

Study on forensic dental identification methods by labeling prosthetic restorations

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Abstract: Positive identification by labeled prosthetic implants plays a key role in dental forensic identifying. Marking prosthesis was considered an important part of forensic dentistry, although no standardized method has been followed so far. The purpose of this study was the discovery and testing if different ways of applying the identification code (PIN) on prosthetic restorations as safe and sustainable methods to help indefinitely at the identifying of the person, taking into account the oral status of the population which varies in different countries, wearing total prosthesis is becoming a reality for the foreseeable future. To do this, we chose 4 patients aged between 46-77 years, wearing mobile acrylic prosthetics, who came to a social center for oral rehabilitation of their prosthetic works. Thus, for each patient we noted the following data: personal ID number, origin - urban or rural environment - and the type of applied work, taking into account a number of factors used in practice of identification technique addressed in our study, such as the difficulty in performing the technical marking, duration of the execution, the material used for marking the identification code, marking endurance over time and last but not least, marking appliance costs.

Key Words: forensic identification, personal identification number (PIN), prosthetic, engraving, inscriptioning, embedding.

The dento-maxillary system is a complex morphological structure which consists of a number of units specified by number, shape and size in relation to periods of development and at the same time has a number of normal and pathological morphological individual features which add permanent traces of local treatment and conservative radical or replacement treatment, specific and characteristic, which allows the establishing of an individual dental formula.

This system shows an increased resistance to the action of physical, chemical or post mortem factors,

compared to other tissues that are commonly used for identification. In general, it is estimated that there are no two identical dental formulas. This eases a lot the activity of comparison and discriminatory analysis for individual identification.

It has been observed that dentures remain intact or slightly damaged even when the victim suffers a violent trauma, whether it's crushing, explosion or burning; also because they made of durable materials, they do not decompose under the conditions of burial or postmortem changes of the victim.

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The diversity of restorative works of the dento-maxillary system, of the technical implementation methods, of the nature of prosthetic materials and their outstanding resistance to the aforementioned factors, justifies the analysis of these materials in order to individual identification and in certain circumstances, to identify a group with the occasion of mass disasters and accidents when other known methods of identification may not apply.

Currently, the value of dentistry expertise is recognized in all countries, and different schools have permanently enriched the forensic research methods.

MATERIALS AND METHODS

The study was conducted on a total of 4 patients, aged between 48-77 years, who came at the Social Dentistry Center "Ilarie Voronca" in Constanta for oral rehabilitation.

Before allowing the technician to affix the marking, patients were required an enrollment agreement by informing them about the study and its importance. Application markings was done in the dental laboratory of the collaborator technician, using the following materials: sheets of paper, lamination foil, printer cartridge, metal dental matrix, diamond burs of different sizes and different granulation and fluid solution obtained by mixing the following substances: henna, black ink cartridge, multi surfaces black paint, all of them resistant to moisture and heat.

Thus, for each patient we noted the following data: personal ID number, origin - urban or rural environment - and the type of work applied.

The significance of the personal id number for its inclusion in the study

The PERSONAL ID number or PIN code represents the unique code given to each person born in Romania and it is composed of 13 digits. It is assigned at birth to every newborn and can be found on the birth certificate. The PIN also appears in the identity card and driving license.

S	AA	LL	ZZ	JJ	NNN	C
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Personal ID number

S represents the sex and the century when the PIN holder was born.

AA is a 2-digit number and represents the last two digits of the birth year.

LL is a 2-digit number and represents the person's month of birth

ZZ is the day of birth in 2 digit format

JJ is a two-digit number and it represents the county code or sector (for Bucharest) where the person was born or wher they had the domicile or residence at

the time of PIN granting

NNN is a 3-digit number in the range 001 - 999. The numbers in this range are divided by counties, offices of population registration, so that a number in that range is assigned to a single person in a given day.

C is the control number (an autodetect code) in relation to all the other 12 digits of the PIN. The control digit is calculated as follows: each digit of the PIN is multiplied by the number in the corresponding position of number 279146358279; the results are summed and the final result is divided by 11. If the rest is 10, the control digit is 1, otherwise the control digit is equal to the rest.

In our study, the adopted coding methods are represented by: lettering, engraving and embedding of the code inside acrylic restorations in various ways: by etching in the metal matrix, by using the barcode system and digits and by using the grid.

Inserting an identification code by affixing

Patient named AC, female, aged 48 years, PIN XXXXXXXXXX1691, originating from an urban area, clinically healthy, with history of dental problems, came to the Social Dentistry Centre on 28.05.2014 for oral rehabilitation. Following clinical examination, the prosthetic diagnosis for the maxillary was complete edentation and the method chosen was by prosthetic replacement with a mobile acrylic denture.

In the last stage, of manufacturing (performed in the dental laboratory) the complete denture will be inscribed. We used the following substances for inscriptioning: henna (50%), cactus black ink (25%), black paint for surfaces (25%). The final mixture was applied to the external, shiny surface, of the maxillary denture in the lateral area, opposite the 6-year molar (1.6) with a thin felt brush, we inscriptioned the last 4 digits of the patient's personal identification number - no. 1691. The inscription code length was 10 mm and a width of 5 mm. The inscription was done before applying the final coat of transparent acrylic resin (Fig.1), its role

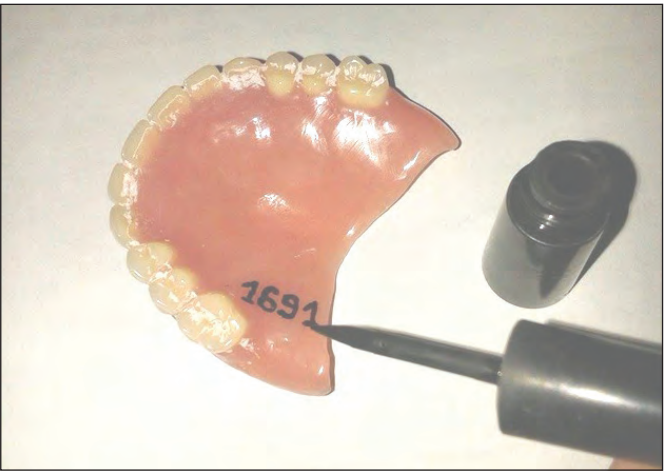


Figure 1. Affixing marking of the total acrylic denture with henna-based fluid substance (technical stage, before applying the final coat of acrylic resin).



Figure 2. The marking appearance after applying the last layer of material (resin) acrylic.

being to maintain the longevity of the substance applied (Figs 2, 3).

Inserting an identification code by engraving

Patient named MF, female, aged 77 years, PIN XXXXXXXXXX1223, from urban areas suffering from primary hypertension, with dental history, came to the Social Center Dentistry on 28.5.2014 for oral rehabilitation. Following clinical oral examination, the prosthetic diagnosis upon the mandible was class II Kennedy edentation with 2 variations (absent lower central incisors - 3.1. and 4.1.), the chosen prosthesis method being metal- resin fixed dental prosthesis to rehabilitate the frontal area.

During manufacturing the metal frame stage we will engrave the inscription with the aid of a spherical diamond bur with the last 4 digits of patient's PIN on the metal frame –the lingual side of the metal component. Each digit was engraved on one incisor; after which the sanding was done to the lingual face of the metal frame to not hurt the lingual mucosa during its mobility. The following stages will consist in the manufacture of the of metal- resin fixed dental prosthesis (Figs 4, 5).



Figure 4. Marking appearance engraving done by milling, composed of the last 4 digits of the patient's CNP (1223) - final aspect exooral.



Figure 3. Endooral final aspect of the maxillary denture acrylic total marked with the last 4 digits of the patient's CNP.

Labelling methods by embedding the code inside the acrylic mobile dentures

Embedding the id code engraved on a metal matrix

To achieve this goal we used a dental metal matrix segment with the length of 10mm, width of 5 mm, on the surface of which we inscribed the last 4 digits of the patient's personal identification number using a large granulation round diamond cutter connected to the turbine.

Patient named CM, female, aged 59, PIN XXXXXXXXXX5602, originating from rural areas, clinical suffering from insulin-dependent diabetes and osteoporosis, with dental history, came at the Social Dentistry Center on 28.05.2014 for oral rehabilitation. The edentation diagnosis upon the mandible was class II Kennedy edentation with 1variation, the chosen prosthesis method being mobile partial acrylic denture with wire clasps. During last stage, the input of acrylate in the partial denture, step made in dental laboratory, it will take place the embedding of the code engraved on the metal matrix into the partial mobile denture. The region chosen for the matrix embedding will be the lingual side,



Figure 5. The appearance of marking engraved with mill on lingual face of the metal component - endooral lingual view.



Figure 6. The appearance of marking by entrapping the engraved metal matrix with the 4 digits of the patient's end CNP (5602) - exooral appearance.



Figure 7. The appearance of marking engraved by entrapping the metal matrix - endooral appearance.

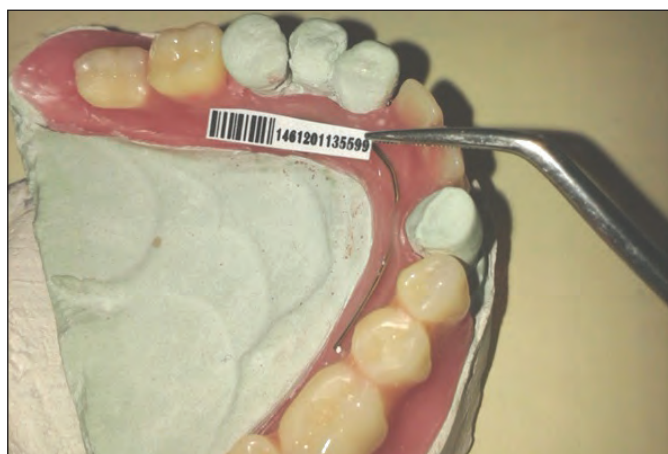


Figure 8. The appearance of the barcode before being embedded on the lingual side of the partial denture (model stage).

near the 3.6 molar and the embedding depth will be 2 mm (Figs 6, 7).

Embedding the id code as barcodes and figures

Patient named EM, male, aged 68, PIN 1461201135599, originating from rural areas, suffering from pancreatitis, with dental history, came to the Social Dentistry Centre on 28.05.2014 for oral rehabilitation. Both mandible and maxilla area were subtotal edentations,

the prosthetic method chosen for both edentulous fields being the partial mobile acrylic dentures with wire hooks. For this type of marker we used a paper tape with dimensions 20mm x 7mm, and on its surface, using the printer, we printed the whole patients' PIN both as bar code and as figures.

Each digit of the PIN has been associated with a vertical stripe. Vertical stripes are parallel, with a distance of 1 mm from each other, they all have different thicknesses, each figure corresponding a certain thickness, except identical figures which will have identical stripes. The figures will be in continuation of the PIN, occupying the remaining space on the paper tape. We chose this method to be assured that any small damage will provide sufficient data for identification.

After printing the barcode, the paper tape was laminated to preserve the code's visibility in the denture so that it cannot be damaged during technical maneuvers. In the last stage we created a slot in the denture the size of the marking, making a slot of slightly larger size compared to the barcode both in depth and in width. On the floor of the slot we applied a drop of acrylic resin for optimum soldering of the barcode. Later the code was fully covered with transparent acrylic resin (Figs 9, 10).



Figure 9. The appearance of the marking on the slope of the lingual mandibular prosthesis.



Figure 10. The appearance of mandibular prosthesis acrylic marker in mouth.



Figure 11. The appearance of the identification grid.



Figure 12. Testing and choosing the prosthetic potting area of the grid according to the thickness of the prosthesis base (inadequate area, thin).

Embedding the id code as a grid (dpid or qr-code)

Getting the DPID or QR code was done by accessing QR-Code Generator on the Kaywa website. We introduced the PIN and got the matrix which we printed. By scanning with a smart phone that has the decoding program we identified the patient by obtaining the entered the data– the PIN. (To display the code on your phone, it will be necessary to download from the web the code read application). The DPID Code (Fig. 11) was manufactured in a similar manner to that described in the previous chapter (the barcode) by printing, lamination and embedding the code in a slot created on the surface of the denture. After manufacturing the denture, the technician made a slot slightly larger in size compared to the identification grid. On the floor of the slot we applied a drop of acrylic resin for optimum soldering of the grid. Later the code was fully covered with transparent acrylic resin (Figs 13, 14).

DISCUSSION AND RECOMMENDATIONS

Among the techniques studied, the surface method appears to be applicable and relatively cheap, but it disappears very easy and requires reapplication. The methods of inclusion were definitely of greater duration and gave a positive result, with no tendency to weaken the denture or create porosity. It proved to be more expensive, requiring trained technical personnel and well-equipped

laboratories, irrespective of the chosen method.

Most situations require the individual to be identified. It is obvious that only by marking a person's denture one's identity can be revealed when all other methods fail. This in itself is reason enough to justify the implementation of ID marking on dentures. The dentist must inform the patient of the benefits of labeling the dentures and motivate him to do the same.

In the United Kingdom, the National Health Service offers a bonus to the dentists who label the dentures of the patients in the "house" care. In the US, denture marking is mandatory only in 21 states, and the marked number is the social security number of the individual. In Australia, tax files numbers are being used, while in Sweden is marked the patient's unique personal ID. In India, marking prosthesis is neither taught nor practiced in any faculty of dentistry.

People with prosthetic restorations can carry their business card in their oral cavity, since each restoration is unique for each individual. The used material, the qualification of the dentist and the changes seen after restoration provide a great help in identification.

For the manufacture of dentures with identification marks, in their routine practice, denture technicians should be aware of the details of the right location for placing the marking and also the forensic significance of dental marking.

As a result of the study, we noted that the most suitable placing for dental marking are the following: posterior oral surface of the maxillary prosthesis and lingual portion of the mandibular prosthesis because these areas are accessible for reading, it does not affect the aesthetics of the prosthesis and often there is a sufficient thick layer of resin that does not impose technical difficulties.

Usually it is preferred to use the polished surfaces of the prosthesis, but considering the prevailing aesthetic, we tried to use the engraving or printing surfaces. Also, with the use of these areas we noticed that when we place the denture labeling on the engraving surface, it becomes invisible when the denture liner stage occurs.



Figure 13. The appearance of identification grid embedded in the finished prosthesis, extraoral view.



Figure 14. The appearance of the finished prosthesis with identification grid, QR code or DPID, intraoral view.

CONCLUSION

Most reasons for not marking the dentures are costs, lack of awareness of the existence of various methods and the belief that it has too little importance. Needless to say that labeling dentures has tremendous value when an individual's identity is requested.

You need a proper framework in dental education to ensure that students, dentists and dental technicians are informed about marking methods and that they apply them.

There is a need to offer patients a method of marking the dentures according to aesthetic requirements and also to be permanent and inexpensive.

Lack of teeth frequency decreased in recent years

due to oral health improvement. However, there is still a need to address the issue of denture marking because of social and legal reasons because oral status of the population varies in different countries and wearing dentures will be a reality for the foreseeable future.

Knowing the composition of alloys and, in general, the constituent materials and their physicochemical properties, we can focus on the environmental conditions in which the destruction of the victims was produced. This value may increase considerably in terms of applying conventional marking specific to each country, community or period of time, which is a definite proof of identity bearer.

The most important benefit of marking the dentures is that both the coroner's effort to id and identification time are reduced considerably.

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