Review Article

Denture markers: A comparison

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ABSTRACT

Denture markers have played an indispensable role in forensic odontology and in the identification of hospitalized patients/inmates of community centers. Surface inscription and inclusion markers have been used through the years with their own advantages and limitations. Barcodes routinely used for commercial purposes generally hold data in a single dimension. A two-dimensional (2D) barcode can hold loads of information as it holds the data in length and width. A simple technique using barcode as a denture marker is described.

Key words: Denture markers, forensic odontology, radiofrequency identification tags, two-dimensional barcode

INTRODUCTION

It is a well-documented practice to mark denture with some means of identification. Though there is an observed reduction in the incidence of edentulousness, dentures would never be an obsolete treatment modality. Denture markers have been used for many years in the past and several benefits have been recognized. These have been primarily used in identification of the wearer as in identification in forensic crime scene analysis. Conversely, the identification of dentures themselves may be needed in places such as old age home or a hospital. Furthermore, denture identification would enable the separation of several sets of dentures belonging to the same individual based on the time of fabrication. Weissenstein first proposed that dentures should have some form of identifiable marking in 1931. To some extent; deoxyribonucleic acid (DNA) analysis has made odontological postmortem analysis superfluous. The ideal characteristics of denture markers were initially described by Vestermark in 1975.[1] These criteria included:

1. Specific marking that is capable of rapidly yielding identification;
2. The marking process should be simple, quick, and inexpensive to carry out;
3. The marking should be fire resistant, and/or placed in the posterior aspect of the palate, where retardation of incineration by tissue mass is maximal;
4. Marking should not significantly weaken the removable prosthesis;
5. Identification marking should have esthetics acceptable to the individual patient.

Various examples of specific identification have been proposed, for example, the use of a national identity number containing date of birth and country of origin. Such marking is mandatory for all new partial and complete removable prostheses constructed in Sweden.[1] There is a multitude of proposed methods for denture identification marking. These can broadly be classified into two principal types: Surface identifiers and inclusion methods. Surface identifiers involve marking of the external surface of the prosthesis. Engraving of the master cast will

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produce embossed lettering or marking on the denture.[2,3] Conversely, engraving of the fabricated prosthesis will result in countersunk marking. Carbon paper has also been utilized to color the acrylic surface with lettering immediately prior to processing. As a temporary technique, patient details may be written on the surface of a processed denture using a 'permanent' marker pen.[2] However, surface marking is vulnerable to accidental or deliberate to maintain. Since it is difficult to cope with long-term usage of a prosthesis combined with the adverse cleaning habits employed by many denture wearers, these surface markings are formed by the application of 0.5 mm acrylic resin.[4] Due to the potential for physical or chemical degradation of surface markers, denture identification has also been incorporated deeper within the bulk of the denture acrylic usinginclusion methods.[2,5] Following denture construction, a recess may be cut within the denture base. An identifying wafer or label would be subsequently placed and the surface replaced and sealed with self-curing acrylic [Figure 1].[4] Alternatively, an identifier may be included in the base plate, immediately prior to packing and processing. Tracing paper, polyethylene tape, stainless steel, and microlabeling have all been advocated as appropriate materials for use as inclusion identifiers.[4-6] The use of specific metal markers has been advocated in relation to their ability to withstand high temperatures. More recently, radiofrequency identification tags (RFID) have been suggested as an alternative means of marking. These have been promoted due to the benefits in automated reading of the marker as it can send signal using the radio transmitter that helps in locating mentally-ill patients. To overcome the limitations involved with previous denture marking systems, a simple and an innovative technique of denture marking system using barcode has been described, which could hold significant volume of information with added advantages of less cost and simple laboratory procedure.

DISCUSSION

In a developing country like India, inadequate database of the citizens, antemortem medical or dental records have challenged the forensic faculty. The barcode can hold lot of information including a photograph. Voters ID is included and is considered to be unique for an individual, in a country like India. The 2D barcode technique is easy to carry out, cost effective, and the marker incorporation does not require any special laboratory technology. They can also be helpful in dental hospitals with large patient volumes and where students have multiple complete denture patients at any given time ensuring rapid recognition and minimal risk of denture exchange and cross-infection. Furthermore, the equipment necessary to produce the markers are ubiquitous and the marker itself is easy to generate and costeffective, which is in contrast to other markers. From a forensic perspective, dentures with bar code markers recovered from the deceased may be recognized by a mobile camera. Since 2D barcode can hold photographic details [Figures 2 and 3]. The denture can also be compared with antemortem photographic records to facilitate identification. However, thermal tests revealed that the photographic marker and barcode were only resistant to around 200-300°C, which is considerably lower than for the metal matrix band

Figure 1. Two-dimensional (2D) barcode incorporated into denture

Figure 2. Phone is used to decode the barcode

Figure 3. The barcode deciphered

Table 1. Comparison of 2D barcode denture marker with other marking systems

Engraving	Photograph	Stainless steel	Labeling	RFID	2D	Barcoding
Readability	+++	+++	+++	+++	++	++
Volume of information	–	+	+	–	+	+++
Ease of fabrication	++	+	++	+	++	+++
Cost effectiveness	+++	++	++	++	+	+++
Resistance to fire	–	–	+++	–	+++	++
Advantage points	8	8	11	6	9	13

(+): Advantages; (–): Disadvantages; RFID: Radiofrequency identification tags; 2D: Two-dimensional.

(1,050°C), this being similar to that of other metal marker. This is one of the reasons why metal markers are considered as most ideal for postmortem identification.[7] However, very high temperatures are reached only in extreme circumstances and conditions in different fire situations. Indeed, others have questioned whether denture markers need to withstand high temperature at all as dentures are well-protected by the buccal pad of fat of the cheeks and the muscular tongue; hence, any type of mark placed posteriorly in a denture which is retained in the mouth during a fire will remain reasonably undamaged and survive incineration. Richmond and Pretty have listed five ideal requirements of a denture marker, one of which states that, if the mark is not fire resistant, 'it must be placed palatally or lingually in the molar region, so that the tongue can protect it'; positions adopted by the barcode marker in this study. Moreover, Venkateshwaran Rajendran[8] reported that a great majority of edentulous individuals who require to be identified are recovered in a decomposed state (usually from their home) and incineration may not be an issue. A drawback of metal markers is that relatively less patient information can be stored. Moreover, with the obsolescence of type-writers, the information needs to be inscribed by hand which may not be easily read. Indeed, some authors have criticized metal markers and questioned the logic of their use. On the other hand, electronic denture marking using bar codes stores considerable amounts of patient data and can be written and read using mobile devices. A more recent fancy denture marker using a RFID, appears promising in its storage capacity, but its associated cost and availability of raw material can make its use limited. A minor disadvantage with barcode marker is that related to the size. The size requirement of atleast 12 mm^2, may limit its use in partial dentures. The major advantage in this technique is that a mobile camera would suffice to encrypt and decode the information in and from the code. With the abovementioned advantages, the use of barcode as a denture marker can be definitely encouraged in our day-to-day prosthodontic denture practice. Patient consent obtained before incorporation of the barcode into the denture would avoid certain legal problems.

CONCLUSION

A new denture marker is suggested, which makes use of a 2D barcode embedded in acrylic denture palate. This showed no difference to metal markers, and was better than photographic markers, in terms of preparation and incorporation into dentures. Its readability through the denture base was equally good, as clear acrylic was used to cover the marker. Although barcode markers are not fire resistant, incorporation of these on a fire resistant material would make it possibly the most reliable marker. The 2D barcode denture marking system described, enables instant identification of the denture-wearer, hold loads of information including a photograph, and is cost effective, thus making its use feasible in a developing country like India [Table 1].

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