# Review Article

## Dental Implants –Evidence in Forensic Odontology - A Review

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**ABSTRACT**:
Dental identification plays a vital role in natural and manmade disaster situations and particular in the mass casualties associated with aviation disasters. The wide use of dental implants in all fields of dentistry , will increase the frequency of implants becoming a part and, in some circumstances, most of the recorded antemortem information for an individual. Recent advances like implant recognition software, radiographic recognition of dental implants and assessment of batch numbers help the forensic odontologist in identifying the victims by comparing with the antemortem records of the affected victims, know the geophraphical area and socio economic status of the victim.
**Key words:** Dental implants, forensic odontology, titanium, incineration.

**INTRODUCTION**:
Forensic dentistry or odontology can be defined as the vital branch of dentistry that occludes its basic principles and knowledge in the field of urban and criminal cases and has as purpose the scientific expertise, the detection and solution of crime, widely existing social problems and finally to be a source of information for archeological and anthropological studies

Unidentified bodies come to light frequently, having drowned, burned, been murdered, having committed suicide or died from natural causes. Most of the circumstances evidence might be apparently available to positively recognise the body, but at times, this identification may greatly rely on dental evidence[1].

Dental identification remains one of the most reliable, recordable and frequently applied methods of identification, predominantly by comparing the ante-mortem and post-mortem records .The various methodsare employed in forensic odontology which include rugoscopy (study of palatal rugae patterns), cheiloscopy (study of lip prints), tooth prints, radiographs, photographic study and molecular methods like polymerase chain reaction (PCR) for pulp DNA analysis[2].Indeed, it is still a major identification method

in criminal investigations, mass disasters, grossly decomposed or traumatized bodies, and in other situations where visual identification is neither possible nor desirable. Dental identifications are expeditious, accurate and cost effective.[1]

**IMPLANTS –A PHEONIX:**
Dental implants for prosthetic rehabilitation in partially or completely edentulous condition have become a popular choice of treatment. It's becoming a very common oral treatment among the urban population. Each branch in dentistry is moving towards the era of implants ,hence forth the forensic odontologists should emphasis dental implants as most reliable evidence .Most dental implants are fabricated with titanium alloys. Titanium implants have a high melting point (>1600 C).

Nonvisual identification of victims utilizes DNA, fingerprint, and dental comparison as primary scientific identifiers. In incidents where a victim has been incinerated, there may be loss of fingerprint detail and denaturing of DNA. Although extremely durable, tooth loss will also occur with extreme temperatures and the characteristics of recovered dental implants, if any, may be the only physical identifying data available. The

physical properties of titanium with high corrosion resistance, high structural strength, and high melting point, would help in forensic identification following most physical assaults[2].

A victim's dentition could be partially or totally constructed from implants with no natural dentition remaining. As a routine procedure radiographic imaging is recommended for preoperative evaluation of the implant site, postoperatively for the evaluation of correct seating of the abutment and further evaluation of bone loss under an implant maintenance regime. The postmortem detection of an implant would signal the likelihood that radiographs must have been taken by a treating dentist and may be located with other antemortem data.

### TYPES OF IMPLANT:

The placement of titanium implants has become widespread throughout the world withover 460 different implant types available to dentists.More recently some manufacturers are constructing their implants from zirconia or a combination of titanium and zirconia.Different manufactures has different designs. Few implants also have name of the manufactures, batch or serial numbers in them.[4,5]

### RADIOGRAPHIC RECOGNITION OF DENTAL IMPLANTS:

The options for identifying the details of implant bodies in the deceased include three dimensional imaging, for example using a CT scanner, panoramic radiography, physical removal of the implants for direct measurement and visual analysis.

### RADIOGRAPHIC IDENTIFICATION OF THREADED ENDOSEOUS DENTAL IMPLANTS :

Increased patient mobility, and the large number of implants systems with different designs, has determined the need for a radiographic catalogue of dental implant images. The dentist should always have a track of records in order to identify the old and new dental implants and thereby help forensic odontologist while attempting the identification of an unknown cadaver. Forensic dental identification is based on the morphological and radiographic comparison of postmortem dental records with ante-mortem .

Morphological features of dental implants depicted on radiographs may be used to develop a dental profile of the individual and provide information that can narrow the search to smaller group or it might also eliminate suspect.The matching of two sets of radiographs is performed with post mortem periapical X-ray of the implants against the dental implants' images of the various implant systems stored in the archive.[6]

### RADIOGRAPHIC DENTAL IMPLANTS RECOGNITION FOR GEOGRAPHIC EVALUATION IN HUMAN IDENTIFICATION:

An unidentifiedbody with one or more implants in the jaws, and no dental record is available, identification the type of implant and prosthesis the victim carries, clues to direction the investigation. The radiographic images provided should help both the forensic odontologist and the prosthodontist to identify pre-existing implants which they may discover from their radiographic images. It is also a starting point for a wider geographical evaluation of different manufacturers in other countries and continents. The quality, quantity and presence or absence of dental treatment may give an indication of socio-economic status or likely country of residence.[7]

### Implant Recognition Software (IRS) :

The drastic increase in the availability of different implant systems with varies designs and rangeindicates the growth rates of the implant markets around the world . There are over 30 commercially available systems in the United Kingdom and more than 230 implant systems world-wide. Implant Recognition Software (IRS) was developed, the database of the web portal, the algorithm determines which database model matches better the implant. Once the nine questions have been answered even if not all the information is known then the data bank will be searched and those implant systems which meet the criteria outlined will be listed below. In order to check the implant system , theradiographic images of the system , clinical images of the implant from above showing the trans-mucosal connector, and clinical images of the implant itself can be checked against the patient. If the software has identified the implant system then a summed up report of that implant system outlining all the implant features, contact details for the implant manufacturer (e-mail addresses, web- page and conventional address and phone numbers) is provided.

This software tool can also be used in the field of forensic dentistry. Body identification, after mass disasters or single murders can often be complex and frequently the facial bones and teeth are the only clue to identity. If a body has a dental implant present, the forensic dentist could identify which system, the site, length and diameter of implant used and this would be a significant lead in terms of body identification. This software program could therefore be a major asset to forensic dentists who may possess limited knowledge in this field.[8]

### BATCH NUMBERS WITHIN DENTAL IMPLANTS:

Implants lack the individuality of hand crafted restorations as they are mass produced. However, since 2010 Straumann™ has been laser etching batch numbers within the chamber of their implants. Straumann™ dental implants which contain batch numbers within the implant[9]. Various other implant systems also provide batch numbers namely noble biocare, ankylos etc. The studies show that batch number is clearly visible within the implants before firing/ incineration. Following firing of the first implant without the abutment, it can be seen in that thenumber is totally obscured by the oxidation layerthat formed. In the implant which had theabutment screwed on and subsequent removal of screw shows the number still visible although not asclearly as in . There

was a slight change to astraw colour in as well as friction markings near the first thread.[2]

## RECOGNITION OF NON‑OSSEOINTEGRATED DENTAL IMPLANTS FOLLOWING CREMATION

Identification of dental implants after cremation would be possible due to the color and texture change on its surface. According to **Berketa** , the changes that occur in the implants placed within the sheep mandible as well as the visibility of the batch numbers present within an implant following cremation. Three different system of implants (straumann, nobelbiocare and, ankylos) were used in this study and were placed in two fresh adult sheep head which are then transported to the professional animal crematorium and incinerated for 2.5 hrs at a maximum temperature of 780°C. Radiographic images of the implants before and after firing and were compared using adobe photoshop software. The result shows that there was a minimal image difference of all implants with identifiable threads and grooves. Even the batch numbers of the implants were alsoclearly visible on microscopic examination.[10]

## Q-R CODE:

QR code (abbreviated from Quick Response Code) is the trademark for a type of matrix barcode (or two-dimensional barcode) first designed for the automotive industry in Japan. A barcode is a machine-readable optical label that contains information about the item to which it is attached. A QR code uses four standardized encoding modes (numeric, alphanumeric, byte/binary, and kanji) to efficiently store data; extensions may also be used.A QR code consists of black squares arranged in a square grid on a white background, which can be read by an imaging device such as a camera, mobile phones and processed using Reed–Solomon error correction until the image can be appropriately interpreted. The required data is then extracted from patterns that are present in both horizontal and vertical components of the image.

## LABELING PROSTHETIC RESTORATIONS:

Embeddinga Dental Prosthetics Identification (DPid) or QR code was done byaccessing QR-Code Generator. Inserting an identification code by engraving during manufacturing the metal frame  or abutment fabrication stage the inscription with the aid of a sphericaldiamond bur or laser sintering .The Dental Prosthetics Identification(DPid) stores the patient's name and prosthesis information and providesaccess through an embedded code in dental prosthesis or an identificationcard. All of this information is digitally stored on servers accessible onlyby dentists, laboratory technicians and patients with their own level ofsecure access. DPid provides a complete single-source list of all dentalprosthesis features (materials and components) under complete and securedocumentation used for clinical follow-up and for human identification.[11]

## CONCLUSION:

In the human identification process of unidentified victims with no dental records available, the identification of dental implants in victims may add a precious note  to narrowdown the search to a smaller group or eliminate certain candidates altogether. In performing the forensic evaluation and superimposition, forensic odontologists must be familiar with implant designs and implant therapy. Survival of serial numbers in dental implants after incineration is yet another milestone in forensic dentistry. Hence forth further adds of  the laser etching and Q R coding in prosthesis with proper records makes the odontologist work easier.

**LIST OF ABBREVIATONS:** Polymerase Chain Reaction (PCR), Implant Recognition Software  (IRS), Quick Response Code (QR Code), Dental Prosthetics Identification (DPid).

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