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Retention performance of magnetic attachments on dental implants

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Authors:

Dr. med. dent. Arne F. Boeckler, Carolin Ehring, Prof. dr. med. dent. habil. Jürgen M. Setz
 Poliklinik für Zahnärztliche Prothetik, Martin-Luther-Universität Halle-Wittenberg
 Halle / Saale, Germany

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Introduction

Implants in the edentulous jaw have become standard treatment. The use of an implant retained overdenture with magnets offers a simple treatment approach to the problem of instability of complete denture 1, 2. Advantages with magnets include a simplified clinical technique and reduced lateral stresses on the abutments 3. Contemporary three different physical and technical concepts can be found: dual systems with two unlike magnets and an open magnetic field (DO) and mono systems consisting of a magnet and a corresponding keeper from magnetizable alloy with an open (MO) or with a closed magnetic field (MC) 4. The force produced by any two magnets is inversely proportional to the square of the distance between them 5. Separation between magnet and keeper, however caused, will result in a drastic reduction in the retention. DO's are relatively voluminous and providing a lower initial retention force which is admittedly remaining when the magnets are separated for a small distance. So an adequate re-seating force for the prosthesis is given. MC's have a smaller design and produce the highest initial retention force. The characteristics of MO's are positioned between the other two types. The retention provided would be quite close to that claimed by the manufacturer as long as the magnet and the abutment remain in contact. This condition may not be possible in the clinical situation. The retention in function is very sensitive to distance. The point to be made, therefore, is that the manufacture's claimed retention may not be what is obtained clinically. Following the manufacturers' information recently developed or improved products despite their small size should produce high retention forces.

Objectives

The aim of this study was to verify and to compare the initial retention force and the force-distance relation of contemporar magnetic systems for dental implants.

Material and Methods

12 products of different height and diameter were tested (Tab 1 and Fig 1). All of these retention systems consisted essentially of a magnetic assembly which is incorporated into the prostheses and a corresponding magnetic implant abutment. In the magnetic units rear earth magnets from SmCo or NeFeB are embedded. The magnetic implant abutments consist of a magnetizable corrosion resistant alloy or a rear earth magnet as well. To protect the brittle rare earth magnets against corrosion they are incorporated into a thin non magnetizable alloy casting (Ti or stainless steel). From each product or combination 5 specimens were tested in an adjusted and computer navigated pull-testing machine (Z005, Zwick, Ulm, Germany). A special non magnetizable holder for the implant abutments was locked onto the base of the testing machine (Fig 2). To avoid tilting of the moving magnet it was fixed on the tip of a special holder which was connected with the crosshead by a nonflexible string. The crosshead speed was set at 20 mm/min ($s=40$ mm). The breakaway force was the maximum force during the separation of the magnet and the abutment when the magnet slowly moved away. The breakaway force measurement was repeated ten times and the mean for each sample was used. The results were descriptive and statistical analysed (H-/U-Test, $p \leq 0.05$). The findings were compared with the manufacturers' statements.

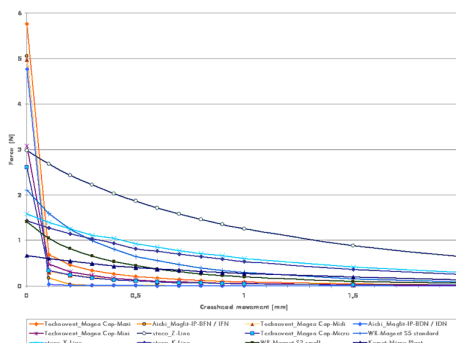


Fig.3 Force-distance-relation of magnetic attachments on implants

Table 1 Magnetic attachments for dental implants

Manufacturer	Magnet assembly		Magnet characteristics		
	Implant abutment	Magnet	System	Field	Alloy
Aichi Steel (Japan)	Magfil-IP-IPN abutment keeper	Magfil-IP-IPN dome type	mono	closed	NiFeB
	Magfil-IP-IPN abutment keeper	Magfil-IP-IPN flat type	mono	closed	NiFeB
Brasseler (Germany)	Kamel MicroPlant primary anchor	Kamel MicroPlant secondary anchor	duo	open	NiFeB
Dyna (Netherlands)	Medical Sekundärteile	WR-Magnet S3 small	mono	closed	NiFeB
	Medical Sekundärteile	WR-Magnet S5 standard	mono	closed	NiFeB
stecco (Germany)	X-Line Titanmagnetics Insert	X-Line Titanmagnetics	duo	open	SmCo
	Z-Line Titanmagnetics Insert	Z-Line Titanmagnetics	duo	open	SmCo
	K-Line Titanmagnetics Insert	K-Line Titanmagnetics	duo	open	SmCo
Technovent (Great Britain)	Magnabulment Mini	Magna Cap - Micro	mono	closed	NiFeB
	Magnabulment Mini	Magna Cap - Mini	mono	closed	NiFeB
	Magnabulment - Maxi	Magna Cap - Midi	mono	closed	NiFeB
	Magnabulment - Maxi	Magna Cap - Maxi	mono	closed	NiFeB

Table 2 Initial retention forces of the tested implant magnetic attachments

Manufacturer	Magnet assembly		Initial retention force		
	Implant abutment	Magnet	Manufacturer's instructions [N]	Results of measurements [N]	Relation [%]
Aichi Steel (Japan)	Magfil-IP-IPN abutment keeper	Magfil-IP-IPN dome type	5,9	4,8	80,8
	Magfil-IP-IPN abutment keeper	Magfil-IP-IPN flat type	6,4	5,1	78,9
Brasseler (Germany)	Kamel MicroPlant primary anchor	Kamel MicroPlant secondary anchor	1,5	0,7	44,5
Dyna (Netherlands)	Medical Sekundärteile	WR-Magnet S3 small	2,9	1,4	48,6
	Medical Sekundärteile	WR-Magnet S5 standard	4,9	2,1	43,0
stecco (Germany)	X-Line Titanmagnetics Insert	X-Line Titanmagnetics	1,7	1,6	92,9
	Z-Line Titanmagnetics Insert	Z-Line Titanmagnetics	3,0	3,0	99,4
	K-Line Titanmagnetics Insert	K-Line Titanmagnetics	1,6	1,4	89,1
Technovent (Great Britain)	Magnabulment Mini	Magna Cap - Micro	3,0	2,6	86,9
	Magnabulment Mini	Magna Cap - Mini	4,0	3,1	77,0
	Magnabulment - Maxi	Magna Cap - Midi	6,2	5,0	80,2
	Magnabulment - Maxi	Magna Cap - Maxi	7,2	5,8	80,0

Tab.1 Magnetic attachments for dental implants

Tab.2 Initial retention force of the tested implant magnetic attachments

Results

The highest initial retention force was 5.8 N. In a recently developed and distinctly smaller specimen an initial force of 5.1 N were found. The smallest initial breakaway force was measured with 0.7 N (Fig 3 and Tab 2). Beside the different initial forces the recorded force-distance relations according to the respective type of magnetic system were characteristically for each of the samples. The highest retention forces achieved the MC's followed by the DO's and MO's. After a separation of 1 mm the remaining forces were reversed (Fig 3). The DO's produced about one third of their initial force whereas the MC's showed approx. 5 % of their initial breakaway forces. The results of the MO's were between. The value of the retention force is depending on the dimension of the magnet unit. Therefore the discrepancies of the recorded breakaway forces and the manufacturers' claimed retention were determinate (Fig 3 and Tab 2). In one product there was nearly no difference between the experimental and the manufacturers' values. In another specimen more than 90 % of retention that was claimed by the respective manufacturer could be found. In 7 samples there were more than 75 % but in 3 products under 50 % of the indicated breakaway force.



Fig.1 Tested specimens

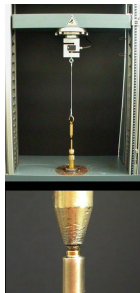


Fig.2 Non magnetizable holder and mounting

Conclusions

Within the limits of this study it could be drawn that there were significant differences between the clinically important breakaway forces. In the majority of cases the maximum retention forces were found notable under the manufacturers' claimed retention. Mono-systems with a closed magnetic field were the smallest and produced the highest breakaway forces. Concerning the reseating forces the force-distance relations could indicate advantages for the more voluminous dual-systems with an open magnetic field. These results should be taken into consideration when choosing implant supported magnetic attachments for individual situations.

Literature

1. Burns D, Unger J, Elswick R, Giglio J. Prospective clinical evaluation of mandibular implant over dentures: part II. Patients' satisfaction and preference. J Prosth Dent 1995;73:364-369.
2. Naert I, Gizani S, Vuylsteke M, van Steenberghe D. A 5-year prospective randomized clinical trial on the influence of splinted and unsplinted oral implants retaining a mandibular overdenture: prosthetic aspects and patient satisfaction. J Oral Rehabil 1992;26:195-202.
3. Walmsley A, Frame J. Implant supported overdentures-the Birmingham experience. J Dent 1997;25 (Suppl 1):543-547.
4. Riley M, Walmsley A, Harris I. Magnets in prosthetic dentistry. J Prosth Dent 2001;86:137-142.
5. Jackson T. The application of rare earth magnetic retention to osseointegrated implants. Int J Oral Maxillofac Implants 1986;1:81-92.

This Poster was submitted by *Dr. med. dent. Arne F. Boeckler*.

Correspondence address:

OA Dr. med. dent. Arne F. Boeckler
 Poliklinik für Zahnärztliche Prothetik
 Martin-Luther-Universität Halle-Wittenberg
 Grosse Steinstrasse 19
 06108 Halle / Saale



Retention performance of magnetic attachments on dental implants

Objectives

In order to be suitable for long-term treatment, the use of an implant-retained complete denture with magnetic offers a simple treatment approach to the problem of stability of complete dentures. The advantages with magnetic include a simplified dental technique and reduced dental stress on the denture. Consequently these different physical and material concepts can be found. This system with two active magnets and an active magnet (M2) and passive magnet (M1) is compared with a corresponding passive magnet system with an active magnet (M2) and a passive magnet (M1). The force produced by one two magnets is directly proportional to the square of the distance between them. Therefore, the magnetic force between magnets is directly proportional to the square of the distance between them. The force produced by one two magnets is directly proportional to the square of the distance between them. The force produced by one two magnets is directly proportional to the square of the distance between them.

The retention provided needs to be able to be adjusted by the manufacturer as long as the magnet and the denture remain in contact. The condition can be provided in the dental practice. The retention is directly proportional to the square of the distance between the magnets. The condition can be provided in the dental practice. The retention is directly proportional to the square of the distance between the magnets.

Following the manufacturer's instructions, the magnets are placed in the denture. The retention is directly proportional to the square of the distance between the magnets. The condition can be provided in the dental practice. The retention is directly proportional to the square of the distance between the magnets.

Material and Methods

12 patients of different height and diameter were tested (Table 1 and Fig. 1). All of them received complete dentures with magnetic attachments. In the magnets with two active magnets (M1 and M2) and one active magnet (M2) and one passive magnet (M1) were tested. The magnets were placed in the denture. The retention is directly proportional to the square of the distance between the magnets. The condition can be provided in the dental practice. The retention is directly proportional to the square of the distance between the magnets.

Table 1: Magnetic attachments for patient groups

Attachment	Number of magnets	Force (N)	Retention (N)
Group 1	2	100	100
Group 2	2	200	200
Group 3	2	300	300
Group 4	2	400	400
Group 5	2	500	500
Group 6	2	600	600
Group 7	2	700	700
Group 8	2	800	800
Group 9	2	900	900
Group 10	2	1000	1000
Group 11	2	1100	1100
Group 12	2	1200	1200

Figure 1: Force distance relation of magnetic attachments in dentures

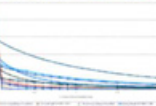


Table 2: Retention forces of the tested magnetic attachments

Attachment	Retention (N)	Retention (N)	Retention (N)
Group 1	100	100	100
Group 2	200	200	200
Group 3	300	300	300
Group 4	400	400	400
Group 5	500	500	500
Group 6	600	600	600
Group 7	700	700	700
Group 8	800	800	800
Group 9	900	900	900
Group 10	1000	1000	1000
Group 11	1100	1100	1100
Group 12	1200	1200	1200

Results

The highest initial retention force was 1.8 N. It is directly proportional and directly proportional to the square of the distance between the magnets. The highest retention force was measured with 1.8 N (Fig. 1 and Table 2). The highest retention force was measured with 1.8 N (Fig. 1 and Table 2). The highest retention force was measured with 1.8 N (Fig. 1 and Table 2). The highest retention force was measured with 1.8 N (Fig. 1 and Table 2).



Conclusion

While the force of the study it could be shown that there were significant differences between the different magnet configurations. The retention is directly proportional to the square of the distance between the magnets. The condition can be provided in the dental practice. The retention is directly proportional to the square of the distance between the magnets.

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