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Review Article

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CLINICAL EVALUATION OF OVERDENTURE USING MAGNET RETENTION LITERATURE REVIEW

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ABSTRACT

Overdenture is an alternative solution for removable prosthodontics treatment due to the fact that periodontics and endodontics can provide a promising outcome. Moreover, most patients tend to be more motivated in keeping the teeth and/or the remnants, such as the roots, that are still left over inside the mouth. Keeping the natural tooth roots for overdenture construction purpose is basically to keep the proprioceptor existence; to improve the support, retention and stability of the prosthesis. An effort to improve the overdenture retention can be done by applying magnet onto the denture base, and placing a soft magnetic keeper on the tooth root surface. Samarium-cobalt and neodymium-iron-boron magnets are used because of their small compact sizes. They are enclosed in a metal casing. If this is breached then the materials rapidly corrode in contact with saliva. A safety testing shows that the static magnetic field does not appear to produce any biological effects although the alloy themselves may be cytotoxic. The desire to use magnetic retention is related to the simplicity of the clinical and laboratory procedure. However, the long term durability of the magnet remains a problem. Further researches are required in the following areas: the biological compatibility, the corrosion resistance, and the wear of steel casing. Such research will hopefully provide a permanent magnet, which will be resistant to the adverse environment of the oral cavity and allow the potential of overdentures, retained with magnets, to be realized.

KEYWORDS: overdenture; magnets; retention.

INTRODUCTION

Overdenture (OD) is a partially or completely removable denture that covers and leans on one or more of the natural teeth, tooth roots, and/or dental implants. Today, OD is often used for periodontics and endodontics treatment, and has become a reliable caries control technique. By maintaining the elements of the natural teeth and/or roots, this can provide benefits in terms of increasing the stability and the retention of the denture, as well as maintaining the sensory stimuli and the vertical dimensions.[1,2]

Retaining some of the natural teeth is a psychological value for patients. OD is the last defense to prevent a patient from losing teeth, so that the masticating function will still work properly and alveolar bone resorption can be prevented.[2]

Patients taking OD are susceptible to caries, particularly for teeth located under the denture base. Many also have less retention and stabilization. To keep the rest of the natural teeth/root under the OD base healthy, putting copings (soft magnetic root keepers) on the root surface, and then installing magnet on the OD base has become an alternative solution.[2,3] (Figure 1)

Magnet is a metal that can attract other metals. In dentistry, rare earth magnets that are often used are the samarium-cobalt and neodymium-iron-boron. Both magnets are chosen because they can be formed into a small size, as well as produce a huge attractive force.[4,5,6]

The purpose of this article is to evaluate the use of magnets inside the oral cavity as a retention device for OD.

Clinical Examinations for OD Treatment

OD is a treatment with preventive and conservative approaches. The success of this treatment depends on the condition of the remaining teeth or the tooth roots in the mouth, especially the remaining tooth roots under the prosthesis. Keeping the existence of some remaining teeth inside the mouth not only will retain the integrity of periodontal tissues, but also becomes a relief effort for patients. It can be a serious mental trauma for patients to see the rest of their teeth removed.[7]

With the fact that the periodontal tissues and the receptor therein are maintained, the different perceptions about the magnitude and the direction of a force can be better distinguished. Also, the difference in dimensions and consistency of the food will be felt more clearly. Proprioceptor retained will support the ability to masticate and will give positive support to the prosthesis adaptation.[1,3,7]

Alveolar bone is highly dependent on the existence of teeth. A treatment with OD utilizing the retained teeth (RT), or the natural teeth that are retained, can protect the ridge from pressures and help maintaining the dimension of alveolar bone (ridge preservation).[1,2] (Figure 2)

Since the prosthesis is supported by RT, the retention and stabilization will be better. It is all because the ridge height is still maintained and the loading on the mucosa is reduced by the presence of a vertical load on the buffer elements, so that the mucosal irritation will become smaller. The retention and stabilization can even be increased by placing an attachment or magnet.[2,3]

In general, since endodontic treatment is required the treatment must be done carefully to avoid problems in the future. Endodontic treatment for the selected supporting teeth will allow grinding on the crown length and increase the ratio of the crown, the roots, and widen the inter-occlusal distance, so it will facilitate the preparation of the denture elements. Sharpening on the clinical crowns to the gingival margin limit can reduce the tooth mobility by 40%. [2,8]

A healthy supporting tooth for OD should have a minimal mobility, a treatable gingival sulcus depth, a well-attached gingiva. Periodontal factor is the major consideration and only the most potential teeth can be used for supporting OD. The alveolar bone that supports the tooth roots should also be noted. Sufficient bone support is needed to strengthen the teeth against vertical and lateral pressures. The supporting teeth should be conditioned as proper as possible to reach an ideal ratio for the crowns and roots.[2,9]

Patients who are susceptible to caries need a special treatment for their supporting teeth. The treatment can be done by giving a regular fluoride protection, protecting the rest of the tooth roots with glass ionomer restorations, and composite or coping placement. [2,9,10]

The percentage of supporting teeth for OD, which are left without care or without protection on their clinical surfaces having caries, reaches 6-30% per year. It is caused by the cleansing activities of the tongue; the cheeks and the salivary actions. The most effective way to prevent the occurrence of the above is to provide metal extension protection (coping). If there is a retention problem retention, magnet can be given on the OD base.[11]

Magnet for OD

Magnet can be defined as a metal that can attract other metals. All types of material that can be attracted by a magnet are called magnetics. Very strong magnetic materials are called ferromagnetic, included in this type are iron, steel, aluminum, nickel, cobalt and alloys of these materials. Meanwhile, the very weak ones are called paramagnetic or non-magnetic. The loss of magnetic force (demagnetization) can occur due to the age of the magnet, the effect of heat, the direct impact, or the influence of other stronger magnetic fields. Magnetic field is an area around a magnet, where the magnetic force lines work. The concentration/density of the magnetic force lines are located at both ends of the poles, then spread out from the north pole and concentrate back to the south pole. The density of the force lines is determined by the distance between the poles and the magnetic intensity. The spread of the force lines around the magnet reflects the radius magnetic field.[12,13]

Considering the vast surface area of the supporting teeth's roots (root face) and the thickness of the denture base for the magnetic housing, a magnet must be able to be formed in a small size without losing its magnetic strength when it will be used in a construction of OD (Figure 3). Additionally, the magnet must have a resistance to the possibility of demagnetization because magnet replacement is difficult to conduct and never expected.[6,12,13]

There are two types of alloys used to produce dentistry magnet in small size: samarium-cobalt and neodymium-iron-boron. Both magnets have a high attraction force, but a very low resistance to corrosion with the presence of streptococcus sanguis (figure 4). To overcome this problem, the magnets are placed in stainless steel, titanium or palladium capsules.[14,15,16,17]

Based on the spread of the magnetic field, magnet is classified into magnets with open magnetic field (open field magnet) and those with controllable magnetic field (close field magnet). An open field magnet generally consists of a single magnet (5 mm in diameter and 2 mm thick). It has 95 mT magnetic induction on the edge and 30 mT at a distance of 1 cm from the magnet. Meanwhile, controllable magnetic field is designed in a reverse split pole shape, in which a single magnet is split into two equal new magnets (hemi-sectioned), then reassembled with its two opposite poles far from each other, and between the two magnets an air gap is given. Finally, on both sides of the poles there is a keeper which is 0.74 mm thick. According to the research, the magnetic induction value is 10 mT, and 0.04 mT, at a distance of 1 cm from the magnet edge.[18,19]

Safety

The safe use of this magnet has been examined closely. The impact on biological tissues showed that static magnetic field does not appear to cause any changes on the dental pulps or the tissues around the magnet.[19] An in-vitro study on osteoblasts did not show any changes in the cell cultures when exposed to a static field associated

with the magnet. Furthermore, the field did not generate any impacts on blood circulation.[20]

In the in-vitro study, it is indicated that a samarium-cobalt magnet designed without a coated capsule, can cause cytotoxic. Meanwhile, a neodymium-iron-boron magnet showed a little cytotoxic effect on cells.[21] A fibroblast model system from a mouse and a human showed that both magnets were cytotoxic and those were related to the resulting rust, although the effects of the magnetic field may be unreduceable.[22] Human oral mucosa fibroblast is the most sensitive to the effects of earth's magnetic field.

An in-vivo study on five dogs that lasted for six months, three with magnetic implants and other two as the control, showed that there were no pathological abnormalities after a microscopic examination.[23] In another study on thirty rats, a cobalt samarium magnet was mounted on one of the tibias, while the others worked as the control. The result showed that after an evaluation the morphometric resorption area increased continuously. This is most likely an inhibition effect on osteoblast.[24]

A clinical evaluation toward 21 patients having taken OD for 5 years, showed that the majority (19) of the magnet needed replacing. That was caused by the corrosion which followed the loss of magnetic power.[25] Thrust between the same magnetic poles can be used for maintaining and improving the retention and stability of the dentures. A constant thrust will cause alveolar bone resorption and deterioration in the stability of the denture.

Novella [26] states that magnetic fields can cause the erythrocyte/red blood cell around the magnet to get attracted due to the hemoglobin in the erythrocyte-containing Fe (Figure 5)

Clinical benefits

The discovery of magnetic materials, such as samarium-cobalt and neodymium-iron-boron, that have more magnetic force than conventional magnets, such as aluminum-nickel-cobalt and platinum-cobalt alloy; the possibility to use them in a small size (1/5 the size of conventional magnets); and their resilience against the danger of demagnetization, it is possible to provide a stimulus for wider uses of these materials. In Prosthodontics, those magnets, especially cobalt-samarium, are widely used in overdenture constructions.

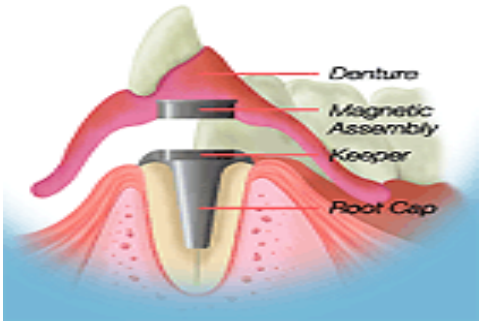
Overdenture retention can be obtained by utilizing attractive force between the magnets embedded in the denture bases, with a ferromagnetic metal material (keeper) placed on the surface of the tooth roots, in which a root canal treatment was previously given (Figure 6).

The magnet determines the quality of the denture retention. Reverse split pole magnet design (Figure 7) can give 2.07 gram of power to each 1 mm^3 samarium-cobalt magnet material. With the maximum volume of the magnet that reaches 70 mm^3, which is the maximum volume possibly used as a retention tool, as much as 150 grams of retention power can be obtained. Since the minimum power to remove the denture from basal seat ranging between 23 and 54 gr/cm^2, the magnetic attractive force is positively supporting the denture retention on the supporting tissues. If a greater additional retention is needed, then an attempt can be done by increasing the number of supporting teeth.[4,12,19]

A clinical magnet Installation is normally done directly (direct technique). The first step is to perforate the denture base that corresponds to the keeper. The magnet is then placed in the area on top of the keeper, and followed by a relining process performed with a self-cured acrylic.[27] (figure 8)

CONCLUSION

OD is a treatment with preventive and conservative approaches. OD has developed into a useful clinical procedure. Basic periodontal treatment and conservation are essential steps to preserve the natural remaining teeth. The use of magnets as a material for OD retention is possible to do. It is associated with the simplicity of handling procedures in clinical and laboratory. However, long-term durability of the magnet is still a problem. Further research in this regard is still needed, especially in terms of biological compatibility, resistance to corrosion, and the use of a metal casing. The study is expected to produce a magnet that has resistance to environmental conditions of the oral environment.



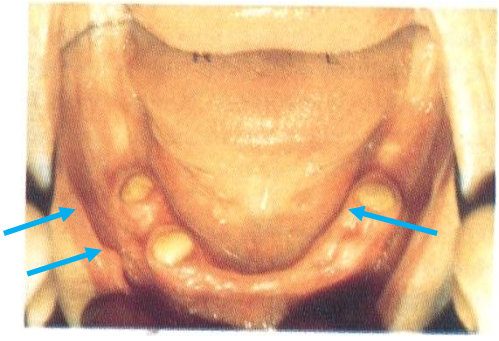


Figure 1: The Scheme of OD with Magnet Retention.

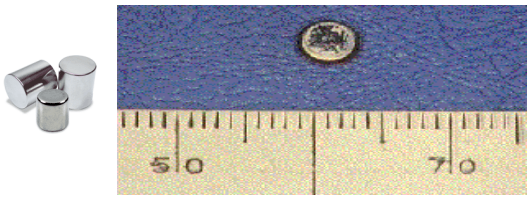


Figure 3: Dentistry magnet.

Figure 2: Some successfully retained tooth roots after endodontic treatment.

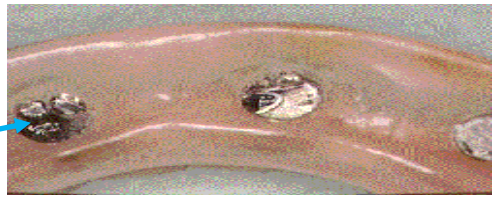


Figure 4: Magnet corrosion on a denture base.

Figure 5: Clumping of red blood cell.

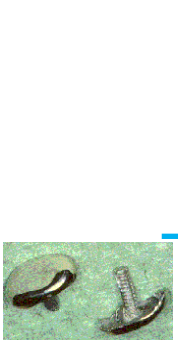


Figure 6a: Ferromagnetic keeper.

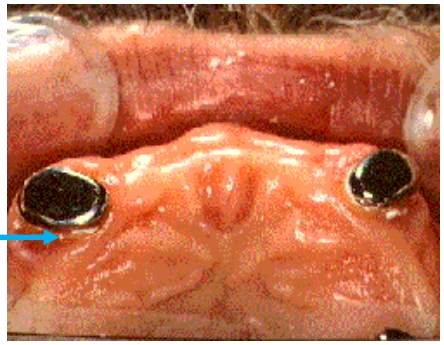


Figure 6: Keeper placement in the tooth roots.

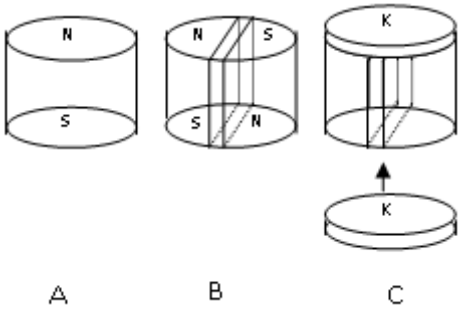


Figure 7: Setting of reverse split pole magnet.

A single magnet (A) is divided into two new magnets whose poles are then placed in a reverse position, then rearranged in a way that different poles are placed close to each other with an air gap in between (B). Two pieces of ferromagnetic keeper (K) are each attached to both sides of the magnet (C)

Figure 8a. Magnet and keeper position towards OD base.

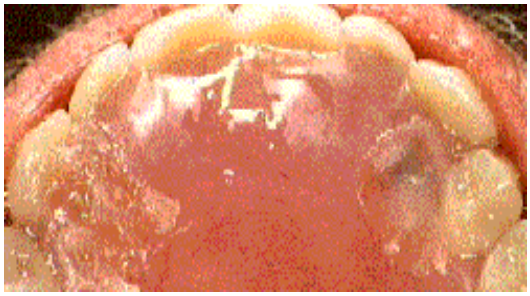


Figure 8b. Self-cured acrylic manipulation for placing and holding magnet on the OD base.

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