

# A Case Report of Metal Induced MRI Accident and Diagnosis by Ultrasonography

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## ABSTRACT

Dental radiology has shown great developments in recent years. In addition to conventional radiography techniques, advanced imaging techniques are frequently used in dental radiology when necessary. Magnetic Resonance Imaging (MRI) is an advanced imaging technique that is frequently used because of its high soft tissue resolution and no risk of ionizing radiation. However, it should be noted that MRI also has some risks. Ultrasonography (USG) is a very useful technique for imaging foreign bodies especially superficial ones. The purpose of this case report was to present the USG diagnosis and subsequent surgical removal of a metallic foreign body that interferes with MRI in a cheek of 40 years old female. At the same time, it was aimed to draw attention to the disadvantages of metals for MRI and the role of USG in detecting superficial foreign bodies.

**Keywords:** Magnetic resonance imaging, ultrasonography; foreign bodies.

## 1. INTRODUCTION

Magnetic Resonance Imaging (MRI) was used first by Damadian in 1971 and by Lauterbur in 1973 (1). The most important advantages of MRI are that it does not contain ionizing radiation and it is the technique with the highest soft tissue contrast. Since patients are exposed to a strong magnetic field during MRI, metallic objects in the environment or in the patient's body may be adversely affected by this magnetism. MRI has some contraindications such as; cardiac pacemakers, cerebral aneurysm clips, metallic foreign bodies, vena cava filters, IV stents, middle ear prostheses and orthopedic prostheses.

Ultrasonography (USG) is a technique that uses high-frequency ultrasound waves, does not contain ionizing radiation, and is generally used to examine muscles, tendons, joints, vessels and internal organs that are not behind the bone. USG has many advantages such as allowing simultaneous imaging, being portable, inexpensive, free of radiation, being non-invasive and not affected by metal artifacts. Although the use of USG in dentistry is thought to be limited to the evaluation of salivary glands, cervical lymph node evaluation, facial muscles, face and neck soft tissues; with the development of high-resolution devices in recent

years, USG has begun to be used in different areas in our field as well as in the examination of foreign bodies in the head and neck region (2).

The necessity of radiological examination in detecting foreign objects is indisputable. Conventional radiography, Computed Tomography (CT), MRI and USG are generally used to identify foreign bodies (3). The purpose of this case report was to present the MRI accident caused by a metallic foreign body in cheek and its diagnosis by USG followed by surgical removal. At the same time, it was aimed to increase the awareness of the readers about the disadvantages of metals for MRI and the role of USG in detecting superficial foreign bodies.

## 2. CASE REPORT

A 40-year-old female patient applied to our clinic with an interesting medical history. She stated that MRI was requested for orthopedic discomfort in her arm. For this purpose, when she entered the MRI device, she stated that there was an excessive swelling and pain in the left cheek with the operation of the device and the operator then immediately stopped shooting. The patient was told

that there was a metallic object in her cheek and MRI could only be performed after this object was removed. When the patient came to us for this purpose, we saw the metallic object superimposed on the left mandibular molar teeth in the Panoramic and periapical films available in the telemedicine system. However, the patient stated that she did not remember any event in her history that could have caused this.

In the clinical bi-digital examination of the patient's cheek, we felt a hardness in that area (Fig. 1). On panoramic radiography, the object was not noticed at first because it was superimposed on the left mandibular first molar with metallic filling (Fig. 2). A metallic object was observed in the periapical film taken in the superior direction, but the location of the object was not fully discernible (Fig. 3). It was decided to take extra-oral and intra-oral USG from the patient for further examination. USG was applied using an Aplio-300 device (Toshiba Corporation, Tokyo, Japan) and 12 MHz linear probe used for extra-oral USG and 18 MHz Hockey stick probe used for intraoral USG. Metallic foreign body was clearly observed in both techniques.



**Figure 1.** Clinical examination of the foreign body in the cheek.

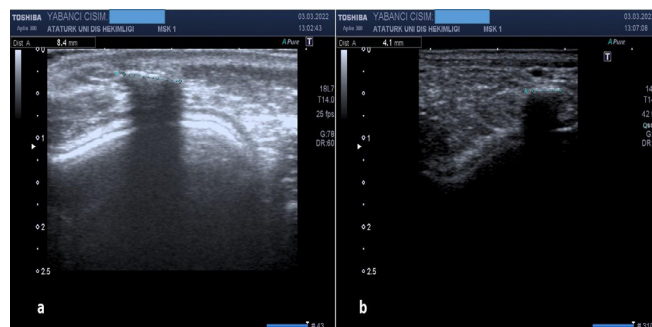


**Figure 2.** The metallic object superimposed on the left mandibular first molar with metallic filling is observed on the panoramic radiography.

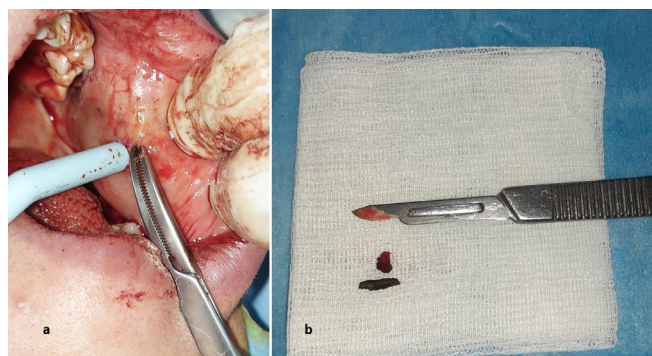


**Figure 3.** The periapical radiographic image of the metallic object.

Extra-oral USG examination revealed an 8.4 mm foreign body with posterior acoustic shadowing in the subcutaneous area (Fig 4). In the intra-oral USG examination, a foreign body with posterior acoustic shadowing of 4.1 mm was observed in the submucosal area (Fig 4). Later, the patient was referred to the surgical service for the removal of this object. The body was removed by intra-oral intervention under local anesthesia (Fig 5). Afterwards, the patient was called for control post-operatively. When there was no problem, the patient was referred for MRI again after the post-operative edema and pain subsided. Afterwards, the patient was able to have an MRI without any problems.



**Figure 4.** The ultrasonography of the metallic object revealed a hyper echogenic foreign body with posterior acoustic shadowing. a: Trans cutaneous-approach, b: trans-oral approach.



**Figure 5.** Removal of the metallic object by intra-oral intervention under local anesthesia. a: The operation, b: The extracted metallic object.

### 3. DISCUSSION

MRI is an advanced imaging technique that is frequently used because of its high soft tissue resolution and no risk of ionizing radiation. However, it should be noted that MRI also has some risks for both patients and healthcare personnel (4). Although radiologists are educated about the feasibility and indication of MRI, other doctors who request MRI should also be aware of benefits and risks of MRI. Referring physicians, especially those who know the patient's medical history better, can better know whether their patients have any risky conditions for MRI. This is even more important for patients carrying metallic medical devices.

Ferromagnetic objects in the MRI room or on the patient can be a hazard to both the patient and the staff, as they can be moved by the strong magnetic field. In this respect, necessary precautions should be taken, these objects should be removed from the environment, and a detailed story should be taken from the patients as to whether they have any metallic objects in their bodies. In this case, our patient was unaware that she had such a metallic object on her cheek until the MRI scanning. According to, guidelines to Prevent Excessive Heating and Burns Associated with Magnetic Resonance Procedures, metallic objects that come into contact with the patient's skin should be removed, use insulation material of 1 cm or thicker to prevent skin-to-skin contact and the formation of closed-loops from touching body parts and only materials proven to be MRI safe should be allowed (5).

As it is known, static and time-varying electromagnetic fields are used in MRI. However, although there is no risk of ionizing radiation, these magnetic fields can pose a danger to humans from time to time. Namely, the radiofrequency used in MRI may cause heating of the tissues (6). Fatal MRI accidents have been reported in patients with metallic implants in the literature (7). The most important cause of serious injuries in MRI scans is heating caused by radiofrequency. Namely; in phantom experiments, metal heating was found to reach 75°C following RF exposure (8).

The hazards caused by metallic implants in MRI due to their physical structure can be examined under four headings; torques and slips, movements in metal objects, malfunction in active devices such as pacemakers, and tissue damage due to local heating (9, 10). MRI may cause undesirable conditions in patients with metallic implants such as orthopedic devices (11), cardiovascular devices (12), and cochlear implants (13). With the developments in biomedical engineering, safe MRI devices are now available (12). In addition to all these, metals also cause image artifacts in MRI more severe than in CT (14). In recent years, new protocols have been developed to eliminate these negative interactions of MRI with metals. The most basic factors affecting metal interactions in MRI are the type of metal, MR field strength used, MR protocol and sequence. The location, size, orientation, and configuration of the metal play a role also. Titanium, which is frequently used in many treatment materials today, definitely causes smaller interference and artifact in MRI compared to Cobaltchrome

and stainless steel (15-19). Recently developed aluminum-free titanium composites, biodegradable magnesium alloys or radiolucent carbon-fiber-reinforced polymers have reduced unwanted metallic interactions in MRI.

USG is a safe diagnostic method in which internal organs are imaged using ultra sound in medicine. It does not carry the risk of ionizing radiation and is not affected by metal artifacts. USG is used in dentistry generally for several purposes such as; salivary gland diseases, cervical lymphadenopathy, various soft tissue mass, masticatory and neck muscles and as well as novel usage areas such as; maxillofacial fractures, periapical lesions, Temporomandibular Joint, tongue tumors, dental tissues' decay, cracks and fractures, mucosal lesions, periodontal tissues, implant dentistry, evaluation of rapid palatal expansion in orthodontia (20).

Foreign bodies can enter the body unintentionally in different ways due to aspiration, ingestion or insertion and they can be imaged with various techniques such as conventional radiography, USG, fluoroscopy, or CT depending on the type and location of the object (21). In the literature, there are many cases of foreign body in the cheek diagnosed by various radiological methods (22). However, we did not encounter a similar case that caused an MRI accident and was diagnosed with ultrasonography in dentistry. In fact, the use of USG in dental radiology has been increasing in recent years. Different bodies can give different images in different imaging techniques and in different environment. USG with high frequency probes should be preferred to examine superficial foreign bodies even non-opaque ones that cannot be seen on radiography. In this case, USG gave us a clear benefit in imaging the metallic foreign body on the patient's cheek. The metal fragment was clearly observed with its hyperechoic structure and acoustic shadow in both intraoral and extra oral USG examination. In the present case, the size of the object was measured smaller in the intra-oral USG. But it should be said that; size of the object measured by USG can of course also vary depending on the localization of the object and holding angle of the probe. Of course, it may not always be possible to approach the desired area from the inside of the mouth at the desired angle with the USG probe.

Although plain radiographs are sufficient for imaging radio-opaque foreign bodies, they are insufficient for full localization of the object because they do not allow three-dimensional imaging. As a matter of fact, the same inadequacy was encountered in this case as well. As in this case, if the metallic foreign body on the patient's cheek had been detected on time in the previous dental panoramic radiograph, the patient might not have encountered an undesirable situation during MRI. In this respect, every radiographic examination should be examined in detail. Dentists may be the first to notice foreign bodies in the maxillofacial region.

### 4. CONCLUSION

This case report concluded that, it should be questioned whether patients have metal implants or objects in their

bodies before they were admitted to magnetic field devices such as MRI. Because metallic objects on the patient or inside his body will be strongly attracted by the machine. In addition, this case report reminded us the importance of USG in imaging foreign bodies that may be found in superficial soft tissues.

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