Summary of: Temperature rise in cavities prepared by high and low torque handpieces and Er:YAG laser

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FULL PAPER DETAILS

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Objective The aim of this study was to compare intrapulpal temperature increases produced by a high-speed high-torque (speed-increasing) handpiece, a high-speed low-torque handpiece (air-turbine) and an Er:YAG (Erbium: Yttrium-Aluminum-Garnet) laser. **Subject and methods** Thirty bovine incisors were reduced to a dentine thickness of 2.0 mm. Class V preparations were prepared to a depth of 1.5 mm, measured with a caliper or by a mark on the burs. A thermocouple was placed inside the pulp chamber to determine temperature increases (°C). Analysis was performed on the following groups (n = 10) treated with: G1, low-torque handpiece; G2, high-torque handpiece; and G3, Er:YAG laser (2.94 µm at 250 mJ/4 Hz), all with water cooling. The temperature increases were recorded with a computer linked to the thermocouples. **Results** The data were submitted to ANOVA and Tukey statistical test. The average temperature rises were: 1.92±0.80°C for G1, 1.34±0.86°C for G2, and 0.75±0.39°C for G3. There were significant statistical differences among the groups (p = 0.095). All the groups tested did not have a change of temperature that exceeds the threshold of 5.5°C. **Conclusion** Temperature response to the low and high torque handpieces seemed to be similar, however the Er:YAG laser generated a lower temperature rise.

EDITOR'S SUMMARY

Most general dental practitioners spend a large proportion of their working time treating and repairing carious teeth and the potential problems of pulp damage arising from an increase in temperature within the cavity are well known. Since the action of the dental bur used to remove carious tissue will inevitably cause the temperature inside the cavity to rise, it is not possible to eliminate the risk of temperature-induced pulp damage. However, research can assist practice by showing which methods and pieces of equipment are most effective and carry as little risk as possible.

The use of lasers in restorative dentistry is not, as yet, common practice, but it has been shown to be effective. The paper on lasers and hard dental tissue in the *BDJ* series on lasers in dentistry, published in 2007 (*Br Dent J* 2007; **202:** 445-454), aimed to increase readers' awareness in this area and show what can be achieved. This study also set out to add to our knowledge in this area by investigating the temperature rise in cavities prepared by high torque and low torque handpieces and an erbium: yttrium-aluminium-garnet (Er:YAG) laser.

The study showed that with conventional water cooling used in all cases, none of the handpieces caused a temperature increase in the pulp that exceeded the threshold temperature for irreversible pulp damage of 5.5°C. Indeed, there was no significant difference between the temperature increases caused by the high and low torque handpieces. However, the laser caused a significantly lower temperature increase than the two more traditional handpieces, with a mean value of 0.74°C compared with 1.77°C and 1.40°C for the low and high torque handpieces, respectively.

While the study has limitations – the work was carried out *in vitro* on bovine teeth and not under clinical conditions – the paper provides more evidence that lasers can be effective tools in the dental surgery for a variety of procedures. Lasers have their own unique risks, but when used safely and correctly they can be beneficial and their use is likely to increase in future, as equipment becomes more affordable and the techniques more widely known. However, given that it is unlikely that lasers will replace conventional high-speed handpieces in the near future, it is also heartening to see confirmation that neither high nor low torque handpieces cause dangerous increases in pulp temperature when used correctly.

The full paper can be accessed from the *BDJ* website (www.bdj.co.uk), under 'Research' in the table of contents for Volume 205 issue 1.

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IN BRIEF

- In this study low and high torque handpieces and Er:YAG laser did not promote an increase in intrapulpal temperature higher than 5°C.
- Even the high torque handpiece did not promote a statistically significant high temperature increase.
- The Er:YAG laser generated a lower temperature rise. This fact denotes the possible advantage of Er:YAG laser compared to the conventional handpieces.

RESEARCH

COMMENT

Despite the advances in preventive dentistry, the greater occupation of the general dental practitioner remains the repair of carious tooth cavities. That need, together with the modification of tooth structure associated with cosmetic restorative procedures, accounts for the dilemma of achieving hard tissue manipulation whilst preserving a healthy level of pulp vitality.

This study addresses a key factor in possible pulpal injury through thermal conduction arising from the range of instrumentation chosen; careful adoption of operating parameters have sought to standardise the use of each instrument and perhaps replicate a clinical scenario. The results may appear surprising to those who view the use of high-speed rotary drills as being a common source of indirect pulpal injury through frictional contact with the tooth, but the findings of low or negative temperature rise associated with the use of the erbium YAG laser is in keeping with many other studies.

The word 'laser' is a generic and the current ability to ablate dental hard tissue and caries within an acceptable clinical setting has only been possible with the development of the erbium YAG and erbium, chromium YSGG laser wavelengths for use in dentistry. Their mechanism of action in vaporising interstitial water within enamel, dentine and caries, leads to explosive dislocation of structural components. Water vaporises at 100°C and much of the resultant energy escapes outwards from the cavity. Together with the use of a water spray, it is possible to appreciate the hypothesis of resultant low thermal rise within the tissue and the findings in this investigation.

Of course, the 'deep cavity' scenario that this study seeks to replicate may carry significant concerns for laser use when extrapolated to the clinical setting, in that the need to maintain adequate water cooling may be compromised by the problems of access. The empirical nature of the investigation does not allow such compromising factors to be addressed. Equally, such concerns will also apply to the use of rotary instruments in similar situations, whereby the possible thermal assault on the pulp may be magnified. This, along with many other aspects of the dynamics of laser action on tooth tissue, has been investigated by many workers.

The growth in evidence-based protocols serves us well as we seek to provide what is best for our patients. It is without doubt that as there is a shift in treatment towards early diagnosis and interceptive action that is more selective in preserving healthy tissue, the choice of a laser may become more commonplace. Choice may add excitement to the battle with dental caries and places the dental profession in an evermore responsible position in the delivery of patient-centred restorative care.

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AUTHOR QUESTIONS AND ANSWERS

1. Why did you undertake this research?

The constant release of new equipment for dental professionals stimulates the development of new research about its effects on dental tissues. In this way, considering the possible damage to the pulpal tissue that can compromise the dental vitality, we developed this study evaluating the influence of the use of low and high torque handpieces and Er:YAG laser on intrapulpal temperature. The aim of this study was to verify how much heat could be transmitted through the dentine, mainly for standardised low dentine thickness (0.5 mm) that is very near to the pulpal tissue.

2. What would you like to do next in this area to follow on from this work?

It is observed in the literature that dentine thickness can influence heat transmission through the dentine. Also, for Er:YAG laser, it is observed in the literature that different parameters are used even when applied to the same dental tissue. To follow this work we would like to study the influence of dentine thickness on intrapulpal temperature increase using different equipment for the preparation of cavities. We would also like to further evaluate Er:YAG behaviour, varying the laser parameters following the manufacturer's protocol and the most widely used parameters found in the literature.