ORIGINAL ARTICLE

TO DETERMINE MEAN DISTORTION SCORE OF MRI AT NINE DIFFERENT SECTIONS OF HEAD AND NECK WITH DANTAURAM METALLIC ORTHODONTIC BRACKETS ON THE TEETH

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ABSTRACT

Magnetic Resonance Imaging (MRI) is a medical imaging technique used in radiology to visualize detailed internal structure. The presence of metallic sources, such as dental implants, orthodontic braces and metallic dental crowns may reduce the image quality of MRI in the maxillofacial region causing large magnetic field distortion and signal loss.

Study was designed to evaluate the effects of Dantauram metallic orthodontic brackets on diagnostic quality of MRI image at nine craniofacial regions.

A Cross sectional study was carried out on 30 patients visiting Department of Orthodontics, de' Montmorency College of Dentistry / Punjab Dental Hospital Lahore (tertiary health care center). Patients with 18 years or above, of either sex and recently bonded with Dantauram metallic orthodontic brackets were included in the study. Duration of study was six months. Dantauram metallic brackets were bonded to all incisors, canine and premolars except molars.

The mean distortion score of MRI at nine different sections of head and neck including tongue, body of mandible, hard palate, orbits / globes, nasopharynx, pituitary gland, frontal lobe, temporal lobe and brain stem with Dantauram metallic orthodontic brackets on the teeth was noted. The neuroradiologist was requested to rank the images according to the distortion of these regions using a modified receiver operating characteristic method of distortion classification.

The results of the current study revealed that 53.33% patients were between 18-30 years, 36.67% 31-40 years, and 10% patients with > 40 years age. Among these patients 76.67% were females and 23.33% males. The mean distortion score of MRI at nine different sections of head and neck with Dantauram metallic orthodontic brackets on the teeth of these patients was noted. It was observed that mean distortion score was 2.15±0.93 for tongue, body of mandible 2.79±0.88, hard plate 2.02±0.12, orbits / globes 2.32±0.38, nasopharynx 2.11±0.43, pituitary gland 1.96±0.23, frontal lobe 1.15±0.21, temporal lobe 1.75±0.76 and for brain stem was 0.78±0.53.

It was concluded that mean distortion score of MRI at nine different sections of head and neck with Dantauram metallic orthodontic brackets on the teeth is <3 in all sections. This means that there is insignificant distortion of MRI at different craniofacial regions with Dantauram metallic orthodontic brackets on the teeth. However, more trials are required to confirm the findings and recommending for non-removal of brackets before MRI.

Key Words: *Mean distortion score, MRI and Dantauram metallic orthodontic brackets.*

INTRODUCTION

Magnetic Resonance Imaging (MRI) is widely used for clinical evaluation in neurology, oncology and orthodontics etc. This creates images using a strong uniform static magnetic field and switching magnetic field gradients with radiofrequency magnetic field pulses.[1] In the United States a classification system for implants and ancillary clinical devices has been developed by ASTM International. These include MR-Safe, MR-Conditional and MR-Unsafe.[2]

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The presence of metallic implants and other metallic objects may either make MRI unsafe or greatly limit its diagnostic value. These metallic objects in MRI may cause substantial image artifacts, including signal loss, failure of fat suppression, geometric distortion, and bright pile-up artifacts. Also may cause large resonant frequency changes and failure of many MRI mechanisms.[3]

The magnetic field distortions in the presence of metal ions cause large resonant frequency variations, resulting remarkable number of artifacts in MRI. When the field changes speedily with position, there is significant dephasing of the signal, resulting in signal loss.[4,3]

Metallic materials with magnetic properties cause an artifact which is similar to a 'black hole' in the final picture that can lead to a misinterpretation of the MRI results.[5,6] Three types of substances with different magnetic susceptibilities need to be considered in MRI. These may include ferromagnetic materials (iron, cobalt and nickel strongly amplify the magnetic field), diamagnetic materials (copper, gold, zinc, lead, carbon and bismuth slightly weaken the magnetic field) and Para-magnetic materials (chromium, manganese and aluminum slightly amplify the magnetic field).[7,8] Dentists usually use precious (Au, Ag, Pt) and non-precious alloys (Cr, Co, Mo, Ni), pure gold, titanium and titanium alloys.[8] The presence of metallic sources, such as dental implants, orthodontic braces and metallic dental crowns may reduce image quality of MRI in the maxillofacial region causing large magnetic field distortion and signal loss.[9]

Both clinical and experimental studies have shown that metallic orthodontic appliances may produce image distortion on MRI scans of head and neck. There is, however little evidence about need/ no need of removing fixed metallic orthodontic appliances prior to taking MRI scans if the area to be scanned is distant from oral cavity. Moreover there is insufficient evidence to suggest that brackets and bands are dislodged during MRI scans, which could lead to possible tissue damage. As MRI use large magnetic field thus ferromagnetic materials alter the homogeneity of this field. Alteration of the magnetic field obstructs the signal and causes significant difficulty with the reconstruction of a magnetic resonance image.[10]

Orthodontic brackets are used to align and straighten the teeth and help to position them with regard to a person's bite, while also working to improve dental health. They are often used to correct under bites, overbites, cross bites, open bites, crooked teeth, malocclusions, and various other flaws of the teeth and jaws. Orthodontic braces are often used in conjunction with other orthodontic appliances to help widen the palate or jaws and to otherwise assist in shaping the teeth and jaws.[11]

The rationale of this study would be, if the radiologist will need MRI of body areas distant from oral cavity, there will be need/no need of removal of metallic orthodontic brackets from the teeth. It is assumed that the distortion would decrease to insignificant level as the area of MRI scan is away from oral cavity. There is no previous study available in this regard.

Present study was designed to evaluate the effects of Dantauram metallic orthodontic brackets on diagnostic quality of MRI image at nine different craniofacial regions.

METHODOLOGY

A Cross sectional study was carried out on 30 patients visiting Department of Orthodontics, de,Montmorency College of Dentistry/Punjab Dental Hospital, Lahore (tertiary health center). Patients with 18 years or above age, of either sex and recently bonded with Dantauram metallic orthodontic brackets were included in the study. Patients with metallic medical devices such as aneurismal clips, pacemakers, metal dental fillings, metal containing crowns, fixed orthodontic retainers and dental implants or severe periodontal problems were excluded from the study. Duration of study was six months. Study was approved from the Ethical Committee of Punjab Dental Hospital as well as department of Radiology, Lahore General Hospital, Lahore. A written consent was taken from the patient or their parents/ guardians to include them in the study.

Dantauram metallic orthodontic brackets were bonded to all incisors, canine and premolars except molars. All subjects underwent MRI scans without contrast using a standard quadrature head coil. Imaging sequence included axial fast-apinecho T2 weighted images (TR/TE_3500/90 msec), axial and sagittal conventional spin-echo T1 weighted images (TR/TE_500/14sec, 5 mm thick, 20% gap), and axial gradient-recalled echo images (TR/TE_720/26msec, flip angle 25`, 4 mm thick). Here T1 and T2 present the relaxation time based on the type of tissue to be scanned whereas TR is the repetition time and TE is the echo time basic parameters of image acquisition.

The mean distortion score of MRI at 9 different sections of head and neck including tongue, body of mandible, hard palate, orbits/globes, nasopharynx, pituitary gland, frontal lobe, temporal lobe and brain stem with Dantauram metallic orthodontic brackets on the teeth was noted. The neuroradiologist was requested to rank the images according to the distortion of these regions using a modified receiver operating characteristic method of distortion classification.

Statistical analysis was performed using SPSS for Window software 16.0 (SPSS Chicago, III). Quantitative data like ages, distortion score of different regions (base of tongue, body of the mandible, hard palate, orbits/globes, nasopharynx, pituitary gland, frontal lobe, temporal lobes and brainstem) was presented in the form of mean+ S.D. Qualitative variable like gender were presented in the form of frequency and percentages.

RESULTS

The results of the current study reveals that 53.33% (n=16) patients were between 18-30 years, 36.67% (n=11) between 31-40 years, and 10% (n=3) patients with age >40 years (Table 1). Among these patients 76.67% (n=23) were females and 23.33% (n=7) males (Table 2). The mean distortion score of MRI at nine different sections of head and neck with Dantauram metallic orthodontic brackets on the teeth of these patients was noted. It was observed that mean distortion score for tongue was 2.15±0.93 for body mandible 2.79±0.88 for hard plate 2.02±0.12 for orbits/globes 2.32±0.38 for nasopharynx 2.11±0.43 for pituitary gland 1.96±0.23 for frontal lobe 1.15±0.21 for temporal lobe 1.75±0.76 and for brain stem was 0.78±0.53 (Table 3).

TABLE 1: AGE DISTRIBUTION OF THE PATIENTS (N=30)

Age (in years)	Patients	%
18-30	16	53.33
31-40	11	36.67
>40	3	10
Total	30	100

TABLE 2: GENDER DISTRIBUTION OF THE PATIENTS (N=30)

Gender	Patients	%
Male	7	23.33
Female	23	76.67
Total	30	100

TABLE 3: MEAN DISTORTION SCORE OF MAGNETIC RESONANCE IMAGE AT 9 DIFFERENT SECTIONS OF HEAD AND NECK IN THE PRESENCE OF DANTAURAM METALLIC ORTHODONTIC BRACKETS (N=30)

Sections	Mean Score
Tongue	2.15±0.93
Body of mandible	2.79±0.88
Hard palate	2.02±0.12
Orbits/globes	2.32±0.38
Nasopharynx	2.11±0.43
Pituitary gland	1.96±0.23
Frontal lobe	1.15±0.21
Temporal lobe	1.75±0.76
Brain stem	0.78±0.53

DISCUSSION

Magnetic Resonance Imaging (MRI) is considered a powerful diagnostic method which enables the visualization of soft tissue contrast without the use of ionizing radiation. As in all imaging modalities, artifacts can occur, resulting in degraded image quality which can compromise image evaluation and in some cases render it impossible.[14]

Present study was tried to evaluate the effects of Dantauram metallic orthodontic brackets on the diagnostic quality of MRI at nine craniofacial regions considering the fact according to Elison et al[10] that mean distortion scores of stainless steel brackets are less than 5 (5 considered complete obliteration non-diagnostic) in most of the sections.

The results of the current study revealed that 53.33% patients from either sex were with age range 18-30 years, 36.67%) with 31-40 years, and 10% >40 years age. Mean age of total sample was 23.54 years. Among these 23.33% were male and 76.67% females.

According to MRI report mean distortion score revealed 2.15±0.93 for tongue, 2.79±0.88 for body of mandible, 2.02±0.12 for hard palate, 2.32±0.38 for Orbits/globes, 2.11±0.43 for Nasopharynx, 1.96±0.23 for Pituitary gland, 1.15±0.21 for Frontal lobe, 1.75±0.76 for Temporal lobe and 0.78±0.53 for Brain stem.

The results of this study are in contrast with a group of workers[10] as they determined mean distortion scores of stainless steel brackets at base of tongue 4.83±2.415, body of mandible 5.00±2.5, hard palate 4.83±2.4, orbits/globes 4.56±2.28, Nasopharynx 3.66±1.83, pituitary gland, 3.02±1.51, Frontal lobe 3.46±1.73, temporal lobe 3.11±1.5, brain stem 2.69±1.345, and value of each section was ≥ 3 which shows non-diagnostic obliteration. Study also evaluated cranial magnetic resonance image (MRI) distortion caused by various orthodontic brackets and concluded that ceramic, and titanium brackets cause minimal distortion of cranial MRI. On the other hand, stainless steel brackets cause significant distortion, rendering several cranial regions non diagnostic. Areas with the most distortion were the body of the mandible, the hard palate, the base of the tongue, the globes, the nasopharynx, and the frontal lobes in their study. In general, the closer the stainless steel appliance to a specific anatomic region, the greater the distortion of the MR image.

The reason behind difference between previous studies9,10,14 and the current study is that they used ferromagnetic metallic brackets and in this study non-ferromagnetic Dantauram metallic brackets used, showed <3 distortion score. However, use of Dantauram metallic brackets is beneficial and allows non removal of brackets before taking MRI particularly the regions away from the oral cavity.

The findings of the current study are primary as no study has been done in this regard in our setup. However, more trials are required to confirm the findings and allowing for non-removal of brackets before MRI.

CONCLUSION

We concluded that mean distortion score of MRI at 9 different sections of head and neck with Dantauram metallic orthodontic brackets on the teeth is <3 in all sections that is insignificant. However, more trials are required to confirm the findings and suggesting recommendations for non-removal of brackets before MRI.

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