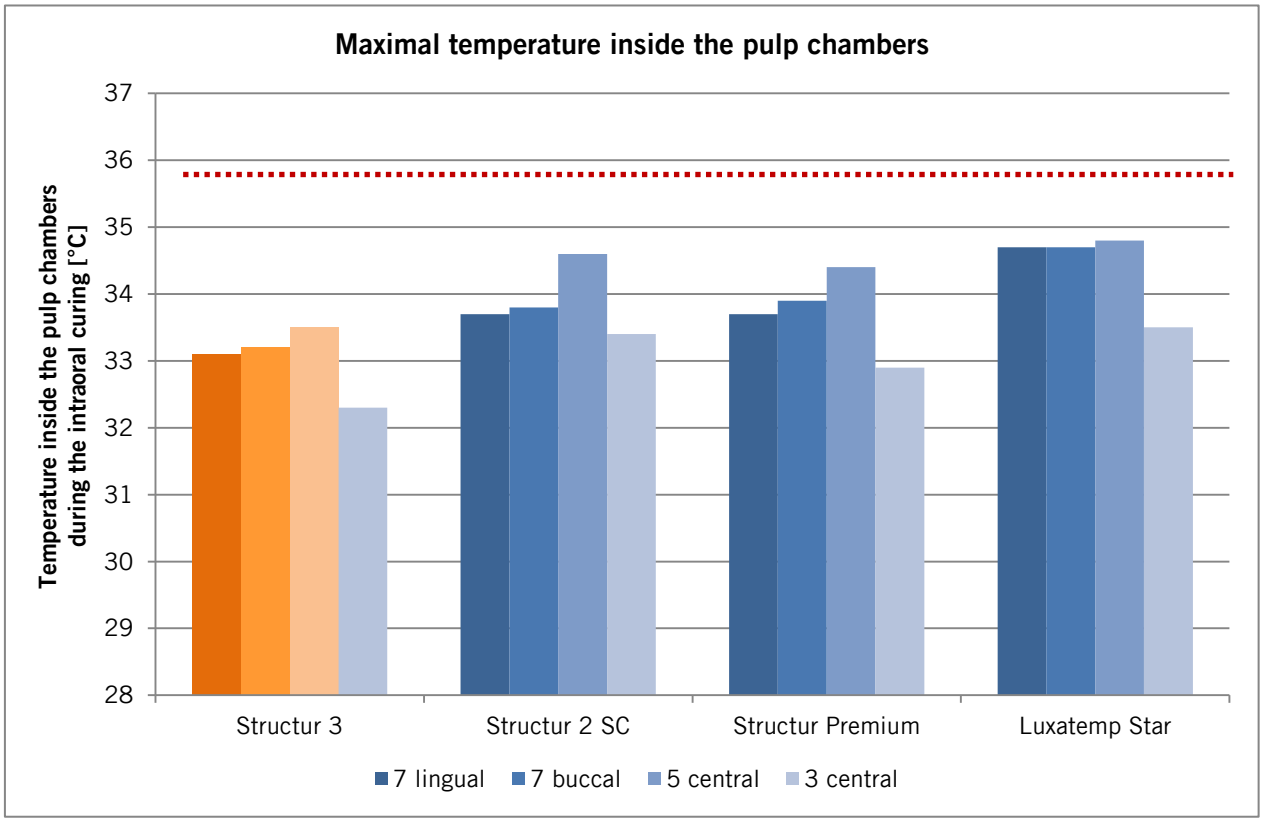

Figure 1: Maximal temperature inside the pulp chambers during intraoral curing

The temperatures that resulted when the single crown was produced on 25 were similar to those resulting when producing the bridge, a circumstance that can be attributed to the smaller quantity of material. Although the stump does not cool down as much at the outset, the polymerisation heat generated is not as great either, so that there is no major difference between the final temperature of the crown and the temperature of the bridge.

As all temperatures of the materials remain below the initial temperature of 36°C, there is no risk of the pulp overheating if the product is used correctly. With a temperature difference of only 1.2°C Luxatemp Star was closest to the initial temperature, while Structur 2 resulted in the second greatest pulp temperatures (dT_{max}: 1.4°C). Averaging 2.5°C, Structur 3 showed the greatest deviation from the initial temperature.

Conclusion: The critical temperature of 41°C was not attained by any of the materials tested. However, the study gave special attention to Structur 3 as it generated the lowest pulp temperature during intraoral curing. The deviation from the critical temperature averaged 7.5°C in this study. When Structur 3 is used, pulpal overheating is ruled out.

[1] Dr.-Ing. Lothar Borchers, Hanover Medical School, report on the commissioned study "Temperaturerhöhung in der Pulpa präparierter Zähne bei der Aushärtung von Provisorien aus verschiedenen Kunststoffen" (Temperature rises in the pulp of prepared teeth when curing temporary restorations made from various composites), 26.07.2011