

Prosthodontics an “arsenal” in forensic dentistry

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Abstract

After major disasters such as earthquakes, fires, floods, tsunamis, bomb blasts or terrorist attacks, accurate, and early identification of the dead and injured becomes an utmost importance. Restorations, cariesteeth, missingteeth and/or prostheses are most useful aids for the dental identification. At times, only identifiable remains are a victim's partial or complete dentures. The central principle of dental identification is that postmortem dental remains can be compared with antemortem dental records which include, studycasts, radiographs, etc., to confirm the identity of the victims. Marking/labeling dentures have been considered an important aid in forensic dentistry. Other than finger printing, when compared with all the methods, the marking/labeling of dentures is an accurate and rapid method to identify the unknown victims. There are no standardized methods to follow, but dental practitioners need to maintain some dental records of their patients. This may include documentation of the “marking of dentures.” The preparedness is the key to success in mass disaster identification. The aim of this review article is to discuss the methods of denture identification, advantages of denture labeling for the rapid identification during major disasters/accidents and the importance of maintaining the patient records.

Key words: Antemortem records, dental profiling, identification of dentures, inclusion methods, marking/labeling, palatal rugoscopy

Introduction

According to Keiser-Nielson “Forensic dentistry is that branch of dentistry, in the interest of justice, related with handling, examination, evaluation, and dental findings presentation.”^[1] The identification of the victims during natural calamities and accidental deaths is a very difficult task and the early identification is of prime importance. There are many ways of identifying the bodies by the forensic experts in which the dentists in general

and prosthodontists in particular play a major role by identifying the victims with their natural teeth, caries teeth, restorations on the teeth like fillings or dental prostheses including crowns, partial, or complete dentures. Bridges^[2] and implants^[3] The experts also utilize palatal Rugoscopy^[4] and DNA analysis^[5] as an aid for the identification purpose. All these will become easy when the antemortem records are available, i.e., documentation of the patient details or the prosthodontic work must be labeled marked. There are many incidents in the history where the victims are

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identified with their prostheses, like a young dentist, Paul Revere, with the help of bridge work identified the US revolutionary war victims. With the help of missing lower teeth identified the body of Charles the Bold^[6] and the Countess of Salisbury's burned body was identified with the help of his gold denture.^[7] Adolf Hitler and Eva Braun, World Trade Centre bombing, in the Waco Branch Davidien siege, and in numerous airplane crashes and in post tsunami period.^[8]

Identification of a body is made more easy with the traced dentures were labeled/marked. The concept of dental identification is by comparing postmortem dental remains with ante mortem dental records such as study casts and radiographs to confirm identity for dentulous patients.^[9]

If the victims were found with unmarked/unlabeled dentures then one accepted method of denture identification can be followed, by placing those dentures on the casts which were retained by the dentists or laboratories to check for the fitting on the casts properly.

This review article will emphasize the role of prosthodontic specialty in forensic odontology, the awareness of denture labeling among patients, general dentists and prosthodontists, general advantages of denture marking/labeling and the need for the introduction of denture labeling in the undergraduate teaching curriculum.

The prosthetic services and dental laboratory relations council given some standards on denture marking. They are:^[10] Markings should be inexpensive, easy, quick and efficient. Labeling should be visible and durable too. Same time should not interfere with patient esthetics and strength of the dentures. Should be non allergic and possible to retrieve from any sort of accidents. And finally resistant to acids or commonly using disinfectants and denture cleaning agents.

The advantages of having denture labeled/marked are: During forensic identification, the unknown denture wearers can be identified with the help of "marked" dentures. Marked dentures can be easily returned to the owner, in the case of lost and found incidents. Dr. Robert H, the importance of denture identification was brought in to focus.

Classification: Many methods are available in the literature and are broadly classified in to:

- Surface marking methods
- Inclusion methods.

Surface marking methods

Includes:

- Scribing or Engraving method
- Embossing method

- Writing on the tissue surface or the polished surface.
- Scribing or Engraving method: In this method by "Scribing or Engraving" on the denture directly, the labeling are placed on one of the denture's surface. Engraved on the fitting surface of the maxillary denture, numbers or letters with the help of small round bur. Possibility for bacterial infections because the engraving are a may be come site for food debrislodgment
- Another surface marking technique, "embossing," this method carries on the master cast scratched the surname and initials of the patient, and in turn transferred on to the intaglio surface of the denture. These embossed letters may cause constant tissue irritation and it may lead to malignancy^[11]
- With the help of fiber-tip pen writing on the tissue-fitting surface or the polished surface of the finished denture surface is another type of surface marking and is a temporary method.^[12]

Inclusion methods

Labeling enclosed in the denture at the packing stage using metallic or nonmetallic materials, micro labels, and microchips. The general advantages with these techniques over surface marking are, these are more permanent where as having some of the disadvantages includes more time consuming, the possibility for dislocation, wrinkling, or tear while packing stage.

- ID-band
- Paper strips
- T-bar
- Laser etching
- Electron microchips
- Radio-frequency identification (RFID)-tags
- Lenticular system
- Denture bar coding
- Photographs.

ID-band

This technique the dentures are labeled with an identifiable coding system contains patient's details on Titanium foil or Ho Matrix band incorporating in the denture base. In the suitable location of the denture base, as hallow recess prepared with 6 mm longer and 3 mm deeper than the metal band, placing the clear acrylic at the base over that the metallic band and covering with again clear acrylic. These metal bands have high corrosive resistance. Among all the ID bands, the Swedish ID-Bands are having international standards, which can resist temperatures up to 1100° C, radio-opaque, acceptable esthetics, less cost, and does not require any special equipment.^[12]

Paper strips

A piece of "Onion skin paper" typed the patient details placed on the denture fitting surface, in the palatal area between the ridge and center of the palate, closed with clear or pink acrylic before final closure of the denture flask.

However, the Vestermarks method uses “red inscription on pink paper.” Greatest drawback with this is, it cannot with stand fire.^[12]

T-bar

A t-shaped clear acrylic polymethyl methacrylate resin bar is prepared and fixed with printed label contains patient details with print-face inward, and then this bar will be placed in the trough prepared on the denture base.^[13]

Laser etching

A patient’s identification can be etched on to the metal surface of a “partial denture” by copper vapor laser. It can label the cobalt-chromium components of dentures easily, legibly, and reduce the font size of the data. The draw back with this method is expensive and requires specialized equipment and technicians to perform the procedure.^[14]

Electronmicrochips

The patient’s information was etched on to a chip, which is radio-opaque and bonded well with acrylic resin. Some tests showed positive results of chips embedded in acrylic resin and proved that chips are resistant to high temperatures (600°C), and acids. Disadvantages of the chip were that it could be inscribed only by the manufacturer and not by the dentist and requires additional equipment to transfer details to a computer.^[15]

Radio-frequency identification tags

The RFID system consisted of a data carrier, or tag, and an electronic hand held reader that energizes the transponder by means of an electro magnetic field emitted via the reader’s antenna. It allows rapid and reliable identification of the wearer without hampering esthetics. RFID tags are in small size (8.5 mm × 2.2 mm) and huge amount of data can be stored. It then receives the coded signal returned by the transponder and converts it in to readable data. The chip is resistant to disinfectants and solutions. Denture strength will not be hampered because of its small size. Resistant to 1500°C and even sub-zero temperatures. Whereas it is high cost and may not be available in most dental set-ups.^[16]

Lenticular system

In this method, the images are produced by a lenticular lens with an illusion of depth, morph, move, or the ability to change when the image is viewed from different angles. The images are to print on the back side of the synthetic paper and laminated on the lens by the lenticular technology. Advantages with this method include, simple, cheap, quick, and water resistant. Disadvantages are unless the strip placed in most posterior part of the denture, it is not fire resistant, and data cannot be changed.^[17]

Denture bar-coding

A bar code consists of the code of series of bars and spaces which are machine-readable printed in defined ratios can be

used for denture labeling. It is a tedious technique, to print a number code on paper, in turn, photographing the same and the negative move on to a piece of silk. Then the machine will force the paint through the silk and after heating to 860°C for 30 min in industrial porcelain oven will emerge in to an image of a readable bar code on faience. Later, it can be incorporated in to denture and sealed with acrylic resin. Having advantages like can be used for crowns also it provides exact information, resistant to high temperatures, and oral solutions. Draw back with this is expensive special equipment required.^[18]

Photograph

A new denture marker has been suggested which makes use of the patient’s photograph embedded in clear acrylic denture base. This method is useful in the countries with low literacy rate where a photograph is the easiest method of identification. However, photographs are resistant to around 200–300°C only.^[19]

Only a few countries in the world following denture labeling/marketing like Sweden and Scotland, UK and Australia and 21 states in the US. In New York State only after the request of the patient, also in Few teaching institutes in the UK and the USA having the “denture marking/labeling” in their academic curriculum.^[20]

Discussion

The role of prosthodontics in the field of forensic dentistry can be discussed related to the “unidentified victims” in three ways. (1) Dentulous victims, (2) edentulous with the prostheses, including (a) marked prostheses and (b) unmarked prostheses, and (3) Edentulous without any prosthesis.

Dentulous victims

If the unidentified victims dentulous, then the general dentist/prosthodontists can identify with the help of teeth, missing teeth, caries, restorations such as fillings, onlays, and inlays, crowns, bridge work, and implants. There is documented evidence available in the history, which supports this. For example, during the US revolutionary War, Paul Revere a dentist, identified war casualties by their bridge work. The body of Charles the Bold was identified by the absence of a lower tooth.^[9]

A gold denture helped to identify the burned body of the Countess of Salisbury, Adolf Hitler and Eva Braun, World Trade Centre bombing, in the Waco Branch Davidien siege, and in numerous airplane crashes and post tsunami period.^[21,22]

The guidelines of American Board of Forensic Odontology also supporting the same.^[23] Dental Implants can be used as source of victim identification in forensic dentistry. Berketa

et al.^[3] from their blind study differentiated dental implants by company type using radiographs.

Edentulous victims with prostheses

The victims with prostheses are marked/labeled

Comparatively easy to identify this situation. There are many methods available, but unfortunately no single method is universally accepted one, though the surface method comparatively easy to apply, inexpensive but worn off very easily. Whereas the inclusion methods were more permanent and provides positive results, but it may lead to porosities in the denture and in turn may weaken the denture. When all other methods fail to reveal the positive identity of the victim, then the labeled dentures can be trust worthy. The recommended areas for marking dentures are the posterior regions of the lingual flange of lower denture and the palatal region of upper denture.^[9]

Victims with unmarked prostheses

In this type of condition, it is difficult but by applying some methods, it is possible to identify the victims, like the retrieved dentures can be poured and casts can be obtained and compare with the “old casts of the victims either from their treated dentist/prosthodontists or from the laboratories from where those dentures were processed”. The difficulty lies with this situation is that “the antemortem records” should be preserved. One more method is by DNA analysis. DNA recovered from saliva, and saliva stains attached to materials such as stamps, cigarette butts, and human skin can be used as sources for DNA analysis. As per Inoue *et al.*^[5] resin prosthesis used in the oral cavity and left at room temperature for as long as approximately 200 days could be used for DNA extraction followed by DNA analysis for identification of the persons.

Edentulous without any prosthesis

If the victim is edentulous and without prostheses, then it is really difficult situation for the expert to identify the victim. After a disaster, from an unidentified edentulous victim, a palatal rugae pattern is one of the unique and relatively obtainable morphological features, and pattern can be taken from the hard palate. Palatal Rugoscopy may be helpful in this type of situation for the identification. Palatal rugae were used in human identification due to their singularity and their nature which was proved by Ohtani *et al.*^[4]

As per Andersen *et al.*,^[21] deceased persons in single accidents as well as in mass disasters could have been identified if their dentures had been marked.

Different authors published different denture labeling methods, but no single method is universally accepted. Denture labeling/marketing is following in few countries in the world, such as Sweden and Scotland, UK, 21 states in the US, and Australia. In Sweden, legislated authority is supervising the denture marking. It is mandatory for all the

dentists to offer and motivate their patients, to have their dentures to be marked with personal numbers in Sweden according to National Board of Health and Welfare.^[20] Only after the request of the patient’s denture marking is performing in New York State, whereas for Army it is the compulsory procedure.^[22] Several states impose the obligation to mark dentures on long-term care facilities, and denture marking is compulsory for the army. In Australia, the tax file numbers are used, whereas in Sweden, the unique personal identity of the person is labeled. Even in these countries also, there is no proper awareness among the patients, as well as the dental profession including general dentists, prosthodontists, and clinical laboratory personnel about denture labeling/markings.

There are few studies available on the attitudes of patients and dentists towards denture marking/labeling. According to Stenberg and Borrman^[23] in Sweden majority of the patients are accepting for denture marking/labeling, and very less number of dentists is doing denture markings.

There are some studies available on “denture marking” in Sweden, UK, and Australia in the literature. As per Cunningham and Hoad-Reddick^[24] questionnaire survey revealed that major portion of the denture wearers was unaware of denture marking. According to Richmond and Pretty^[15] almost all the denture patients are ready for the denture marking in the UK teaching hospital. In a well-designed survey in UK and Sweden from the Dental Practice Board for England, Wales and Scotland in 2004–2005, Murray *et al.*^[25] found that very low percentage of dentures were marked.

There is some published literature available on the attitudes of dental professionals on denture markings. From a comprehensive survey in the UK by Murray *et al.*^[25] revealed that more than half of the prosthodontists carried out complete denture markings. In few countries, only the “denture marking” methods are teaching in dental schools. According to the available published information, the majority of the dental schools in the USA having an academic curriculum which includes teaching of denture marking to their under graduate students. As per Borrman and Rene^[26] dental profession was possibly responsible for the non marking of dentures. Results published from a survey in South Australia; by Alexander *et al.*^[22] revealed that very few prosthodontists and general practitioners marked the dentures whereas better number of technicians marked dentures. The UK Alzheimer’s Society advised the dental fraternity to “mark the new dentures.”^[27]

Conclusion

After critical evaluation, there are many methods available, but none of the methods is fulfilling all the requirements of denture labeling/marketing. All the teaching institutes should

start teaching to their Under graduate students about the denture marking/labeling methods. Need of the hour is “If the dentists/prosthodontists and laboratories maintain the records properly and marked/labeled all their patients prostheses, then the Prosthodontics” really will become a weapon for the forensic dentistry.

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Conflicts of interest

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