Practical application of self- and light-curing resin for attaching a magnetic assembly into the denture base resin

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Introduction

Generally, the magnetic assembly was attached into the denture base resin using self-curing resin. However, an enough retentive force is often suppressed by the air gap between keeper and magnetic assembly due to the polymerization shrinkage.

Objective

In this study, the retentive force was compared with 3 different height spaces onto the magnetic assembly which were filled with self-curing resin or light-curing resin with low-shrinking.

Materials and Methods

GIGAUSS D400, D600 magnetic assemblies (GC company®) and each gypsum dummy were used as a specimen. The diameters of the magnetic assemblies increase in order of D400, D600, but the height is same (1.3 mm). The diameter of the gypsum dummy is 0.3 mm wider than that of magnetic assembly, and the height is 0.3 mm higher than the top surface of the magnetic assembly. (Fig. 1).

90 magnetic assemblies were placed on the keeper which were fixed by the resin and attached into each resin blocks using self- or light-curing resin following three groups: (1) Unifast Ⅲ No.8(GC company®) (n=30), (2) Unifast LC (GC company®) (n=30), and (3) G-FIX (GC company®) (n=30). The retentive force between keepers and attached magnetic assemblies were analyzed.

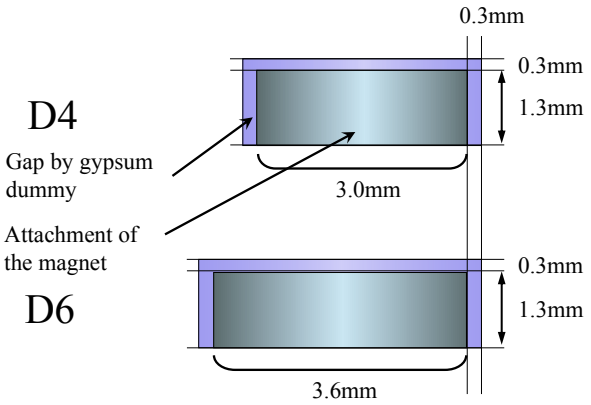

Fig. 1 Diameter and height space of magnetic assembly and gypsum dummy (various)

Additionally, sheet wax of the same thickness as a spacer (0.6 mm and 1.2mm) added to the gypsum dummy.

1) Adjustment of the space

The gypsum dummy without adding sheet wax is control. (referred to as C group) （Fig. 2).

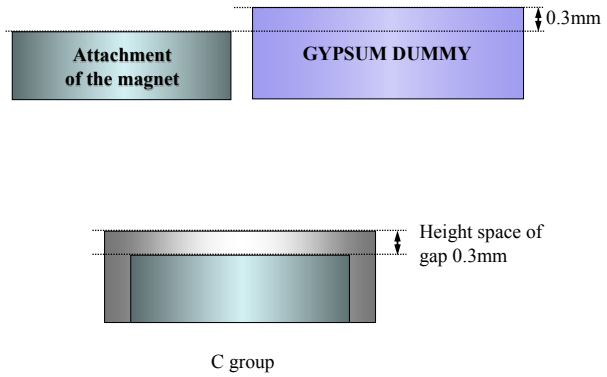

Fig. 2 Amount of gap when sheet wax is not added, and it makes it to spaser

0.6 mm of sheet wax (two sheets) onto the gypsum dummy made the spacer at 0.9 mm which is three times as long as C group (referred to as 0.9 group) (Fig. 3).

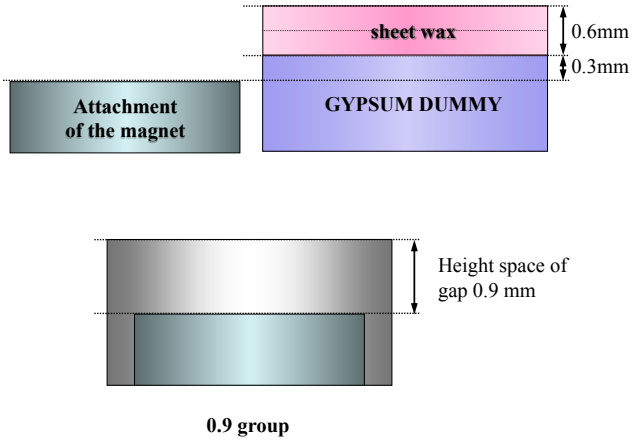

Fig. 3 Amount of gap when as much as two sheet wax is added

1.2 mm of sheet wax (four sheets) onto the gypsum dummy made the spacer at 1.5 mm which is five times as long as C group (referred to as 1.5 group) (Fig. 4).

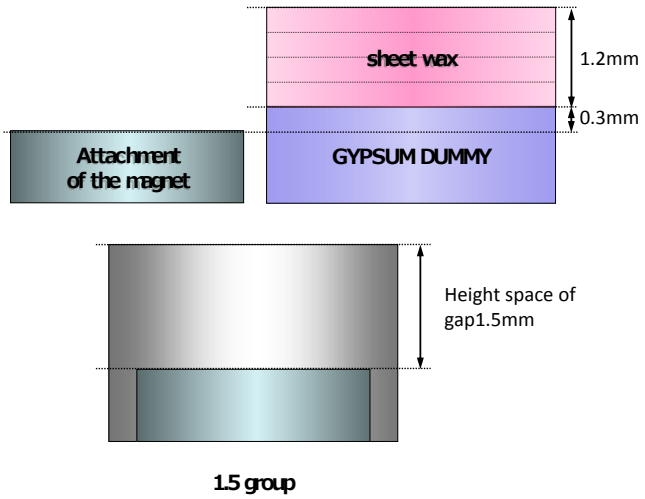

Fig. 4 Amount of gap when as much as four sheet wax is added

2) Preparation of resin block

A resin block (10×10×7 mm) was put on a specimen with 3 different spaces (Fig. 5).

Spillway within the resin block was formed with a round bar No. 6 (φ1.6mm) (Fig. 6).

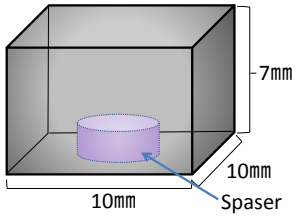

Fig. 5 Resin block from the spacer adjusted

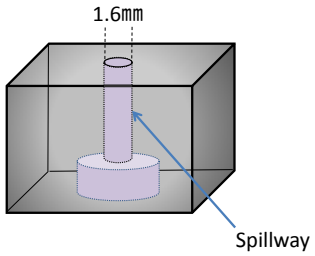

Fig. 6 Resin block after spillway is formed

3) Attachment of the magnetic assembly

Before attachment, alumina sandblast was performed on the surface of the magnetic assembly and metal primer Z (GC company®) was coated.

At Unifast Ⅲ and Unifast LC , the standard ratio of powder and liquid (2 g/1 ml) for 10 seconds was mixed and filled the same amount in the spacer, and then the magnetic assembly was attached within 60 seconds from the start of mixing.

On the other hand G-FIX was inserted from spillway using the syringe after resin blocks were held by hands. The material was poured along the edge carefully (Fig. 7).

During attachment of the magnetic assembly using Unifast Ⅲ, 150g of static loading was applied after 150 seconds from the start of mixing at room temperature[2)].

At Unifast LC and G-FIX, while holding by hands, the light was irradiated toward the upper surface of the magnetic assembly longitudinally for 20 seconds from the top of spillway (Fig. 8).

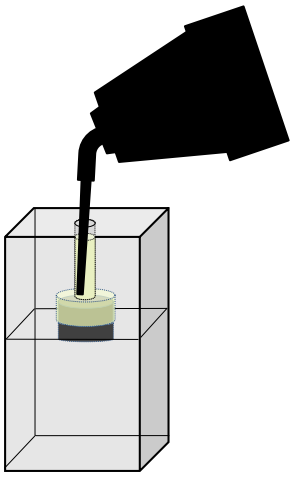

Fig. 7 Insertion the syringe from spillway

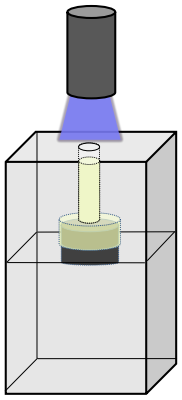

Fig. 8 Irradiation from the top of spillway with light curing units

4) Tension test

The retentive force was measured in a universal testing machine (EZ-Test, SHIMADZU, Kyoto, Japan), and D400 and D600 magnetic assembly-keeper composition were tested 5 times for each specimen with cross head speed 5 mm per minute. The specimens were pulled and measured the point at which the magnetic assembly was detached to the keeper and the mean values were compared.

5) Statistical Analysis

Two-way ANOVA and the multi-comparison of Tukey test were used to compare with 3 different height spaces onto the magnetic assembly with self-curing resin or light-curing resin with low-shrinking. ; < 0.05 was considered statistically significant. (Mean g ±SD)

Results

Table. 1 and 2 show the retentive force was compared with 3 different height spaces onto the magnetic assembly which were filled with self-curing resin or light-curing resin with low-shrinking.

	G-FIX	Unifast Ⅲ	Unifast LC
C group	334.2(±3.1)	310.1(±1.8)	313.9(±5.8)
0.9 group	319.7(±4.5)	304.9(±16.3)	294(±12.0)
1.5 group	293.4(±6.7)	243.8(±21.2)	251(±5.5)

Table. 1 The average value of the retentive force and the standard deviation in D400 （Mean g ±SD）

	G-FIX	Unifast Ⅲ	Unifast LC
C group	509.8(±7.9)	487.8(±10.4)	463.1(±13.1)
0.9 group	473.4(±14.3)	445.3(±9.3)	418.6(±22.7)
1.5 group	406.4(±14.3)	363(±5.4)	349.2(±6.2)

Table. 2 The average value of the retentive force and the standard deviation in D600 （Mean g ±SD）

At Fig. 9, the retentive force was shown for the difference of 3 materials and the 3 spacers in D400. The underlined value of a vertical axis was a mean of the retentive force of the magnetic attachment alone, which was specified as a standard value[3)].

In the atacched material, the retentive force was smaller C group, 0.9 group, 1.5 group respectively. Among the spacer, C group in G-FIX had the greatest retentive force significantly which was closest to standard value in D400.

D600 figure was shown, as the space onto the magnetic assembly was higher, the retentive force decreased significantly in G-FIX ,Unifast Ⅲand Unifast LC. At 0.9 group and 1.5 group, the retentive force in G-FIX was greater than other materials significantly which was also closest to standard value at Fig. 10.

The retentive force in Unifast LC had mostly the same data in Unifast Ⅲat each spacer at Fig.9 and 10.

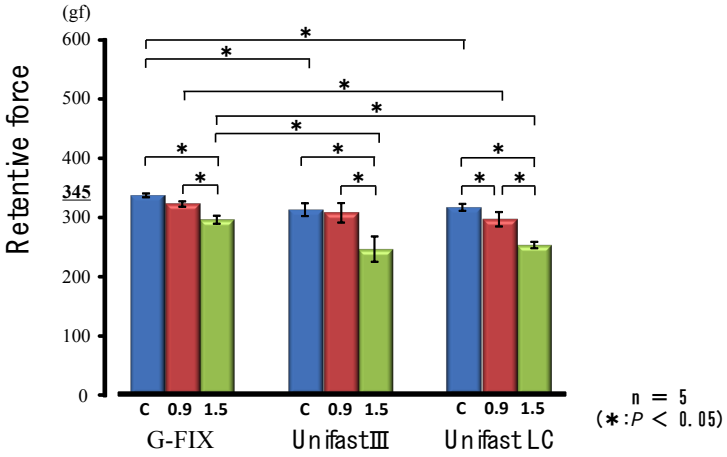

Fig. 9 Retentive force when using different materials and spacer in D400

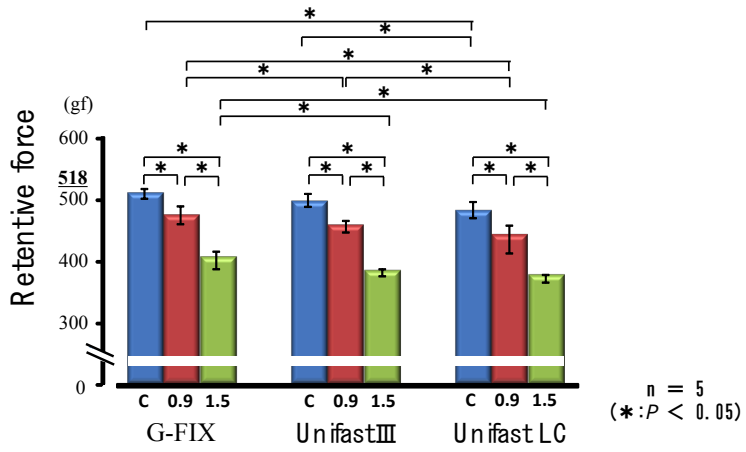

Fig. 10 Retentive force when using different materials and spacer in D600

Conclusions

In D400 and 600, the retentive force reduced clearly C group, 0.9 group, 1.5 groups respectively in each material as well as previous Nakabayashi's report[1)].

In each spacer, G- FIX had the highest retentive force which was showed closest to a standard value.

When attaching a magnetic assembly into the denture base resin, a low-shrinkage material like a G-FIX was capability to suppress occurrence of the air gap. It is supposed to be a material which can demonstrate the enough retentive force reproducibility without the air gap.

References

1. S. Nakabayashi, H. Takimoto, T. Ishigami, et al.: Regarding relations between the amounts of cold-curing resin used for attaching a magnet structure and suction power, The 14th Scientific Meeting of the Japanese Society of Magnetic Applications in Dentistry, Kitakyusyu, 2005.
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