Denture base strength influence of its thickness surrounding magnetic assembly -Examination by the model experiments-

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Introduction

Denture fracture is frequently reported in during long-term use of a magnetic overdenture. There are not so much studies about effect between thickness of denture base resin around magnetic assembly and its fracture. [1)] In this study the effect between thickness and strengths of denture base in overdenture was examined.

Objective

Experiments are performed using two types of bending test (modified 3-point bending test and modified 4-point bending test) to simplified overdenture models.

Materials and Methods

1. Materials

a. Coping models

Fig 1 shows the coping model made of the stainless steel (TOKYO GIKEN, Inc). The coping models have two difference shape types. Model A has dome shape (dome) and model B has trapezoidal shape (trapezoidal).

Dome is 6.0mm in diameter and 2.0mm in height. Trapezoidal is 6.0mm in the diameter of bottom, 4.5mm in diameter of surface, and 2.0mm in height.

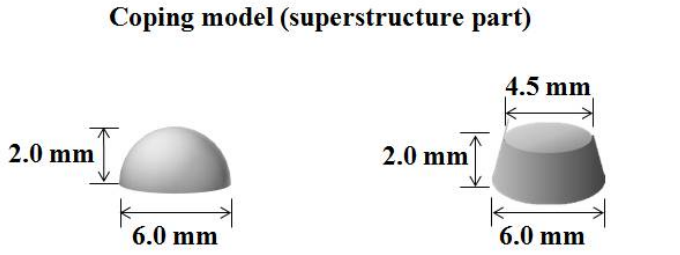

Fig1

b. Bending specimens

Rectangular solid bending specimens were fabricated by heat-curing resin (ACRON, GC). The shape of specimens is 64.0 mm in width, 10.0 mm in length, and 2.5, 3.0 and 3.5mm in thickness (Fig 2,3). [2)] Polymerized resin blocks were shaped by using semi-automatic polishing machine (Doctor Lap ML180, NARUTO) and silicon carbide paper.

According the shape and the number of concave portion, four specimen groups were fabricated and named type A,B,C and D. Five specimens were randomly assigned to each group.

Type A had one hemisphere concave part in center. Type B had one concave frustum of circular cone part in center. Type C had two hemisphere concave surfaces in the position of 9.5mm and

39.5mm from the left end of the major axis. Type D had two concave surfaces of circular cone parts in same position as type C.

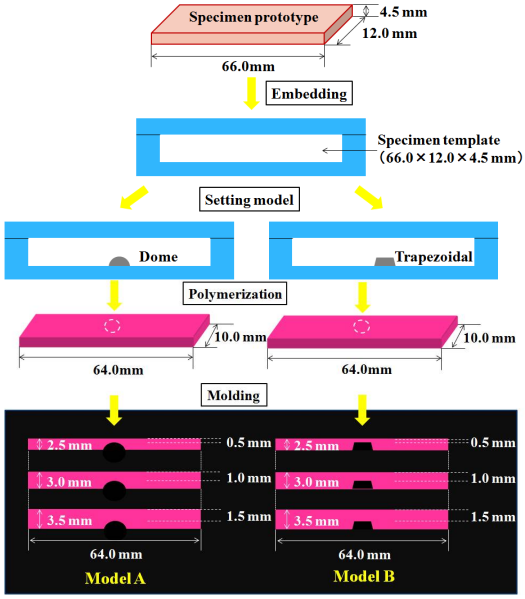

Fig2

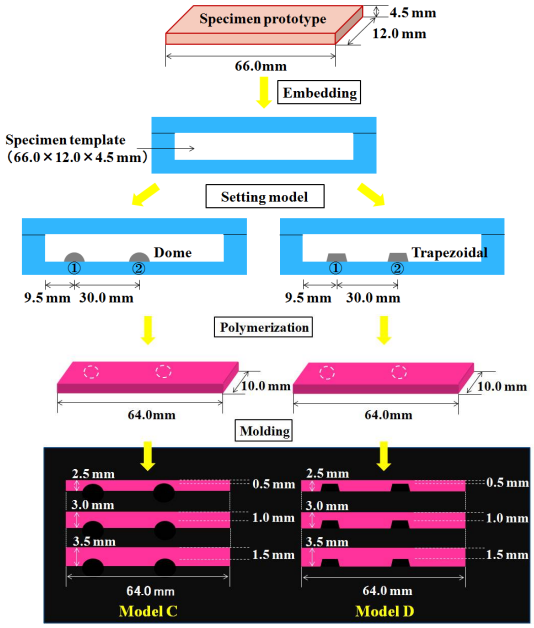

Fig3

2. Methods

Each specimen used for the experiments was soaked in the water of 37℃ for 48 hours. The bending test utilized a universal testing machine (EZ-test, SHIMADZU). The loading plunger according to JIS T6501 was used for the experiments. [3] The experiments were conducted on two kinds (modified three-point bending test and modified four-point bending test). The modified three-point bending test (3PB) was assumed for experiment 1, and the modified four-point bending test (4PB) was assumed to experiment 2.

a. Modified three-point bending test (3PB)

Type A or B was loading until fracture from both sides on a coping model. (Fig4) Coping model attached to under part in EZ-test. Type A is on top of dome model. Similarly, type B is on top of trapezoidal model. Loading plunger attached the crossing head part in EZ-test by the distance 30.0mm between fulcrums. Bending test was done a crosshead speed of 5.0 mm/min. Bending strength of the specimen measured in the maximum loading point. And it was calculated the average value.

Acquire data did statistical analysis by critical region 5%. It was used to two-way ANOVA and Tukey-Kramer test for statistical analysis.

b. Modified four-point bending test (4PB)

Type C or D was loaded until fracture on same kind of two coping models. (Fig5) On the right coping model it loaded from both sides. On the left coping model it loaded from one side only. It was assuming unilateral free-end in this state. The bending test did at the distance between fulcrums 30.0mm and a crosshead speed of 5.0 mm/min. The statistical analysis was similar experiment 1.

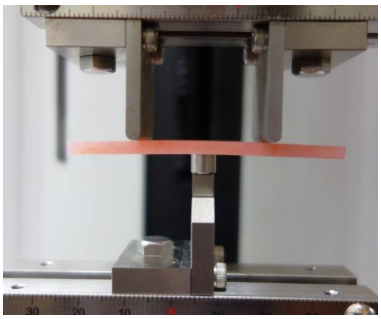

Fig4

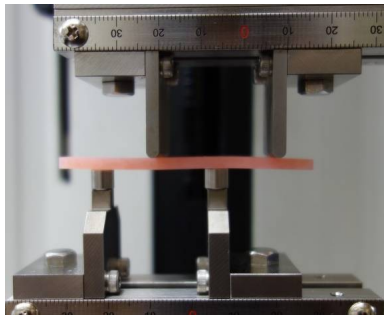

Fig5

Results

Fig 6 shows the result of experiment 1. Bending strength increased intentionally in both models of type A and B whenever the thickness of the specimen increased. As a result of two-way ANOVA, it was not admitted for the alternating cropping. Moreover, there was not a significant difference by the difference to coping shape.

Fig 7 shows the result of experiment 2. It's not fractured in 1.5mm (type C and D) in the loading areas of EZ-test. Therefore, the value was not able to calculate. In the comparison between 0.5mm and 1.0mm (type C and D), there were significant differences in the bending strength, more strength for more thickness. As a result of two-way ANOVA, it was not admitted to the interaction. Moreover, there were significant differences to the coping shape.

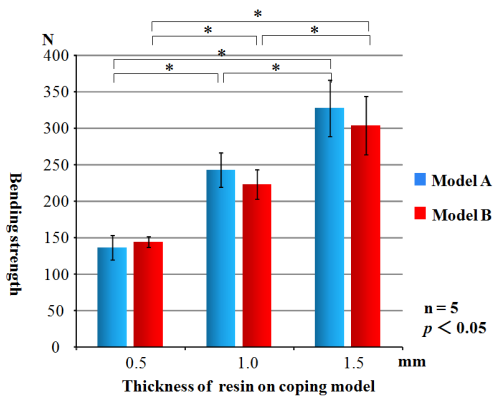

Fig6

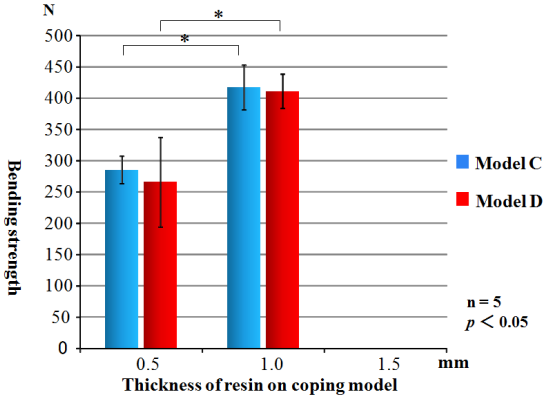

Fig7

Fig 8 shows to the appearance of fracture from the underside in 1.0mm specimen (type A, B, C and D). In type A, It was shown that a lot of the fracture from the slightly position displaced to one side from the deepest in concave portion. In type B, It was shown that a lot of the fracture occurred from the position that hit a near edge of concave portion. In type C and D, It was shown that there was a lot of the fracture from the middle of both coping models. This corresponds to a part of the left indenter of loading plunger.

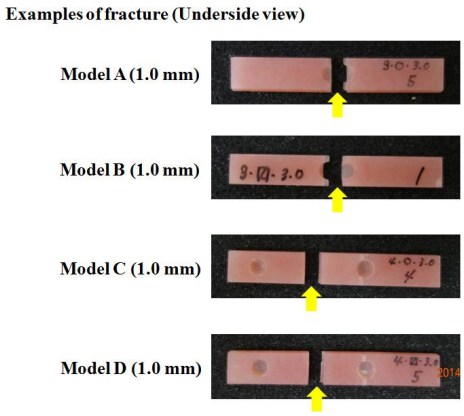

Fig8

Discussions

In this bending tests, the thickness of the resin plate is increased the flexural strength increases, the difference between the coping no effect. In the case of one coping, many of the specimens were fracture in coping mounting portion. In the case of two copings, many of the specimens were fracture at the mid-point of the coping. This result is different from the clinical reports that often fracture of the coping mounting portion.

Conclusions

This time of specimen, consideration by the three-dimensional finite element method is also based, is a simplified shape. [4)] For future, based on the review by this model experiment and three-dimensional finite element method, it is necessary to consider the experiment in line with more clinical. For fracture of resin base on coping, the studies are needed in terms of thickness.

References

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