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Prosthodontics: Succour for Forensic Odontology

[1]Dr. Umashree Davangere, Sr. Lecturer, Department of Prosthodontics, Crown & Bridge and Implantology, Pandit Deendayal Upadhyay Dental College & Hospital.

[2]Dr. Shreya C Patil, Sr. Lecturer, Department of Conservative Dentistry and Endodontics, Pandit Deendayal Upadhyay Dental College & Hospital.

[3]Dr. Kaustubh Mahajan, Reader, Department of Prosthodontics, Crown & Bridge and Implantology, Pandit Deendayal Upadhyay Dental College & Hospital.

[4]Dr. Priti Mehta, Sr. Lecturer, Department of Prosthodontics, Crown & Bridge and Implantology, Pandit Deendayal Upadhyay Dental College & Hospital.

[5]Dr. Ravikiran Asabe, Sr. Lecturer, Department of Prosthodontics, Crown & Bridge and Implantology, Pandit Deendayal Upadhyay Dental College & Hospital

[6]Dr. Nikita Mehta, Sr. Lecturer, Department of Prosthodontics, Crown & Bridge and Implantology, Pandit Deendayal Upadhyay Dental College & Hospital

Corresponding Author: Dr. Umashree Davangere, Sr. Lecturer, Department of Prosthodontics, Crown & Bridge and Implantology, Pandit Deendayal Upadhyay Dental College & Hospital.

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Abstract

Dental identifications have always played a key role in natural and manmade disaster situations, and in particular, the mass casualties normally associated with aviation disasters. Prosthodontists play an important role in forensic odontology as they are concerned with fabrication of various prosthesis which can serve as a main tool for early and rapid identification of the victim. The preparedness is the key to success in mass disaster identification. It has been noted by several authors that in many cases of air disaster where the limbs are completely burnt off, some denture materials survive, especially the posterior part of acrylic dentures and metal-based dentures. Thus, marked dental prostheses (full and partial dentures, mouth guards and removal orthodontic appliances) would lead to rapid identification in the event of accidents and disaster. The aim of this article is to highlight the different identification methods used by prosthodontists in forensic investigatory purposes.

Keywords: Denture Identification, Forensic Odontology, Prosthodontics, Palatal Rugoscopy, Cheiloscopy, Bitemark Analysis, Elder Abuse.

Introduction

One of the major objectives of the field of prosthodontia is to assess and rehabilitate the patient with the aid of an appropriate prosthesis. Employing appliances used in the

discipline of prosthodontics for the purpose of forensics is gaining weight owing to the success ratio[1]. Teeth on exposure to postmortem influences survives longer than any other body tissue as the material used to restore damaged teeth are extremely resistant to physical, chemical and biological destruction[2]. Prosthodontic appliances are assuming greater significance in forensic identification as they could provide vital clues for victim identification when traumatic tissue injury lack of a finger print record invalidate the use of visual or fingerprint method[3].

Main Applications

Identification of deceased individual helps in various ways as follows[4,5,6]:

1. Criminal – Typically, an investigation of a criminal death cannot begin until the victim has been positively identified.
2. Marriage – Individuals from many religious backgrounds cannot remarry unless their partners are confirmed deceased.
3. Monetary – The payment of pensions, life assurance, and other benefits relies upon positive confirmation of death.
4. Burial – Many religions require that a positive identification be made prior to burial in geographic sites.
5. Social – It is the duty of society to preserve human rights and dignity beyond life begins with the basic premise of an identity.
6. Closure – The identification of individuals missing for prolonged periods can bring sorrowful relief to family members.

Prosthodontic applications

Broadly classified methods for prosthodontic identifications are:

Scribing or Engraving Fixed & Removable Restorations:

This is the simplest way of marking dentures. Two letters (initial and first letter of the patient) are engraved with a small round bur on the fitting surface of maxillary complete denture resulting in countersunk letters[2]. In case of fixed restoration as well as cast partial denture framework, the identification details of the patient can be incorporated which will help even in more extreme situations, such as fires and traffic accidents[5,7]. (Fig.-1)

Figure 1

Marking with embossed letters

Embossed letters are made by scratching or engraving on the model before processing the acrylic dentures[2]. In CPD embossing tape is embedded in the wax pattern of the major connector. The +ve resulting casting reproduces the embossed lettering, which is identifiable through the tissue colored acrylic denture base resin[8]. (Fig.-2)

Figure 2

Writing on denture surface

Patients initials are written on the buccal surface of distobuccal flange with a fiber tip pen and the marks are protected against abrasion with layers of sealant[2]. (Fig.-3)

Figure 3

Lead Paper Label and Radiographs

Using a lead foil paper found in the intra-oral x-ray film to type the patient's data with any manual ribbon typewriter. During the trial closure stage, the flask is reopened and identification label is incorporated. When a periapical radiograph of the denture is taken, the patient's details would appear clearly in it[9].

Bar Coding[2,5,10,11]

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 labelling. 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 to860°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 tohigh temperatures, and oral solutions. To decode it, hold a code decode enabled mobile camera and translate into text on a mobile phone display easily. Drawback with this is expensive special equipment required. (Fig.-4)

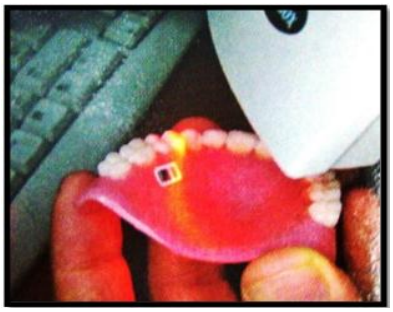

Figure 4

Paper strips / Onion skin paper method[2, 6, 11]

Incorporation of paper strips is an economical technique. 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. Greatest drawback with this is, it cannot withstand fire. (Fig.-5)

Figure 5

ID band

Dentures may be marked with stainless steel band. The most commonly used fire- resistant materials are titanium foil and HO matrix band containing an identifiable coding system reprinting patient details[10]. 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[11]. (Fig. - 6)

Figure 6

Denture micro labeling system

The identification label bearing the patient's details was computer generated and placed in slot in the denture[9]. Chemical treatment with 100% cyanoacrylic acid is done prior to the incorporation of the label into the denture. A thin layer of autopolymerising clear acrylicresin can then be coated[6]. (Fig.-7)

Figure 7

Photographs

Patient photograph is embedded to clear acrylic denture base. Useful in countries having low literacy rate. It was resistant only upto 200 to 300°C[10,11]. (Fig.-8)

Figure 8

Laser-Etching[8,10]

This is used for labelling of cobalt chromium components in a partial denture. It uses copper vapour laser to etch patient details. 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. (Fig.-9)

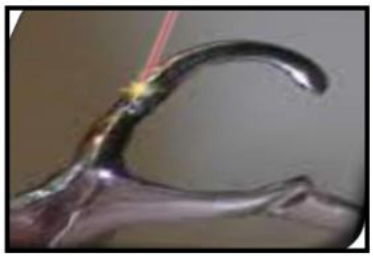

Figure 9

Lenticular system

It is a simple, cheap and quick method[2]. It is a technology in which the lenticular lens is used to produce images with an illusion of depth, morphology or the ability to change or move as the image is viewed from different angles. Lenticular printing is a multistep process consisting of creating a lenticular image from atleast two or more existing images, and combining it with a lenticular lens. Each image is sliced into strips, which are than interlaced with one or more of the other images. These are printed on the back of a synthetic paper and laminated on the lens[5]. Information once written cannot be altered[7]. (Fig.-10)

Figure 10

RFID Tags

Radio Frequency Identification (RFID) is a cosmetic labeling method of identification with the help of using radio waves[6]. The RFID system consisted of a data carrier, or tag and an electronic hand held reader that energizes the transponder by means of an electromagnetic 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 × 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[11]. (Fig.-11)

Figure 11

Data matrix code incorporation

Ceramic discs of 4mm diameter and 0.5mm thickness is laser engraved with matrix codes. These coded ceramic discs are incorporated into heatcured clear resin at flasking and packing stage of denture fabrication[2].

Electronic Microchips

Patient information was etched onto a chip measuring 5 × 5 × 0.6mm . It is bonded with acrylic resin. Further advancement includes specialized equipment to transfer details to computer[10]. 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 acomputer[11].

T-Bar

A T-shaped clear PMMA resin bar is constructed in clear PMMA and identification printed label (reduced in size, print-face inward) is fixed against the flat section of the bar. The thickness of the block is reduced so as to place it in the groove made in the denture[9]. It is then surface-polished to produce a clear window displaying the ID label[10].

Palatal Rugoscopy

Palatal Rugoscopy is the study of palatal rugae. Palatal rugae comprise of irregular and asymmetric ridges of the mucous membrane. The rugae pattern is found to be unique to an individual and therefore, can be used as reliable method in victim identification. In addition rugae are usually protected from trauma due to their position in the head also insulated fromheat by the tongue and buccal fat pads. It is specifically useful in edentulous cases and also in certain conditions where there other methods for identifications are less reliable as in burnt cases or where bodies have undergone severe decomposition. Rugae pattern may be also be unique to racial groups therefore facilitating population identification[7]. They can be used as a reliably reference landmark during forensic identification subjected to prior storage of antemortem data. A prosthodontist may be able to identify denture wearer by the identification of the rugae pattern[6]. The most prevalent palatal rugae shape was sinuous followed by curve, line, point and polymorphic varieties (Fig.-12, 13, 14). The palatal rugae that were larger were the sinuous. The advantages of palatal rugae include[5].

1. Uniqueness
2. Post mortem resistance
3. Overall stability
4. Low utilization cost

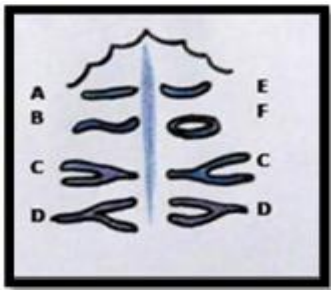

Figure 12

Type of Rugae	length
Primary Rugae(Type P)	5mm or over
Secondary Rugae(Type S)	3 to 5 mm
Fragmentary Rugae(Type F)	2 to 3 mm

Figure 13

Figure 14

Bite Mark Analysis

Individual Bite Marks - The marks left by the teeth in a person may be used to identify an individual. The differences in size and shape of teeth can sometimes be easily noticed, especially when teeth are missing or prominent. The most common type of bite marks are contusions[10]. Like fingerprint and DNA, bitemark is unique to an individual. This type of impression can be left in the skin of a victim, and also in food, chewing gum and other items such as pen and pencils[2]. Bite marks may be both two or three dimensional evidence. However, the interpretation of bite marks involves a three-dimensional reproduction. Prosthodontists who are usually well versed in the properties of different impression materials and hence can easily help in the construction of an accurate replica of the marks (Fig.-15,16). Bite marks should include[7],

1. Distance from cuspid to cuspid.
2. Tooth alignment.
3. Teeth width, thickness and spacing.
4. Missing teeth.
5. Wear patterns.
6. Dental history including fillings, crowns, etc.

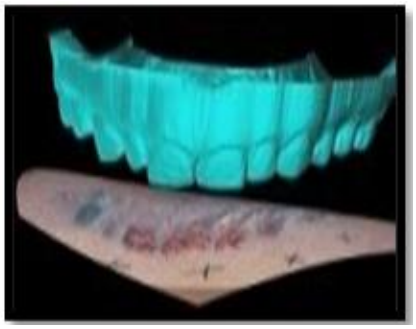

Figure 15

Figure 16

Cheiloscopy

Cheiloscopy or lip-print analysis deals with identification of humans based on lip traces. It can be defined as a method of identification of a person based on characteristic arrangements of lines appearing on the red part of lips or as a science dealing with lines appearing on red parts of lips[2]. The characteristics of the lips formed by lip grooves are as individually distinctive as the ridge characteristics of finger prints[10].

The methods to obtain lip prints are of two types:

1. **Direct Method**
2. **Indirect Method**

Identification with implants

In victims who have been incinerated, there may be loss of finger print detail and denaturing of DNA. In such cases the characteristics of recovered dental implants, if any, may be the only physical identification data available[2]. Implants have high corrosion resistance, high structural strength, and high melting point which will help in the retention of intact implants following most physical assaults[7].

Elder Abuse

The dentist should be aware of child, elderly or spousal abuse when confronted with unusual oral injuries, especially in cases of persons with accompanying head or body injuries[7]. Suspicion is further aroused if, in the dentist's opinion, the nature of the injuries is inconsistent with the historical and chronological explanation of their origin[5]. Abusive trauma to the face and mouth includes fractured teeth, laceration of the labial or lingual frenum, missing or displaced teeth, fractures of the maxilla and mandible, and bruised or scarred lips.

Abuse is most often physical or in the form of psychological threats directedat the elderly, especially in old age homes & similar institutions[12].

A prosthodontist, who usually deals with geriatric patients, can help to identify abused patients by recording a detailed case history & understanding their psychology[13].

For recognising an abuse a dentist should look for---

Head

- Bald spots (traumatic alopecia)
- Bruises behind ears (battle's sign)
- Skull injury

Eyes

- Retinal haemorrhage
- Blackened eyes (raccoons sign).

Face

- Fractures
- Bruises
- Lacerations
- Angular Abrasions

Intra Oral

- Frenum Tears,
- Palatal Bruising
- Residual Tooth Roots.

Teeth

- Fractured, Mobile, Avulsed or Discolored Teeth In
- The Absence of Reasonable Explanations
- Untreated Obvious Infections or Bleeding.

Sex Determination from Pulpal Tissue

The sex determination from pulpal tissue is based on the presence or absence of X-chromosome[10].

DNA in Forensic Odontology[10,14,15]

The highly variable regions of DNA have unique patterns for each individual. Several biological materials may be employed for isolation of DNA and accomplishment of laboratory tests for human identification, including teeth, bone tissue, hair bulb, biopsy sample, saliva, blood and other body tissues.

Conclusion

The contribution of a forensic odontologist in medico legal proceedings cannot be overstressed. In spite of having progressed by leaps and bounds through various techniques in the identification of accident victims and in investigative criminology, forensic odontology is still bound by precincts. A prosthodontist has an immense role in maintaining and incorporating the antemortem records. The task of determining the identity of the deceased persons has paramount importance. Most dental identifications are based on restorations, caries, missing teeth, and/or prosthetic devices, such as complete

removable prostheses, which may be readily documented in the record.

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