SURVIVAL OF BATCH NUMBERS WITHIN DENTAL IMPLANTS FOLLOWING INCINERATION AS AN AID TO IDENTIFICATION

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ABSTRACT

Dental implants have become a popular choice of treatment in replacing individual lost teeth or entire dentitions. The physical properties of high corrosion resistance, high structural strength and high melting point, suggest the retention of intact implants following most physical assaults. As the implants are machine made, they lack the individualisation required for their use as identifiers of the deceased, however the Straumann™ Company (Waldenburg, Switzerland) has recently released information that within the chamber of their implants they have laser etched batch numbers. The number of implants with the same batch number varies from 24 to 2400. The purpose of this study was to ascertain if the batch number was still identifiable following intense heat exposure in a furnace. A Straumann™ Standard Plus 3.3 x 8 mm implant, with no healing cap nor abutment attached was incinerated to 1125 degrees Celsius. Another Straumann™ Standard Plus 3.3 x 8 mm implant was also incinerated in the same way as the first implant but with an abutment attached. The results indicated that the first implant had totally oxidised within the internal chamber whilst the second implant following the removal of the abutment revealed an intact identifiable batch number. If the companies constructing implants were to place individual serial numbers rather than batch numbers on these implants then the potential exists for a new approach to be established for the identification of the deceased.

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Keywords
Human identification, dental implants, incineration, batch numbers, serial numbers

Running Title
Batch numbers within implants

INTRODUCTION

A dental implant is a prosthetic device that is inserted into the upper or lower jawbone, onto which an artificial tooth, crown or bridge can be anchored. Dental implants are typically constructed from titanium.[1] More recently some manufacturers are constructing their implants from zirconia[2,3], or a combination of titanium and zirconia[4] The placement of titanium implants has become widespread throughout the world with over 460 different implant types available to dentists. In some countries the growth of implants placed within patients is greater than 1% per year.[5] The likelihood of implants present in the deceased in the future would also increase at this rate within those countries.

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. The number of implants with the same batch number varies between 24 to 2400. (*Per com.* Schuler M, Head Clinical and Scientific Affairs, Straumann™ company). Although this number is still quite high it reduces the frequency from many thousands in some cases.

The Victorian bushfires of 2009 highlighted the fragility of and lack of dental postmortem remains. Postmortem radiographic images of intact dental implants surrounded by lost dental remains were noted. Dental implants made from titanium have a melting point greater than 1650ºC[6] and those made from zirconia have a melting point greater than 1850ºC[7]. This physical property of extremely high melting point[8,9] could potentially assist in the identification of victims where there is lack of other scientific evidence such as DNA or fingerprints[10] and loss of the fragile dental remains.

In the cases of extreme incineration of victims who have been treated with implants it is important to ascertain if the implant batch or serial numbers within the implant chambers survive the incineration process sufficiently that their numbers can be identified. The authors decided to test the

Straumann™ dental implants which contain batch numbers following incineration in a temperature controlled kiln. The hypothesis was that the batch numbers of pre- and post-incineration implants could be reliably compared.

MATERIALS AND METHODS

The Straumann™ Company kindly donated implants for this study. The implants selected from the donations were Straumann™ Standard Plus 3.3 x 8 mm. The composition of the implants was commercially pure titanium. The same type of implant was used in a previous study and its oxide layer determined by elemental analysis to contain titanium, oxygen with only trace amounts of other elements.[11] One implant had neither abutment nor healing screw attached, whilst another implant had an abutment finger tight screwed onto it. Both implant batch numbers were imaged using a WILD Heerbrugg™ (Leica Microsystems, Wetzler, Germany) microscope attached with a digital camera (Nikon Coolpix 5900, Tokyo, Japan).

The implants were placed in an INFI-TROL™ (K.H. Huppert, Chicago, USA) kiln designed to heat porcelain restorations. The temperature within the INFI-TROL™ kiln was monitored with a digital thermometer Model N19 - Q1437 (Dick Smith, Chullora, Australia), with a temperature range of -200 to 1,370°C (±0.5%) using K-Type thermocouples.

The implants were heated to 1125 ºC and left at this temperature for five minutes. Photographs of the implants within the kiln were taken at 100 ºC intervals commencing at 600 ºC. At the conclusion of the experiment, the kiln was switched off and the door opened to allow the implants to cool off slowly. At room temperature the implants were again photographed before removal. They were then examined using light microscopy and the inner chambers of the implant bodies digitally imaged.

RESULTS

The batch number is clearly visible within the implants before firing as shown in Fig. 1. Following firing of the first implant without the abutment, it can be seen in Fig. 2. that the number is totally obscured by the oxidation layer that formed. In Fig. 3, the implant which had the abutment screwed on and subsequently removed shows the number still visible, although not as clearly as in Fig. 1. There was a slight change to a straw colour in Fig. 3. as well as friction markings near the first thread.

DISCUSSION

The results indicated that there was clearly a marked difference to whether the batch number could be observed between the uncovered implant and the abutment attached. As both implants were heated under the same conditions, it is assumed that the tightening of the abutment precluded sufficient oxygen from entering the chamber to form a thick oxide layer. The straw colour (Fig. 3.) indicated that there was a small amount of oxidation and probably this phenomenon was due to the amount of oxygen retained within the chamber following sealing with the abutment. The friction markings indicated that the contact area is away from the area where the batch number is etched. This allays the concern that the number is not damaged by the screwing and unscrewing of the abutment. This is a small initial study which needs to be repeated with many more implants to substantiate the current findings.

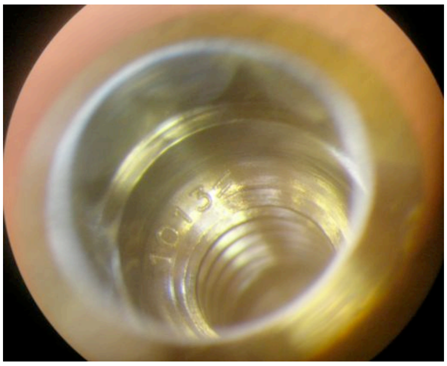

Fig. 1*. Batch number clearly visible within implant before incineration.*

Fig. 2*. Implant without abutment following incineration. Number not visible.*

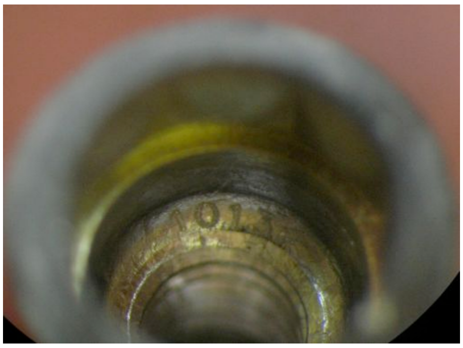

Fig. 3*. Implant with abutment after incineration and following removal of abutment. Number visible.*

The oxidation layer formed following firing of the second implant created a sufficient bond between the abutment and the implant which necessitated a wrench to separate the two even though it was initially finger tight. At this temperature metal fusion had not occurred, however at higher temperatures fusion might develop especially if the implant was exposed directly to a flame. Difficult mechanical sectioning of the implant might be required to view the batch number in such a case.

It was suggested that perhaps the oxidation crust could be easily removed from the first implant to reveal the number beneath the first implant, however attempts to do so proved fruitless. Perhaps a gentle oxidation removal liquid might be of benefit. Where there is an oxidation layer the survival of the identifying batch number will depend on the depth of the etched number and the thickness of the oxidation layer. It would be unlikely that batch number would be preserved within an oxidised layer but this would need to be confirmed by more sophisticated image analysis techniques.

During treatment with dental implants the inner chambers of the implants would be sealed either with a healing cap initially or some form of abutment restoration. Depending upon the skill of the surgeon, it is assumed that the healing caps should be tightly screwed down so that the healing cap would act similarly to an abutment and hence produce the same results although further testing with healing caps is required.

Currently there are several internet search websites to assist in the recognition of dental implant types.[11-13] Where there is lack of circumstantial evidence indicating who the victim is, the identification of the implant type could assist the identification team.[14] This is especially relevant where the implant type is rare as there could be only one or two surgeons placing these types of implants in that jurisdiction. The number of implants, the widths and lengths of them together with the information from the company agent suppliers of those specific implants could narrow the search to find the dental surgeon which inserted them. Linking the batch numbers to the notes of the surgeons would increase the weight of evidence linking the identification of that victim. The ideal would be that the companies producing the implants etch an individual serial number within each implant.

CONCLUSIONS

Extreme heat will destroy teeth and conventional dental restorative materials, as well as other scientific identifiers in victims. Due to their physical properties, implants will resist thermal insult although the lack of uniqueness of mass produced objects limits the use of implants in identification. The addition of batch numbers within implants and the ability of these implants to retain their numbers following high temperature assault would increase the weight of evidence.

This small study indicated that batch numbers within Straumann™ implants survived heating to 1125 ºC where an abutment was attached. If the companies could be convinced to insert serial numbers on each implant this could help establish a new approach to identify deceased persons.

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