



Review Article: Applications of Magnets in Orthodontics

Amit Gupta¹, Sheetal Yamyar², Shantanu Sharma³, Pooja Kanwar^{4*}, Snehal Narute⁵, Riya Khatri⁶,
Shaivi Pathak⁷

¹HOD and Professor, Department of Orthodontics and Dentofacial Orthopedics, Nims Dental College and Hospital, Jaipur, Rajasthan, India.

²Reader, Department of Orthodontics and Dentofacial Orthopedics, CSMSS Dental College, Aurangabad, Uttar Pradesh, India.

³Reader, Department of Orthodontics and Dentofacial Orthopedics, Nims Dental College and Hospital, Jaipur, Rajasthan, India.

⁴Third Year Post Graduate Resident, Department of Orthodontics and Dentofacial Orthopedics, Nims Dental College and Hospital, Jaipur, Rajasthan, India.

⁵First Year Post Graduate Resident, Department of Orthodontics and Dentofacial Orthopedics, Nims Dental College and Hospital, Jaipur, Rajasthan, India.

^{6,7}Intern, Nims Dental College and Hospital, Jaipur, Rajasthan, India.

[Review Article](#)

***Corresponding Author:** Pooja Kanwar, Department of Orthodontics and Dentofacial Orthopedics, Nims Dental College and Hospital, Jaipur, Rajasthan, India

E-mail: kanwarpooja501@gmail.com

Crossref doi: <https://doi.org/10.36437/ijdrd.2024.6.3.A>

ABSTRACT

Magnets have been used in dentistry for many years. The force they deliver can be directed, and they can exert their force through mucosa and bone, as well as within the mouth. In orthodontics, they are used for intrusion of teeth, tooth movement along archwires, expansion, retention, functional appliances, and in treatment of impacted teeth. There are various types of magnets used in the field of orthodontics with their advantages and disadvantages, along with their biological safety which has been discussed in this article. This article reviews various uses of magnets in the field of orthodontics.

Keywords: Archwire, Expansion, Functional Appliances, Impacted Teeth, Magnets, Molar Distalization, Retention.

Introduction

We live in an environment of magnetic fields, both natural and artificial. Evolution and normal biological processes may well be magnetic field-dependent. We are always exposed to magnetic fields of significant intensity at home, in our automobiles, in wristwatches, and when walking under high-power electric lines.¹ Magnets have been used in dentistry for many years, most

commonly to aid the retention of dentures and overdentures.^{2,3,4} In orthodontics, they have been used in both research and clinical practice, particularly in the treatment of unerupted teeth^{5,6} for tooth movement along archwires⁷, expansion, fixed retention⁸, in the correction of anterior open bite, and in functional appliances. Magnets are said to have significant advantages over other materials used to move teeth such as elastic chains or push-

coils as they are able to produce a measured force continuously over long periods of time for various kinds of tooth movement. They can be made to attract or repel and the force they deliver can be directed, and they can exert their force through mucosa and bone, as there does not need to be direct contact between them.

Biological Safety

It is important to ensure, that magnets used intra-orally for clinical use should not produce any side effects at a local or systemic level. A full evaluation must include three levels of testing.

Level 1: In vitro testing in order to establish the toxic, allergic, or carcinogenic nature of the material.

Level 2: In-use testing on animals.

Level 3: Clinical trials.

Magnets used in orthodontics produce static magnetic fields. Biological testing of magnets containing rare earth elements has evaluated the effects of both the static magnetic field and the possible toxic effects of the materials or their corrosion products. Lars Bondemark and Jure Kurol compared in vitro the cytotoxic effects of uncoated and paralene-coated rare earth magnets by using 2 methods.⁹

1. Millipore filter method

2. Extraction method

Types of Magnetic Materials

In various dental applications the following materials have been used:

- Platinum - Cobalt (Pt-Co).
- Aluminium-Nickel-Cobalt (Al-Ni-Co)
- Ferrite
- Chromium -Cobalt -Iron (Cr-Co-Fe)
- Samarium-Cobalt (Sm-Co)
- Neodymium -Iron-Boron (Nd Fe B)

Attracting Magnets

1. Increased activation may be built into the initial construction bite for appliances using attracting magnets.

2. The attracting magnetic force pulls the appliances together and encourages the patients to act actively and consistently in a forward position.

3. Clark has used 2 materials SmCo5, and Neodymium boron to test the clinical response to magnetic twin blocks.

- Neodymium Boron applies a higher magnetic force from smaller magnets but is more likely to corrode if not adequately protected from abrasion.

4. Attracting magnets were used clinically in different situations.

- Class II div 1 malocclusion with a large over jet.
- Mild residual class II buccal segment relationship.
- Mild class II Div 1 malocclusion with an over jet of 7mm.
- Unilateral Class II adult patient with temporomandibular joint pain.
- Skeletal class III malocclusion with persistent cross bite.
- Correction of facial asymmetry.

Repelling Magnets

1. Repelling magnets may be used in twin blocks with a lesser mechanical activation built into the inclined planes.
2. The repelling magnets were intended to induce additional forward mandibular posture without the need for reactivation of blocks.
3. Whether attracting or repelling magnets are used, reactivation of the block by the addition of acrylic to the inclined planes deactivates the magnets.
4. So screws are included in the appliance design for magnetic twin blocks to achieve continuous reactivation of magnetic force.
5. Attracting magnets are indicated in cases in which the patient does not or cannot make the muscular effort to posture consistently to the corrected occlusion.
6. Magnets should be used only where speed of treatment is an important consideration, or where the response to nonmagnetic appliances is limited.

Simple tooth movement without archwires

Muller¹⁰ because of the predictable, constant low forces they deliver suggested that small magnets (approximately 5 3 1 mm) could be used to deliver light continuous forces to close diastemas without archwires. The magnets were bonded to the labial aspect of the teeth using the indirect. The force delivered was determined by the distance apart the teeth and, therefore, the size of the magnet bonded. Muller suggests that rotations and angulation problems can also be corrected with this technique. The magnets produce a light continuous force that increases as the teeth get nearer is the reason the teeth move quickly.

Expansion

Intra-maxillary expansion and orthopaedic movement of the palatal shelves have been used in orthodontics for many years. Vardimon et al reported on a study that looked into the effects of using samarium-cobalt magnets to provide the expansion force on monkeys.¹¹

This demonstrated that magnetic expansion does produce controlled forces over a predicted range and time. The expansion is slow compared with rapid maxillary expansion and consequently, there are fewer tendencies for the mid-palatal suture to fracture. In addition, as the forces can be made to be more physiological it avoids the complications of the rotations of the maxilla seen in the high force appliances such as RME.

Molar Distalization

One of the effective methods to resolve a Class II malocclusion is the distal movement of upper molars to establish a Class I relationship. The premolars and canines are subsequently moved back to class I positions and finally, the incisors retracted. Repelling magnets can provide the continuous force needed to establish a class I molar relationship in the early mixed dentition, Gianelly et al used intra-arch repelling magnets to distalize the maxillary molars.¹²

Retainers

Despite the success of fixed retainers to stabilize anterior spacing which are often used in orthodontics, they have a number of undesirable characteristics. They restrict access to the gingival tissues, leading to poor oral hygiene, and they often fracture because the individual teeth move independently and excessive strain on the retainer.

Micromagnetic retainers have been suggested to retain central incisors that have been brought together to close a median diastema. After tooth movement small Neodymium iron-boron magnets are bonded with a light-cured low-viscosity resin on the mesiopalatal aspect of the teeth separated during bonding by an acetate finishing strip to ensure the two magnets are not fused together. Directly bonded magnets have a number of advantages over other types of retainer.

Functional Appliances

Magnets have been used for the correction of Class II and Class III malocclusions. Vardimon and co-workers developed the functional orthopaedic device (FOMA II and III), which has shown positive treatment effects in monkeys.¹³ In the case of FOMA II, upper and lower attracting neodymium-iron-boron magnets maintain the mandible in an advanced sagittal position. The objectives of the study were to develop an appliance capable of leaving the mandible in the advanced position and to establish a skeletal response. The first clinical experience with a magnetic activator device (MAD) for the correction of a Class II division 1 malocclusion and another device for Class III cases has recently been described.¹⁴

Several types have been designed to deal with differing clinical problems, e.g. lateral displacement (MAD I), Class II malocclusions (MAD II), Class III's (MAD III), and open bite cases (MAD IV). Chate¹⁵ describes the propellant unilateral magnetic appliance (PUMA) in the treatment of hemifacial microsomia. This appliance uses samarium-cobalt magnets. Moss¹⁶ has described the use of the twin block appliance.

Conclusion

The introduction of rare earth magnets into orthodontics for various therapeutic uses is very recent. Within 10 years magnetic forces have gained good acceptance in the correction of skeletal and dental defects. The main advantage of magnets is operator controlled. It eliminates patient cooperation. Conceivable risks of harmful biological effects are negligible with magnets. It is easy to maintain oral hygiene. Compared with other conventional orthodontic methods of force delivery systems magnets are cost-effective. Their high cost can be overcome by reusing it after sterilization and recycling. These magnets after recycling have not shown much change in their force system. Magnets suffer from tarnish and corrosion. Tarnish and Corrosion products are cytotoxic. Tarnish and Corrosive nature is prevented by casing them in stainless steel jackets (or) giving a Paralene coat. Magnets exert continuous forces with less friction, compared to other conventional orthodontic appliances. Teeth movement is bodily in nature and treatment time is shorter. They can be associated with fixed, removable, and functional appliances. The use of extra oral forces is minimized and anchorage control with them is very precise. Magnets can be used to give predictable forces in either attraction or repelling mode. The orthodontic stimuli provided by the magnetic appliance have reduced the systemic stress reaction seen with conventional orthodontic mechanotherapy. The incidence of periodontal disturbances, root resorption, and caries are considerably low, and foremost no discomfort.

References

1. Abraham M. Blechman. Magnetic forces in orthodontics. Am J. Orthod. 1978; 74:435. doi: [https://doi.org/10.1016/0002-9416\(85\)90041-7](https://doi.org/10.1016/0002-9416(85)90041-7)
2. Javid, N. The use of magnets in a maxillofacial prosthesis. Journal of Prosthetic Dentistry: 1971;25: 334-341. doi: [https://doi.org/10.1016/0022-3913\(71\)90196-X](https://doi.org/10.1016/0022-3913(71)90196-X)
3. Federick, D. R. A magnetically retained interim maxillary obturator. Journal of Prosthetic Dentistry: 1976: 36, 671-675. doi: [https://doi.org/10.1016/0022-3913\(76\)90033-0](https://doi.org/10.1016/0022-3913(76)90033-0)
4. Gillings, B. R. (1981) Magnetic retention for complete and partial overdentures, Part I, Journal Prosthetic Dentistry: 1981;45:484-491. doi: [https://doi.org/10.1016/0022-3913\(81\)90032-9](https://doi.org/10.1016/0022-3913(81)90032-9)
5. Sandler, P. J. An attractive solution to unerupted teeth, American Journal of Orthodontics and Dentofacial Orthopedics: 1991;100:489-493. doi: [https://doi.org/10.1016/0889-5406\(91\)70089-F](https://doi.org/10.1016/0889-5406(91)70089-F)
6. Darendeliler, M. A. and Freidle, J. M. Treatment of an impacted canine with magnet. Journal of Clinical Orthodontics: 1994: 28:639-642. <https://www.jco-online.com/archive/1994/11/639-case-report-treatment-of-an-impacted-canine-with-magnets/>
7. Abraham M. Blechman. Magnetic force systems in orthodontics: Clinical results of a pilot study. Am. J. Orthod. 1985; 201-210; doi: [https://doi.org/10.1016/0002-9416\(85\)90041-7](https://doi.org/10.1016/0002-9416(85)90041-7)
8. Springate S.D. Micromagnetic retainers- An attractive solution to fixed retention. British. Orthod.1991; 18:139-141. doi: <https://doi.org/10.1179/bjo.18.2.139>
9. Lars Bondemark. Biocompatibility of new, clinically used, and recycled orthodontic samarium cobalt magnets. Am. J. Orthod.1994; 105:568-574. doi: [https://doi.org/10.1016/s0889-5406\(94\)70141-5](https://doi.org/10.1016/s0889-5406(94)70141-5)
10. Muller M. The use of magnets in orthodontics: an alternative means to produce tooth movement, European Journal of Orthodontics: 1984;6: 247-253. doi: <https://doi.org/10.1093/ejo/6.4.247>
11. Alexander D. Vardimon. Magnetic versus mechanical expansion with different force

- thresholds and points of force application. Am. J. Orthod. 1987; 92:455-466. doi: [https://doi.org/10.1016/0889-5406\(87\)90227-7](https://doi.org/10.1016/0889-5406(87)90227-7)
12. Anthony A. Gianelly. Distalization of molars with repelling magnets. J. Clin. Orthod. 1988; 40-44. <https://pubmed.ncbi.nlm.nih.gov/3163344/>
 13. Vardimon. Functional Orthopaedic Magnetic Appliance (FOMA) III. Am. J. Orthod. 1990; 135-148. doi: [https://doi.org/10.1016/0889-5406\(90\)70087-s](https://doi.org/10.1016/0889-5406(90)70087-s)
 14. Ali Darendeliler. Magnetic activator device II (MAD II) for correction of Class II, division 1 malocclusions. Am. J. Orthod. 1993; 223-239. doi: [https://doi.org/10.1016/0889-5406\(93\)70003-7](https://doi.org/10.1016/0889-5406(93)70003-7)
 15. Chate R.A.C. The propellant unilateral magnetic appliance (PUMA): a new technique for hemifacial microsomia. European journal of orthodontics.1995; 17: 263-271. doi: <https://doi.org/10.1093/ejo/17.4.263>
 16. Moss, J. P., Linney, A. D., Goodwin, P. and Shaw, I. A. Three-dimensional study of treatment with magnet and non-magnet twin blocks, European Journal of Orthodontics: 1993;15:342.

How to cite this Article: Gupta. A, Yamyar. S, Sharma. S, Kanwar. P, Narute. S, Khatri. R, Pathak. S;

Review Article: Applications of Magnets in Orthodontics; Int. J. Drug Res. Dental Sci., 2024; 6(3): 1-5, doi:

<https://doi.org/10.36437/ijdrd.2024.6.3.A>

Source of Support: Nil, **Conflict of Interest:** Nil.

Received: 4-9-2024 **Revised:** 16-10-2024 **Accepted:** 25-10-2024