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## Report (08-07-09)

### Thermal Properties of the Valo (Ultradent) LED Curing Light R. Yapp, J.M. Powers

#### Objective:

To measure the temperature increase from 37°C versus cure time for four different scenarios:

1. The maximum tip temperature reached to understand the heating effect on patient soft tissue if the tip is inadvertently touched against or rested upon lips or gums during a procedure (measured at 3 intensity settings).
2. The increase in temperature during the curing time within the pulp chamber experienced during a single illumination curing procedure (measured for 3 intensity settings).
3. The increase in temperature during the curing time within a composite restoration during the curing procedure where one illumination is used (measured for 3 intensity settings).
4. The increase in temperature during the curing time within a composite restoration during the curing procedure where three consecutive illuminations are used (measured for 3 intensity settings).

#### Methods:

##### Equipment:

Omega HH306 Thermometer/Data Logger, which samples data at a rate of 1.25 times per second and displays the information on a PC and a K type bead probe thermocouple.

1. The maximum tip temperature increase from 37°C during the curing time.
  - a. A thermocouple was positioned between the muscle at the end of a chicken drumstick (warmed in a controlled temperature oven to 37 °C) and directly in contact with the curing light tip. The chicken muscle tissue in the drumstick nicely simulates the human soft tissue, which could potentially be in contact with the light tip (and doesn't generate any pain).
  - b. First the ambient condition was recorded (approximately 37 °C).
  - c. The temperature recording continued while turning on the curing light positioned over the top of the thermocouple and drumstick.
  - d. The light illuminated the thermocouple for the three different intensity settings.
  - e. The amount of temperature increase ( $\Delta T$ , °C) was determined from the recorded data.
2. Temperature increase from 37°C within a composite restoration over period of a single illumination.
  - a. An adult human third molar was prepared with a class II restoration using TPH3 (DENTSPLY Caulk) composite.
  - b. The thermocouple was inserted into a 0.5 mm hole drilled into the composite parallel to and 1 mm below the occlusal surface and centered in the area of the composite as projected on the occlusal plane.
  - c. The curing light was then brought into light contact with the composite and turned on to illuminate the composite.
  - d. The initial un-illuminated temperature of the restoration was recorded and then the curing light turned on and the temperature increase over time was recorded. The recorded data was used to determine the amount of temperature increase and maximum temperature reached.

3. Temperature increase from 37°C within a composite restoration over period of three consecutive illuminations each separated by 2-seconds of no illumination.
  - a. The prepared tooth used in number 2 above was used for this experiment.
  - b. The curing light was then turned on to illuminate the composite for a sequence of three cycles with a 2-second off period between each illumination. This was done for each intensity setting.
  - c. The initial un-illuminated temperature of the restoration was recorded and then the curing light cycled on and off and the temperature increase over time recorded. The recorded data was used to determine the amount of temperature increase over the three sequential cure cycles.
  
4. Temperature increase from 37°C within the pulp chamber.
  - a. An adult human third molar was prepared with a class II restoration using TPH3 (DENTSPLY Caulk) composite and a thermocouple was inserted into the pulp chamber via one of the tooth's roots. The tooth pulp chamber was cleaned of nerve tissue and then packed with chicken muscle to simulate the nerve tissue.
  - b. Follow steps "2.c" and "d" above.

Repetitions: 5 for all data sets

Results:

**Tip temperature when pressed against soft tissue**

Standard Setting – 50.0 °C [range for similar lights – 46.7-58.3 °C]

High Setting – 45.0 °C [range for similar lights – 45.0-57.2 °C]

Plasma Setting – 53.3 °C [range for similar lights – 53.3-56.1 °C]

**Temperature increase within the pulp chamber**

Standard Setting – 0.8 °C [range for similar lights – 0.0-1.0 °C]

High Setting – 0.0 °C [range for similar lights – 0.0-1.2 °C]

Plasma Setting – .1 °C [range for similar lights – 0.0-0.1 °C]

**Temperature increase within the composite restoration**

Standard Setting – 17.8 °C [range for similar lights – 9.4-18.3 °C]

High Setting – 8.3 °C [range for similar lights – 8.3-20.6 °C]

Plasma Setting – 17.8 °C [range for similar lights – 9.4-17.8 °C]

**Temperature increase within the composite for a three illumination cycles**

Standard Setting – 22.2 °C [range for similar lights – 9.4-22.2 °C]

High Setting – 17.8 °C [range for similar lights – 17.8-38.9 °C]

Plasma Setting – 21.1 °C [range for similar lights – 14.4-21.1]