Magnets and their Role in Prosthodontics: A Comprehensive Review

S.Lakshmi Narayana[1], M.Bharathi[2], K.Sujitha[3], M.Anjaneyulu[4], D.Nagaveni[5], S.N.H.Afsar Shareef[6]

1,3,4,5,6-P.G Student, Dept of Prosthodontics including Crown and Bridge, G.Pulla Reddy Dental College, Andhra Pradesh, India. 2-Professor and Head, Dept of Prosthodontics including Crown and Bridge, G.Pulla Reddy Dental College, Andhra Pradesh, India.

Correspondence to:
Dr. P.G Student, Dept of Prosthodontics including Crown and Bridge, G.Pulla Reddy Dental College, Andhra Pradesh, India.
Contact Us: www.ijohmr.com

ABSTRACT

Magnets have generated great interest in dentistry especially in Prosthodontics, and their applications are numerous. In order to overcome the problems associated with mechanical attachments efforts to employ magnetic attachments were made. Small size and strong attractive forces attribute for their popularity and allow their use within prostheses without being obtrusive in the mouth and advantages include ease of oral hygiene, ease of placement for both dentist and patient. Magnets have a poor corrosive resistance within oral fluids and therefore require encapsulation within a relatively inert alloy such as stainless steel or titanium. This review article describes the development and their applications in prosthetic dentistry.

KEYWORDS: Magnets; Rare earth; Biomedical material, Dentistry; Overdenture, Dental implant, Maxillofacial prosthesis

INTRODUCTION

Man's need for artificial replacement of missing body parts undoubtedly dates back as far as humanity itself. All prostheses should resist array of forces which may be directed toward, away from, or at an angle to the supporting structure. Magnetic attachments serve to dissipate vertical and lateral forces preventing them from being transferred to the implants or surrounding bone. In 1940 Freedman first used magnets in dentistry to improve the retention of mandibular dentures in patients with severely resorbed edentulous mandibles.

REVIEW OF LITERATURE

The first recorded use of magnets in prosthetic dentistry dates back to 1953. Freedman in 1953 used magnets in repulsion to maintain and improve the seating of complete dentures. As the patient closed their jaw mutual repulsion of the magnets seated the dentures against the alveolar ridges.[1]

Nadeau in 1956 first described the use of combination extra oral- intraoral prostheses connected by magnets.[2]

Behrman SJ in 1960 presented a technique for the implantation of magnets in the jaw to enhance retention of the prosthesis.

Robinson in 1963 stated that magnets could be used to retain surgical prosthesis for patients who have a radical surgical treatment, such as complete maxillectomy. He described a method of constructing a two section intraoral prosthesis with the use of attracting magnets as positive locking devices and stated that once positioned;they provided definite continuous retention. [3]

In 1967 a new magnetic alloy was developed by Becker and Hoffer that combined the transition element, cobalt, with samarium, a rare Earth element, to form Co_5Sm, which had magnetic properties superior to the commonly used magnets. Co_5Sm has 20 to 50 times greater magnetic-field strength than its predecessors, the cobalt-platinum (CoPt) and Alnico alloys.[4]

Robert J Connor in 1977 stated that it is possible to effectively seal a Sm – Co magnet from vivo environment by use of protoplast coating composed of polytetrafluoroethylene and pyrolytic graphite. [5]

H.Sasakietal in1984 stated the use of Sm–Co magnets to retain sectional prosthesis.[6]

James C. Lemon, DDS Rene A. Brignoni, DMD in April 2004 studied the effect of microwave irradiation on the retentive force of magnets. They showed that the retentive force of samarium cobalt magnets exposed to microwave irradiation might be reduced up to 12% under certain conditions. This potential reduction in force may be compensated for by altering the design of the prosthesis with the addition of more magnets to the prosthesis .[4]

MAGNETIC MATERIALS

The main magnetic material used is the rare earth material neodymium iron boron (Nd-Fe-B), which is the most powerful commercially available magnet material. Other materials used include the RE alloy samarium cobalt. Prior to the evolution of rare earth magnets, Alnicos—alloys based on aluminum, cobalt, and nickel were the principal materials in use, although cobalt platinum (Co-Pt) magnets also prevailed.

Samarium iron nitride is a promising new candidate for

How to cite this article:
Laxmi NS, Bharathi M, Sujitha K, Anjaneyulu M, Nagaveni D, Shareef SNHA. Magnets and their Role in Prosthodontics: A Comprehensive Review. Int J Oral Health Med Res 2016;3(1):155-157.

permanent magnet applications because of its high resistance to demagnetization, high magnetization, and better resistance than Nd-Fe-B-type magnets to temperature and corrosion. This material is still under development, but it is expected to become available for dental purposes in time ahead.

Types Of Magnetisml: Magnetic materials can be classified into either "soft" magnets (easy to magnetize or demagnetize) or "hard"magnets (able to retain magnetic properties and can be converted into permanent magnets).

Magnetic Systems:

Open-field systems: The first device was of an *'open field'* type. This was used in the rehabilitation of a patient with a cleft lip and palate. Here two magnets were used, one in the jaw and the other in the denture. In this configuration the magnets were unshielded and hence magnetic fields were experienced in the oral cavity.

Closed –field systems: In order to reduce magnetic field effects in the oral cavity, a soft ferromagnetic material can be implanted into the jaw (eg: ferritic or martensitic stainless steel or a Pd-Co-Ni alloy), which serve as the 'keeper' rather than a magnet. This then connects the two poles of the magnet in the denture. In this configuration, the magnetic field lines are shunted through the keeper as it is the path of minimum energy and hence, there is no magnetic field experienced in the oral cavity. Numerous commercially available magnetic systems are of this type.

Magnets And Their Biocompatibility: The magnetic potential produced by intraoral magnets in the surrounding blood vessels is very negligible (2.0-5V) compared to resting membrane potential of cell membranes (60-100V). Though rare earth metals are biocompatible and acid resistant, it is advisable to seal them hermetically for dental use.

APPLICATIONS

Magnets retained tooth supported overdenture: The magnetic retention unit contains a denture retention element and a demountable "keeper" element. The denture-retention element has paired, cylindrical, cobalt-samarium magnets, axially magnetized and arranged with their opposite poles adjacent.[6]

Magnets retained implant supported over denture: Numerous problems reported by conventional complete denture wearers can be abolished when implants are used to support fixed prosthesis or removable overdentures.

Magnets in maxillofacial prosthesis: Fe-Pt dental magnetic attachments are clinically useful for retention of prostheses due to excellent attractive force. Since the Fe-Pt magnetic attachment system (magnet and keeper) can be cast in a dental casting machine, any size or shape of castable magnetic attachment can be fabricated for prostheses.

Magnets have been used in both mandibular and maxillary implant-supported, full-arch bar, fixed-detachable prosthesis in the fabrication of sectional intraoral maxillofacial prostheses. A sectional RPD connected by a magnetic system can be designed with consideration given to the outline form of the defect and the possibility of improved oral function.

Retentive forces generated by magnetic attachments are somewhat limited against lateral masticatory forces. Therefore, techniques to further stabilize the sectional denture without compromising insertion/removal should be considered. Applicable techniques are (1) the use of additional retentive form at the edge of the obturator, (2) extension of a bar or a connector from the obturator toward the missing left side area, and (3) cross bite arrangement of the right artificial teeth.

The metal surface can be conditioned with alumina air-abrasion and a phosphate primer, followed by the magnetic retainers bonded to the obturator with an adhesive resin. Application of mechano-chemical retention should be considered to retain magnets in the denture base for a longer period. A retentive groove is currently formed around the newest version of the magnetic retainer.

DISCUSSION

Effects of magnetic field on tissues have been extensively investigated with conflicting results. In Open field configuration, the magnets are unshielded and hence magnetic fields are experienced in the oral cavity. Due to concerns about the possible effects of magnetic fields on the local tissues most systems used today are of the closed field type. The major problem associated with these magnets as retentive devices is corrosion by oral fluids which limits their use. Both Sm-Co and Nd-Fe-B are extremely brittle and susceptible to corrosion, especially in chloride-containing environments such as saliva. Improvements in sealing techniques have ensued in greater effective sealing of magnet encapsulations. However, further work is needed to find more and better corrosion and wear-resistant encapsulation materials.

CONCLUSION

Magnetic retention is at the most an aid but not of itself an effective method to properly retain any prosthesis. The desire to utilize magnetic retention is linked to the simplicity of the clinical and laboratory procedures. However, long-term durability of the magnets remains a problem. Further research is required in accessing their biological compatibility, corrosion resistance. Such research will optimistically provide a permanent magnet, which will be unaffected by the adverse environment of the oral cavity and allow the full potential of the appliance.

REFERENCES

1. Bijan Khaknegar Moghadam, Forrest R. Scandrett: Magnetic retention for overdentures. J Prosthet Dent 1979 41: 26-29.
2. Nadeau J.Maxillofacial prosthesis with magnetic stabilizers

J Prosthet Dent 1956 ; 6 :114-19

3. Robinson JE. Magnets for the retention of a sectional intraoral prosthesis 13, 1167-1171, 1963.
4. James C. Lemon, Rene A. Brignoni, Stephen M. Collard et al ; In vitro effect of microwave irradiation on the retentive force of magnets. J Prosthet Dent 2004; 91.
5. Robert J, Connor, Carl W Svare Protoplast coated high strength magnets as potential denture stabilization devices: J Prosthet Dent 1977; 37; 339- 42.
6. H.Sasaki, Y. Kinouchi, D.eng, H.Tsutsui: Sectional prostheses connected by samarium – cobalt magnets : . J Prosthet Dent; 1984; 52:556-58.
7. James C. Lemon, Rene A. Brignoni, Stephen M. Collard et al ; In vitro effect of microwave irradiation on the retentive force of magnets. J Prosthet Dent 2004; 91.
8. Robert J, Connor, Carl W Svare Protoplast coated high strength magnets as potential denture stabilization devices: J Prosthet Dent 1977; 37; 339- 42.
9. H.Sasaki, Y.Kinouchi, D.eng, H.Tsutsui: Sectional prostheses connected by samarium – cobalt magnets : . J Prosthet Dent; 1984; 52:556-58.
10. E Angelini , M Pezzoli ; Corrosion under static and dynamic conditions of alloy used for magnetic retention in dentistry ; J Prosthet Dent 1991;65;848 -53.
11. Hideo, Matsumara, Koji Kawasaki; Magnetically connected removable sectional denture for a maxillary defect with severe undercut: A clinical report
12. Prosthetic dentistry; Medical applications for magnets ; University of Bermingham ; Med Mag Network
13. John F Schmitz; Measurement of the efficiency of the platinum – cobalt magnetic implant; J Prosthet Dent 1966;1151-58
14. Herman B. Dumbrigue Ann Fyler Minimizing prosthesis movement in a midfacial defect: a clinical report. . J Prosthet Dent ; 1997 ;78 : 4
15. Robin W. C. Chung, Adam S. C. Siu, Frederick C. S. Chu; Magnet-retained auricular prosthesis with an implant-supported composite bar: J Prosthet Dent 2003; 89; 5
16. Stanley J Behram ; Magnets implanted in the mandible ; aid to denture retention ; J Prosthet Dent 1964 ;68;207-15.

Source of Support: Nil
Conflict of Interest: Nil