Applications of Magnetic Attachments in Dental Prosthesis Technology

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Ready-made dental magnetic attachments are increasingly used in overdentures and removable partial dentures due to the development of small Nd-Fe-B magnets. They were introduced in dentistry as retention systems and are used as alternatives to other retention, support and bracing special systems such as sphere attachments, slide attachments and telescopes. They came to meet emerging problems especially in retention of full dentures or partial dentures when we face a subtotal edentulous. [1, 2] Dental magnetic attachments are increasingly used in overdentures and removable partial dentures due to the development of a small Nd-Fe-B magnet with high intrinsic coercivity [3]. Ready-made magnetic attachments have become increasingly more common in clinical dental practice. These attachments are made from rare earth permanent magnet with a magnetic stainless steel yoke, and they are covered and sealed completely by non-magnetic stainless steels [4].

Appropriate support is provided through the transmission of forces in the long axis of the teeth and thus maintains periodontal health [5]. Regarding bracing, it is not favorable by magnet nature. That is why its association with other retention elements is indicated. Retenion is adequate and distinct, with a value of 4 N to 10 N. The retention function of dental magnets is based on force of attraction between the two components. This gives some unique properties of magnetic attachments, among which is control over disortodontic forces resulted on the abutment teeth. On the other hand, it should be noted that the force decreases rapidly with the distance between the components. For example at a distance of 0.1 mm, the strength decreases by half.

The first magnetic attachments were designed in 1991, and since then has been continuously improved. Sm-Co magnets were first introduced in practice. Entering Nd-Fe-B magnets in 1995 represented a milestone in dentistry. They are 20% stronger per unit volume than the former.

The magnets used in mouth are open magnetic field, This is a clinical consequence because a removable partial denture has some degree of mobility, which means that there is not always an intimate contact between the magnet and keeper. [6].

In Japan, a new generation of magnetic attachments developed (Magfit system), and also solving the problem of corrosion. They are produced for use on both natural teeth and implants application [7]. Parallel systems have been developed with cushion function (Magsoft). The retentive force of these magnets ranges from 3.9N to 7.8N and the average diameter size of the magnet ranges from 2.8 mm to 4.0 mm.

The MAGFIT DX 800/600/400 (Aichi Steel, Japan) system contains a thin disc-shaped magnet of Nd-Fe-B with high strength while used on back teeth where vertical space is limited. The keeper is made of steel covered with a layer rich in chromium to prevent it from oxidation during casting. Magnetic system outer lip shape ensures a secure fit under the denture. The MAGFIT DX 800/600/400 height is reduced, the magnet of 1.3 mm, 1.2 mm and 1 mm, and the keeper of 0.8, 0.7 and 0.5 mm. Keeper diameter of 4 mm, 3.6 mm and 3 mm. DX600 and 400 are intended for use on canines and DX 800 and 600 on the lateral teeth. The forces of attraction are the 800, 600 and 400 g respectively.

The MAGFIT EX 600W / 400W (Aichi Steel, Japan) has a sandwich structure, the attractive forces of 400-600 g, comparable with the clasps keeping forces. The diameter is smaller than DX system, magnet having ellipsoidal shape. The MAGFIT EX 600W is recommended where there is sufficient space (height of 3.8 mm at the front and 4.3 mm to the side).

MAGFIT EX 400W system is recommended if space is reduced (height of 3.3 mm at the front and 3.8 mm in the side) and in cases that does not require a strong retention. Sizes for EX400W and EX600W are 1.8 mm high and 1.5 mm, 3.8 mm x 2.8 surface mm and 3.4 mm x 2.4 mm. The forces of attraction are 600 g and 400 g.

MAGSOFT System (Aichi Steel, Japan) is a magnetic attachment with cushion, which protects teeth against harmful vertical tensions and rotational forces. Due to the resilience of the cushion dentures clogging and limited rotation is permitted. The system allows vertical mobility of 0.2 mm and a rotation of 6 degrees. The cushion allows

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REV.CHIM.(Bucharest) ♦ 67 ♦ No. 2 ♦ 2016 http://www.revistadechimie.ro 267
Experimental part

The aim of the study was to evaluate the use of magnets in dental prostheses technology, namely for overdenture. A magnetic attachment is a magnetic retention unit consisting of two parts which are attracted due to the magnetic field. Attachments used for composite prosthetic restorations have a fixed component and a mobilized component, and the fixed one is castable or overcastable. Due to the fact that the magnets do not lend themselves to casting, the use of two magnets is problematic. Thus it appeals to the second option, namely using the magnetic-iron alloys which are castable. Thus magnet that would be attached to the fixed component is replaced to a selected keeper who is a cape cast metal. Such alloys on the basis of Pd-Co have been developed, for molding magnetic attachment. In other systems the keeper is prefabricated and is overcastable. The magnetic system consists of a magnet and an alloy that can magnetize itself (fig. 1):

- magnet (Sm-Co, Nd-B-Fe type), active element,
- keeper (steel, Pd-Co alloy), passive element.

Technological stages of making overdentures maintained with magnetic devices on cast root disposal (RD) are:

- casting working model,
- achievement of root disposal wax pattern; they must have convergent to acclusal proximal walls and occlusal surface diameter should not have less then magnet diameter,
- magnetic attachments will be introduced in RD wax pattern,
- a gold-silver-palladium alloy is highly recommended for root cap casting; they have favorable strength, hardness, elasticity, corrosion resistance and accurate,
- overdenture manufacturing according to classical steps (fig. 2),
- embedding magnetic attachments in dentures basis, step that can be made also in dental laboratory or dental praxis.

Results and discussions

It is desirable for magnetic attachments to maintain original attractive force as long as possible. One chief cause for reduction in attractive force is the corrosion of magnetic alloys [8, 9]. However, this problem has been overcome considerably by embedding magnetic alloys in cup and disk yolkes made of corrosion resistant stainless steel. Another problem associated with reduction of attractive force is degradation and deformation of keepers [10].

Magnetic attachments have many advantages, including the following: the attractive force is difficult to decrease, the denture is easy to insert/remove, the crown-root ratio is improved, harmful lateral force is reduced, and wider application ranges are possible. It is an especially important phenomenon that the pressure burden can be decreased when the magnetic assembly is slid on the root and implant with the application of lateral force. In contrast, weakness of the mechanical strength of the denture base on the magnetic attachments and uncleanliness around the abutment teeth have been identified as disadvantages. Consequently, complications such as the following might easily occur: denture breakage, removal of the magnetic assembly, gingival retraction, and decreased attractive force. In addition, one of the problems that can be overlooked is difficulty in fixing the magnetic assembly to the denture base chairside. If not adequately fixed, the attractive force will decrease [11-17].

Conclusions

The possibility of using magnets in dental prosthetics became current with the introduction of magnets Sm-Co based and then the Nd-Fe-B, which can achieve optimal retention using appropriately sized for dentures. They are a viable alternative to spherical dental attachments and bars. They are characterized by simple technology, a number of features, but still have the disadvantage of increased cost price. Overdentures retention with magnetic attachments involve an easy manipulation. They do not require a path of insertion and cleaning is simple.

References


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