

# Evaluation of awareness among dentists about magnetic resonance imaging and their interactions with restorative dental materials: A survey among dentists in three districts of Tamilnadu

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## ABSTRACT

**Introduction:** Patients with dental restorations may require magnetic resonance imaging (MRI) of the head and neck, to assess the progress of diseases or to determine the cause of any subsequent symptoms, or for a purpose unrelated to the dental restorations. This may cause distortion of the images or the dislodgement of the prosthesis which thereby can cause injury to the adjacent tissues. **Objectives:** The objective of this study was to evaluate the awareness among dentists in three districts of Tamilnadu, regarding the interaction between restorative dental materials and MRI. **Material and Methods:** A questionnaire was designed to obtain information about materials used by dentists in treating their patients and their effect on MRI and vice versa, and to determine the perceptions of respondent dental practitioners. The study population included all dentists in three districts of Tamilnadu, India ( $n = 354$ ). Data were collected using a semistructured questionnaire on sociodemographic characteristics, knowledge and practice of dentists, materials they use for restoration, etc. The data was analyzed using SPSS. **Results:** The questionnaire was provided to 354 dentists and 101 (28%) responded. Out of them 49.5% dentists did not know the type of alloy their lab technician was using for fabrication of metal crowns and fixed partial dentures; 27% of dentists never used all ceramic crowns; 63.4% of dentists perceived that dental materials can produce artifact in MR, and among them 36.6% did not have any idea of how to prevent it. **Conclusion:** Continuing dental education programs about these interactions are required to improve the knowledge of dentists. The syllabus of dental course should include magnetic property of materials and its interactions with diagnostic procedures like MRI and CT.

**Key words:** Dental materials, metal artifacts of MRI, MRI

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## INTRODUCTION

Patients with dental restorations later in life may require magnetic resonance imaging (MRI) of the head and neck, to assess the progress of degenerative diseases or to determine the cause of any subsequent symptoms, or for a purpose unrelated to the dental restorations. MRI of the head and neck has become an important aid in evaluating pathologic conditions related to the brain, midface, and pharynx. The advantages of MRI are to provide sectional images of anatomical regions in any plane and its excellent soft-tissue contrast resolution.<sup>[1]</sup>

When a patient with dental restorations/appliances undergoes MRI, the following problems could be encountered:

- Movement/dislodgement of dental materials (leading to accidents) because of high magnetic field.
- Artifacts in MRI due to these dental materials.
- Thermal heating of materials due to radio waves (although negligible for dental materials).

An artifact may be defined as a distortion of signal intensity or void that does not have any anatomic basis in the plane being imaged.<sup>[2]</sup> It can also be defined as the pixels that do not exactly represent the tissue components being studied.<sup>[1]</sup>

Dentists should be aware of the interactions of various restorative dental materials and different technical factors needed for using an MRI scanning machine. Specific knowledge about these impacts, at the dentist level and at the level of the personnel working at the MRI centers can save valuable time for the patient and prevent errors in MRI images.

MRI is contraindicated in patients with ferromagnetic metallic implants or other ferromagnetic materials, primarily because of the potential risks associated with dislodgment or movement of these objects. Studies have assessed the ferromagnetic qualities of various metallic implants and materials by measuring the deflection forces induced by the static magnetic fields used for MRI. The authors of these studies concluded that patients with certain metallic implants or materials can safely undergo MRI if these objects display little or no ferromagnetism or exhibit only minimal deflection relative to the objects *in vivo* applications (i.e., if the deflection forces are thought to be insufficient to move or dislodge the implant or material *in situ*).<sup>[3]</sup>

Previous knowledge of the specific types of metallic implants or materials is essential for screening patients before MRI. As this awareness is essential for dentists and as there were no previous surveys conducted especially in Tamilnadu, the present study was done. The aim of this study was to evaluate the awareness among dentists in three districts of Tamilnadu regarding the interaction between dental materials and MRI.

## MATERIAL AND METHODS

A semistructured questionnaire was prepared and provided to dentists who were practicing in and around Salem, Erode, and Namakkal districts of Tamilnadu, India. The questionnaire was pretested, revised, and retested before used. The reliability score of the questionnaire, Cronbach's alpha was found to be 82.8%. The study population included all the dentists in districts of Salem, Erode, and Namakkal ( $n = 354$ ), to whom the questionnaires were provided. The data was collected using mailed questionnaire method. Among 354, 101 (28%) responded. Data was analyzed using the SPSS. Mann-Whitney test was used to evaluate the difference in knowledge between dentists qualified with a BDS and MDS degree.

## RESULTS

Out of 354 dentists, 101 (28.53%) responded. Among them, 68 (67.3%) were men and 33 (32.7%) were women [Table 1].

The mean age of the dentists was 31.8 years. While 42 of them were specialist and 59 were general dentists [Table 2].

Out of 101 dentist, 57 (56.4%) were working in teaching institutions (part-time private practitioners) and 44 (43.6%) of them were full-time practitioners [Table 3].

**Table 1: Number and percentage of dentists (genderwise) response to the questionnaire**

Gender	n	%
Male	68	67.3
Female	33	32.7

**Table 2: Number and percentage of specialists and general dentist (professional status) who responded to the questionnaire**

Professional status	n	%
General dentist	59	58.4
specialist	42	41.6

**Table 3: Number of dentists working in teaching institutions**

Working in teaching institution	n	%
Yes	57	56.4
no	44	43.6

**Table 4: Do u know what type of alloy, your lab technician is using for the fabrication of metal crowns or fixed partial dentures for your patients?**

	Frequency	Percent	Valid Percent
No Response	4	4.0	4.0
Yes	50	49.5	49.5
no	47	46.5	46.5
Total	101	100.0	100.0

Among them 59 of them were from Erode, 23 from Namakkal, and 19 from Salem. They had a mean experience in practice of 5.67 years. 64 (63.4%) of them preferred all ceramic restorations as IDEAL for patients who met all the requirement of an IDEAL anterior restoration. 52% preferred metal ceramic over all ceramic (17%) for IDEAL posterior restorative material. 20% of the dentists always insisted the dental technician about the type of alloy to be used for fabrication of the restorations. In that only 4% of them preferred high noble alloy. 46.5% of them did not know the type of alloy their lab technician was using for the fabrication of metal crowns or fixed partial dentures [Table 4].

27.7% of them have never used an all ceramic restoration. 46.6% of dentists thought that dental alloys were highly attracted to magnets [Table 5].

60% of them were not able to answer about the magnetic potential of materials like all ceramic, metal ceramic, amalgam, acrylic resin, titanium, stainless steel, Ni-Cr, and Co-Cr alloys. When asked about magnetic field of MRI's effect on magnets in overdentures, 45.5% of them had no idea. While 14% of them have answered that they have been approached by patients for removal of dental prosthesis or appliances from them, prior to an MRI scan [Table 6].

4% of them answered that they have been contacted by MRI lab for removal of prosthesis from patients prior to an MRI. None of them have got a complaint from the patient about dislodgement of prosthesis after an MRI. 64% of them thought

**Table 5: Are dental alloys attracted to magnets?**

	n	%
No Response	18	17.8
Yes	47	46.5
no	36	35.6

**Table 6: Patient approached for removal of appliances/restoration prior to MRI?**

	n	%
No Response	1	1
Yes	14	13.9
no	86	85.1

**Table 7: Statistical analysis of the association between the qualification and the preference of ideal posterior restorative material (all ceramic and all metal), and total number of all ceramic crowns delivered to patients**

Variable	Qualification	N	Mean Rank	P value
Ideal Posterior material- all ceramic	MDS	42	58.9	0.003*
	BDS	59	40.89	
ALL Metal	MDS	42	53.26	0.499
	BDS	59	47.10	
No. of All Ceramic Crowns	MDS	42	43.48	.023*
	BDS	59	56.36	

\*significant

dental materials can cause artifact in MRI. Among them 30.7% think amalgam can cause artifact. Regarding the prevention of artifacts, 36.7% of them had no idea and 30% of them thought MRI will increase the temperature of dental prosthesis. The chi-square analysis showed that there is a significant ( $P < 0.05$ ) association between the qualification and the preference of ideal posterior material (all ceramic and all metal), and total number of all ceramic crowns delivered to patients.

Mann-Whitney test was carried out for the significant variables of chi-square analysis. The results were tabulated in Table 7.

It depicts that there is significant difference between the MDS and BDS practitioners in the preference of ideal posterior material (all ceramic), and total number of all ceramic crowns delivered. While the preference of all metal as an ideal posterior restoration was not significant.

The value of mean rankings indicates that the MDS group had more preference for all ceramic as ideal posterior restorative material whereas; the BDS group had delivered more number of all ceramic crowns.

## DISCUSSION

The study reveals that, 46.5% dentists did not know about the type of alloy they were using for restoring their patients' teeth. The most common problem in MRI caused by dental materials is not the accident as compared to other implantable materials but is the artifact caused by these dental materials in the MRI.<sup>[4-17]</sup> There are many studies suggesting that only ferromagnetic material can cause artifact, hence it is essential for the dentist to know the type of alloys they are using for their patients. 27.7% of dentists have never used all ceramic restorations in treating their patients, even though all ceramic restorations do not cause any artifact or accidents in MRI.<sup>[1]</sup> The literature indicates that patients with particular ferromagnetic metallic implants or materials, as well as the other metallic objects that were determined to be non-ferromagnetic, can safely undergo imaging by MR scanners with static magnetic field strengths up to and including those used for the specific evaluations.<sup>[3]</sup>

Several important factors influence the relative risk of using MRI in patients who have ferromagnetic implants or materials. These include: (1) the strength of the gradient and static magnetic fields, (2) the degree of ferromagnetism of the implant or material, (3) the location and orientation of the implant or material *in situ*, (4) the geometry of the implant or material, and (5) the amount of time the implant or material has been in place. These factors should be considered carefully before a patient with a ferromagnetic implant or material has MRI, particularly if the device is located in a potentially dangerous area of the body.<sup>[3]</sup>

All patients who have metallic implants or materials or who have objects made from unknown materials should be evaluated by using *ex vivo* techniques before MRI is performed. The presence and degree of ferromagnetism must be determined first so that a competent decision can be made about possible hazards associated with the use of MRI.

Regarding artifact, studies have contradictory findings about some of the dental materials that cause artifacts, but it has been concluded from these studies that the most significant artifacts were produced by cobalt-chromium crowns, nickel-chromium crowns, stainless steel crowns, metallic dentures, magnetic keepers, orthodontic appliances, and orthopedic metal plates. All ceramic, noble metals, amalgam, acrylic, and produce no artifact. Titanium may produce artifact.

## CONCLUSION

Knowledge about the interaction of dental materials and MRI is essential for dentists. MRI centre can be notified whether the restoration/appliance is MR friendly or not. Preference can be given for nonmetals like all ceramic restorations over metal ceramic. Even if metal ceramic is preferred it is better to choose a noble metal alloy. Removable prosthesis/appliances are not a matter of concern, because patients can remove it. All materials can be considered as MR unsafe, if the dentist is not sure about the type of prosthesis/appliance and it is advisable to remove the prosthesis/appliances prior to an MRI. Materials for prosthetic restoration should be selected based not only on their biological compatibility and functional and esthetic qualities, but also on whether they generate minimum artifacts in MRI. Thus ALL ceramic restorations can be considered as a valuable alternative in dentistry.

The results of the present study showed that the knowledge of dentists is relatively limited about the interaction between dental materials and MRI. This situation indicates that this topic does not arouse interest among dentists, or that there is a deficiency in continuing dental education on these interactions.

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## Conflict of interest

There are no conflicts of interest

## REFERENCES

1. Chen DP, Wu GY, Wang YN. Influence of galvano-ceramic and metal-ceramic crowns on magnetic resonance imaging. *Chin Med J* 2010;123:208-11.
2. Harris TM, Faridrad MR, Dickson JA. The benefits of aesthetic orthodontic brackets in patients requiring multiple MRI scanning. *J Orthod* 2006;33:90-4.
3. Shellock FG. MR imaging of metallic implants and materials: a compilation of the literature. *AJR Am J Roentgenol* 1988;151:811-4.
4. Costa AL, Appenzeller S, Yasuda CL, Pereira FR, Zanardi VA, Cendes F. Artifacts in brain magnetic resonance imaging due to metallic dental objects. *Med Oral Patol Oral Cir Bucal* 2009;14:E278-82.
5. Kaneda T, Minami M, Curtin HD, Utsunomiya T, Shirouzu I, Yamashiro M. Dental bur fragments causing metal artifacts on MR images. *AJNR Am J Neuroradiol* 1998;19:317-9.
6. Raphael B, Haims AH, Wu JS, Katz LD, White LM, Lynch K. MRI Comparison of periprosthetic structures around zirconium knee prostheses and cobalt chrome prostheses. *AJR Am J Roentgenol* 2006;186:1771-7.
7. Harris TM, Faridrad MR, Dickson JA. The benefits of aesthetic orthodontic brackets in patients requiring multiple MRI scanning. *J Orthod* 2006;33:90-4.
8. Ernstberger T, Heidrich G, Bruening T, Krefft S, Buchhorn G, Klinger HM. The interobserver-validated relevance of intervertebral spacer materials in MRI artifacting. *Eur Spine J* 2007;16:179-85.
9. Abbaszadeh K, Heffez LB, Mafee MF. Effect of interference of metallic objects on interpretation of T<sub>1</sub>-weighted magnetic resonance images in the maxillofacial region. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000;89:759-65.
10. Hinshaw DB, JrHolsouser BA, Engstrom HI, Tjan AH, Christiansen EL, Catelli WF. Dental material artifacts on MR images. *Radiology* 1988;166:777-9.
11. Lissac M, Metrop D, Brugirard J, Coudert JL, Pimmel P, Briguet A. Dental materials and magnetic resonance imaging. *Invest Radiol* 1991;26:40-5.
12. Guerhazi A, Miaux Y, Zaim S, Peterfy CG, White D, Genant HK. Metallic artefacts in MR imaging: effects of main field orientation and strength. *Clin Radiol* 2003;58:322-8.
13. Cunningham AS, Harding S, Chatfield DA, Hutchinson P, Carpenter TA, Pickard JD. Metallic neurosurgical implants for cranial reconstruction and fixation: assessment of magnetic field interactions, heating and artefacts at 3.0 Tesla. *Br J Neurosurg* 2005;19:167-72.
14. Schueler BA, Parrish TB, Lin JC, Hammer BE, Pangrle BJ, Ritenour ER. MRI compatibility and visibility assessment of implantable medical devices. *J Magn Reson Imaging* 1999;9:596-3.
15. Okana Y, Yamashiro M, Kaneda T, Kasai K. Magnetic resonance imaging diagnosis of the temporomandibular joint in patients with orthodontic appliances. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003;95:255-63.
16. Starcukova J, Starcuk Z, JrHubalkova H, Linetskiy I. Magnetic susceptibility and electrical conductivity of metallic dental materials and their impact on MR imaging artifacts. *Dent Mater* 2008;24:715-23.
17. Ernstberger T, Buchhorn G, Heidrich G. Artifacts in spine magnetic resonance imaging due to different intervertebral test spacers: an *in vitro* evaluation of magnesium versus titanium and carbon-fiber-reinforced polymers as biomaterials. *Neuroradiology* 2009;51:525-9.