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The Teaching of Denture Marking Methods in Dental Schools in the United Kingdom and the United States^{*},[†]

ABSTRACT: Forensic organizations worldwide have recommended that dental prostheses should be marked with, at a minimum, the patient's name and preferably with further unique identifiers such as a social security number. The current study aimed to assess the denture marking practice of dental schools within the United States and the United Kingdom. A questionnaire-based survey was employed to gain both quantitative and qualitative data on the methods, practices, and ethos behind denture marking in 14 U.K. and 32 U.S. dental schools. One hundred percent of U.K. and 87.5% of U.S. schools returned surveys and the results suggest that, for dental schools where there is no legal or legislative need for denture marking, the practice is inconsistently taught and appears to be reliant on internal forces within the school to increase awareness. Among those schools practicing marking, only 18% employ a technique likely to withstand common postmortem assaults; this is a concern.

KEYWORDS: forensic science, education, denture, identification, marking, postmortem

On May 11, 1985 the main stand of the Bradford City football stadium (U.K.) caught fire during an end of season match which was attended by 10,000 spectators, 3000 of which were in the stand. The fire, caused by a discarded cigarette falling through the floor into a pile of litter swept from one end of the stand to the other within 4 min, killing 53 people. A further 250 victims, both young and old suffered severe burns and/or crush injuries. The fire was described as the worst disaster in British football history (1–4). In the aftermath, although 38% of the victims wore dentures, only one was found to have been marked. It was reported that a positive identification was accomplished using dental records on 58% of the victims. This figure however, would have increased to 85% had all of the victims' dentures carried some form of denture identification mark (1).

In the inquest following the fire, the jury made 20 recommendations, the first of which was for the: "...marking of dentures, preferably with the name of the owner, should be mandatory (1)." This recommendation has still to be acted upon some 28 years after the inquest.

With regard to incidences of mass disaster, to some extent, DNA analysis has relegated odontological postmortem analysis to that of a secondary identification procedure. However, denture markings have distinct advantages over DNA analysis. Complications from DNA contamination and degradation pose problems not inherent in denture marking for identification. The expediency and cost benefits of denture marking identification are key reasons for its continued importance in a post-DNA era. In addition, the incorporation of markings in removable dental prostheses facilitates an immediate identification in almost all circumstances (5).

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The practice of denture marking is not a new concept in either prosthetic or forensic dentistry and its regular application has been sought after by forensic dentists for several decades (6). The first cases recorded of the extensive use of denture marking for the purpose of identification in mass disasters occurred in the 1930s, when Carlsen and Weissenstein campaigned for its routine application during the process of denture fabrication (7). In fact, according to Webster (8), a British National Health Service document published in 1967 stated in paragraph 5 "...All dentures supplied by the hospital dental service should have the patient's name incorporated into the denture in such a way that the denture is clearly identifiable."

Turner (9) reported that the Federation Dentaire International (FDI) set up a committee to investigate the problems involved in the development of standardized denture marking procedure. In its report the committee recommended that all member associations "should introduce denture marking in their respective countries." However, the committee also referred to the problems involved in promoting an internationally acceptable coding system; after which, they made no further comment on the matter.

One of the perceived barriers to the adoption of denture marking cited in the dental literature relates to the infringement of patient privacy. However, attitudes toward denture marking have been investigated (10,11) and results show that patients do not object to it. Furthermore, the British Dental Association (BDA), in reply to the Home Office regarding an approach by the Association of Police Chief Officers of England and Wales on the subject of compulsory denture marking for identification purposes, stated that it had "no objection provided the patient agrees in each case." In fact, they went on to further suggest that all dentures should be marked routinely unless the patient requests otherwise (9). However, despite calls over many years from both the forensic and dental communities for legislation in support of mandatory denture identification in the U.K., there remains a bewildering degree of apathy with regard to addressing this.

The lack of willingness to embrace the practice of denture marking is not limited to the U.K. According to Borrman (12) all

dentures fabricated in the University of Iceland Dental School are marked routinely, whereas, with the exception of Sweden, no legislation exists governing the marking of dentures in the rest of Scandinavia or Europe. In Norway, Holland, Germany, and the Netherlands denture marking is carried out solely upon the dentist's initiative, whilst in Denmark, dentures are marked only for patients in institutions. This situation appears little better on the other side of the world where in Southern Australia, Alexander (6) reported the results of a survey undertaken to determine the extent of the practice of denture marking, the methods in use, and the attitudes of dentists, dental technicians, and institutions to this practice. The results indicated that 74.5% of all practitioners providing removable dental prostheses to their patients did not include an identifying mark as part of the service. This included 19% of general dental practitioners, 2% of specialist prosthodontists, 57% of practitioners with training in forensic odontology, and 43% of clinical dental technicians of those that did mark. No practitioner marked dentures routinely. Reasons cited for not marking dentures included cost, lack of awareness of standards and recommendations, and a belief that marking was of little importance.

In contrast, the U.S., where the American Dental Association (ADA) provides clear guidance on denture marking, the situation appears somewhat more positive (13). The marking of removable dental prostheses is mandatory in 21 out of 50 states; see Table 1, which the ADA provides clear guidance on the issue (13). The State of New York's Dental Practice Act is more conservative in that it requires dentures to be marked provided the patient requests it. Several other states impose the obligation to mark dentures only in long-term care facilities.

Denture marking is also obligatory in Iceland. In Sweden, dentures have been permanently marked for many years *i.e.*, with a stainless steel metal band incorporated into the acrylic and containing the patient's birth date, a special number, and "S" for Sweden. However, Swedish citizens also have a right to refuse the option of having their dentures marked. A recommendation issued by the Swedish National Board of Health and Welfare states that "The patient shall always be offered denture marking and be informed about the benefit thereof," and that "Denture marking is not permitted if the patient refuses it" (12). Conversely, in the U.K. as to date, although denture marking is mandatory practice in all branches of the U.K. military dental services, there are still no specific guidelines available to civilian application (13).

Studies undertaken by Cunningham and Hoad-Reddick (10) and Richmond and Pretty (11) suggest that such ambivalence toward the practice of denture marking appears to lie more within the dental profession than members of the general public. This perception is augmented by information from their inquiries indicating that an overwhelming majority of patients appear very much in favor of denture marking. Research also indicated that a great many patients were unaware that their dentures could actually be made

identifiable. Nevertheless, a slightly more encouraging study conducted by Murray et al. (5) investigated the attitudes of dental practitioners in the U.K. toward the practice of denture marking. Their aim, facilitated via a postal questionnaire was to assess the attitudes of specialists within the U.K. towards the practice of marking removable prostheses. The results of their study undertaken within the U.K. between 2002 and 2006 showed that 81% of the specialists interviewed were overwhelmingly in favor of the use of denture marking as a routine procedure.

The dental literature suggests that the unwillingness to adopt an international code of practice for marking dental prostheses appears to be multi-factorial in nature. Factors noted so far include cost, apathy, privacy, and lack of communication between dentist and patient. Yet, how many dentists are really aware of what their Dental Practice Acts state about marking dental prostheses? (5,10,14–21) How many dentists are aware of the different methodologies involved in the practice of denture marking? Are they taught these methods as part of their training?

In 1974 one General Dental Practitioner, Gordon Webster, consulted a member of the U.K. Parliament regarding the possibility of presenting a private member's bill to the House of Commons to make the marking of dentures a statutory obligation. Webster was advised that if interested, its parliamentary agents should prepare a draft bill. However, after receiving a negative response from the BDA, he subsequently wrote to the *British Dental Journal* to register his disappointment. He also made a number of proposals in order to spark an interest between the various parties he perceived to be responsible for the practice of denture marking; one of which is stated below:

"Perhaps it would be possible for a discussion to be arranged between dentists who mark dentures in their practice, those who teach students how to do it, private and commercial dental technicians with experience in the techniques, any with the knowledge of research into the relevant materials and their use, and professional and civil administrators" (8).

Information in the dental literature pertaining to the exploration of attitudes of practicing dentists toward the universal application of denture marking appear to be well documented; however, very little is known about the view of academics toward this subject or whether denture marking techniques are taught within dental schools. Therefore, the purpose of this study was to determine if denture marking methods were taught to students in dental schools in both the United Kingdom and the United States; and if so, which methods are demonstrated. In those schools where denture marking is not taught, reasons for this omission were sought in order to determine the barriers to the implementation of routine denture marking, a valuable tool in forensic science.

Materials and Methods

A questionnaire was sent electronically to all 14 dental schools in the United Kingdom and a total of 32 United States dental schools, including at least one school located in each of the states with mandatory denture marking. This sampling technique was designed to ensure a geographical spread and a mixture of state and privately funded schools (Table 1). Anonymity was assured to all schools involved in the study. The questionnaire examined whether or not denture marking methods were employed for dentures produced by staff and students and if so what type of mark was used. A secondary question was whether or not denture marking was taught to students and again, if so which method. A third area examined the opinions of the dental schools regarding the use of Radio Frequency Identification (RFID) chips within dental

TABLE 1 —States requiring denture labeling.

| | | |
|------------|---------------|---------------|
| Alaska | Massachusetts | New York* |
| California | Michigan | North Dakota |
| Georgia | Minnesota | Ohio |
| Illinois | Missouri | Texas |
| Indiana | Montana | Washington |
| Kansas | Nevada | West Virginia |
| Louisiana | New Jersey | Wisconsin |
| Maine | | |

*New York requires dentures to be marked if the patient makes a request.

prostheses. In total eight questions were posed to the respondents. These assessed the nature of the provision of denture labeling including the frequency it was performed, whose dentures were labeled (i.e., students, specialist trainees, or staff), what system was employed, and why a particular system had been chosen. Reasons why denture labeling was not conducted was asked of those who responded that the practice was not undertaken. Respondents were also asked their view on whether or not denture labeling should be made mandatory across all jurisdictions. At the end of the questionnaire space was left for the respondents to provide any additional comments.

Questionnaires to U.K. schools were emailed to the lead academic dental technician or the academic head of the dental prosthetics department. For the U.S. schools the questionnaire was emailed to the lead prosthodontist or the head of school administration. Questionnaires that were not returned after 28 days were followed up by a second email and if there was still no return a letter and paper copy of the questionnaire were delivered by conventional mail.

Completed questionnaires were received and anonymized by removing and destroying any reference to the school other than to indicate nationality and, in the case of the U.S. schools, whether or not the questionnaire came from a school within a state mandating denture marking policies. Responses from the quantitative section of the questionnaire were entered into the Statistics Package for Social Sciences program (Version 15, SPSS Inc., Chicago, IL) and comments from the qualitative section were copied into a Microsoft® Word Document to ensure anonymity and a simple narrative analysis was conducted on emerging themes. Quantitative analysis was performed using categorical data analysis with simple descriptive statistics (central tendency and distribution).

Results

Of the questionnaires sent out, 14 (100%) responses were made from the U.K. and 28 (87.5%) from the U.S. All but one of the states in the U.S. in which denture marking is mandatory were represented. In the U.K., 67% of schools taught a method of denture marking, in the U.S. this was 86% across all states represented in the study (Fig. 1). Similar results were found for dentures fabricated by students and those fabricated by staff members (e.g., there was no preference to mark staff dentures above those produced by students with a total of 58% in non-mandatory states). In the U.K., consultants' dentures were marked 78% of the time, slightly higher

than for other grades of staff; complete details can be found in Fig. 1.

The most popular denture marking system in both the U.K. and U.S. was an inclusion technique (89%) consisting of a typed piece paper containing the patient's name or hospital number. The paper would then be incorporated into the denture either during or after the dentures were processed (11). In the U.S., of those states with obligatory denture marking, 100% of schools taught a system that was in line with the recommended state legislation. One concern was that despite the use of an inclusion technique, only 18% of schools used a metal inclusion, the remainder using paper or acetate versions, which are not fire resistant. Other systems employed included the use of an indelible pen or similar to write on the polished surface (9%) and in 2% of cases an identifier was drilled into the polished surfaces.

Seventy-one percent of U.K. and 56% of U.S. dental schools felt that if cost were not an option, they would consider using an RFID chip for their denture marking, Thirty-five percent of U.K. and 42% of U.S. schools commented that personal privacy issues would be of concern with this system. Currently, no school employed RFID as a method of marking dentures. Seventy-five percent of U.K. and 80% of U.S. schools felt that denture marking should be a legal requirement.

The qualitative component of the research provided interesting findings. This section was most often completed by the U.S. schools. A recurring theme among those schools where marking was not undertaken was that there was a desire to do so. Frequently it was stated that denture marking was a good idea yet it was often ignored during the curriculum due to an emphasis on the technical skills required to produce dentures rather than the consideration of their possible uses by the forensic analysis at a later date.

Another theme from those schools that did utilize the procedure was that there was often a champion for denture marking within the school. This individual varied; in some cases it was a staff member with an interest in forensic dentistry; in other cases it came from dentists with a public health background. One school reported that a senior care facility served by its students had requested implementation of the marking process.

From the qualitative responses it was clear that the dental curriculum both in the U.S. and U.K. was extensive and spare instructional capacity limited. However, if there was an emphasis from within the school, time was found to deliver teaching and service related to denture marking. It was also found that the opportunity to learn about the marking procedure was welcomed by staff and students. None of the schools within mandatory states describe the required teaching as a burden and none stated that they would withdraw such teaching should the legislation change.

Discussion

Since there is no international consensus regarding the viability of denture marking, it is important to address this issue. A survey from the Nordic countries has shown that if denture marking was in general use, the contribution to the establishment of a positive identity using dental identification in cases of fire would increase significantly (12,22). This would also be the case in a number of other postmortem assaults, including trauma, freezing, and chemical attacks (23). However, it should be noted that the method of denture marking employed does impact on the survivability of the identification information. The use of a metal band with an inclusion technique has been shown to be the most resistant (23) and it is therefore of concern that only 18% of schools undertaking marking used such a technique.

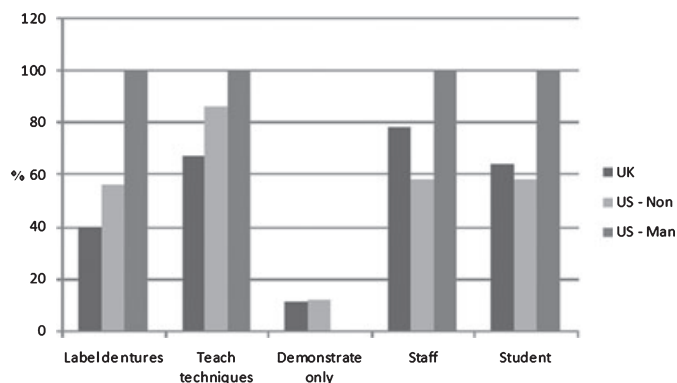


FIG. 1—Quantitative data from the questionnaires. U.S.—Non = States where denture labeling is not mandatory. U.S.—Man = States where denture labeling is mandatory under legislation.

Research has demonstrated that the skills and knowledge acquired during dental training is well retained and practiced long into an individual's professional career (24–28). The incorporation of denture marking into the core curriculum of dental schools will ensure that the technique is widely disseminated instead of relying on interested individuals capturing such learning through additional courses or programs. The sporadic teaching of denture marking in the U.K. and in those U.S. schools in states where denture marking is not mandatory is worrying. While there is a lay view that denture wearing is decreasing, millions of individuals will be provided with their first complete denture in 2009, due mainly to the growth of the world's elderly population (28).

When considering the dissimilarity in terms of the quantity and quality of antemortem data available to the forensic community around the world, it becomes evident that denture marking is both a simple and cost effective means of identifying edentulous individuals. Hence further work is required within dental education to ensure that both student dentists and student dental technologists are exposed to denture marking methodologies in order to ensure that they are able to offer patients an esthetically suitable marking system that is also resilient to common postmortem assaults. Furthermore, the results of this study indicate that increased international collaboration is needed in order to solve the issue of denture marking for clinical and forensic purposes worldwide.

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