

# Denture marking: An introduction and review

Thallam V Padmanabhan,  
Rajiv K Gupta  
*Department of  
Prosthodontics, Sri  
Ramachandra Dental  
College, Chennai, India*

**Address for correspondence:**  
*Dr. T. V. Padmanabhan,  
Department of Prosthodontics,  
Sri Ramachandra Dental  
College, Porur, Chennai-600  
116, India.  
E-mail: tvpadu@gmail.com*  
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## Abstract

Forensic odontology plays an important and often decisive role in the identification of disaster victims. Dental description of unknown or missing persons in case of mass disasters is a very successful odontological means of identification in forensic research. Difficulties arise if the dentition has disappeared for one reason or another or has been replaced by dental prosthesis. From a prosthodontist's point of view, this can be prevented by using denture marking, in order to give this registration a more personal character. This article describes some of the denture marking techniques described to date.

**Key words:** Denture labeling system, denture marking, forensic dentistry, forensic identification

## Introduction

Forensic dentistry can be defined in many ways. One of the most elegant definitions is simply that forensic dentistry represents the overlap between the dental and the legal professions.<sup>[1]</sup>

Violent and heinous activities that shatter the life of victims, their friends, and families occur every day. Often, little can be done to repair such damage. The apprehension and subsequent prosecution of the perpetrator(s) 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 dental records, dentists assist those involved in crime investigation.<sup>[1]</sup>

Dental identification takes two main forms. First, the most frequently performed examination is a comparative identification that is used to establish (to a high degree of certainty) that the remains of a decedent and a person represented by the antemortem (before death) dental records are the same individual. Information from the body or circumstances usually contains clues as to who has died. Second, in those cases where antemortem records are not available, and no clue to the possible identity exists, a postmortem (after death) dental profile is completed by the

forensic dentist suggesting characteristics of the individual, which may probably narrow the search for the antemortem materials.<sup>[2]</sup>

Dental identification of humans occurs for a number of different reasons and in a number of different situations. The bodies of victims of violent crimes, fires, motor vehicle accidents, and various mass disasters, can be disfigured to such an extent that identification by a family member is neither reliable nor desirable.<sup>[3]</sup> Persons who have been deceased for some time prior to discovery and those found in water also present unpleasant and difficult visual identification. Dental identification has always played a key role in natural and manmade disaster situations, and in particular, in mass casualties normally associated with aviation disaster.<sup>[4,5]</sup>

Forensic odontology in a well-established branch of dentistry, and being dentists we are an integral part of this branch. There is enough literature available to prove the role of forensic odontology in various mass disasters. The contribution of forensic odontology to the identification of tsunami victims in Thailand was 80%.<sup>[6]</sup> Dental records were the primary identifiers in 46.2% of those identified following the Indian Ocean Tsunami disaster in Thailand.<sup>[7]</sup> In the 'Scandinavia star' ferry disaster in 1990, a forensic odontologist identified 107 cases out of 158 victims.<sup>[8]</sup>

Contribution of odontological identification of the flight ALIT 5748 air disaster victims, which occurred on 20 January, 1992, was 33 cases out of 84.<sup>[9]</sup> Dental identification was established in 57 out of 94 victims of M/S Estonia, which was Europe's worst passenger ferry disaster.<sup>[10]</sup> More than a year has elapsed since the seaquake in south east Asia in December 2004, and more than 92% of the non-Thai victims have been identified, and about 80% of these victims were identified by dental information.<sup>[11]</sup> Therefore, this much literature evidence is enough to prove our role as forensic dentists in the identification of mass disaster victims.

The identification of a large number casualties in mass disasters are complex and fraught with hazards, both physically and emotionally.<sup>[12,13]</sup> The identification process is fundamentally the same as that in a routine comparative dental identification, but the inherent problems are magnified.<sup>[14]</sup> Problems of body fragmentation, mutilation, commingling and incineration, idiosyncratic dental records from numerous regions, poor working conditions, and psychological stresses all confound the identification process. The key to successful mass disaster identification is preparedness.<sup>[15]</sup>

## Denture Marking

Following major disasters such as earthquakes, fires, or floods, a definitive and early identification (ID) of the dead and injured is of utmost importance. Often this ID must be accomplished via some form of forensic dentistry.<sup>[16]</sup> Determination of the various individual physical and genetic characteristics of human dentition has proved to be very efficient in aiding the task of identification.<sup>[17,18]</sup> Edentulous subjects, on the other hand, have lost all or most of the key features that have proven valuable in such cases, hence, the process of identification is made so much more difficult, unless the victims wear ID-marked dentures.<sup>[19]</sup> The dentures generally remain undamaged owing to the protection afforded them by the soft tissues of the oral cavity.<sup>[20]</sup> The frequency of edentulousness has decreased in recent years due primarily to improvements in oral health brought about by factors such as fluoridation and increased patient awareness.<sup>[21]</sup> However, owing to a wide variation in the oral status of the population in different countries, the need to address the issue of denture identification still remains, as it is more difficult to identify an edentulous person than a dentate one.<sup>[22]</sup> In such cases, in the absence of marked dentures, dental identification is problematic and hence may only be established by well-trained examiners via the comparison of bone trabeculation patterns that have been recorded in the antemortem and postmortem radiographs. The ID marks on dental prosthesis serve two main functions. First, they facilitate the ID of the patient from the denture, for example, in cases of unconsciousness, loss of memory or for forensic purposes. Second, the ID of the denture of a living patient,

is not only helpful for the production laboratories, but also for institutions such as hospitals and community homes.<sup>[23,24]</sup>

Dentures containing some form of identity mark have proved to be of great benefit.<sup>[25]</sup> Over the years various denture marking systems have been reported in the literature and have been divided broadly into surface marking or engraving methods and inclusion methods.<sup>[21]</sup> However, none of the methods fulfills all the requirements of the American Dental Association (ADA). The ideal requirements are:<sup>[26,27]</sup>

1. The mark carried by the denture must be capable of yielding a positive ID.
2. The marking technique must be easy, quick to carry out, and cheap to introduce, bearing in mind the requirements of the above.
3. The mark should ideally be fire resistant, and if it is not, it must be placed palatally or lingually in the molar region, so that the tongue can protect it.
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.

## Engraving Methods

In this technique, identification marks are scratched, engraved or written on the surface of the denture. Heath<sup>[24]</sup> introduced a method of writing on the surface of the denture using a spirit-based pen or pencil, before covering the ID mark with a clear denture base polymer dissolved in chloroform [Figure 1]. This method has disadvantages such as, poor abrasion resistance, it is unaesthetic, there are chances of losing the ID marks if the denture needs relining, and chloroform is a known carcinogen. Later on Heath<sup>[28]</sup> modified his technique by application of dental sealants instead of chloroform. Except for the use of chloroform the other disadvantages of the previous technique still remain.

Another cheaper technique was introduced by Stevenson,<sup>[29]</sup> where a scalpel blade was used to make an ID on the distobuccal flange of the denture. The mark was then highlighted with a graphite pencil. This technique had the disadvantages of being unaesthetic and having poor resistance to plaque accumulation and fire [Figure 2].

Another surface marking technique involves scribing ID marks directly on the master cast before denture processing. Hence, embossed ID marks will come on the tissue surface of the denture. However, this has disadvantages of causing tissue irritation and plaque accumulation.<sup>[26]</sup>

## Inclusion Techniques

Inclusion methods enclose the ID mark within the denture

base material, hence, rendering them relatively permanent.<sup>[21]</sup> A number of inclusion methods have been described to date, and some of them are described here.

Lose<sup>[20]</sup> described a technique wherein the patient's name was typed on a piece of "onion skin" paper and incorporated within the fitting surface of the denture, during the packing

procedure. The author described the method as "simple, non-time consuming, and effective," but it was not resistant to fire [Figure 3].

Later the Lose technique was modified by Ling,<sup>[30]</sup> who used white typing correction paper to form the characters instead of conventional ink, but it had some disadvantages. Furst<sup>[31]</sup>



**Figure 1:** Heath's method



**Figure 2:** Stevenson's technique



**Figure 3:** Lose inclusion technique using onion skin paper



**Figure 4:** Young's technique



**Figure 5:** Oliver's technique



**Figure 6:** Dippenaar's technique



**Figure 7:** Reeson's technique



**Figure 8:** RFID tag



**Figure 9:** Handheld reader



**Figure 10:** Denture marked with Venkat Nag's technique



**Figure 11:** ID mark revealed after taking x-ray of same denture

advocated the use of a metallic strip of 0.001 inch thickness, as it would be more likely to withstand thermal insult.

Another simpler post-fabrication technique reported by Young,<sup>[32]</sup> involved cutting a groove 0.5-1 mm deep into the buccal flange of the denture; the length of which would correspond to the length of the patient's name. An ordinary ball point pen or felt tip pen was then used to print the patient's name in the recess before it was sealed with fissure sealant [Figure 4].

Oliver<sup>[33]</sup> described a technique that involved producing

a label comprising a 0.3 mm thin strip of heat cure resin. A fine fiber tipped pen was then used to mark this label before including it in the fitting surface of the denture base during the trial packing procedure. Lamb<sup>[34]</sup> modified it by producing a label using clear auto polymerizing resin, but the technique was expensive in terms of laboratory time [Figure 5].

Dippennar<sup>[35]</sup> introduced a technique utilizing a standard soft metal band that was either typed or engraved with the patient's details before being rolled up and inserted into a predrilled cavity of 2-3 mm width. A small wax plug was then placed over the metal band, prior to filling the remainder of the cavity, with self cure resin. However, the disadvantage was that the markings were not readily visible [Figure 6].

Reeson<sup>[36]</sup> has described the use of a piece of 0.125 mm thick stainless steel tape on which the patient's details are engraved. The tape is then incorporated into the fitting surface of the denture during the trial packing stage. The disadvantage includes loss of details if relining becomes necessary, although it can overcome this if the denture is

relined in clear acrylic resin, which will allow the ID plate to remain visible [Figure 7].

Ling<sup>[37]</sup> has described a method employing a high power copper vapor laser in order to maximize the amount of data that can be written onto a metallic ID label. By using such a device the font sizes of microscopic level can be produced, thus allowing a greater amount of data to be recorded. However, this high tech solution is out of reach of many dental laboratories and practitioners and hence not cost effective.

Millet and Jeannin<sup>[38]</sup> implanted a Radio Frequency ID (RFID) transponder into a complete upper denture. This system consists of a data carrier, generally known as a tag or transponder, and an electronic handheld reader. The tag consists of a torpedo-shaped microchip with a coiled antenna, measuring 8.5 x 2.2 mm. The reader energizes the transponder by means of an electromagnetic field emitted by the reader's antenna. It then receives the coded signal returned by the transponder and converts it into readable data. However, apart from cost and unavailability, one disadvantage is that it is not fire proof [Figures 8 and 9].

Venkat and Shenoy<sup>[39]</sup> introduced a radiographic technique wherein a lead foil with the patient's details is sandwiched between two layers of resin during the processing of the denture. Authors claim that the method has proved to be simple, easy, quick, durable, and cosmetically acceptable, fulfilling all the requirements of the ADA [Figures 10 and 11].

Looking at the equipments used, which are readily available, and the results obtained, this innovative technique seems to be the most cost effective and easy to follow, to date. Also the ID mark is fire resistant. Therefore, this technique seems to fulfill all the requirements of the ideal technique and does not have disadvantages like the other old techniques of denture marking.

## Summary and Conclusion

Haines reported that among 380 air disaster victims there were 97 dentures and only seven were marked.<sup>[40]</sup> In the case of the Bradford football ground fire disaster, it was reported that 38% of the victims wore dentures of which only one was marked. The author also stated that while dentistry contributed to an ID in 58% of the victims, this would have increased to 85% had all the victim's dentures been identifiable.<sup>[19,41]</sup>

These cases, at present, need some form of ID mark, not only for humanitarian and legal purposes, but also to minimize the cost of the ID. According to a survey conducted by Raymond, 99% of the individuals accept marking of their dentures.<sup>[21]</sup>

Forensic dentistry plays a major role in the identification of those individuals who cannot be identified visually or by other means. In this brief overview, the authors have shown the reader some of the traditional and upcoming techniques of denture marking.

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