REVIEW ARTICLE

Denture Identification by Incorporation of RFID in Dentures: A New Approach

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Abstract

Introduction: Forensic identification by prosthodontics appliances, as labeling of dentures, is significant in providing a vital clue for patient identification. The purpose of denture marking thereby not only assists in the return of a lost denture but also facilitates the identification of edentulous persons who are either living or deceased. It is a very cheap, inexpensive, and simple procedure that has multiple benefits. There are different methods for denture identifications. Radiofrequency identification (RFID) is one of them. RFID is a small transponder that can be radio-transmitted to a reader connected to a computer. It is a cosmetic, effective labeling method permitting rapid and reliable identification of the wearer.

Objective: This review highlights the different labeling techniques and procedures of RFID-tag in denture and its application.

Materials and methods: Data were obtained and analyzed from previously published literature and electronic database searches of relevant published literature from PubMed and Google Scholar.

Conclusion: Forensic identification using odontology is an old story in science. Denture itself reveals information like the number of missing teeth, which helps in identification of the person. But with development of newer techniques radiofrequency identification (RFID) tag into denture reveals much information about person wearing denture. It also helps in identification of body during mass disaster, dead and decomposed bodies during the burn and natural calamity. So, the study should be done on RFID tags for better understanding, to give more information regarding optimum designs.

Keywords: Denture identification, Denture labeling, Forensic odontology, Radiofrequency identification tag.

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Introduction

Forensic identification by prosthodontic appliances, as labeling of dentures, is significant in providing a vital clue for patient identification. Prosthodontists are playing a very crucial role in forensic dentistry as they are concerned with fabrication of various prostheses which can serve as an important tool for identification.[1] The American Board of Forensic Odontology guidelines are based on restorations, caries, missing teeth, or prosthetic devices.[2] The purpose of denture marking thereby not only assists in the return of a lost denture but also facilitates the identification of edentulous persons who are either living or deceased. The identification of unknown or missing persons by means of denture labeling is a very successful method of identification in forensic investigation. Various methods have been proposed for denture marking, namely the surface method and the inclusion method, but it is important to use a method that is simple, practical, affordable, and universally acceptable.[1]

Discussion

Advantage of Denture Labeling[1]

- Due to the lack of a comprehensive fingerprint database, denture identification is essential for identification of the individuals.
- In identify an unknown denture wearer in cases of amnesia or senility, loss of memory, psychiatric cases, homicide, suicide, victims of fire, explosion, floods, earthquake, plane crash, or war.
- In the laboratory, it is easy to identify a denture, especially at the deflasking stage.
- In case of denture delivery to the respective patient.

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The American Dental Association Have Specified Certain Criteria for Denture Marking[3]

- Identification should be specific
- Technique should be simple
- Mark should be fire and solvent resistant
- Denture should not be weakened
- Mark should be cosmetically acceptable

Methods of Denture Identification

There are two main methods in marking dentures, namely

Surface Method

It is less technique sensitive and less time-consuming.

Scribing or engraving method. In this technique, letters or numbers are engraved with a small round dental bur on the fitting surface of the maxillary complete denture. This technique is economical and easy to operate. But it has detrimental effects such as lodged food debris leading to bacterial infection and irritation.[4]

Embossing method. This technique comprises initials of the name and the surname of the patient that are scratched on the master cast. So produces embossed lettering on the fitting surface of the denture after processing. The method is economical, but disadvantage of this technique is that it has been associated with malignancy due to continuous irritation of tissues.[5] So to overcome the disadvantage of continuous irritation, marking on the denture framework made with the denture base acrylic and processed it to the finished state so that it becomes smooth and causes no irritation to the tissue.

Inclusion Method

This method is more permanent, but it is technique sensitive and time-consuming.

Denture bar coding. It consists of a machine-readable code of a series of bars and spaces printed in defined ratios.[6]

Technique: printing a number code on paper, photographing the paper, making and transferring the negative to a piece of silk. An image of the bar code appeared on prepared faience, by a machine that forced the paint through the silk, when heated to 860°C for 30 minutes in an industrial porcelain oven. The barcode was then read with a reader, and incorporated on to the denture, sealed with acrylic resin.[7] It can also be fabricated on crown. It gives exact information in every situation regardless of whether fire or water is involved. Denture bar-coding is easy to perform, and it is not very expensive else it is technique sensitive.

Lenticular card method. In this technique, the lenticular lens is used to produce images with an illusion of depth, morph, or the ability to change or move as the image is viewed from different angles. It is a simple, cheap, and quick method. This method can store a large amount of information. The labels showed no sign of fading or deterioration. The lenticular card stores the patient's information has two or more images that can be viewed by changing the angle of view.[8] Disadvantages of this technique are that information can never be changed, and may not withstand fire, unless the strip is placed in the most posterior part of the denture.

ID band method. In this method, the denture is marked with a stainless steel metal band and most commonly used fire-resistant materials are titanium foil and Ho Matrix Band containing an identifiable coding system representing patient details.[9] It is easy to perform, cost-effective, and fire-resistant.

Technique: length 6 mm longer shallow recess longer than the identification band is prepared in the desired location in the denture base for the metal band. The preparation is 3 mm deeper than the thickness of the metal band. The band is covered with clear acrylic resin, trimmed and finished in the usual manner.

Paper strip method. It utilizes an onionskin paper.[10] It is economical and easy to perform but may not withstand fire.

Technique: the acrylic resin fitting surface situated adjacent palatally between the ridge and the center of the palate is moistened with monomer on a small brush. The strip of typed paper is laid on this surface, and the paper is moistened with the monomer. Clear resin is then placed over the paper before the final closure of the denture flask.[10]

T bar method. This technique is easy, inexpensive, time-effective and it is a T-shaped bar made of clear polymethyl methacrylate (PMMA) resin.

Technique: bar is constructed by cutting baseplate wax and then is flasked, packed, processed, and finished in clear PMMA. An identification printed label (reduced in size, print-face inward) against the flat section of the bar is fixed. It is then surface polished to produce a clear window displaying the ID label.[11]

Lead foil. This technique is easy to operate, economical, and is radiographically visible.

Technique: this method describes a radiographic technique where a lead foil marked with patient details is sandwiched between two layers of resin during the processing of the denture. After processing the denture, radiograph can be taken to visualize the patient details marked in the lead foil incorporated inside the denture.[12]

Laser etching. A copper vapor laser (CVL) is used to etch a patient's identification into the metal surface of a partial denture. The method is expensive and requires specialized equipment and technicians to perform the procedure.

Technique: the CVL beam is focused and delivered to the material surface by the two-axis scanner mounted with mirrors. A personal computer controls the movement of the scanner and the firing of the CVL.[13]

Electron microchips. The patient's information is etched onto an electronic microchip measuring $5 \times 5 \times 0.6$ mm. It has excellent acid resistance, is radio-opaque and bonded well with acrylic resin. Disadvantage of the chip is that it could be inscribed only by the manufacturer and not by the dentist. This method required additional equipment to transfer details to a computer.[14]

Photograph. In this technique patient's photograph is embedded in the denture with the help of clear acrylic resin. It is useful in the countries with low literacy rate where a photograph is the easiest method of identification. However, thermal tests revealed that the photographic marker and bar code were only resistant to around 200–300°C.[15]

RFID-tags. It is a cosmetic, effective labeling method permitting rapid and reliable identification of the wearer.

The RFID stands for radiofrequency identification, which is a wireless electronic communication technology.[16] It was first introduced in 1940, during World War II, and used to identify airplanes belonging to the Royal Air Force.[17] It forms part of a technology known as "automatic identification and data capture" and is used to identify, locate and track people, animals, and property.[18]

RFID Technique

An RFID technique, which consists of a reader device that converts the radio waves reflected back from the passive RFID-tag into digital information that is then passed to a computer with applications to interpret it is recommended for incorporation into a denture. An RFID-tag comprises of a serial number that identifies a person stored in a microchip with an attached antenna. Tags are available in various forms and dimensions. The chip and antenna together

are called an RFID-tag or transponder. There are "passive" tags and "active" tags so named because the power for reading the information on the chip is sent from the reader by the passive tags and active tags carry their own power supply enabling them to communicate between tag and reader, thus increasing the potential for detection of the signal.

The tags used in this experiment were provided by an Italian RFID manufacturer (MRFID network). Passive, 12 mm length × 2.1 mm width, torpedo-shaped, read-only low-frequency tags were chosen. Only low-frequencies, 125–134 kHz, are employed for veterinary use and are also acceptable for human use. The transponder contains no batteries and is hermetically sealed in a protective tube. The reader energizes the transponder by means of an electromagnetic field emitted via the reader's antenna. The reader is connected to a computer in the keyboard jack, and the signal is displayed on the pc monitor using a word processor.

Procedures for Incorporating RFID-tag in Dentures

A 12 mm × 3 mm in depth depression was made in the denture's external surface with a carbide bur without structurally weakening the denture. The antenna orientated mesially and read-only low-frequency tags with dimension 12 mm length × 2.1 mm width, torpedo-shaped, were positioned so that their long axes parallel to occlusal plane, then were auto-polymerized with pink resin covering over it. The tag was visible even when embedded in pink acrylic resin. The denture was then processed in a pressurized container with warm water (40°, 25 psi), and was finally finished and polished. The three RFID-tag implanted dentures were tested to verify the efficacy and range of data transmission. The reader sends a coded signal that is returned by the transponder and then converts it into readable data. Tags have 'read only' and 'read/writable' chips, to which new data can be transmitted. In *in vitro* test it had been seen that the optimum data is achieved with the reader perpendicular to the long axis of the microchip, with a maximum scanning range of 1 cm.[17]

Application of RFID-tag

- As an aid for forensic dental identification based on the comparison of antemortem and postmortem dental records, by placing a small transponder in teeth and dental prostheses.[19]
- In identification of edentulous people as they have lost all or most of the key features.
- Allowing not only the storage of patient's medical records on a searchable database but also information on the materials used and so providing traceability.

Conclusion

Denture marking has its significant application in personal identification in case of accidents, disasters and mass destruction of human beings, wars, also in identifying lost or misplaced dentures in health care centers, in a coma or unconscious person. In the healthcare sector, the use of RFID-tags has been tested for suitability in various fields, such as transfusion medicine. There are other possible applications of this technology are proposed in the forensic field. Recent studies have investigated the use of an RFID for body tagging and management of resources at a hospital during a mass casualty. So study should be carried out to give more information regarding optimum design, choice, and implantation of the ideal tag in a complete upper denture and its technical performance in various conditions.

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