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Original Article

Dentistry Section

In-vitro Evaluation of the Integrity of RFID Tags Incorporated in Denture Bases Following Simulated Physical and Chemical Assaults

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ABSTRACT

Introduction: Radiofrequency Identification (RFID) tags can be used for denture identification during war, natural catastrophes like tsunamis, fire hazards or while looking for suspects in cases of violence. It is important that these tags are readable even after the assault to retrieve the stored information. Exposure to various chemicals like strong acids or physical assaults like fire must not damage the tags.

Aim: To study the effect of various physical and chemical assaults on RFID tags incorporated in both heat cure and self-cure acrylic denture base.

Materials and Methods: The present in-vitro experimental study was carried out in Department of Prosthodontics of Maharishi Markandeshwar Institute of Dental sciences and Research, Ambala, Haryana, India from July 2024 to December 2024. For the study total of 150 denture bases; 75 heat cured denture base (Group A) and 75 cold cured denture bases (Group B) were fabricated. RFID tags (Rapid radio Solutions Pvt., Ltd., Mumbai) of dimension 18 mm×18 mm were incorporated during fabrication into the heat cure denture bases and post fabrication in cold cure denture bases. Information was recorded into all RFID tags (example denture base material used, sample number and assault exposure) with help of Apple iPhone 11. The samples of both Group A and B were randomly divided into five subgroups of 15 samples each (n=15) according to exposure to various physical and chemical assaults. Assaults were 98% sulphuric acid for 24 hours (Subgroup A), 20% nitric acid for 24 hours (Subgroup B), liquid Nitrogen for three hours (Subgroup C), direct flaming with butane torch for three minutes (Subgroup D) and Incineration at 200°C for 20 minutes (Subgroup E). Post assault RFID tags were scanned to retrieve information from them. The number and percentage of RFID tags that were readable in each subgroup of both groups were noted. Only descriptive statistics were done in the study.

Results: In Subgroup A of both heat cured (Group A) and cold cured denture bases (Group B) RFID tags incorporated, were not readable after assault 0 (0%) and all the denture bases showed severe surface deterioration. All RFID Tags of Subgroup B 15 /15 (100%) and Subgroup C 15 /15 (100%) of both Group A and Group B were readable after assault and denture bases did not show any surface deterioration. In Subgroup D and Subgroup E some RFID tags were readable after assault. 9/15 (60%) samples of Subgroup D in Group A and 14/15 (93.33%) of Subgroup D in Group B were readable post-assault whereas in Subgroup E, 8/15 (53.33%) in Group A and 7/15 (46.66%) in Group B RFID tags could be read post-assault.

Conclusion: RFID tags are resistant to assaults of dil. nitric acid and liquid nitrogen. Exposure to heat by direct flaming or incineration may render them unreadable. With conc. sulphuric acid there is complete damage to RFID tags.

Keywords: Denture identification, Denture labelling, Forensic dentistry, Near field communication, Radiofrequency identification,Technology

INTRODUCTION

According to Article-6 of United Nations Universal declaration of human rights "Every person has right to recognition everywhere as a person before law [1]." Identifying a deceased individual in case of accidents, mass disaster or fire is crucial and often relies on forensic science. Identification can be aided by recovering Deoxyribonucleic Acid (DNA), fingerprints, blood or saliva as evidence. When such biological evidence is unavailable, identification may still be possible through dental records such as teeth present, caries status, radiographs, restorations or prosthesis [2,3].

Denture has long been used as a means of identification with documentation dating back to early 1830 s [4]. Labelled dentures prove particularly valuable during natural disasters like tsunamis, fire hazards or when identifying suspects in violent crimes. Beyond forensic application, denture labelling also supports clinical management in settings like dental camps, geriatric care and hospitals helping identifying dentures among multiple users. Therefore, denture marking system must be simple, reliable, cost effective and clinically feasible [5].

Common denture labelling techniques include surface marking (such as scribbling or engraving) and inclusion marking (embedded material into denture) [6-8]. With conventional denture labelling techniques there is loss of legibility, susceptibility to abrasion, thermal destruction and chemical degradation. With recent advancements in digital identification systems such as RFID tags has emerged as promising alternative [9,10]. Near Field Communication (NFC tag) is a subset of high frequency RFID tags which offers several advantages over other embedded denture markings. They offer secure data storage; have sufficient memory, smartphone-readable, ultra-thin thus does not compromise denture aesthetics or strength. The NFC tool can be easily downloaded from Google Play Store in all smart phones which helps in writing and reading of tags.

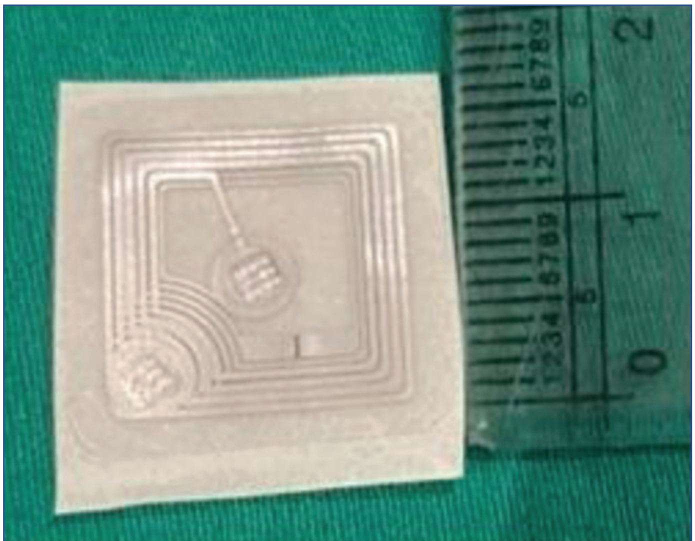
The ideal denture identification or labelling method should be both readable and resistant to thermal and chemical assaults. In situations such as acid exposure, fire or freezing with liquid nitrogen, the integrity and readability of denture labels are critical for effective identification.

Several studies have evaluated the durability of different denture labelling technique after such assault [11-15]. However, most available evidence is limited to small scale pilot investigations that either use acrylic blocks instead of complete denture bases. Furthermore earlier studies differ widely in tag types, embedding depth, resin material and exposure conditions making it difficult to generalise their results to clinical fabrication. Very few studies have evaluated RFID tags in actual denture bases under rigorous and reproducible assault models. The present study addresses this gap with greater specificity by incorporating commercially available RFID tags directly into clinically fabricated maxillary denture base of both heat cure and cold Cure Polymethyl Methacrylate Resin (PMMA). Unlike previous reports the present study evaluates tag integrity and readability following standardised series of physical and chemical assaults including controlled flaming, high temperature and immersion in strong acids. The study design therefore replicates challenges in mass disasters, fire accidents and chemical trauma. Thus, the aim of the present study was to study the effects of various assaults such as exposure to strong acids (sulphuric acid and nitric acid), liquid nitrogen, direct flaming and incineration on RFID tags incorporated in heat cured and self-cure denture bases.

MATERIALS AND METHODS

The present in-vitro experimental study was conducted in controlled laboratory conditions in the Department of Prosthodontics of Maharishi Markandeshwar institute of Dental Sciences and Research, Ambala, Haryana, India from July 2024 till December 2024. Ethical clearance was taken from Institutional ethical committee (IEC-2639).

Sample size: A total of 150 denture base samples (75 from heat cured resin and 75 from cold cured resin) were fabricated on ideal edentulous cast and were randomly divided into five subgroups of 15 samples each. A convenience sampling technique was adopted for this in-vitro study based on similar in-vitro study done by Narang V et al., in which each subgroup consisted of 10 samples [11]. Commercially available RFID (NFC) tags (Rapid radio Solutions Pvt., Ltd., Mumbai) of dimension 18 mm×18 mm [Table/Fig-1] with technical specifications listed in [Table/Fig-2] were incorporated in all samples.



[Table/Fig-1]: RFID tag (Rapid Radio solutions).

Features	Specification
Tag type	ISO 14443-3A NXP-NTAG213
Technology	Type A
Available Serial No.	04:2F: A6:B2:DO: 11:91
ATQ A	0×0044
Protected by Password	No
Memory Information	180 bytes:45 pages (4 Bytes each)
Data format	NFC forum Type 2
Size	19/137 Bytes (13%)
Writable	Yes

[Table/Fig-2]: Technical specification of RFID Tag.

Study Procedure

Fabrication of denture base with RFID tags: For heat cure denture bases (Group A) wax up was done on the edentulous cast followed by conventional flasking and dewaxing. Tags were incorporated in the heat cure denture bases during packing stage. One square piece of size 20×20 mm and 1 mm thick base plate wax was cut and wrapped in aluminium foil and placed on palatal surface of denture bearing area to create space for RFID tags during packing. Trial packing was done by keeping moist cellophane sheet in between. The flask was reopened and cellophane sheet along with foil wrapped base plate were removed. The RFID tags were placed on the space created on palatal surface of the denture and covered with heat cure resin material (DPI, Dental product India, Mumbai) [Table/Fig-3].

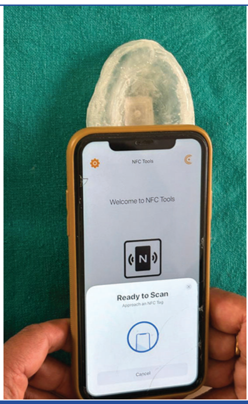
[Table/Fig-3]: Heat cure denture base sample with incorporated RFID tag.

Curing was done using long curing cycle. For cold cure denture bases (DPI-Dental product India, Mumbai) (Group B) a square ditch of dimension 20×20 mm and 1 mm depth was created on the palatal surface of wax up so as to accommodate RFID tags at later stage followed by conventional flasking and curing procedure. Cold cure denture base was retrieved and finished. Later on, RFID tags were placed in the ditch created in palatal surface of denture and sealed using cold cure resin material by sprinkle on technique [Table/Fig-4].

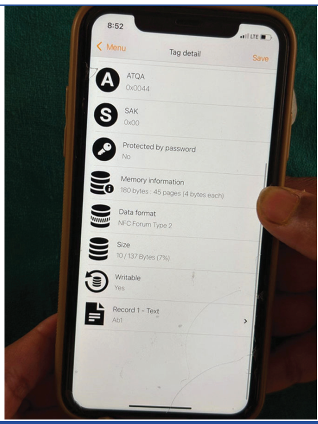
[Table/Fig-4]: Cold cure denture base sample with incorporated RFID tag.

Data entry into RFID tags: The RFID tags were programmed with Apple iPhone 11 (US) Smartphone [Table/Fig-5] using in-built NFC (Near Field Communication) tool. Following information was recorded into each RFID tags using the option "write" in tool:

1. Denture base groups, on the basis of types of material used (heat cure or cold cure acrylic denture base material). Letter "A" for-heat cure samples and "B" for cold cure samples was used
2. Subgroup information according to types of assaults used. Small letters "a", "b", "c"; "d", "e" was used.
3. Numbering of denture base sample (1,2,3…...15) [Table/Fig-6].



[Table/Fig-5]: NFC tool in build in apple i phone 11.



[Table/Fig-6]: Data entry into RFID tags.

For example, Aa1 denoted Heat cured denture base kept in conc. Sulphuric acid, sample no. 1.

Data entered into RFID tag of each sample was scanned to ensure functioning tags before assault and served as baseline control.

Subgrouping of samples according to physical and chemical assaults: Denture bases of both Group A and Group B were subjected to different assault according to the subgroup they belonged to [Table/Fig-7].

Subgroup A: Exposure to 98% sulphuric acid for 24 hours [Table/Fig-8].

Subgroup B: Exposure to 20% nitric acid for 24 hours [Table/Fig-9].

Subgroup C: Exposure to liquid nitrogen for three hours [Table/Fig-10].

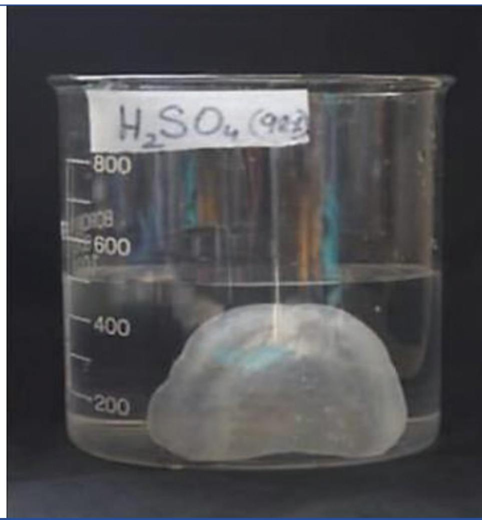
Subgroup D: Direct flaming using a butane torch [Table/Fig-11].

Subgroup E: Incineration at 200°C for 20 minutes [Table/Fig-12].

All physical and chemical assault protocols in the present study were adapted from earlier validated methods described by Narang V et al., and Richmond R and Pretty IA [11,12]. For exposure to acids the specimens were immersed in respective acids in a glass beaker. For exposure to liquid nitrogen specimens were kept in a box in liquid nitrogen chamber. For direct flaming specimens were

S. No.	Physical/Chemical assault	Subgroup	Group A Heat cure denture base (n=75)	Group B Cold cure denture base (n=75)
1	98% sulphuric acid (H_2SO_4) for 24 hr	Subgroup A	n=15	n=15
2	20% nitric acid (HNO_3) for 24 hr	Subgroup B	n=15	n=15
3	Liquid Nitrogen for 3 hr	Subgroup C	n=15	n=15
4	Direct flaming for 3 min	Subgroup D	n=15	n=15
5	Incineration 200°C for 20 min	Subgroup E	n=15	n=15

[Table/Fig-7]: Grouping and subgrouping of samples.



[Table/Fig-8]: Denture base sample in 98% sulphuric acid.

[Table/Fig-9]: Denture base sample in 20% nitric acid.

[Table/Fig-10]: Denture base sample in liquid nitrogen.

[Table/Fig-11]: Direct flaming of a denture base sample with butane torch.

[Table/Fig-12]: Denture base sample in incinerator.

exposed to the tip of inner blue cone, the hottest and most stable zone of the butane flame to ensure uniform heat application. Each specimen was exposed to direct flaming for three minute similar to the method described in previous literature [11]. For incineration specimens were kept in incinerator chamber.

Evaluating RFID tags after assault: Post-assault, all samples were washed and evaluated for surface damage and RFID tag readability using the same device. All samples were evaluated by single examiner. For each Subgroup, of both groups, number and percentage of readable RFID tags were noted.

STATISTICAL ANALYSIS

The data obtained were entered into Microsoft excel (Microsoft Corp., USA) and analysed using descriptive statistics. The outcome variable was categorical (RFID tags readable or not readable) and results were expressed as numbers and percentage for each subgroup within each resin type. No inter-group comparisons were intended.

RESULTS

The results of the study are depicted in [Table/Fig-13] and explained as follows.

S. No.	Subgroup	Types of assaults used	Heat cure denture base Group A (n=75)		Cold cure denture base Group B (n=75)	
			Number	Percent-age	Number	Percent-age
1	Subgroup A	Conc. sulphuric acid (98%) for 24 hr	0/15	0%	0/15	0%
2	Subgroup B	Dil. nitric acid (20%) for 24 hr	15/15	100%	15/15	100%
3	Subgroup C	Liquid Nitrogen for 3 hr	15/15	100%	15/15	100%
4	Subgroup D	Direct flaming for 3 min	09/15	60%	14/15	93.33%
5	Subgroup E	Incineration at 200^{0}C for 20 min	08/15	53.33%	07/15	46.66%

[Table/Fig-13]: Number and percentage of RFID tags that could be read in all groups and subgroups.

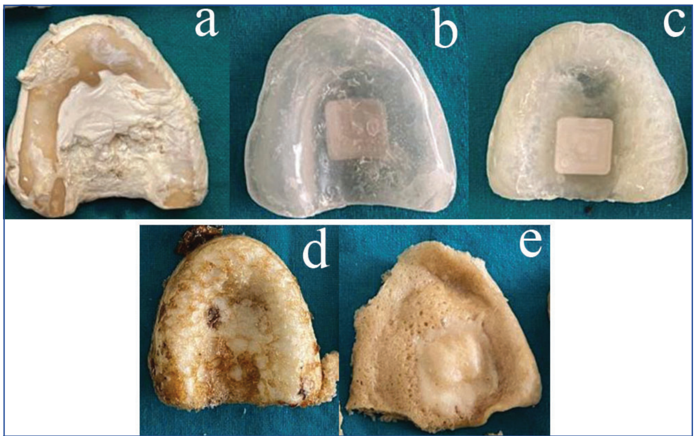
Subgroup A (98% sulphuric acid for 24 hr): All the denture base samples of both groups i.e., heat cure denture base (Group A) as well as cold cure denture base (Group B) showed surface deterioration with white chalky precipitates [Table/Fig-14a]. None of the RFID tags were readable in either group 0/15 (0%).

Subgroup B (20% nitric acid for 24 hr): All the denture base samples for both heat cure resin materials (Group A) as well as cold cure resin material (Group B) did not show any surface deterioration [Table/Fig-14b]. All samples of both groups had readable RFID tags 15/15 (100%) post assault.

Subgroup C (Liquid nitrogen for 3 hr): Surface of all denture bases of both heat cure resin materials (Group A) as well as cold cure resin material (Group B) showed surface crazing [Table/Fig-14c]. RFID tags of all samples of both groups were readable 15/15 (100%).

Subgroup D (Direct flaming for 3 min): All denture base surface for both heat cure resin material (Group A) as well as cold cure resin material (Group B) showed surface deterioration [Table/Fig-14d]. Only 09 RFID tags out of 15 (60%) were readable from heat cure denture base group and 14 out of 15 RFID tags (93.33%) were readable from cold cure denture base group.

Subgroup E (Incineration at 200°C for 20 min): There was complete deterioration of denture base surface for both heat cure resin material (Group A) as well as cold cure resin material (Group B) [Table/Fig-14e]. Only 08 RFID tags out of 15 (53.3%) were readable from heat cure denture base group and seven RFID out of 15 RFID (46.66%) were readable from cold cure denture base group.



[Table/Fig-14]: Denture base samples post assault.

DISCUSSION

Identification of denture from its marking is not new. For edentulous population, labelled dentures are critical in positive identification [16]. Criteria for denture marking is that it must be easy to do, aesthetic, inexpensive and also resistant to thermal and chemical insults. The present study evaluated the readability of RFID (NFC) tags incorporated into denture bases made from heat cure and cold cure resins when subjected to simulated physical and chemical assaults.

The RFID tag was introduced first time in 1940, during World War II, and was used for finding out the airplane of Royal air force. It was used in dentistry by Millet C and Jeannin C in 2004 [17]. These tags can also be used to keep the medical details of the geriatric patient undergoing treatment in various departments in the hospitals. RFID works on the bases of “automatic identification and data capturing” technology [9]. RFID tags work on different frequency ranging from low, moderate and high frequency ranging from 10-1000 MHz. High frequency is used in aeroplanes and ships. RFID NFC tag sticker works at the frequency of 13.56 MHz [11]. Near Field Communication (NFC) tags have more advantage of safety and security. The NFC tags are readable at distance of about 10 cm or even less for the purpose of security. The NFC tags are incorporated in debit card, credit card, metro card, key cards, microchip bracelets etc. now-a-days. In the present study commercially available RFID (NFC) tags were used as a method to label the denture by inclusion technique. These tags are relatively thin thus can be incorporated in dentures without compromising its structure and strength.

The RFID tags were incorporated into the palatal surface of maxillary denture. To ensure that tags are placed at similar depth for all the samples, a modified technique similar to that demonstrated by Narang V et al., and Venkat Nag PR and Shenoy KK and was followed [11,18]. A 1 mm thick base plate of dimension 20×20 mm covered with aluminium foil was incorporated into the dough stage of trial packing and replaced by RFID tags at final closure. Dimension of commercially available RFID tags used in the present study was 18×18 mm which could be easily accommodated in the palatal area of maxillary denture. This tag size was selected because it provided reliable signal strength while still being small enough to be embedded in the denture base without compromising fit or contour. Narang V et al., in their study also incorporated similar size NFC stickers as denture labels in the palatal surface of denture [11].

In previous research works, commonly used assaults range from exposure to chemical like strong acids (sulphuric acid, hydrochloric acid), strong bases (sodium hydroxide), exposure to direct flame, incineration at temperatures ranging from 100⁰C to 1200⁰C, exposure to extreme cold, exposure to acidic salts, exposure to sea water etc., [11-15]. Literature is still limited with regard to effect of such assaults on RFID tags. In the present study denture bases incorporated with RFID tags have been exposed to different physical/chemical assaults like conc. Sulphuric acid (98% H_2SO_4), dil. Nitric acid (20% HNO_3), Liquid nitrogen (N_2), Incineration (200⁰C for 20 min) and direct burning (butane torch). The physical and chemical assaults used in this study were selected to simulate the conditions that may be found in case of fire hazard, violence, mass disaster or industrial accidents.

Sulphuric acid is highly corrosive and commonly used laboratory chemical. Industrial accidents may expose the worker to the acid. Strong acid has also been used by criminals to dispose of the dead bodies so as to eliminate the evidence. In the present study samples of Subgroup "a" of both heat cure (Group A) and cold cure denture base (Group B) were exposed to 98% sulphuric acid. There was complete deterioration of denture bases of both groups and RFID tags could not be read in any of the sample. Also, there was formation of chalky white precipitate. Similar surface deterioration was reported by Richmond R and Pretty IA and Phulari RGS et al in their study [12,13]. Narang V et al., reported 20% positive results for heat cure samples when RFID tags were exposed to 98% sulphuric acid and none of the samples responded in cold cure groups similar to our study [11]. Richmond R and Pretty IA reported functional RFID tags after exposure to conc. Sulphuric acid for 24 hours. But the concentration of sulphuric acid used by them was not specified. Also, they conducted their study on acrylic blocks instead of denture bases as opposed to our study [12].

Nitric acid in concentration of 20% was chosen as a chemical assault in the present study. Nitric acid is used in production of fertilisers, explosives etc., It is corrosive to skin and can produce severe burning and scarring. Industrial accidents may cause risk of exposure to acids. None of the studies published in literature have used this acid as a physical assault, so, its effect on readability of RFID tags post assault is not known. Samples of Subgroup B of both Group A and B were exposed to nitric acid for 24 hours. There was no surface deterioration seen in any of the sample and all the RFID Tags were responsive (100% positive).

In case of fire or deliberate burning of victim, identifying a person with the help of labelled prosthesis is only possible if the label is resistant to heat and temperature. Direct flaming as a physical assault has been used by Narang V et al., and Richmond R and Pretty IA in their study [11,12]. In the present study, direct flaming of samples with butane torch was done for three minutes for all samples of Subgroup D of both groups A and B. All denture base sample showed little surface deterioration or burnt surface. A 60% RFID tags (9/15) incorporated in heat cure denture base were readable after the assault whereas approximately 14/15 (93.33%) tags in cold cure denture base were readable after the assault. Contrary to result of the present study, in the study done by Richmond R and Pretty IA [12], all RFID tags were readable after an assault with flame for five minutes but were rendered non responsive after further flaming for another five minutes. Probable reason for difference could be that, the tags in their study were embedded at a depth of 2 mm in acrylic blocks and number of samples was only four. Narang V et al., also reported 100% functioning tags after direct flaming for one minutes [11].

Incineration as a physical assault was used by Richmond R and Pretty IA and Phulari RGS et al., [12,13]. The incineration temperature used by them was 800⁰C for 20 minutes. Narang V et al., incinerated at temperature of 200⁰C for 20 minutes followed by 400⁰C for 10 minutes [11]. Neculai-Candea LS et al., in their study, subjected the NFC tags embedded in acrylic prosthesis placed in pig's head to incineration at a temperature gradually increasing from 100⁰C to 900⁰C for period of 5 minutes at each 100⁰C increase. They concluded that NFC tags can withstand temperature of 200⁰C and beyond that they are not usable [14]. In the present study sample of Subgroup "e" of both heat cure (Group A) and cold cure denture base (Group B) were placed in preheated furnace at a temperature of 200⁰C for 20 minutes. There was complete deterioration of the denture bases. Eight out of 15 (53.3%) RFID tags incorporated in heat cure denture base Group (Group A) and seven out of 15 (46.6%) RFID tags of cold cure denture base Group (Group B) were readable after the assault. Contrary to present study, study done by Richmond R and Pretty IA reported functioning RFID tags after the assault [12]. The tags in their study were embedded at a depth of 2 mm in acrylic blocks and only four samples were evaluated by them. Whereas, Narang V et al., reported 80% and 90% functioning RFID tags incorporated in cold cure and heat cure denture bases respectively, after the incineration [11]. Patel D et al., incinerated the dentures fabricated from different materials with embedded NFC tags at a temperature of 100⁰C, 200⁰C, and 300⁰C for 15 minutes and reported readable tags with partial carbonisation at higher temperature [19].

Discrepancies between present findings and earlier studies can be attributed to heterogenicity in experimental design and technological configuration. RFID/NFC based identification systems demonstrate performance characteristics that are highly sensitive to variations in tag architecture (chip dimension, memory type), depth of embedding and polymer matrix within which the device is contained. Prior studies employed different tag formats, different thermal and chemical assault protocols, different material selection all leading to different outcomes. Thus the disparity between the present study results and previous reports reflects the influence of material selection, technological designs and testing parameters.

Limitation(s)

There were certain limitations in the present study like, limited sample size, tags were incorporated in maxillary denture base only, only two denture base materials were studied so results cannot be extrapolated to other resins, long term durability of tags, repeated exposures to thermal and chemical challenges were not evaluated, exposure to only five assaults were evaluated. Direct flaming was not distance standardised as the procedure aimed to mimic an uncontrolled real life scenario. This may introduce variability in heat intensity received by each specimen. Also, the absence of inferential statistical analysis limits comparative interpretation between denture base materials.

CONCLUSION(S)

Within the limitations of this In-vitro study RFID tags embedded in both heat cure and cold cure denture base resin demonstrated variable survival and readability following exposure to different chemical and thermal assaults. Exposure to nitric acid and liquid nitrogen did not affect the readability of RFID tags in all samples but did show some surface crazing in samples exposed to liquid nitrogen. In contrast exposure to sulphuric acid rendered all tags not readable. Direct flaming and incineration at 200⁰C resulted in surface deterioration along with reduction in RFID tag readability. These findings suggest that RFID tags show good resistance to chemical and cryogenic challenges while extreme thermal exposure and sulphuric acid exposure may result in compromised tag functionality. Future studies may focus on in-vivo validation.

Clinical implications: RFID tags may enhance forensic identification during disaster and may be useful in geriatric and Institutional prosthodontic care.

REFERENCES

[1] United Nations. Universal Declaration of Human Rights. Article 6. 1948. Available from: https://www.un.org/en/about-us/universal-declaration-of-human-rights.
[2] Harvey W. Identity by teeth and marking of Denture. Br Dent J. 1966;121:334-40.
[3] Aujla H. A review on identifying human bodies through the use of forensic dentistry. Int J Dent Med Sci Res. 2022;4(1):812-16.
[4] Thomas J, Muruppel AM, Dinesh N, Gladstone S, George N. Dentures in forensic identification: A review of methods and benefits. J Adv Med Dent Sci. 2014;2(1):85-94.
[5] Rathee M, Yadav K. Denture identification methods: A Review. IOSR J Dent Med Sci. 2014;13(10):58-61.
[6] Stevenson RB. Marking dentures for identification. J Prosthet Dent. 1987;58(2):255.
[7] Heath JR. Denture identification: A simple approach. J Oral Rehabil. 1987;14:147-63.
[8] Richmond R, Pretty IA. Denture marking: Patient preference of various methods. J Forensic Sci. 2007;52(6):1338-42.
[9] Nuzzolese E, Marcario V, Vella GD. Incorporation of Radio Frequency Identification Tag in dentures to facilitate recognition and forensic human identification. Open Dent J. 2010;4(1):33-36.
[10] Kumar S, Kiran K, Singh R. Denture identification by incorporation of RFID tags in denture: A new Approach. J Oral Maxillofac Pathol. 2019;10(2):75-77.
[11] Narang V, Kuckreja H, Oberoi N, Kaur J, Birdi NK, Mahajan S. Resistance of a novel denture identification system to various assaults: An in-vitro study. J Indian Prosthodont Soc. 2021;21(2):180-85.
[12] Richmond R, Pretty IA. A range of postmortem assault experiments conducted on denture labels used for the purpose of identification of edentulous individuals. J Forensic Sci. 2009;54(2):411-14.
[13] Phulari RGS, Rathore RS, Jariwala PN, Kapuriya AD, Shah AK. Denture labels: Various types and their abilities to resist different assaults. J Forensic Dent Sci. 2017; 9(3):175-84.
[14] Neculai-Cândea LS, Ştefănescu CL, Popa MF. A thermal resistance study of dental prostheses marked with intelligent materials (NFC, Aero gel): Importance in medico-legal odontological identification. Rom J Leg Med. 2021;29:91-95.
[15] Poovannan S, Jain AR, Krishan CJ, Chandran CR. An in-vitro evaluation of the reliability of QR code denture labeling technique. J Forensic Dent Sci. 2016;8:179.
[16] Gosavi S, Gosavi S. Forensic odontology: A prosthodontic view. J forensic Dent Sci. 2012;4:38-41.
[17] Millet C, Jeannin C. Incorporation of microchips to facilitate denture identification by radio-frequency tagging. J Prosthet Dent. 2004;92(6):588-90.
[18] Venkat Nag PR, Shenoy KK. Dentures in forensic identification: A simple and innovative technique. J Indian Prosthodont Soc. 2006;6(2):75-77.
[19] Patel D, Ahuja P, Raghavan S, Patel J, Parikh T, Chawla AN, Hirani T. Forensic identification through denture tags: Performance under stimulated environmental conditions. J Pharma Bioallied Sci. 2025;17(3):s2256-s2258.

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