

Forensic Odontology and Its Ineluctable Slice: Prosthodontics - A Review

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ABSTRACT

The branch of forensic science that deals with dental evidence is called forensic odontology. It is a very recent science that makes use of dentists' expertise to benefit the legal system. The importance of forensic identification based on examination of prosthetic appliances is growing since labelling on dentures and other prosthetic devices may offer crucial hints for patient identification. This article reviews the relevant research and emphasises how a prosthodontist can be crucial in the identification of a deceased person.

Keywords: Denture marking, embossing, forensic odontology, inclusion, denture marking medium

INTRODUCTION

The handling, analysis, and appraisal of dental evidence in a criminal justice setting are all part of forensic dentistry, also known as forensic odontology. Both criminal and civil law employ forensic dentistry. Forensic dentists help investigators identify human remains, especially when identifying information is either limited or nonexistent. For example, burn victims can be identified by looking at their dental records¹. Additionally, forensic dentists may be requested to help identify unidentified

people and ascertain their age, race, employment, past dental history, and socioeconomic level².

Due to their extreme toughness and resilience, dental structures outlast most other human body parts when exposed to post-mortem factors. The materials frequently utilised to reconstruct teeth are very resistant to damage brought on by annihilation that is physical, chemical, or biological³. Denture marking, bar coding, and other prosthodontic appliances that provide information that may be used for forensic identification are becoming increasingly important as they support patient identification by offering important clues³.

Therefore, a prosthodontist's main role in forensic odontology is to have a thorough understanding of the different dental materials that are used, know how to engrave records into prosthetics, be familiar with rugae patterns, be able to make bite mark impressions, and be able to record and recognise lip prints.

Any natural tooth loss, whether single or several, need prosthodontic rehabilitation. Each dental prosthesis is distinctive and produced specifically for the wearer. Thus, in forensic investigations involving

unidentified deceased corpses, dental prosthesis acts as the principal identification⁴. This article seeks to provide some light on the many methods by which dental prostheses may be examined for forensic purposes as well as the importance of combining prosthodontics and forensic dentistry for the convenience of forensic investigations.

DISCUSSION

Surface markings or inclusions done on removable dentures, fixed partial dentures and batch numbers on dental implants form forensic identification methods in prosthodontics.

REMOVABLE DENTURES

Two major denture marking systems exist based on the present literature.

- 1) Surface Marking Methods
- 2) Inclusion Methods

SURFACE MARKING METHODS

- This technique does not physically alter the denture and preserves its structural integrity by writing a brief message or a code number on it.
- This method's main drawback is the gradual fading of the printed information or code over time as the prosthesis is used often.
- The three main methods for surface marking a denture are
 - a) engraving or scribing
 - b) embossing.
 - c) writing on the denture surface
- a) Scribing or Engraving -.In these procedures, a tiny round bur is used to engrave a short message or a code onto the tissue-fitting surface of the mandibular dentures and the tissue-fitting surface of the maxillary dentures, respectively. To protect the structural integrity of the denture, the trough created by the bur should be as tiny as possible. Additionally, the patient should be given instructions on how to clean their dentures and maintain good dental hygiene⁴.The method is

straightforward and makes it possible to include a robust and fireproof label into the denture base material⁵.

- b) embossing-In these techniques, a tiny round bur is used to engrave a short piece of information or a code on the tissue-fitting surface of the mandibular dentures and the tissue-fitting surface of the maxillary dentures. To protect the structural integrity of the denture, the trough created by the bur should be as tiny as possible. Additionally, the patient should be given instructions on how to clean their dentures and maintain good dental hygiene⁴.Large numbers of letters may be included in the personal identifying label without running out of room, and the mechanical strength of the denture would not be negatively impacted by this manner⁵.
- c) c)writing on the denture surface-Stevenson proposed in 1987 the use of a tape-wrapped disposable blade to cut the patient's name or social security number on the buccal surface of the distobuccal flange and then wipe a lead pencil or ink pen over the tiny grooves to make them more noticeable. Heath et al (1988) claimed that a fibre-tip pen could be temporarily used to mark a finished denture's roughened surface, and that these marks could then be sealed with layers of sealant to prevent abrasion^{6,7}.

Other methods include^{9,10}

- a. invisible ink method
- b. Weckers electro pen method
- c. Laser etching method
- d. Onion skin paper method
- e. Denture bar coding method

DENTURE MARKING MEDIUM

- a. The proposed materials include paper, onion skin, nylon, linen, or fibered glassware. Any of these mediums can have the identification markings typewritten, pencilled, or written with a pen.
- b. Metal inserts made of materials like aluminium, shim steel, matrix band,

stainless steel, or orthodontic band may be employed. To endure the most common postmortem attacks, it is advised to employ an inclusion denture marker that is ideally metallic.

- c. A modified acrylic denture base material can be employed, which improves the material's radiopacity by including barium sulphate. It is possible to employ radiopaque materials that contain barium sulphate, such as Stellan and Chex gauze⁸.

Inclusion Methods¹¹.

- Lose inclusion method
- Youngs method
- Dippenars method
- Reesons method
- Clear acrylic T bar method
- Olivers method
- Lenticular card method
- Bar coding method
- Radio frequency identification tag
- Lead foil method
- Metallic band according to Swedish guidelines
- Photograph inclusion method
- Min I Dent method
- Data matrix code
- Microlabelling
- Cast embossed identification plate
- Ceramic crown engraving method
- Memory card method

1.Lose inclusion method ¹²

In Lose's method, the patient's name was written on a piece of "onion skin" paper and included into the denture's fitting surface during the packing process. It is an easy, efficient, and economical way to label dentures.

2.Young's Technique^{9,18}:

Young suggested a method in which the length of the patient's name is matched to the length of a groove that is carved into the buccal flange of the denture, which is 0.5–1 mm deep. The patient's name is then written in the recess using a regular ballpoint pen or

felt tip pen before the area is sealed with fissure sealant. It is an easy, efficient, and economical approach.

3.Dippennar's Method^{9,18}:

Dippennar devised a method in which a soft metal band bearing the patient's information was either written or engraved before being fitted into a 2-3 mm wide predrilled hole. In the event of a fire, the metal band must be fire resistant.

4.Reeson's Method^{9,18}:

Reeson employed stainless steel tape in the required size that was 9.5 x 0.125 mm thick. During the trial packing process, the polished surface of the steel tape was etched with a rosehead bur to include the patient's name, identification number, and country of origin. This method is straightforward, economical, and needs no specialised tools. Fire resistance exists for the stainless steel tape. The main drawback is that relining is necessary, but this may be avoided by relining the denture with transparent acrylic resin, which will make the identifying plate visible.

5.Clear Acrylic Resin T-bar:

A wax bar is prepared, flaked, packed, processed, and finished in clear polymethylmethacrylate resin to create a T-shaped clear polymethylmethacrylate resin bar. A reduced-size, print-face inward identifying label is fastened to the flat portion of the bar. The identifying label is then visible via a clear window created by surface polishing. This process is simple, affordable, and efficient.^{9,16,18}.

6.Oliver's Approach⁹

With this technique, the patient's information is written with a Lumicolour 313 (Staedtler) permanent marker on a rectangular sheet of heat-curable acrylic resin that is 0.3 mm thick. At the trial closing stage, the strip labelled with the patient's name is placed during packing. Then a very thin coating of acrylic resin dough is placed on top of it. The denture is

prepared once the flask is properly shut. The benefits of employing polymethyl-methacrylate sheet as a name tag material are (i) the tag and base are made of the same material and are thus compatible, and (ii) an acrylic resin tag may be readily repaired if the tag slides during packaging and a corner protrudes through the denture surface.

7. Lenticular Cards⁹

Lenticular lenses are used to create pictures that appear to have depth, morph, or to alter or move depending on the angle at which the image is seen. A lenticular picture is made by mixing at least two or more existing images with a lenticular lens in the multi-step process known as lenticular printing. To interlace one or more of the other photos, each image is divided into strips. These are bonded onto the lens after being printed on the reverse of a synthetic paper. Polyvinyl chloride (PVC), amorphous polyethylene terephthalate (APET), acrylic, spectra, and polyethylene terephthalate glycol (PETG) are the materials most frequently used to create lenticular pictures. The lens is integrated into the denture's channel cutout, and auto-polymerizing transparent acrylic resin is applied around the identification rather than directly on it. Advantages: When submerged in water, the lenticular card doesn't exhibit any symptoms of fading or degradation. Because of its small size, it does not interfere with oral function and does not require a specific reading instrument or equipment to read the data, such as a computer or handheld reader. Lenticular printing is an easy, affordable, and speedy technique^{9,16}

8. The use of bar codes

The following are some of the fundamental specifications for bar coding:

1. It must be simple to implement.
2. In every circumstance, specific information must be provided.
3. The dentures' material's structure or qualities cannot be changed.

4. Must not interfere with the dentures' ability to adjust to the supporting tissues.
5. Cannot compromise aesthetics.
6. Must be temperature-resistant.
7. It must be affordable.

The denture base has a recess formed for the bar code, which is then filled with autopolymerizing resin and sealed.

9. Incorporating Radio-Frequency Identification Tags^{9,16}

Radio-frequency identification, sometimes known as RFID, is a wireless electronic communication technique. In 1940, during World War II, radiofrequency identification technology was initially developed and utilised to identify Royal Air Force aircraft. An antenna and microchip along with a serial number used to identify a person are referred to as a transponder or tag for radio-frequency identification. The chip may send the serial number or other information to a reader thanks to the antenna. These radio waves are transformed by the reader into digital data, which is then sent to a computer with software to understand it. RFID-tags also provide a read/write capability that allows for the transmission of new data.

Advantages

1. Individual tags within a group can be identified thanks to a transponder with a special identifying number.
2. Setting the tag in the denture is a simple, quick, and reliable approach that doesn't require any specific training.
3. A lot of data can be saved without weakening the denture, and the denture may be relined or rebased without removing the device from it.
4. The chip is resistant to cleaning agents.

10. Lead Foil incorporation⁹

This procedure outlines a radiographic approach in which, when fabricating the denture, two layers of resin are sandwiched over a lead foil marked with patient information. A radiograph can be obtained after the denture has been processed to show

the patient information etched on the lead foil used to make the denture.

Advantages: It is a quick, straightforward, and uncomplicated procedure. It is a long-lasting and aesthetically pleasing approach that satisfies all ADA criteria. The denture's durability is not jeopardised.

11.Metallic Band Inclusion (Based on Swedish Guidelines)

The Swedish ID-Band (SDI, AB, Sweden) is a stainless-steel band with a patient-specific, ten-digit personal number. A letter (S- for Sweden) plus a ten-digit number make up the personal number. The patient's birthdate, day, month, and year are the first six digits, with zero as a prefix to numbers less than ¹⁰. The birth date is the following three digits, while the final digit denotes the sex.

Advantages -The ID-Band is temperature-resistant up to 1,100 degrees Celsius.

There have never been any reported cases of allergies being brought on by stainless steel, which is a well-established material for dental equipment. In situations of intense conflagration, it is the sort of marking that lasts the longest.

12.Image Inclusion Technique.

This method takes use of a patient's picture that is set into a transparent acrylic denture foundation. Using a micro-tip graphite pencil, the patient's name, age, and location are inscribed on the reverse of the image. The marking is especially helpful in nations with low literacy rates, where a photo ID is the most convenient¹³.

Advantage: The identification may be quickly determined by the unaided eye by lay people¹⁴.

13.Including Min. I. Dent^{14,18}.

The Min. I. Dent denture identification strip is typed with the patient's information before being baked in an oven at 325-degree Celsius for 30 s to 1 minute. As a result, the strip turns into a chip and the text or numbers might decrease. The chip is cut with a carbide bur to the necessary size. The

denture is given a groove that has been carved out of it, and the chip is inserted into the groove and sealed with orthodontic resin.

14.the use of Data Matrix Code

A 4 mm diameter thermally resistant substrate wafer serves as the matrix marking. It is scanned with an M210 handheld scanner and is made up of a two-dimensional data matrix with bright and dark-coloured sections that stand in for binary 0 and 1. 60% of the wafer disintegrated into the monomer when it was implanted in the auto-polymerizing acrylic resin and became useless. Thus, the code was directly laser engraved into a ceramic disc. The discs had a thickness of 0.5 mm and a diameter of 4 mm. These matrix codes are capable of holding 16 upper case alphabetic letters. At the flasking and packing step of the denture production, the coded ceramic discs were subsequently included into the heat-cured clear resin¹⁵.

15.Denture micro labelling system:

In this system, the patient's name and other information are recorded on a transparent film. This label is chemically processed with 100% cyanoacrylic acid before being inserted into the denture. After adding the label to the denture, a thin layer of auto polymerizing transparent acrylic resin may be put on top of them.

Other inclusion methods include

- Incorporation of Embossed Identification Plate into Partial Denture Frame Work
- Incorporation of memory card
- Denture marking using aadhar number

DENTAL IMPLANTS IN FORENSIC IDENTIFICATION

Because the implants are manufactured by machines, they lack the individualization required for their use as identification for the deceased. If the manufacturer of implants identifies each implant with an individual serial number rather than a batch number, it would be feasible to create a new way for identifying the dead²¹.

A new area of forensics is the identification of victims using dental implants. An element called a dental implant is inserted into the jawbones to help the osseointegration process sustain the dental prosthesis. Recently, dental implants have become increasingly often employed for dental identification, particularly in situations when the complete dentition is made of implants. Through osseointegration, a biological process, these dental implants join with bone. Some materials, such as titanium and ceramic, aid in bone integration as opposed to triggering a foreign body reaction. The forensic odontologist can identify the victims by comparing them to the ante mortem records of the impacted individuals thanks to recent innovations like implant identification software, radiographic recognition of dental implants, and batch number analysis. When used in conjunction with radiographic methods, implant software identifies (IRS) implants in accordance with the requirements specified, making the operation effective. The odontologist has used a variety of identification methods to identify implants. IRS collaborates with general dentists to detect unidentified implants¹⁷.

In a study, Berketa et al. investigated the effects of cremation on bone-supported dental implants inserted into sheep mandibles. Dental implants were radiographed and photographed in various configurations. The complete sheep heads were then burned in a commercial cremator after being surgically implanted into sheep mandibles. Image subtraction analysis of the radiographs was done after the implants were removed and re-irradiated. The Straumann TM implant's batch number was still clearly visible when the implants were photographed, which might considerably strengthen the case for using antemortem data to identify the deceased¹⁹.

Research was conducted by Berketa et al²⁰. to see if the batch number could still be identified after being exposed to high heat in a furnace.

Within the chamber of their implant, a laser carved batch number was visible. The outcome showed that after removing the abutment, there was an intact, distinguishable batch number.

The implants lack the individualization necessary for their use as identification for the deceased because they are machine-made. It may be possible to develop a new method for identifying the deceased if the company making implants assign individual serial numbers rather than batch numbers to these implants.

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FIXED PROSTHESIS

Method for Engraving a Ceramic Crown^{3,9,22}

Dentin porcelain is placed after baking the opaque layer of porcelain, and letters or the patient's initials are etched with a brush. On carved initials, stains are applied, then enamel porcelain is applied and moulded with a gentle brush to preserve the initials. Due to a paucity of space, only a few initials may be engraved in the crown and bridge.

CONCLUSION

When the procedures are used appropriately, precision is guaranteed by the distinctiveness of our dental anatomy and the installation of personalized restorations. The practice of forensic dentistry is crucial in identifying those who aren't already identified aesthetically or in some other way. Denture labelling or marking is not a novel idea in either forensic or prosthetic dentistry, and forensic dentists have advised its regular use internationally for a long time. The overseeing body for Denture marking should be required in the health industry. Moreover, as prosthodontists, we suggest that our fellow dentistry specialists,

as well as normal dentists, it is our moral and professional obligation to do so.

Declaration by Authors

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