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Role of Lasers in Forensic Prosthodontics-A Review

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ABSTRACT

The identification of the deceased individuals in case of crime and mass disasters is of utmost challenge to the forensic experts. The lack of fingerprint data makes it challenging to identify the victims of mass disasters. Dental identifications have always played a key role in natural and manmade disaster situations, and, the mass casualties normally associated with aviation disasters, Tsunami etc. Hence Prosthodontics can play an important tool for the investigators to easily identify the victims through denture marking techniques. Incorporating a paper or embossing the data of patient in denture can be tough to read by naked eye because of the opacity of the acrylic resin. Hence the laser can be an especially useful tool in auto-identification as it is cost effective, time effective and less cumbersome.

Key words: Forensic, Disasters, Prosthodontics, Laser, Auto-identification

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INTRODUCTION

The development of many different types of laser during the past five decades has offered researchers many wavelengths of laser light to investigate for a variety of surgical and medical procedures [1]. The physical development of lasers and the understanding of the various wavelengths, and as well as the improvement of the equipments have brought these two areas closer together, with laser representing an upgrade of dentistry as a whole, particularly in esthetics and prosthetics [2].

Dental identification has always played a key role in natural and manmade disaster situations and the mass casualties. Due to the lack of a comprehensive fingerprint database, dental identification is growing as an essential part of forensic investigation [3]. The most common role of the dentist is the identification of deceased individuals. Dental identifications have always played a key role in natural and manmade disaster situations, and, the mass casualties normally associated with aviation disasters. Because of the lack of a comprehensive fingerprint database, dental identification continues to be crucial in the world. Numerous authors have cited various methods for denture marking [4-6]. However, the inclusion method is the simplest and commonly used method for inserting the marked strip. The procedure is like the normal denture processing procedure till the point of final closure of the flask during the packing process. Labeling of dentures can be important in early identification of the dead and injured people in the event of major disasters such as earthquakes, floods, plane crashes, and accidents; for patients suffering from dementia; or the denture itself being inadvertently misplaced on admission of the patient in the hospital [7]. Identification of a body is made easier with the traced dentures were labeled/ marked. The concept of dental identification is by comparing postmortem dental remains with ante mortem dental records such as study casts and radiographs to confirm identity for dentulous patients [8].

LASERS AND FORENSIC DENTISTRY

Denture marking techniques can be an effective tool in personal and forensic identification of

human subjects. The most used denture marking techniques include impregnation, engraving, and embossing methods [9-12]. The purpose of automatic identification (auto ID) is to automate computer data entry. Auto ID can be carried out using bar codes, data matrix codes, magnetic strips, radiofrequency tagging and data communication. In health care it has been used for patient and sample identification. An interest in forensic application of Auto ID for complete dentures is shown in relation to the body identification following disasters.

Initial work was done using bar codes printed on paper. These codes were scanned with a telepen reader and then incorporated into various materials. Firstly, the bar codes were embedded into autopolymerised pigmented and clear acrylic resin. The scanner could not retrieve the data from these strips of acrylic due to opacity of acrylic resin. Secondly, the bar codes were placed between five strips of clear polyvinyl acetate polyethylene mouth guard material. Scanning was successful. Thirdly the bar code was incorporated into one laminated, custom made mouth guard, but the curvature of the mouth guard caused the distortion of the bar code making it unreadable. This bar code was too large for most dental appliances.

Data matrix code

In the development of auto ID, data matrix codes were used. These matrix codes were laser engraved onto instruments. As a result of this work it was decided to evaluate matrix codes for the identification of dental appliances. Matrixes marking were able to produce a flexible, thermally resistant substrate wafer of 4mm diameter. Thermal resistance to 8000C was preferable due to the forensic interest in the body identification. The wafers were then embedded into poly methyl methacrylate.

The wafer comprised of two dimensional data matrix of light and dark colored regions representing binary 0 and 1. Contrast is not as critical for scanning as it for bar codes and matrix codes can contain substantially more data than bar codes of the same dimensions. When embedded in autopolymerising acrylic 60% of the wafers dissolved in the monomer to the extent that they were unusable. The matrix codes were all successfully read however, after incorporation into mouth guard materials.

Direct laser engraving of the code into a ceramic disc is then carried out. This is done to obviate the need for ink marking and to use a material widely used in dentistry. The discs are 4mm in diameter and .5mm thick. Such matrix codes can contain 16 alphanumeric characters. The coded ceramic discs are placed into the heat polymerized clear resin at the flasking and packing stage [13].

PROCEDURE

The matrix code was first scanned using a M210 handheld reader. After the wax try in, the denture was flasked in the conventional manner. At the boiling out stage, a Perspex spacer was placed at the posterior buccal portion of the denture (this area is accessible to the scanner, and there is sufficient thickness of material for the code to be incorporated without any technical difficulties). Trial packing of the acrylic resin was then undertaken, the flask was opened, and the Perspex spacer removed. The matrix code was then placed in position and heat cured clear acrylic because of better aesthetics compared to pink acrylic [14] was packed over the coded disc. The denture was polymerized, trimmed, and polished in the conventional manner. The high-resolution reader was then used to scan the matrix code and automatic identification was consistently successful.

The justification and the advantages of auto-ID include:

Patient identification.

Appliance identification.

Retrieval of dental records.

Diagnostic and decision support.

Education.

Recording and storage [13,15].

Laser etching

Lasers have been used for engraving purposes such as the CO 2 lasers, fibre lasers, and diode lasers. Laser micro-etching is a very precise method which is not visible to naked eyes and required the help of a magnifying lens, loupes, or microscope. Copper vapor laser (CVL) can fetch a patient's identification into the metal surface of a partial denture [16]. It can label the cobalt-chromium components of dentures easily, legibly, and reduce the font size of the data. The draw back with this method is expensive and

requires specialized equipment and technicians to perform the procedure [16,17].

Identification of dental implants through laser etching

The main scientific identifiers are DNA, fingerprint, and dental comparison. In cases where there is loss of fingerprint detail and denaturing of DNA due to incineration of the victim. With such extreme temperatures tooth loss will also occur with extreme temperatures. Then the recovered dental implants, if any, may be the only evidence which will identify the victim. 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 [18]. Berketa, et al. found that the batch number of implants was still intact even after the implant was subjected to intense heat exposure in a furnace. In the experiment, the batch number was laser etched within the chamber of their implant and was exposed to intense heat [19].

CONCLUSION

The use of lasers in the forensic dentistry has shown an interest in forensic application of Auto ID for complete dentures in relation to the body identification following disasters. Initial work was done using bar codes printed on paper. In the development of auto ID data, matrix codes were laser engraved onto instruments. As a result, matrix codes were evaluated for the identification of dental appliances which made the process less cumbersome and cost effective, thus helping the forensic experts in timely and effectively identifying the victims of the mass disasters.

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