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### REVIEW ARTICLE

#### Denture Marking System – Useful Aid In Forensic Investigation

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#### ABSTRACT

Identification refers to the establishment of a person's individuality. Ascertaining the identity of the deceased is a crucial part of the investigation for both legal and humanitarian reasons. Mass disasters such as fires, accidents and crime such as murder require identification of the deceased individual. Approximately 1.5 deaths per 100,000 persons due to fire hazards have been reported globally in the year of 2017, while the total number of incidents reported in the same year is around 3.1 million (Centre of Fire Statistics, 2019) (1). Taking into account the recent tragic train accident of Odisha with mass casualty is the kind of situation wherein identification of severely mutilated individuals is deemed difficult. The dental prosthesis of the deceased individual can also serve as an important tool for identification thus highlighting the role of Prosthodontists in forensic dentistry. This article elucidates the various methods of identification and/or marking of the dental prosthesis for forensic investigation purposes. The Google scholar, National Library of Medicine and PubMed were used to gather the articles

## INTRODUCTION

Forensic Odontology according to Federation Dentaire Internationale is defined as “ that branch of dentistry, which in the interest of justice deals with the proper handling and examination and presentation of dental findings.” Identification is an important aspect of the investigation for both medico-legal and humanitarian purposes. Traditional methods of postmortem include visually recognizing the body and personal property such as clothing, jewellery etc. however these are not very reliable. The most appropriate approach is to analyse the physical features evident on the body.

The dental tissues gain importance in identification as they are resistant to decomposition. Moreover, the fillings, prosthesis etc. also aid in identification purpose.

Denture marking is an acceptable tool for identification of geriatric persons during war, crime, natural as well as mass disasters.

These methods of identification are also helpful in case of patients suffering from neurodegenerative disorders like Parkinson’s disease one of the common symptoms of which includes memory loss(2).

## HISTORICAL EVALUATION OF DENTURE MARKING

During 66 AD, a well documented case of Agrippina and Lollia Pauline. Agrippina wife of Claudius emperor of Rome feared about rich divorcee Lollia Pauline who may still be her husband’s rival. So she instructed the soldiers to kill Lollia and bring her head back. She was satisfied after the identification of the dental alignment and certain distinctive characteristics. This was the first use of dental identification. The first forensic identification in India dates back to 1193 where Jai Chand, ruler of monarchy, destroyed by Muhammad’s army was murdered and identified by his false teeth. (3)

In 1776 at the Battle for Breed’s Hill in Boston, Dr. Joseph Warren was killed and was not in a shape to be identified due to fatal head wound. A dentist Paul Revere identified Dr. Warren’s dead body by a small denture that he had fabricated for him. (3)

The American Dental Association have specified certain criteria for denture marking which are as follows : (4)

- The identification should be specific
- The technique should be simple
- The mark should be fire and solvent resistant
- The denture should not be weakened
- The mark should be cosmetically acceptable

## TECHNIQUES OF DENTURE MARKING

The methods can be broadly categorised as : (5)

### Surface marking Inclusion techniques

- |                              |                       |
|------------------------------|-----------------------|
| - Engraving method           | - Lose inclusion      |
| - Embossing method           | - Young’s method      |
| - Invisible ink method       | - Dippenars method    |
| - Fibre tip pen method       | - Reesons method      |
| - Heaths method              | - Clear acrylic T bar |
| - Stevensons method          | - Olivers method      |
| - Weckers electro pen method | - Lenticular card     |
|                              | - Bar coding method   |
| - Laser etching method       | - Radio frequency     |
| - Onion skin paper method    | - Lead Foil method    |
| - Denture bar coding         | - Microlabelling      |
| - Memory card method         |                       |

## SURFACE MARKING TECHNIQUES

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In this technique the series of letters i.e patient's initials are engraved on the fitting surface of the maxillary complete denture. (Fig.1)

The demerit of these engraved markings is that it can be a site for food debris accumulation which can act as a nidus for the growth of bacteria which may ultimately cause infection.



**Fig. 1** Depicts the engraving method of denture marking

Another method of denture marking includes scribing wherein patient's name is printed on a sheet of paper and then placed in the maxillary denture. A 1mm deep depression is created in the palatal region on the fitting surface. The strip of paper with the name is placed and it is then covered with self cure acrylic resin and polished.

**Fig. 2** Depicts the scribing technique. (6)



**Fig. 2**

**Embossing.** The patient's initials are scratched onto the master cast which then gets reproduced on the denture.(Fig. 3 a-c) (7)

Drawback : As the letters are reproduced in the denture the embossed region is uneven as compared to the rest of the surface therefore it can lead to continued tissue irritation during function.

This has been reported to be related to malignancy. Hence, not considered as an ideal technique.

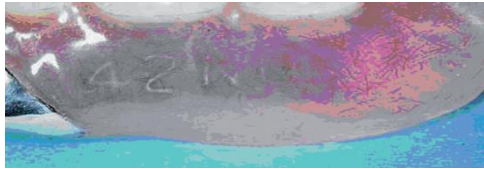
This can be corrected by covering the embossed marking with denture base acrylic and finishing it so that it causes less tissue irritation.



**Fig.3 (A)** An embossed plastic tape has been applied to the RPD wax pattern



**Fig. 3(B)** Casted framework with embossed markings



**Fig. 3(C) Embossed marking visible on the processed denture**

**Fibre Tip Pen Method.** A fibre tip pen is used to write the patient's details on the intaglio surface (interior surface of the denture that is in contact with the mucosa when placed in the oral cavity) or the polished surface of the denture which is then covered by a thin coat of varnish to prolong its lifespan. (Fig.4) (5)

Composition of varnish : (7)

- 5g acrylic resin polymer
- 20 mL chloroform

Advantages : The varnish is inexpensive and resistant to denture cleaners, antiseptics and mouthwashes.

Disadvantages : Unaesthetic denture



**Fig.4 Depicts fibre pen tip marking on intaglio surface of maxillary complete denture**

**Heath's Method.** Here the markings are made using spirit based pen or pencil. This is then covered with clear polymer dissolved in chloroform. The technique was later modified, as chloroform is a potent carcinogen dental sealants were used instead. (5)



**Fig. 5 Heath's method**

**Denture Bar Coding.** Bar code refers to machine readable series of bars and spaces printed in a define ratio. Fig. 6 (A-B) (8)

Technique :

Number code is printed on paper

|

Photograph of the same is taken

|

Negative replica of the same is made and transferred on to a piece of silk cloth

|

Image of bar code is obtained on the prepared faience with the help of a machine that forces the colour through the silk at 860°C for 30 minutes in porcelain oven

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Bar code is placed onto the denture surface and coated with cyanoacrylate resin

Drawback : Incorporating the bar code on the curved flange is a tedious process.



**Fig. 6 (A) Denture bar coding**



**Fig. 6 (B) Intra-oral photograph after placement of denture in the mouth**

### INCLUSION TECHNIQUES

As the name suggests it is a more permanent type of denture marking technique in which either thin paper strips, microchips etc are incorporated into the denture base itself.

**Lose inclusion.** Lose suggested writing patient's details on a piece of thin onion skin paper strip and incorporating it into the fitting surface of the denture base during the packing stage. (Fig.7) (9)

Advantages of the technique include simple procedure that does not require much time and is cost effective.



**Fig. 7 Lose' method**

**Young's method.**(5) He proposed a technique where in a 0.5-1mm deep groove is cut in the buccal flange of the denture, the length of the groove corresponds to the length of patient's name. A ball point pen or felt tip is used to print patients name in the recess after which it is sealed with fissure sealant.(Fig.8)



**Fig. 8 Young's method**

**Dippennar Method.**(5) In this technique a soft metal band is used on which the patient's details are either typed or engraved. This metal band is then inserted into a prepared cavity of 2-3 mm.

Advantage of this technique is that the metal being fire resistant can be helpful in identification in case of fire accidents.



**Fig.9 Dippennar's method**

#### **Radiofrequency identification tags. (7)**

The inclusion of RFID is a cosmetic, effective labelling method. It permits reliable identification of the wearer. (Fig.10 (A))

They are preferred due to following reasons :

1. Small size approximately (8.5 x 2.2 mm)
2. Large amount of data can be stored in them

The system consists of a data carrier, or tag and electronic handheld reader. (Fig. 10(B))

Electronic reader energizes the transponder through an electromagnetic field emitted via the antenna.

Coded data is received that is then converted by the transponder into readable data.

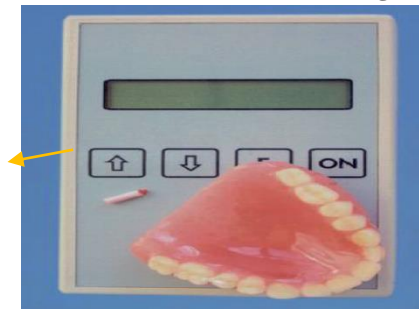
#### **Advantages**

- No expertise required to set the tag in the denture.
- Chip is resistant to disinfectants and solutions of 1% hypochlorite, 4% chlorhexidine and 4% sodium perborate.
- There is no weakening of the denture as the chip size is small
- The chip remains readable in sub-zero temperature as well as after burning for 1hr at 1500°C.

**Fig 11 (A-D) demonstrate the steps of RFID tag insertion (10)**



**Fig. 10 (A) Polished denture with RFID tag incorporated**



**Fig 10. (B) Black arrow depicts RFID tag and Yellow arrow depicts the hand held reader**



**Fig 11. (A) A depression is made using carbide bur on the surface of the denture base**



**Fig 11. (B) Prepared depression to insert RFID tag**



**Fig 11. (C) After placement of the tag it is covered with self polymerizing acrylic resin**



**Fig 11. (D) Polished denture after the insertion and covering of tag with acrylic resin**



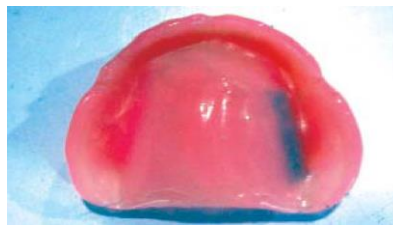
**Onion Skin Paper Method.** An onion skin paper can be used alongwith carbon marker that is applied to the denture base during try in step. The onion skin paper is peeled after processing of the denture, with a carbon impregnation obtained on the surface of acrylic. (11)

**Lead Foil Method.** In this method a strip of lead foil is taken and patient's details are written on it using a ball point pen. Later this lead foil is placed in the posterolateral part of the palate in case of maxillary denture and lingual flange area of the mandibular denture during the packing stage of acrylisation.

Fig. 12(A-B) (12)



**Fig 12. (A) Lead foil with patient's details placed in the posterolateral part of palate of maxillary denture**



**Fig 12. (B) Showing the incorporated lead foil strip after acrylisation**

#### RECENT ADVANCES IN DENTURE MARKING SYSTEM

With the evolving technology newer denture marking methods have been introduced some of which include :

1. Using Memory card
2. Bar code system
3. Engraving the Adhaar Number

**Denture Marking Using Memory Card.** Memory card is a small electronic device that is used for storage of all kinds of data viz, images, audio, video, text, etc. A wide range of memory cards are marketed under the brandnames such as Kingston, SanDisk etc. with varied storage capacities.

The information stored in memory card can be read on any computer system.

This memory card can be used as a denture marking system wherein patient's personal information is stored in it and can act as a valuable tool in case of forensic investigation.

#### PROCEDURE. (13)

All the relevant information regarding the patient such as name, age, sex and photograph are stored in the memory card. It is then wrapped in cellophane sheet to avoid any damage from polymer and monomer..

A recess is created in the maxillary denture base on the palatal aspect to place the memory card.

After placement of the memory card it is then covered with acrylic resin. The denture is finished and polished.

After the introduction of Triad VLC system (Dentsply International Inc., York, PA) the procedure can be simplified by using light polymerised Triad gel instead of acrylic resin.(14) This eliminates the curing step.





**Fig 13. (A) Memory card**



**Fig 13. (B) Recess created on palatal surface for placement of memory card**



**Fig 13. (C) Memory card wrapped in cellophane sheet**



**Fig 13. (D) Memory card placed and covered with auto polymerizing resin, finished and polished.**

**Denture Barcoding(15)(16).** 2D bar coding is another technique that can be employed for denture marking. It is useful not only in case of forensic investigations but also in patients with neurodegenerative disorders such as Parkinson's disease which is the most common example with memory loss. (2) A 2D bar code with patient's information is generated with code generator and laminated. (Fig. 14 (A)) After which it is placed on the palatal aspect of denture base embedded between thin films of autopolymerizing resin (Fig. 14 (B)). The denture is processed and finished.



**Fig 14. (A) Laminated Barcode**



**Fig 14. (B) Bar code placed on palatal aspect of maxillary denture base**



**Fig 14. (C) Bar code placed in the recess created on the distolingual flange of mandibular denture base.**

## CONCLUSION

With advancing technology newer methods are emerging that are proving beneficial and making it the investigation process slightly simpler. Every system comes with its own merits and demerits and efforts are being made to continuously for their betterment. Denture marking systems have been introduced as an important and useful tool that can aid in identifying mutilated bodies. Most of these methods do not require skilled expertise and can be used by practitioners. Denture marking should be incorporated into routine prosthesis fabrication for patients which can prove helpful. The usefulness of the same can be explained to the patient and informed consent about the same should be taken while explaining the treatment plan to the patient.

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