

A COMPREHENSIVE REVIEW OF DENTURE IDENTIFICATION AND TRACKING METHODS: CURRENT APPROACHES AND FUTURE PERSPECTIVES

Dr Malavika M S. *, Dr Menon Prasad Rajagopal **, Dr Pradeep Samuel ***, Dr Rahul N****, Dr Varada M*****, Dr Ameena A*****

Abstract

Forensic dentistry serves as a valuable tool in providing crucial information that helps in identifying victims in medicolegal issues and disasters. The field of Prosthodontics encompasses the design and fabrication of dental prosthetics which can help in establishing the identity of individuals in cases where traditional means of identification are unavailable. This can be achieved using numerous denture marking systems. Denture tracking is another evolving frontier in the field of dentistry, owing to the importance it holds in the retrieval of misplaced dentures in Alzheimer's and dementia patients. This article delves into the innovative technologies and methodologies that have emerged in the field of denture tracking and identification methods, shedding light on the historical records, current state and future potential in the realm of dental prosthetics.

Key words: *Denture identification, Denture marking, Surface methods, Inclusion methods, Denture tracking.*

Denture identification methods have emerged as a vital tool in the field of dentistry serving various purposes from patient identification to forensic investigation. It serves as an essential component of forensic dentistry. According to American board of forensic odontology guidelines, most dental identifications are based on restorations, caries, missing teeth and/ or prosthetic restorations. Owing to the relevance the dental evidence holds in the realm of identification, numerous marking methods for identification of dentures have been proposed[1].

Denture identification methods can help in establishing the identities of the deceased in mass disasters such as natural calamities or large scale accidents. In addition to victim identification, these methods also contribute valuable evidence to medicolegal and forensic investigation ultimately aiding in the pursuit of justice[2].

Geriatric population represents a distinct segment of the society requiring specialized care and attention especially in the realm of oral health. Prosthetic treatment modalities like dentures have played a vital role in restoring oral function and

improving the quality of life. However, they still remain vulnerable to age specific challenges like Alzheimer's disease, cognitive impairment, dementia and communication difficulties. This causes frequent misplacing of dentures in such patients.

To address these challenges, denture tracking methods have emerged as an aid in locating misplaced dentures and identifying the patient.

*Post Graduate Student, Dept. of Prosthodontics, Educare Institute of Dental Sciences

**Professor and HOD, Dept. of Prosthodontics, Educare Institute of Dental Sciences

***Professor, Dept. of Prosthodontics, Educare Institute of Dental Sciences

****Reader, Dept. of Prosthodontics, Educare Institute of Dental Sciences

***** Post Graduate Student, Dept. of Prosthodontics, Educare Institute of Dental Sciences

***** Post Graduate Student, Dept. of Prosthodontics, Educare Institute of Dental Sciences

Correspondence address:

malvikams92@gmail.com

Though many innovative tracking methods have been introduced, most of them are still in their infancy. An effective method for tracking dentures is yet to evolve. The major challenge presented is implementation of small sized trackers that can be discreetly embedded within a denture and function for an extended period of time.

This review article aims to provide a historical perspective and futuristic view of advancements in denture tracking and identification techniques.

HISTORICAL BACKGROUND

Denture identification has evolved over centuries driven by the need for accurate patient care and forensic science. Denture identification has contributed to historical records by preserving information about individuals, their dental health and materials used in the construction. The first reported dental evidence in the history of forensic science dates back to 2500 BC in a pyramid at Gaza where gold wire holding molars together was identified in the remains[3]. Historical records suggest instances where dental prosthesis though rudimentary have played a role in identifying the deceased individuals or victims. Another historically relevant example cited in India was in 1995, when M Raja Jayachandra Rathore's body was identified by his replaced anterior teeth[1]. To provide a well rounded perspective on the relevance of denture identification many discussions were held discussing social advantages and different methods citing relevant historical examples and researches by Turner et al.(1976), Alexander et al(1998) etc[4]. Dental evidence also played a vital role in the aftermath of the WTC disaster in identifying victims. This article focuses on the comprehensive and informative exploration of various methods used, techniques in use and its futuristic perspectives.

DENTURE MARKING

Denture marking or labeling plays a crucial role in patient identification, maintenance of patient records and forensic investigations. ADA specifications for denture marking states that the marking should be specific, simple, esthetically acceptable, visible, fire and solvent resistant and should not weaken the denture[4]. The basic requirements for denture marking states that it should be biologically inert, economic, easy to apply and retrievable after an

accident.

The recommended sites for the location of denture marking includes posterior buccal surface in maxillary dentures and lingual flange of mandibular dentures. In esthetically demanding patients intaglio surface is preferred[2]. Other sites include palatal region or buccal to tuberosity regions and in fixed prosthesis like crowns, lingually initial or identification number can be placed[1].

Denture marking procedures have been broadly divided into :

1. Surface marking methods
2. Inclusion methods

SURFACE MARKING METHODS

These are simplest, cost effective and less technique sensitive methods which are done by scribing on the surface of denture. Various methods proposed are :

a) Engraving method

In this method, letters or numbers are engraved on the surface of maxillary dentures using a small round dental bur. Engraving is a simple and economic method but raises concerns due to food entrapment and irritation[5].

b) Embossing method

This method involves embossing of a patient's particulars like name or initials on the fitting surface of denture. But this has been associated with increased chances of malignancy due to constant irritation of tissues[5].

c) Invisible ink method

This method was introduced by Harvey. It is indicated in esthetically concerned patients who do not want visible marking on the denture. An invisible ink is used for marking which is rendered visible on exposure to UV light. However, to detect the presence of marking examination under special considerations is required[1].

d) Fiber tip pen method

This method utilizes a fiber tip pen to produce details on the tissue surface or polished surface of denture which is followed by application of 2 thin coats of varnish so as to prolong the durability of the

marking. The overall aesthetics of the denture is immensely compromised in this method[6].

e)Heath's method

This method was proposed by Heath. In this method, marking is done using spirit based pen or pencil and is then coated with a layer of clear base polymer dissolved in chloroform. Heath later replaced chloroform with dental sealants accounting for the carcinogenic potential of chloroform[7].

f)Stevenson's method

Scalpel blade is used to make the identification mark on the distobuccal flange of denture . This marking is then enhanced using graphite pencil. This method results in a transient ,unaesthetic marking with chances of food accumulation[1].

g)Weeker's electro pen method

Weeker described the use of an electro pen which has a sharp tip that rotates to write on metal. This method devises marking on the metal portion of removable and fixed partial dentures[1].

h)Laser etching techniques

Copper vapor laser is used in this method . This copper laser is more focussed and can create much legible without compromising the aesthetics.This marking is done on the metals especially Co-Cr components .Data size can be confined using this method. The main concerns arising are the special equipment required, food lodgement chances and the flat uniform surface required for uniform etching in dentures[8].

i)Onion skin paper method

This method was devised by Jeffrey.In this method,onion skin paper with carbon marker inscription is attached to the denture base during trial closure. Paper is then peeled off from the denture after processing and leaving carbon impregnation of the code in the surface layer of acrylic resin.[9]

f)Denture bar coding methods

This method involves printing a machine readable code of series of bars and spaces printed in definite ratios.The laminated strip of bar code is directly placed on the denture surface and is painted to conceal the marking. However, special equipments are required to process and read the data, and also incorporation of bar code on the curved flange is

cumbersome[9].

II) INCLUSION METHODS:

This involves embedding or incorporating identification information within the denture material. These methods aim to make the marking methods discreet ,durable and permanent. Various methods proposed are:

a)Lose inclusion methods

This method was proposed by Lose.In this method, marking is done on a piece of onion paper and is incorporated in the fitting surface of denture during packing[9].

b)Young's method

This is a simple and cost effective method proposed by Young in which 0.5 - 1 mm deep groove is cut in the buccal flange of the denture. To this groove patient name is printed using ballpoint pen or felt tip pen.This groove is finally sealed using fissure sealant {9}.

c)Dippennar's method:

Dippennar proposed a method in which a soft metal band engraved or typed with patient details is placed into a prepared cavity of width 2-3 mm in the denture.Its thermal resistance property is found to be beneficial in cases of calamities like fire accidents[9].

d)Reeson's method

In this method, marking is done on polished surface of stainless steel tape of thickness 9.5 x 0.125mm . Patient name, identification number and country of origin are engraved using rosehead bur. This tape is then incorporated into the fitting surface of denture during trial packing. Though it is fire resistant, identification becomes compromised in cases where relining is required[9].

e)Oliver's method

In this method, Lumicolor 313(staedtler) permanent marker is used to write patient details on 0.3 mm thick rectangular sheet of heat cure acrylic resin. This strip is then incorporated into the denture base during packing in trial closure stage and is covered by a thin layer of acrylic resin dough and is then processed. It is easy to correct and compatible[9].

f)Lenticular card method

Lenticular printing is a multi step process creating a lenticular image from existing 2 or 3 more images which is then combined with a lenticular lens. These strips are printed on the back of a synthetic paper and are laminated on the lens. Most commonly used materials include PVC, APET, acrylic and PETG. This lens is then cut into a channel cut on the denture and auto polymerising clear acrylic is added around it. These labels show no signs of deterioration and is a simple and cheap method for identification[10].

g) Bar code incorporation

Bar codes are placed into a recess created in the denture base and covered using autopolymerizing resin. It can also be given in crown and bridge restorations. However, compromised thermal resistance and requirement for expensive special equipments are major concerns in this method[11].

h) Lead foil

This is a radiographic method in which lead foil with patient details is sandwiched between 2 layers of acrylic resin and processing is done. After this radiographic evaluation is done to visualize patient particulars. Though it requires radiographic evaluation, this method is easy, cosmetically acceptable and not compromising the strength of denture[12].

i) Swedish I Band

In this method, the band used is a stainless steel band with a personal number printed on it. This personal number consists of letter S (denoting Sweden) and 10 figure personal number. The first 6 digits denote the patient's birth date, month, year and zero is included as prefix to numbers less than 10. The next 3 digits denote birth number and last number denotes the sex. This band can withstand upto 1100 degree Celsius. This method is considered to be quite durable and with minimal chances of allergies[1].

j) Photograph inclusion methods

This method is preferably done in countries having low literacy rate. In this method, photograph of the patient is incorporated in the denture base using clear acrylic resin. Using a microtip graphite pencil name, age and geographic location is written on the photograph. Though it is easy to identify, they are not tolerant to temperature above 200-300 degree

Celsius[1].

k) Min I Dent

On the Min I Dent strip, patient details are typed and are heated in an oven at 325 degree Celsius for 30 seconds to 1 minute. This causes shrinkage of letters or numbers and the strip becomes chip. Using carbide bur this chip is further trimmed to the required size. This chip is then incorporated into a groove cut in the denture base and sealed with resin[1].

l) Data Matrix Code:

In this method, marking is done on a heat resistant substrate wafer of 4mm diameter. Two dimensional data matrix of light and dark colored regions are present which represents binary and 1. This is read using a hand held reader (M210). As acrylic monomer dissolves 60% of this wafer, this code was laser engraved on ceramic discs of 4 mm diameter and 0.5mm thickness. These discs are incorporated into heat cure acrylic resin during packing and flasking stage of denture fabrication[1].

j) Micro Labeling method:

There are various microlabelling methods proposed. This includes:

Using machine PT20 P Touch - on 9 or 12 mm white or clear label tape which is incorporated at the time of processing or inserted after finishing.

Labeling is done in personal identification information in a graphic image and it is recorded on an instant polaroid slide film. This film is keyed to a computer slide creating a format of font size 22 and producing a 15 x 3 mm label. This slide was further converted into a 35 mm slide using a polaroid digital palette. This is finally inserted into a 1 mm groove on the denture base and coated using auto polymerising clear acrylic resin.

Labeling computer printed patient personal information, (8 point font size) after diminishing its size to 50% by photocopying. This is then adhered to transparent film using cyanoacrylate and incorporated into the denture base.

Alteration of Ling's method - on the surface of printed transparent sheet, to prevent deterioration of legibility when exposed to monomer, cyanoacrylate adhesive is placed without rubbing. Over this another transparent sheet is placed and shaped

using scissors. This is then incorporated during pre/post fabrication.

Labeling is done on a strip of absorbent tissue surface. This is placed on the internal surface of the denture and saturated with acrylic resin monomer after final trial packing of the denture. It should be placed in areas where breakage chances are minimal[1].

k) Embossed identification plate

In this method embossed tape containing details of the patient is placed on the major connector region of the cast partial denture and the casting is finished. This makes the marking visible in the metal framework of cast partial denture. It is an effective method of identification in cases of road traffic accidents and fire accidents[1].

l) Ceramic crown engraving method

During dentin porcelain application in crown fabrication, initials of name of patient or letters are carved using brush. To this, stains are applied followed by enamel porcelain application. Only few initials can be carved due to lack of available space and also compromises the aesthetics[1].

m) Memory card incorporation

Memory card (15 x 11 x 0.7 mm) containing patient particulars and photographs is stored and wrapped in cellophane sheet and placed on palatal aspect of denture and covered with auto polymerising acrylic resin. The strength of denture is not affected owing to its small size and also not interfering with the oral function. The data can be read using any personal computer[13].

ADVANCES:

1. **RFID TAG (Radio-Frequency identification Tag)**
An advance in the denture identification procedure is the incorporation of RFID tag in the denture base. This system consists of a data carrier having a unique serial number called as RFID Tag/transponder for identification of persons. These tags can be active or passive. It also has a handheld reader that energizes the transponder by means of an electromagnetic field emitted by the reader's antenna and converts it into data. A proposed method for incorporation of the tag is placing the tag in a depression on the denture surface with antenna oriented mesially and positioned parallel to the

occlusal plane[14].

2. QR CODE

Another advanced and economic method proposed is incorporation of QR code in the denture base. As a unique system of identification for all Indian nationals, Aadhaar card or number can be incorporated into the denture. This QR code can be read using any smartphone and gives the authenticated particulars of the patient in a concise form[15].

3) NFC

Another emerging advance in the field of denture identification involves the incorporation of NFC (Near-field communication). It consists of wireless communication between two devices in close proximity. It has a tag with adequate memory that can save patients information. Incorporation into a groove created in the denture base and coating with clear acrylic resin is the proposed method[16].

DENTURE TRACKING :

In an era when dental care and patient well being are at the forefront of healthcare, the geriatric population presents unique and pressing challenges. A significant proportion of older adults rely on denture or other dental prosthetics to maintain their oral health and quality of life. The ability to accurately track and manage these prosthetics is a crucial component of comprehensive geriatric care especially in those with age specific diseases like Alzheimer's disease and dementia.

A proposed method reported is the vacuum packed GPS denture tracker over which a pressed thermoformed material sheet was shaped to cover and protect the sensor. In this method, the sheet covering the USB plug of the sensor was removed and sealed with room temperature vulcanizing silicone and it can be tracked through mobile applications[17].

From privacy concerns to compatibility issues, the path to efficient denture tracking can be intricate. The implementation of denture tracking faces various challenges like unavailability of small sized trackers, the ability to transmit signals when embedded in dentures, thermal and chemical resistance and the rechargeability.

The authors are fervently striving to develop an effective tracking system by harnessing the power of

modern sensors and data analytics. This transformative evolution holds the potential to be a breakthrough in the future of dentistry ensuring improved oral health and quality of life for countless individuals.

CONCLUSION

In this article we delve into the world of denture identification and tracking ,exploring historical significance, contemporary techniques and ever growing importance it holds in modern dentistry and health care. From ancient engraving methods to modern technologies , the means of marking have expanded and diversified.Denture tracking represents a promising frontier in the field of dental care.The ongoing efforts to develop cutting-edge denture tracking systems promise a future in which misplaced dentures become a thing of the past. In conclusion, as these technologies continue to evolve, we can anticipate even greater improvements in the precision and ease of denture tracking and identification, ultimately enhancing the overall quality of dental care and patient's quality of life.

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