Recording of Individual Identification Information on Dental Prostheses Using Fluorescent Material and Ultraviolet Light

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The placement of individual identification on a prosthesis is very important for forensic dentistry and traceability. This article describes the unique naming/labeling of dentures with information for individual identification using a method in which information is invisible under natural light but visible under ultraviolet light-emitting diode/black light exposure. The use of laser beam machining with this method will enable the recording of a large amount of information. *Int J Prosthodont 2013;26:172–174. doi: 10.11607/ijp.3350*

Since the massive disasters associated with the 2011 earthquake and tsunami in East Japan, individual identification with forensic dentistry has become a fundamental aspect in medicolegal investigations aimed at identifying human remains. Teeth and dental prostheses are resistant to heat and putrefactive changes and are therefore the most durable elements of the body.[1] Individual identification has been performed using radiographic and direct observations of tooth morphology, patterns of missing teeth, restorations, and restorative materials. Problems with this method include the requirement for prestored personal data and the large amount of time needed for certification through morphologic matching.

On the other hand, the traceability of dental prostheses is also needed to assess treatment outcome and for patient care. For example, individual identification by dental prosthesis is required in situations in which the denture owner is an unknown elderly patient with dementia in a geriatric hospital.

The embedding of a plastic sheet inscribed with an individual's name in the denture has been reported often.[2] However, materials such as printed ink are not approved as medical/dental materials by the necessary authorities. In addition, elderly patients are often opposed to the placement of a denture that contains naming/labeling information.

In this article, a unique method for naming/labeling dentures with individual identification information is proposed. The information is invisible under conventional light but visible under ultraviolet (UV) light-emitting diode (LED)/blacklight exposure.

Materials and Methods

Figure 1 shows an elemental procedure for recording information. Data such as characters and a barcode are grooved into the acrylic resin base using a bur drill or laser beam machine. The trimmed grooves are filled using a light-curing transparent composite resin paste that includes fluorescent material (Gradia, GC). The filled-in surface is polished according to a conventional procedure. The information is invisible in natural light but visible under UV light. In addition, the information grooved directly onto the fluorescent material can be detected by UV light. Laser beam machining will enable recording of a large amount of information, such as a Quick Response (QR) code.

The recording process must take into account the wear of the resin surface and the accuracy of the information. Straight lines and QR codes with a 10 × 10 mm square were grooved into the acrylic resin plate at a depth of approximately 400 µm using a laser beam machine (Value Direct 7050-35W, Commax Laser System). UV-LEDs (Nichia) were used at a wavelength of 365 nm to irradiate the surface containing the information, and the image was obtained with a commercial digital web camera (QCAM-200SX, Logicool).

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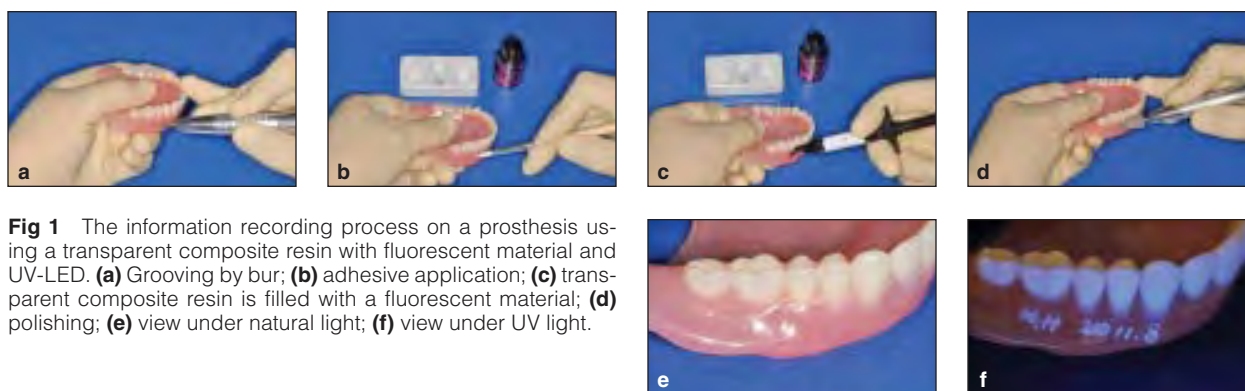
Fig 1 The information recording process on a prosthesis using a transparent composite resin with fluorescent material and UV-LED. **(a)** Grooving by bur; **(b)** adhesive application; **(c)** transparent composite resin is filled with a fluorescent material; **(d)** polishing; **(e)** view under natural light; **(f)** view under UV light.
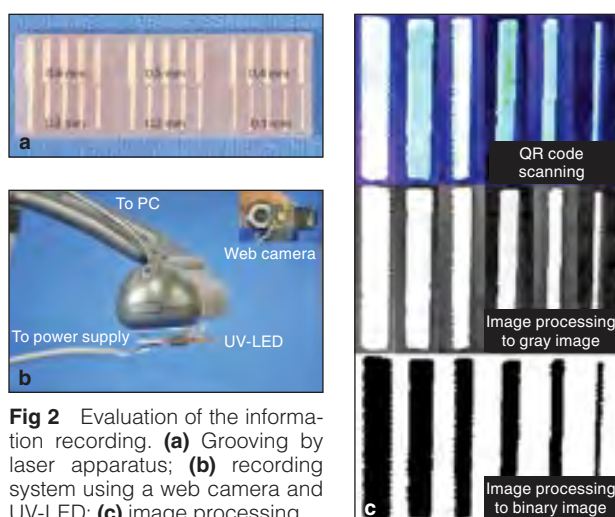

Fig 2 Evaluation of the information recording. **(a)** Grooving by laser apparatus; **(b)** recording system using a web camera and UV-LED; **(c)** image processing.

Fig 3 Two-dimensional QR code recording and reading. **(a)** Development of the QR code; **(b)** information recording on the resin surface; **(c)** QR code scanning; **(d)** image processing to gray image; **(e)** image processing to binary image; **(f)** QR code reading screen using a smart phone.

Figures 2 and 3 show the reading of this recorded information. Lines with a width of 0.1 mm and QR codes with a 10 × 10 mm square in the captured image can be successfully recognized.

The identification of individuals is an urgent issue in the dental field. The recording of information in dental prostheses will be useful in the field of forensic dentistry as well as for the traceability of the prosthesis. Although identification by DNA analysis is currently used and has proven to be valuable and crucial,[3] the procedure is costly and time-consuming. Moreover, although an IC-TAG (IC-TAG Solutions) embedded in the body is effective for individual identification,[4] regulation is necessary in order to protect individual privacy.

Discussion

The proposed method allows individual information to be recorded easily in dental offices and private dental laboratories. Although denture surfaces are often influenced by wear, the wear on the polished surface of the denture should be minimal.

Laser beam machining is also useful and applicable for recording mass information. This method provides groove formation at a depth of more than 400 μm and a width of less than 100 μm. This research suggests that mass information can be recorded using this method. Mass information is more difficult to read because it requires fine grooving. It has been suggested that reading the information accurately depends on the optical distortion of the camera and the presence of air bubbles during the filling procedure.

Conclusion

The proposed method will enable the recording/ reading of a larger amount of information when the appropriate optical and composite resin filling conditions are met.

Acknowledgments

References

1. Hinchliffe J. Forensic odontology, Part 1. Dental identification. Br Dent J 2011;210:219–224.
2. Weedn VW, Baum HJ. DNA identification in mass fatality incidents. Am J Forensic Med Pathol 2011;32:393–397.
3. Madrid C, Korsvold T, Rochat A, Abarca M. Radio frequency identification (RFID) of dentures in long-term care facilities. J Prosthet Dent 2012;107:199–202.
4. Nalawade SN, Lagdive SB, Gangadhar S, Bhandari AJ. A simple and inexpensive bar-coding technique for denture identification. J Forensic Dent Sci 2011;3:92–94.

Literature Abstract

The adult suicide-prone patient: A review of the medical literature and implications for oral and maxillofacial surgeons

According to the authors, because of the scope of treatment provided, as well as the relationship fostered with the patient, oral and maxillofacial surgeons are in a unique position to identify those at high risk of suicide. Therefore, it is important for oral and maxillofacial surgeons to know the risk factors for suicide. Demographic risk factors for suicide include being male, age older than 45 years, from the western United States, in a rural area, and being an American Indian, Alaskan Native, or non-Hispanic white person. Further risk factors include social isolation, lost a loved one within the past year, unemployed, lower intelligence test score, and poor progress in school. Adults who experienced physical or sexual abuse during childhood, had substance abuse, separated or divorced parents, or had imprisoned family members have a higher risk of suicide. The risk of suicide also increases in individuals suffering from mental illness, chronic pain syndromes, HIV or AIDS, or individuals having physical illness as well as concurrent depression and anxiety. Having a family history of suicide or a spouse with a psychiatric disorder or who committed suicide was also found to increase the risk of suicide. Patients treated for oral cancer and cosmetic procedures, as well as patients who suffer from postoperative complications, are also at high risk of suicide. The authors suggested utilizing the modified SAD PERSONS acronym to assist oral and maxillofacial surgeons in evaluating patients for potential suicide risk. In addition, documentation using the modified SAD PERSONS also facilitates referral to and communication with the mental health provider or emergency department physicians.

Friedlander AH, Rosenbluth SC, Rubin RT. *J Oral Maxillofac Surg* 2012;70:1253–1260. **References:** 73. **Reprints:** Dr A.H. Friedlander, VA Greater Los Angeles Healthcare System, 11301 Wilshire Blvd, Los Angeles, CA 90073, USA. Email: Arthur.friedlander@va.gov—*Simon Ng, Singapore*