Magnets in Orthodontics

- **Dr. Anil Kumar** BDS, MDS. Assistant Professor Department of Orthodontics and Dentofacial, Orthopedics, K.V.G. Dental College, Sullia. Karnataka, India.

- **Dr. Rohan Mascarenhas** BDS, MDS. Professor, Department of Orthodontics and Dentofacial Orthopaedics, Yenepoya Dental College, Mangalore. Karnataka, India.

- **Dr. Akhtar Husain** BDS, MDS. Professor and Head, Department of Orthodontics and Dentofacial Orthopaedics, Yenepoya Dental College, Mangalore. Karnataka, India.

**Corresponding Author:** Dr. Anil Kumar k. Madhava compound, kambla cross road, barke, mangalore-575003, Karnataka, India. anilmhk@yahoo.co.in

Para efectos de referencia bibliográfica este trabajo debe ser citado de la siguiente manera: Kumar , A. Mascarenhas, R. Husain, A.

"MAGNETS IN ORTHODONTICS."


**ABSTRACT:**
Magnets have been used in dentistry for many years, most commonly to aid the retention of dentures and overdentures in dentistry. Rare earth magnets have, been used successfully for fixation of dentures and in force systems for tooth movement. However, magnets have not yet been routinely used. Unless one is thorough in magnetic physics one cannot easily use it in to practice. Magnets have also been used in orthodontics but have some limitations. With technological advances some problems may be overcome so as to make the use of magnets in orthodontics possible.

**RESUMEN:**
Los magnetos han sido usados en odontología por muchos años, su uso más común ha sido para ayudar en la retención de dentaduras y sobredentaduras. Los magnetos de tierra rara han sido usados exitosamente para la fijación de dentaduras como sistemas de fuerza para movimiento dental. Sin embargo no son de uso rutinario, A menos que uno sea acucioso en física magnética uno no los puede utilizar fácilmente en la práctica. Los magnetos son también utilizados en ortodoncia, pero con ciertas limitaciones. Con los avances tecnológicos se han solventado algunos problemas para hacer posible su uso en ortodoncia.
INTRODUCTION
A magnet (from Greek μαγνήτης λίθος, "Magnesian stone") is a material or object that produces a magnetic field. This magnetic field is invisible and causes the most notable property of a magnet: a force that pulls on nearby magnetic materials, or attracts or repels other magnets. Magnets attract specific metals, and they have north and south poles. Opposite poles attract each other while like poles repel.

- Ceramic magnets: The magnets used in refrigerators and elementary-school science experiments, contain iron oxide in a ceramic composite. Most ceramic magnets, sometimes known as ferric magnets, aren't particularly strong.
- Alnico magnets: are made from aluminium, nickel and cobalt. They're stronger than ceramic magnets, but not as strong as the ones that incorporate a class of elements known as rare-earth metals.
- Neodymium magnets: contain iron, boron and the rare-earth element neodymium.
- Samarium cobalt: magnets combine cobalt with the rare-earth element samarium. In the past few years, scientists have also discovered magnetic polymers, or plastic magnets. Some of these are flexible and mouldable. However, some work only at extremely low temperatures, and others pick up only very lightweight materials, like iron filings.

The advantages of magnetic force systems are

- Predictable force levels
- Better directional force
- No force decay over time
- Can exert their force through mucosa and bone
- Frictionless mechanism
- Less patient discomfort and more patient co-operation

MAGNETS AND THEIR PHYSICAL PROPERTIES
The field emerges from one pole of the magnet conventionally known as the north pole, and returns to the other or south pole of the magnet (Figure 1).

A magnetic field induces changes in the medium surrounding the magnet, such as air. This is called the flux density of the magnet and can be measured simply by a Hall probe. The flux produced by the magnets causes them to attract or repel other magnets, and attract other materials containing iron.
Force between any two magnets falls dramatically with distance. Magnets are capable of producing high forces relative to their size due to the property of magnetocrystalline anisotropy.

Samarium-cobalt (SmCo5) and neodymium-iron-boron magnets (Nd2Fe14B) magnets not only have the property of magnetocrystalline anisotropy, but they also have high coercivity (the ability of the magnet to resist demagnetization). This is produced by their intrinsic property and the manufacturing process.

**CLINICAL APPLICATIONS OF MAGNETS**
Over the last decade magnets have been used in orthodontic and dentofacial orthopaedics and attempts have been made to evaluate the biological implications of magnets and magnetic fields during clinical application.

**DISTALIZATION**
For distalization repelling magnets, are anchored to a modified Nance appliance cemented on the first premolars, and are activated to move the maxillary first molars distally.

**INTRUSION**
Although posterior tooth intrusion is a difficult procedure, it can be achieved without extruding the adjacent teeth by using magnets. In adult patients whose molars have over erupted due to the early loss of antagonists, tooth movement can rapidly be achieved with the use of magnets along with corticotomy and without discomfort or side effects.

**EXTRUSION**
Impaction and non-eruption of teeth is a common problem encountered in orthodontics and many techniques have been proposed for the management of this condition. It has been
advocated that a system utilizing magnets would supply a continuous, directionally sensitive, extrusive force, through closed mucosa and thus provide not only a physiological sound basis for successful treatment, but also reduce the need for patient compliance and appliance adjustment.

APPLIANCES AND CLASS II CORRECTION
The Functional Orthopaedic Magnetic Appliance (FOMA) II uses upper and lower attracting magnetic means (Nd2Fe14B) to advance the lower jaw and to correct Class II dento-skeletal malocclusions.

Magnetic Activator Device (MAD) a magnetically active, two-piece (upper and lower), functional orthopaedic appliance is used for the correction of Class II malocclusions. Magnetic forces are used to give freedom of mandibular movement and to allow for continuous functioning of the orofacial muscles when the appliance is worn. Samarium cobalt (Sm2Co17) magnets are incorporated on the buccal aspects of the upper and lower appliances. Magnetic forces ranging from 150 to 600 gm per side have been used on patients, and the skeletal or dental response depends on the intensity of the magnetic force used.

The functional magnetic system (FMS) is a removable functional appliance which induces mandibular advance by means of mandibular and maxillary magnets in an attracting configuration. The maxillary and mandibular plates are each equipped with 2 cylindrically shaped cobalt-samarium magnets, 4 mm in diameter and 3 mm in height, which are welded into stainless steel housings.

APPLIANCES AND CLASS III CORRECTION
Magnets can also be used for the treatment of Class III malocclusions that exhibit midface sagittal deficiency with or without mandibular excess. The functional orthopaedic magnetic appliance (FOMA) III consists of upper and lower acrylic plates with a permanent magnet incorporated into each plate. The upper magnet is linked to a retraction screw. The upper magnet is retracted periodically to bring about maxillary advancement and mandibular retardation.

RETRACTION
Canine retraction can be executed on one side with the application of a relatively constant force. This type of force was achieved by three parylene-coated neodymium-iron-boron (Nd2Fe14P) block magnets.

RETAINER
Neodymium-iron-boron micro-magnets can used as a fixed retainers which do not hinder oral hygiene.

MAGNETIC SENSOR
A system was developed for measuring tooth displacement by orthodontic force. Eight small
magnetic sensors and a magnet are combined to measure three-dimensional displacement. Sensors, arranged cubically in the three planes of space, are placed in the mouth and fixed to the posterior teeth by a splint. A magnet is placed in the center of the 8 sensors and attached to a front tooth that is subjected to orthodontic force. Sensors detect the magnet’s movement as target tooth displacement.

**BIOLOGICAL SAFETY OF MAGNETS**

It is important to ensure, as far as it is reasonably possible, that any new material destined for clinical use should not produce any side-effects at a local or systemic level. A full evaluation must include three levels of testing: in vitro testing, animal testing/experiment and clinical trials.

**CONCLUSION**

Magnets can be used to give predictable forces in either attraction or repulsion; they can be made small enough to suit most dental and orthodontic applications and can produce high forces.

Their use in orthodontics, however, is limited due to a number of factors. The force between two magnets drops dramatically with distance and even at small distances apart the forces can be very low. When heated they can suffer considerable loss of flux and, therefore, force. The orientation of one magnet to another is of the utmost importance and when not in perfect alignment the force between them drops significantly.

**REFERENCES**


