RESEARCH SUMMARY

Is the analysis of a QLF measurement reliable and reproducible?

The intra- and inter-examiner reliability of quantitative light-induced fluorescence (QLF) analyses

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Objective

To assess the reliability of the analysis stage of quantitative light-induced fluorescence (QLF). The QLF analysis involves subjective input from the user and this study examines the influence of this on the reproducibility of the QLF data.

Method

QLF images were taken of 20 human molar teeth that had been previously subjected to a demineralising solution (phosphoric acid 37%) to create artificial white spot lesions on their buccal surfaces. Following examination of the images, 16 were chosen to represent a range of lesion size and severity. Three copies were made of the images and each was allocated a different filename. 10 examiners in three centres were asked to analyse each of the 16 images on three occasions, with at least seven days between each attempt. Simple instructions describing the analysis procedure were supplied and examiners asked to adhere to these directions. Examiners were asked to rate each of the 16 teeth on their first attempt both quantitatively (5 point scale) and qualitatively in terms of difficulty of analysis. Data reported were the ΔQ at 5% threshold for each tooth on each of three attempts.

Results

Using ANOVA and paired *t*-tests to detect statistical differences, the three attempts of each examiner were used to determine intra-examiner reliability. Only one examiner (a novice at the technique) demonstrated differences between all three attempts and two demonstrated difference between one attempt. When the mean scores were compared to determine the inter-examiner reliability, only one examiner's results were statistically different when compared with two others.

Conclusion

This study has demonstrated that the analysis stage of QLF is reliable between examiners and within multiple attempts by the same examiner, when analysing *in vitro* lesions. Novices at the technique should be trained before analysing experimental data.

IN BRIEF

- QLF is a new device to detect very early demineralisation of enamel.
- QLF can be used *in vivo* and *in vitro*.
- All diagnostic methods suffer from some form of variability.
- This study determined that, in most cases, QLF does not suffer from significant reliability issues in the analysis stage.
- Further work on *in vivo* lesions is required.
- Novices should be trained before analysing experimental data.

COMMENT

It has been known for sometime that enamel and dentine fluoresce. That is, if ultraviolet light is shone at a tooth it will absorb the energy then emit radiation of a lower energy and longer wavelength, usually in the visible light spectrum. This is useful, because intact and demineralised enamel fluoresce by different amounts. The amount of fluorescence from demineralised enamel is less than that from intact enamel, creating dark areas on fluorescent images, which show up clearly. The difference in the fluorescence between intact and demineralised enamel can be measured and this has been shown to correlate well with the amount of mineral lost. The obvious advantage of using an optical method for quantifying mineral loss is that the tooth can be measured intact. It does not need to be extracted and sectioned in a laboratory, as required for other techniques such as microradiography or chemical analysis.

Previously, ultraviolet or laser light has been used to evoke fluorescence. These are potentially harmful to the eyes or rely upon bulky equipment, which is not ideal for clinical use. The advantage of QLF is that it employs a light source that is mobile and is of the same wavelength as a dental curing light. This makes it potentially a very handy tool in clinical studies of agents to prevent demineralisation or promote remineralisation of enamel or dentine.

Any new technique has to be shown to be valid (measures what it is supposed to measure) and reproducible (obtains the same measurement every time). This study has shown that the analysis of captured QLF images is reproducible both within and between experienced users. These findings are important, and provide a basis from which to evaluate QLF. However, as the authors point out, the error due to analysis is only one source of a misleading result. When capturing images in the mouth there are other potential sources of error, including the wetness of the tooth and the positioning of the camera. If the investigator is depending upon the ability of the eye to see the demineralisation there may be errors in detection as well. Another limitation of QLF is that it can be used on smooth and occlusal surfaces, but not yet on interproximal surfaces.

All measurement techniques are subject to error. When investigators undertake clinical trials, using any technique, it is essential that all potential sources of error are assessed. This study reassures us that following suitable training, individuals can analyse QLF images reproducibly. It also suggests useful guidelines related to the reporting of the analysis, which will ensure that the results from different studies might be compared.

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