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Ultrasound Study to Evaluate Effectiveness of Magnetically Retained Overdenture

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ABSTRACT

Ten patients were selected for lower tooth supported overdentures to be constructed on bilateral canines as abutment teeth for each denture. Conventional upper complete dentures were also constructed for the patients. Two weeks were allowed for each patient to accommodate to his new dentures and to perform any occlusal adjustments. Following that, a keeper for the magnetic system was cemented in place. Finally, endodontically treated abutments were prepared coronally to be very near the gingival level and to receive the keeper's flat surface. Ultrasound scanning (thickness) of the masseter muscles was recorded. This procedure was repeated after one and after three months of magnet fixation inside the fitting surface of the lower overdenture. The results showed marked improvement in the ultrasound scanning (thickness) of the masseter muscles after one and three months of magnet fixation, while the difference was insignificant after fixation of the keeper alone inside the intra-radicular abutment preparation.

Kew words: magnetic overdenture, Keeper, Ultrasound, thickness of the masseter muscles, intra-radicular abutment

Introduction

The advantages of overdentures have been settled as they preserve the residual alveolar ridge and improve the masticatory performance due to the presence of proprioceptive impulses from the overdenture abutments, providing signals against physiological overload.

The popularity of using magnets in prosthetic dentistry, which started by using magnetic repulsion between magnets embedded in upper and lower dentures to help in stabilizing them was carried over in complete and partial overdentures, sectional dentures, fixed partial dentures and certain types of mandibular implants. Moreover, they are also used in the form of magnetic brackets in orthodontic appliances providing smooth and fast tooth movement (Kampen *et al.,* 2005; Gilling 1980).

The biocompatibility of magnets was established through blood analysis and through histological studies on dermal, osseous and glandular samples, showing no harmful effects (Cune *et al.,* 2012)

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The repulsive force of like poles of paired alnico bar magnets embedded in maxillary and mandibular complete denture bases was used. This, however, proved inadequate when the jaws were kept apart (Kampen *et al.,* 2005)

A magnetically retained two-section intra-oral prosthesis was constructed to rehabilitate a case suffering from surgical removal of both maxillae. The magnet consisted of a locking device between the palatal section and the bulbs anchored in the undercuts above the two zygomas (Robinson, 1963)

The positive locking which was gained from sectional interim maxillary Obturator with magnetically augmented retention improved speech and mastication, as well as improving the psychological state of the patient (Yang *et al.,* 2011; Kawata,1977)

Samarium cobalt magnets were used in sectional prostheses to facilitate construction, provide an easy path and avoid excessive undercuts (Sasaki *et al.,* 1979)

Samarium cobalt magnets were also embedded in silicone prosthesis, with the counter magnet in a holding device, to restore a lateral nasal defect (Lemon *et al.,* 1996)

Magnets provide many advantages over other precision attachment devices, such as ease of maintenance and replacement, low cost, and the possibility of embedding them within the roots allowing adequate space for the thickness of the denture and teeth (Choi *et al.,* 2015; Moghadam *et al.,* 1979)

Lack of magnet/root-face contact was rare and dentures reseated automatically when dislodged. The magnetic system provided stress-breaking action and freedom of lateral movement of dentures.

Moreover, magnets do not traumatize roots, enabling them to be used in different cases (Gilling, 1979)

A further advantage of using magnetic units is that they moderately displace mucosa at all times, adding negative pressure retention (Sasaki *et al.,* 1984)

Some years ago, ultrasound technique was used to measure the thickness of the masseter muscle and evaluate qualitative and quantitative condition the muscle. Ultrasound provides an indication of the muscle's force generated capacity. It is non-invasive and painless (Close *et al.,* 1995)

The aim of this study was to measure the effect of magnetic attachment used with overdentures on the ultrasound scanning (thickness) of the masseter muscles.

Materials and Methods

Criteria of Patient's selection

Ten patients were selected according to the following criteria:

- Having mandibular bilateral canines that were supported by adequate alveolar bone.
- Patients having Angle's class I ridge relationship.
- Patients were free from symptomatic TMJ disorders.
- Patients were seen to be free from any systemic disorders that may affect neuromuscular function
- Patients had healthy oral mucosa.
- Patient's co-operation was also taken into consideration.

Preparation of the Abutments to receive the Magnetically- Retained Overdenture

- Selected teeth to be used as abutments were kept while the remaining teeth were extracted.
- Ten weeks were allowed after extraction toallow for reasonable healing and bone remoulding.
- Root canal treatment was performed on the retained canines using gutta percha points as root filling material.
- The clinical crowns of the retained canines were shortened nearly to the gingival level in order to allow for adequate space for the magnetic keepers and magnets, as well as the denture thickness over the abutments.
- An intra-radicular conical preparation was performed coincident with the intra-radicular form of the magnetic keeper (Fig1).
- The root cap and post (keeper) was tried for fitness, height and alignment, and was then cemented intra-radicularly using temporary cement.

Fig.1: Intra radicular preparation to receive the magnetic keeper

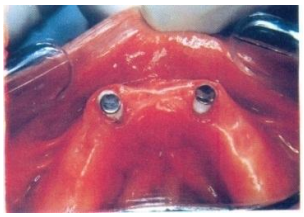

Fig.2: The keeper cemented intra-radicular by glass ionomer cement

Denture Construction

- An upper conventional complete denture was constructed for each patient.
- The secondary impression for the maxillary edentulous ridge was made using zinc oxide and eugenol impression material with a border moulded acrylic tray. The secondary impression for the mandibular ridge was made with medium-body rubber baseusing a special tray with selective relief while keepers were cemented in place.
- Centric relation record with check bite technique was made, and cross-linked acrylic teeth were set following the monoplane occlusal principles (Jones, 1972)
- Dentures were tried in the patient's mouth to check centric occluding relation, vertical dimension, even bearing and facial contour.
- The waxed up dentures were flasked, packed and processed.
- Before separation of the denture from the cast, laboratory remounting was made to correct processing errors. At the time of delivery, occlusion was again refined. Patients were asked to return after short intervals to diagnose and correct any complaints and to evaluate patient's acceptance and especially to discover any painful bearing spots underneath the denture.
- After two weeks of denture insertion, and before fixation of the magnetic system, ultrasound scanning of the masseter muscles was recorded.

The keeper was cemented intra- radicularly by glass monomer luting cement, taking into consideration that the root cap surface was made parallel to the alveolar ridge with a slight inclination lingually (Fig.3). The dentures were then checked for stability and proper seating.

Fig. 3: The magnet fixed into the fitting surface of the denture

Ultrasound scanning of the master muscles was recorded again after cementation of the keeper within the intra-radicular preparation.

The intra-oral magnet of 500 gm. magnetic power (Dyna system)* was seated intra-orally by the following direct technique (Fig.4).

The sites corresponding to the flat surfaces of the root cap's cavities were drilled into the denture base with a drill whose size was slightly larger than the magnets. The magnets were then placed over

the flat root caps with the manufacturer's logo facing upwards. The dentures were then inserted over the magnets to insure that the cavities were sufficiently wide not to displace the magnets.

The dentures, with the exception of the cavities, were coated with Vaseline. The magnets were fixed to the denture base with chair cold curing resin.

Finally, the occlusion was checked and adjusted intra-orally if needed.

After one and three months of the delivery of the magnetically-retained dentures, ultrasound scanning of the master muscles was again recorded and the data were collected and statistically analyzed.

Ultrasound scanning of the masseter muscle

Ultrasound scanning of the masseter muscle was obtained with a real-time (Ornier machine-Germany) A 7 MHz high-resolution liner array transducer was utilized. Patient was seated in an upright, neutral but comfortable position. Scans were taken on the right and left sides during chewing a piece of carrot (hard food). The orientation of the scanning probe was at right angles to the longitudinal direction of the muscle fibers and in the middle of the muscle belly.

To study the thickness of the masseter muscle, two linear dimensions were measured on the cross-sectional scan. These were muscle depth defined as the shortest distance through the muscle belly in its middle third, and the muscle length defined as the greatest distance along the length of the muscle cross section (fig.4)

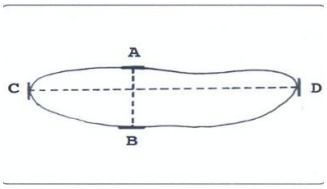

Fig.4: Tracing of outline of a cross section of masseter muscle showing the two linear dimensions measured. Line A-B indicates the shortest distance through the muscle group and C-D is the longest distance (length)

Results

Table (1) shows an increase in the thickness (depth and length) of the masseter muscles of most cases after final cementation of the intra-radicular keeper without fixation of the magnets into the fitting surface of the overdentures. After one month of fixation of the magnets in the fitting surfaces of the overdentures, there was an increase of the mean values of the thickness of the masseter muscles in all cases. The increase was even more apparent after three months of fixation of the magnets, (Fig 5 &6).

Table 1: the means of masseter muscles thickness (depth & length) at different follow up periods.

Immediately after final cementation of the keeper intra-radiculary (I)		One month after complete magnetic system fixation (II)		After three months of complete magnetic system fixation (III)	
Depth(mm)	Length(mm)	Depth(mm)	Length(mm)	Depth(mm)	Length(mm)
7.2	28.6	10.8	33.1	17.3	35.1

Table (2) shows that after one month of magnet fixation, the difference in the thickness (depth and length) of the masseter muscles was significant P 0<.05, while after three months the difference was very highly significant, P 0<.05.

Table 2: Paired t-test between different follow up periods.

	I	Vs	II	II	Vs	III
	Depth		Length	Depth		Length
t- value	2.61*		2.98*	3.84*		4.05*

**Significant at P >0.05*

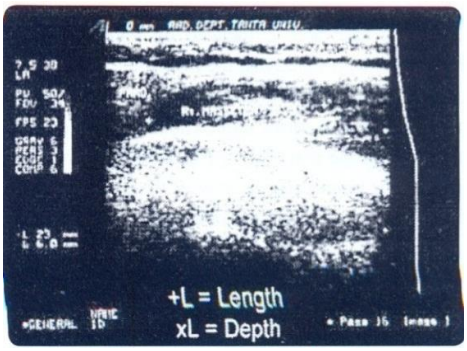

Fig. 5: Ultrasound scan of the masseter muscle after three months

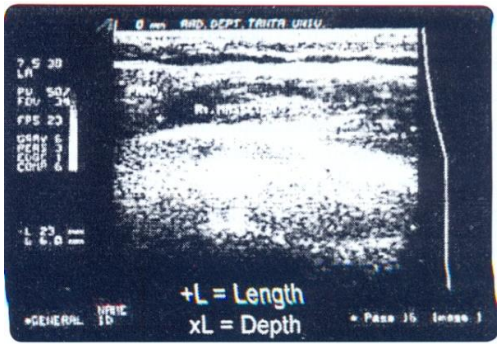

Fig. 6: Ultrasound scan of the masseter muscle after one month.

Discussion

The results of the present study showed an insignificant difference between the mean values of the thickness of the masseter muscles during maximum voluntary biting on the occlusal table of the lower first molars after two weeks of overdenture delivery after fixation of the intra-radicular keeper. This difference could be attributed to the support gained from the abutments; a result which accords with that of Abdel-Rahman (1992) who noticed improved muscular activity after increasing the number of abutments. Moreover, Craig and Deyton, (1987) found that the strength of the biting force directly depended on the efficiency of the masticatory system.

The results also showed a significant difference in the thickness of the masseter muscles one month after fixation of the magnetic system, including the magnet itself, inside the fitting surface of the overdenture. This could be attributed to enhanced intimate contact between the overdenture and the abutments, which improves abutment support; and may also be attributed to the added retention gained from the use of the magnetic system. This is in agreement with Jemt *et al.* (1993) and Lindquist *et al.* (1995) who found that increased biting force followed improved retention and stability. On the other hand, this is in contrast to the findings of Garret *et al.* (1996) who believed that neither denture retention nor the occlusal scheme affected the clenching ability of denture wearers.

Finally, the results showed a highly significant difference in the thickness of the masseter muscles three months after insertion of the magnetic system in the overdentures. This may be attributed to the improved proprioceptive ability of the patients. This is in parallel with the results obtained by Loiselle *et al.* (1972) increased mean axial threshold of pressure, especially in relation to the canine teeth that were used as abutments. The findings are also in accord with the views of Riise and Sheikholeslam (1985) who noted that adaptive behavior and learned skills of denture manipulation were very important factors in the ability of patients to exert force on the dentures and in the functioning of the prosthesis.

References

Abdel Rahman, H., 1992. Natural posterior abutment versus distal implantation overdenture on electromyogrophic study, Doctor Degree Thesis. Prosthodontie Department. Faculty of Oral and Dental Medicine, Cairo, University.

Choi, J. W., J.H. Bae, C. M. Jeong and J.Huh, 2017. Retention and wear behaviors of two implant overdenture stud-type attachments at different implant angulations. The Journal of Prosthetic Dentistry. 117: 628, 2017

Close, P., M. Stokes and P. Lestrange, 1995. Ultras0n0graphy of masseter muscle size in normal young adults. J. Oral Rehabilitation. 22:129.

Craig, R.G. and F. A. Beyton, 1987. Restorative dental materials. Biophysical application of materials.Chap. 4,p 110- 112. The C.V. Mosby, Saint Louis.

Cune, M., M.F. Kampen and F.Bosman, 2005. Patient satisfaction and preference with magnet, bar-clip, and ball-socket retained mandibular implant overdentures: a cross-over clinical trial. The Journal of Prosthetic Dentistry, 94:471.

Garret, N.P., P. Perez, C. Elbertand, K. K. Kapur, 1996. Effect of improvements of poorly fitting dentures and new dentures on masticatory performance, J. Prosthet. Dent., 75: 269.

Gilling, B.R.D., 1979. Two-year assessment of overlay Dentures retained by co-sm closed- field magnets. J. Dent. Res, 56: (Abst. 751).

Gilling, B.R.D., 1980. Magnetic retention for complete and partial overdentures, sectional dentures and implant overdentures, A. synopsis of lectures and demonstrations at the Ist and 2nd international overdenture symposiums. San Antonio.

Jemt, T., K. Book and S. Karlsson, 1993. Occlusal force and mandibular movements in patients with removable overdentures an fixed prostheses supported by Implants in the maxilla, the international. 1. oral and Max- ill of Implants, 8: 301.

Jones, Ph., 1972. The monoplane occlusion for complete dentures dentures, J. Am. Dent. Assoc., 58: 94.

Kampen, V.F., M. Cune, A. V. DerBilt and F. Bosman, 2003. The effect of maximum bite force on marginal bone loss in mandibular overdenture treatment: an *in vivo* study. International Journal of Prosthodontics .16: 128.

Kawata, T., and S.Takeda, 1977. Anew orthodontic appliance by means of magnetic bracket. J. Dent. Res., 56: 189.

Lemon, J., M.S. Chambers, P.J.Wesley and L.W.Martin, 1996. Technique for magnetic placement and orientation of a facial prosthesis, 1. Prosthet. Ent., 75: SO.

Lindquist, L.W., G.E. Carlsson, and B .Hedegard, 1996. Changes in bite force and chewing efficiency after denture treatment in edentulous patents with denture adaptation difficulties. J. Oral Rehabilitation, 13:21.

Loiselle, R.J., R. J.Grum, G.E. Rooney, and C.H. Stuever, 1972. The physiologic basis for the overlay denture. J .Prosth. Dent., 28:4.

Sasaki, H., Y. Kinouchi, H. Tsutsui,1984. Yoshida, Y.; and Ushita, T.: A magnetic attachment for overdentures, J. Prosthet Dent., 51: 450.

Riise, C. and A. Shikheleslarn, 1984. Influence of experimental interfering occlusal contacts on the activity of the anterior temporal and masseter muscles during mastication. J. Oral. Rehabil.,11 :325, 1984

Robinson, J.E., 1963. Magnets for the retention of a sectional in- tra-oral prosthesis, J. Prosth. Dent., 13: 1167.

Yang, T.C., Y. Maeda and T. Gonda, 2011. Attachment systems for implant overdenture: influence of implant. *Clin.Oral Impl. Res*. 22: 1315.