ORIGINAL RESEARCH PAPER

Volume-7 | Issue-9 | September-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

RECOVERING IDENTITIES: DENTURE MARKERS

Dental Science

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ABSTRACT

In modern times, as the number of crimes has increased, we come across situations where victims are not identifiable by their physical attributes. A necessity for simple identification markers has become the need of the hour. Denture identification systems are not only useful in forensic identification but can also solve a common problem among hospitalized patients in long term care fa-cilities and hospitals, where it is the difficult to identify the ownership of lost dentures when found. In this review simple but effective methods of incorporation of markers into the den-tures of patients has been discussed which makes it possible to identify them in case of mass calamities, acts of terrorism as well as in daily life. These are simple and cost effective methods that will prove useful at the time of need.

KEYWORDS

Denture Markers, Rfid, Orthodontic Bands, Barcode, Photograph

Despite leaps in modern technology, medical breakthroughs and geographical changes that the last century has brought, crime still persists in all aspects of our lives. Violent and heinous activities that shatter lives of victims and their friends and families occur every day. Often little can be done to repair such damage. The apprehension and subsequent prosecution of the perpetrators is essential to maintain law and order. Through the specialty of forensic odontology, dentistry plays a small but significant role in this process. By identifying the victims of crime and disaster through records, dentists assist those involved in crime investigation.[1,2]

Identification from facial appearance is possible in a very high proportion of cases but there may be circumstances where putrefaction, physical damage or loss of tissues may prevent or render facial recognition unacceptable. In these circumstances the fingerprint is the next line of investigation but there are still a few cases where these methods will fail. It is the role of the forensic dentist then, to examine the oral structures or skeletonised remains with the purpose of describing the life events of the individual which may be permanently recorded in the teeth. Such information may, at worst, narrow the field of investigation of missing persons and at best may result in a positive identification, either using dental records or other information available at the time.[3]Sometimes a prosthesis may be found within the body or close to the scene where the victim is found. The chances of identification of a patient wearing a marked denture is exponentially increased.[2]

Harvey[4] defined forensic odontology as an investigative aspect of dentistry that analyses dental evidence for human identification. This branch of dentistry deals with the handling, examination of dental evidence with proper evaluation and presentation of dental findings in the interest of justice. Prosthodontics as a specialty plays a vital role in forensics.[1,5] The identification of denture remains of primary importance when the deceased person is skeletonized, decomposed, burned or dismembered. The principal advantage of dental evidenc

The frequency of edentulism has not changed. Hence the need to address the issue of denture identification still remains since it is more difficult to identify an edentulous patient than a dentate one.[3,8] Therefore, denture markers labelled with at least the patient's name and further unique identifiers such as gender, phone number, address, job and national identity number may play an important role in forensic casework's. Denture identification systems are not only useful in forensic identification but can also solve a common problem among hospitalized patients in long term care facilities and hospitals, where it is the difficult to identify the ownership of lost dentures when found. For patients, in long term care facilities, who have lost their memory due to personal health issues such as Alzheimer's disease, denture labelling may provide personal identity and herein lays the significance of this paper as to explore the various methods and procedures available for denture marking.

History : Forensic dentistry may have been born at the Battle of Nancy in 1477 when the body of Charles the Bold was identified by the absence of a lower tooth. The use of denture in forensic investigation was recorded as early as 1835 when a gold denture helped identify the burnt body of the Countess of Salisbury.[10] The significance of denture marking in mass disaster identification was appreciated after the world war II when it was discovered that 819 of the 3,000 unidentified dead soldiers were denture wearers.[6,7]

In 1949,the “Acid bath murderer” John George Haigh who was as an English serial killer, was convicted of the murders of six people, among whom was Mrs Durand-Deacon. He did not actually use acid to kill his victims, but rather - as (he believed) a foolproof method of body disposal – dissolved their bodies in concentrated sulphuric acid. During the investigation, it became apparent that Haigh was using the acid to destroy victims' bodies because he misunderstood the term corpus delicti, thinking that if victims' bodies could not be found, then a murder conviction would not be possible. The substantial forensic evidence, not withstanding the absence of his victims' bodies, was sufficient for him to be convicted for the murders and subsequently executed. The evidence was primarily based on the findings of the pathologist who found an intact upper dentureamidst the sludge, which hadn't melted in the acid, and was later identified by Mrs Durand-Deacon's dentist during the trial and conviction.11The importance of denture identification was brought into focus by Dr. Robert H. Griffiths during his tenure as president of the American Dental Association.[2]

Also the disaster victim identification teams have often been presented with the unprecedented challenge of identifying thousands of badly mutilated disfigured and severely putrefied bodies. Reliance on circumstantial evidence to identify remains can often lead to mistaken identification. It is interesting to note that it takes only one marked denture to accurately and cost efficiently identify a deceased when all other methods may fail.

Requirements of an Identity marking system: [7,10,12]

Denture marking should fulfil all the following ideal criteria laid down by Vestermark(1975) which are basically the same as those proposed by Kruger-Monsen(1962)[10]

1) The mark carried by the denture must be specific, and be capable of yielding a rapid positive identification
2) The marking technique must be easy and quick to carry out and cheap to introduce
3) The mark should ideally be fire resistant or if it is not, it must be placed palatally or lingually in the molar region, so that the tongue

may protect it. It is only in the most severe conflagration that the tongue and posterior part of denture are burned (Camps, 1968)
4) The marking method should not affect the durability of the denture base material.
5) The mark should be cosmetically acceptable to the patient, and as unobtrusive as possible.

Position of the medium: Several authors [1,4,6,7,8] have observed that in many cases of air disaster where the limbs are completely burnt off, some denture materials especially the posterior part of the acrylic denture, lingual surface of the mandibular denture and palatal portion of the maxillary denture outlast because of the tongue. Hence, it is better to position the denture marker at these sites. The recommended areas for marking therefore are the posterior regions of the lingual flange and the palate. (Figure 1, 2)

FIG : 1 Denture Marker – Orthodontic Band In Maxillary Denture

FIG : 2 Denture Marker – Orthodontic Band In Mandibular Denture

There are various methods of incorporating the marker [4,7,8] into the denture. These methods differ in terms of ease of marking, placement and longevity of the marking.

A) Surface marking techniques[4,7,8]

1) Scribing or engraving: is the most common method of marking prosthesis, since it is the simplest way to establish the durable identity on metal and acrylic resin. In this method, letters or numbers are scratched, engraved or written onto the surface of the denture or denture cast. Heath[13] employed a method of writing on the surface of the denture using a sprit based pen or a pencil before covering the ID mark with a clear denture base polymer dissolved in chloroform. This method of denture marking certainly satisfies the criteria for an ideal denture base marker in terms of simplicity and cheapness. However, it does have one or two disadvantages: firstly, the ID mark possess poor abrasion resistance and hence cannot be considered permanent, secondly, chloroform is a known carcinogen and hence it is axiomatic that a non cytotoxic solvent should have been used.

2) Embossing or engraving method: A more durable and cheaper way of the denture marking was described by Stevenson[14] in which a scalpel blade is used to scribe a serial number on the distobuccal flange of the denture. The mark is then highlighted with a graphite pencil. The technique was developed by Columbus society corporation Ident committee in 1982. The technique appears unaesthetic and possesses poor potential in terms of plaque and fire resistance. The final surface marking technique involves scribing an ID mark directly on the working cast before denture processing. This negative mark cut into the cast produces a positive embossed ID mark on the fitting surface of the denture .This technique can cause tissue irritation, plaque entrapment and may contribute to candidial infections.

B) Inclusion methods: enclose the identifying marks within the denture hence rendering them permanent, but these procedures require more skills and are time consuming. They may act as points of weakness unless they are bonded to the acrylic resin.The most popular technique employed is the inclusion method. They are usually enclosed in the denture at packing stage. This involves cutting a window out of the denture, placing a label in situ and sealing using auto polymerizing or light cured acrylic resin. Sometimes a dislocation, wrinkling or tear may occur proving to be a disadvantage.

The most commonly used denture markers [8,10,15,16,17] incorporated into the denture by inclusion techniques are onion skin paper, wax separating paper[18], mixing pad paper, stainless steel shim stock, kitchen foil, stainless steel orthodontic tape[15], radiographic lead. Over the years, various methods of denture marking have been reported. The recent denture markers used are barcodes[16], radiofrequency identification devices[17,18], patient's photograph[19], lenticular card, laser etching, T bar, electronic microchip[20].

Onion Skin paper /Paper strip method/ Wax separating paper: Lose[18] suggested that the patients name is typed on a strip of thin paper such as the kind that separates the sheets of baseplate wax. It is more economical. The acrylic resin, on the palatal surface fitting surface between the ridge and the center of palate is moistened with monomer on a small brush. The strip of typed paper is laid on the surface and the paper is also moistened with monomer. Clear resin is then placed on the paper before final closure of the denture flask.

This technique was criticized by Frust[19] who claimed that the label would be unlikely to survive a fire as it consisted of a simple piece of typed paper. Instead, he advocated the use of a metallic strip, suggesting it would more likely withstand a thermal insult.

Stainless steel orthodontic tape[20,21]: In this method, the patient details are engraved on a stainless steel metal band and placed in a shallow recess prepared in the denture base. It is the simplest way to establish a durable identity on metal and acrylic resin. The band is covered with clear acrylic resin, trimmed and finished in the usual manner. (Figure 1, 2)

In the 1980's, several states in the United states passed a legislation requiring, names of patients to be placed in new removable prosthesis. Some patients objected to this because of the visibility of the printing. Toolson et al[17] then described a procedure for placing a name or social security number in a prosthesis that is simple and invisible to the patient. They used heat shrink plastic strips to produce ID labels. The procedure involved typing the social security number on a denture identification strip, placing it in an oven, when the strip becomes a chip, it was inserted into the denture and processed. Davis et al [22]used a thin lead foil, like that from a radiographic packet, instead and typed the social security number before incorporating this into the denture.

T bar method: Ryan et al [23] utilised a preformed T- shaped clear acrylic resin bar as a vehicle to insert an identification label. It provides an exceptionally clear view of the embedded label. It is then surface polished to produce a clear window displaying the ID label. This method is easy, inexpensive and time effective.

Berry et al[24] used light cured resin instead of autopolymerising resin, thereby, eliminating the need for a pressurised curing unit and a special bur, designed at Loma Linda university school that is used to prepare an ideal preparation site in the denture base. Ling et al[25]used a computer printed label on to a transparency film, treated the film with 100% cyanoacrylic acid esters adhesive solution before packing.

Radiographic lead: El Gohary et al[26] used lead papers that are easily available as denture markers. They concluded that lead papers were not expensive and their incorporation into the denture as well as its reading didn't need sophisticated techniques. In addition, lead paper can withstand heat and be put in an area in the denture which is not subjected to relining thusproviding considerable advantage over microchip inclusion method. Although stainless steel band can withstand more thermal insult yet it isn't as malleable as lead. It also represents a weak point in the denture as during denture processing, it is difficult to pack stainless steel as it can separate the denture and weaken it.

Laser etching[12]: Specially equipped laboratories can provide a copper vapour laser (CVL) that can etch a patient's identification into the metal

surface of a partial denture. A CVL can label the cobalt-chromium components of dentures easily, legibly and reduce the font size of the data. 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. However, this method is not only expensive but also requires specialized equipment and technicians to perform the procedure.

Lenticular card[27]**:** Lenticular printing is a technology in which a 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. Lenticular printing is a multi-step process consisting of creating a lenticular image from at least two or more existing images, and combining it with a lenticular lens. Each image is sliced into strips, which are then interlaced with one or more of the other images. These are printed on the back of a synthetic paper and laminated on the lens. The most common materials used for making lenticular images are Poly(vinyl chloride) (PVC), Amorphous Polyethylene Terephthalate (APET), acrylic, spectra, and Polyethylene Terephtalate Glycol (PETG). This method is cheap, simple and can store a large amount of information thus allowing quick identification of the denture wearer. The labels show no sign of fading or deterioration. The lenticular card which stores the patient's information has two or more images that can be viewed by changing the angle of view.

Print of dimension on **Photographic paper**[28]: **:** In this technique, patient's photograph (Kodak) was embedded in the denture with the help of clear acrylic resin. The marker is particularly useful in the countries with low literacy rate where a photograph is the easiest method of identification. Photographic paper was coated with a light-sensitive chemical formula, used for making photographic prints. When photographic paper was exposed to light, it captured a latent image that was then developed to form a visible image. (Figure 3, 4)

FIG : 3 Photographic Marker In Maxillary Denture

FIG : 4 Photographic Marker In Mandibular Denture

Electronic microchip[29,30]: The patients information was etched onto the chip measuring 5 x 5 x 0.6mm. Tests conducted on chips embedded in acrylic resin performed well under high temperature and showed excellent acid resistance. The chips were radiopaque and bonded well with acrylic resin. However, the main disadvantage of the chips was that it could be inscribed only by the manufacturer and not by the dentist.

A barcode[31] print is obtained on paper, with dimensions 38mm x 13mm. A barcode is an optical machine-readable representation of data relating to the object to which it is attached. It consists of a machine-readable code of a series of bars and spaces printed in defined ratios. Barcode system can contain large amount of data. The wafer comprises of a two dimensional data matrix of light and dark colored regions representing binary 0 and 1.[3,4] Barcoding[4,7,8,30,31,32] is a way of transferring data to the computer. The barcode symbol represents general data such as name, age, sex, address, occupation, phone number and nationality of the patient; which can be scanned with a specific scanning device to transfer information to the computer. After scanning the bar code, the information can be accessed, added or subtracted. In today's world, we cannot find a single product without barcode associated with it. Barcodes are more efficient and can provide a method to track and store information about individuals. They serve an important role and provide advantages as compared to manual entry of the information. Manual tracking leads to many human errors, whereas bar codes are nearly 10,000 times more accurate

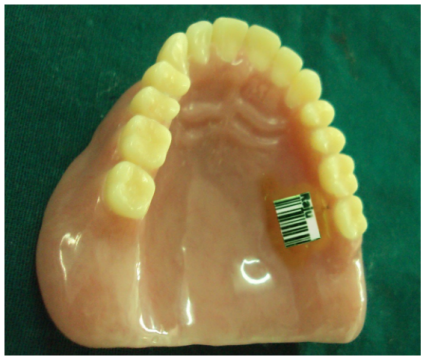

FIG : 5 Denture marker – Barcode in maxillary denture

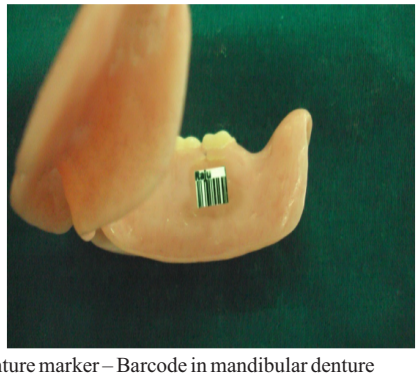

FIG : 6 Denture marker – Barcode in mandibular denture

Radio frequency identification device (RFID)[33]. It is a wireless electronic communication technology. The inclusion of radio-frequency identification (RFID)-tags within dentures is cosmetic and effective labelling method permitting rapid and reliable identification of the wearer. They are preferred because of their small size and the large amount of denture user data that can be stored in them. A serial number that identifies a person, animal or object is stored in a microchip with an attached antenna. Their RFID system consisted of a data carrier, or tag, and an electronic handheld reader that energizes the transponder by means of an electromagnetic field emitted via the reader's antenna. It then receives the coded signal returned by the transponder and converts it into readable data. The chip and antenna together are called as RFID-tag or transponder. The antennas enable the chip to transmit the serial number or other information to the reader. The reader converts the radio waves that have reflected back from the RFID-tag into digital information which is then passed to a computer with applications to interpret it. There are 'passive tags', so named because the power for reading the information on the chip was sent from the reader. No special training is required to set the tag in the denture. The chip is resistant to disinfectants and solutions of 1% hypochlorite, 4% chlorhexidine, and 4% sodium perborate.[15]The RFID tag consists of a torpedo shaped microchip measuring 8.5mm.x 2.2mm.[1,32,34,35]

Although, microchips inclusion techniques such as radio frequency identification (RFID tags), fluorescence markers and other advanced inclusion techniques within dental prosthesis have been suggested as an effective way of labelling the dentures and permitting rapid and

reliable identification of the wearer, these techniques are very expensive, as they far exceed the cost of the acrylic denture. In addition they need sophisticated equipment's for fabricating microchips and its reading. Moreover, electronic devices are considered weak points in the denture structure as they should be put after denture processing and in an area subjected to be relined.

Denture marking should not be restricted to acrylic dentures only but also be extended to those made from cobalt-chromium. Cobalt-chromium appliances resist melting even in some cases of incinerated remains. Identifying markings can also be incorporated in orthodontic appliances, maxillo-facial reconstructive prostheses, crowns, and bridges.

Incorporation of Embossed Identification Plate into Partial Denture Frame Work[36]: This is a simple technique in which embossed tape with patient details is placed into the major connector portion of the plastic pattern of cast partial denture framework and the casting is completed. The patient details are visible in the metal framework of the cast partial denture. Advantages include incorporation of identification mark on a cast partial denture framework which would ensure identification even in extreme situations like fire and traffic accidents.

Ceramic Crown Engraving Method[36]: After baking the opaque layer of porcelain, dentin porcelain is applied and initials of name of the patient or letters are carved with the brush. Stains are applied on carved initials followed by enamel porcelain application shaped with soft brush so that the initials are maintained. Few initials can be carved in crown and bridges due to lack of available space. An electric engraver is the instrument used to mark the fixed denture or crown chairside before final cementation. It provides for rapid identification of deceased victims as metal restorations have a resistance to all insults and they are cemented to the teeth and cannot be readily removed.

Laser marking is another technique utilizing lasers in a variety of methods viz., chemical alteration, charring, foaming, melting, and ablation to produce markings on an object for identification purposes. One subset of laser marking is laser engraving which uses laser beams to engrave markings onto an object.[37]

Laser micro-etching is a precise method where the etching is not visible to ocular vision and can be visualized only with the help of a magnifying lens, loupes or microscope, thus providing good aesthetics. This technique is simple, cost effective and reduces laboratory time involved in other denture marking techniques. Limitations of this technique include requirement of adequate thickness of metal surfaces for etching. Another limitation involved in laser etching is the availability of the laser engraving unit.[37]

Recommendations: The key to successful mass disaster identification is preparedness. Hence, every jurisdiction should have dental identification teams and disaster plans in place. Denture marking should be mandatorily implemented as part of a treatment protocol for the edentulous patient. Dental education must include a course on forensic odontology and denture marking.

CONCLUSION: One of the goals of the forensic dentist is to execute the process of human identification; by this process, the identity of an individual is determined. This area may be considered a science that deals with the gathering, preservation, and comparison of vestiges with patterns obtained at a past moment. The scientific literature has already demonstrated that Forensic Dentistry is an indispensable tool in the process of human identification and it is capable of acting with positive results. In several cases, Forensic Dentistry is the only available method for identification.

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