

Evaluation of Testing Procedure Accuracy Described for the Measurement of Magnetic Attachment Attractive Force in ISO 13017

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Introduction

A dental magnetic attachment International Standard of (ISO 13017) was published in 2012. However the basic methods and techniques for the uniform measurement of magnetic attachments was amended and covered in 2013.

The uniform measurement of magnetic attachments attractive force as applied to an International Standard requires several considerations including, the attractive force measuring method repeatability, measurement accuracy, ease of use and availability. The Japanese Society of Magnetic Applications in Dentistry performed a reevaluation of previous measurement jig and measuring techniques (fixation method) for the measurement of magnetic attachment attractive force. A proposed revision of the written standards was submitted for consideration in April, 2013. A review of the validity, versatility, and accuracy of the document revision contents should be evaluated to confirm attractive force measurement procedures according to the specific written universal standard.

Objective

The present study investigated if the written instructions for attractive force measuring methods specified in the revision of the ISO 13017 written standards can be understood and performed for the first time use. Further, the accuracy and validity of first time use measurements will be examined to determine written standard accuracy and use.

Materials and Methods

1. The proposed revision of the ISO 13017 written standards

Since the proposed revision of the written standards does not contain diagrams, only the documents were distributed. The following are the contents of the proposed revision.

① The lateral surface is positioned so that the centers of the upper and lower stages installed on the attractive force measuring device are in line.

② A magnet or attractive surface of a magnet is temporarily bonded to the center of the lower

stage using double-faced tape.

3 Cyanoacrylate adhesive is carefully applied on top of the temporarily bonded magnet or magnet assembly.

4 The upper stage is moved downward to press against a temporarily-bonded magnet or magnetic assembly. A joint part is reinforced using autopolymerizing resin if necessary.

5 After a magnet or magnetic assembly is completely bonded to the upper stage, the upper stage was moved upward, and double-faced tape is removed.

6 A magnet or keeper is accurately positioned to the attractive surface of a magnet or magnetic assembly bonded on the upper stage, and attach.

7 Cyanoacrylate adhesive is dropped in the center of the lower stage. The upper stage is moved downward, and the bottom part of a magnet or a keeper is fixed to the lower stage so that the attractive surface is perpendicular to the move axis. The joint part is reinforced using autopolymer resin if necessary.

8 Do not move a magnet or keeper until the adhesive is completely cured. Do not remove the upper and lower stages from the device to maintain the proper position.

9 When the attractive force is extremely smaller than 85% (manufacturer's indicated value), the positional relationship between a magnet and keeper, and magnetic assembly and keeper is adjusted, and remeasurement is performed.

2. Verification method of the contents

1) Measurer

Five measurers (A, B, C, D, and E) with no attractive force measurement experience were selected.

2) Verification method

The proposed revision of the ISO 13017 written standards were distributed to each measurer, and was evaluated according to the following procedure.

Stage 1: Measurement was performed only by reference to the proposed revision of the ISO 13017 written standards.

Stage 2: Questions were asked to experts, and remeasurement was performed.

Stage 3: Remeasurement was performed after observing the measurement by experts.

Feedback was performed after the completion of Stage 1 measurement to elucidate unclear points of the proposed revision.

3. Sample and measurement conditions

1) Sample

Dental magnetic attachment (GIGAUSS C600, GC) was used as a measurement sample. The public value of this sample was 5.88 N.(fig. 1)

2) Measurement conditions

A simplified attractive force measuring device was used for the measurement. (fig. 2) The crosshead speed was 4.4 mm/min. The number of a sample was one, and measurement was performed 10 times. The number of attachment and removal was 5 times for each stage.



Fig. 1 GIGAUSS C600



Fig. 2 Simplified attractive force measuring machine

Results

1. Attractive force measurement value by each measurer

Fig. 3 shows the attractive force measurements of measurers A, B, and C. Consistent attractive force measurements were obtained from Stage 1 to 3. Standard deviation became smaller from Stage 1 to 3.

Fig. 4 shows the attractive force measurements of measurers D and E. The average of measurement results of Stage 1 were lower than the public value of 85%. Consistent attractive force measurement values were obtained for Stage 2 and 3.

Fig. 5 shows five measurements of Stage 1 by measurers D and E whose measurements showed a high standard deviation. Although the second measurement of the measurer D reached 85% of the public value, the results were higher error was observed after the third measurement. For the measurer E, measurements became consistent after the third measurement by repeating the measurement.

2. The contents of the proposed revision of the written standards that measurers could not understand

The following show the points in the written standards where measurers did not understand after Stage 1.

- ① The description about a magnet or magnetic assembly, and magnet or keeper is complex.
- ② Cure time and the amount of adhesive are unclear.
- ③ The positional adjustment of a magnetic assembly and keeper is unclear.
- ④ The removal method of a magnetic assembly and keeper is unclear.

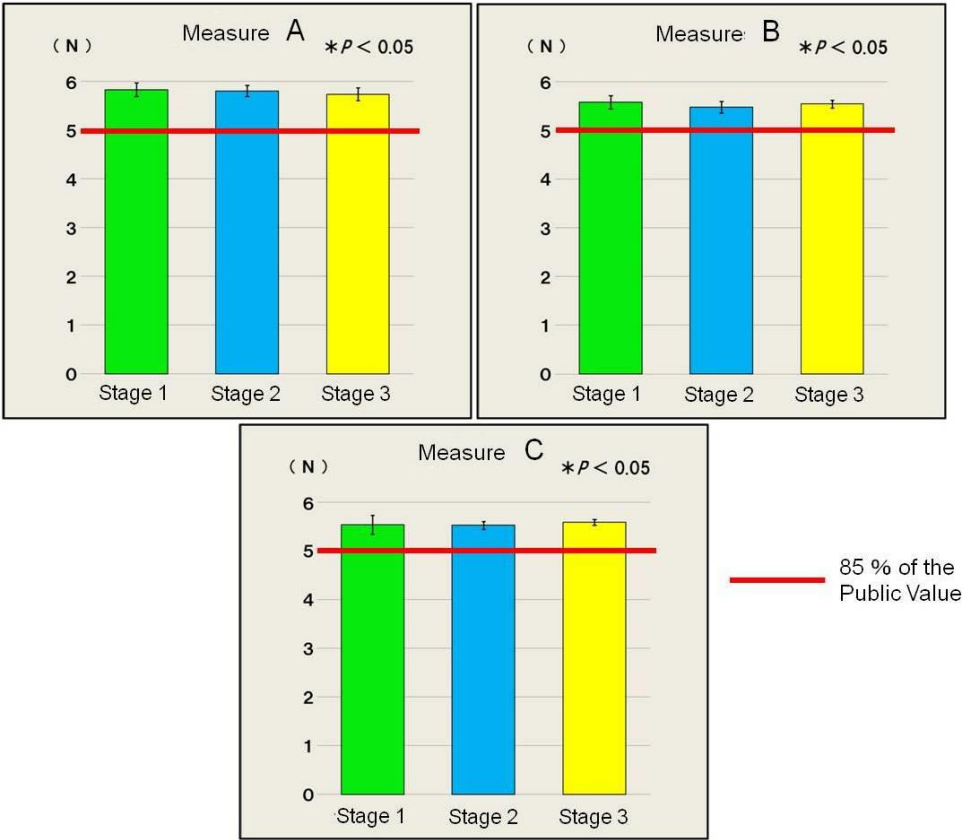


Fig. 3 Attractive force measurements of measurers A, B, C

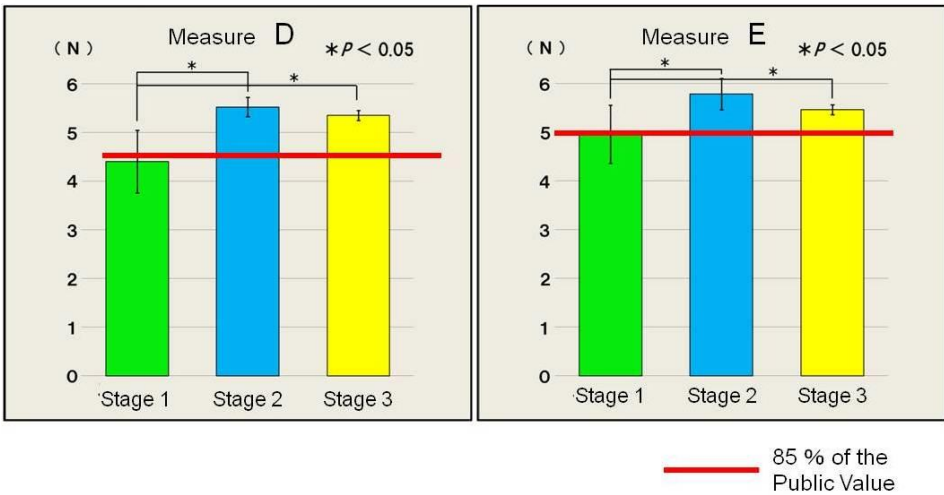


Fig. 4 Attractive force measurements of measurers D, E

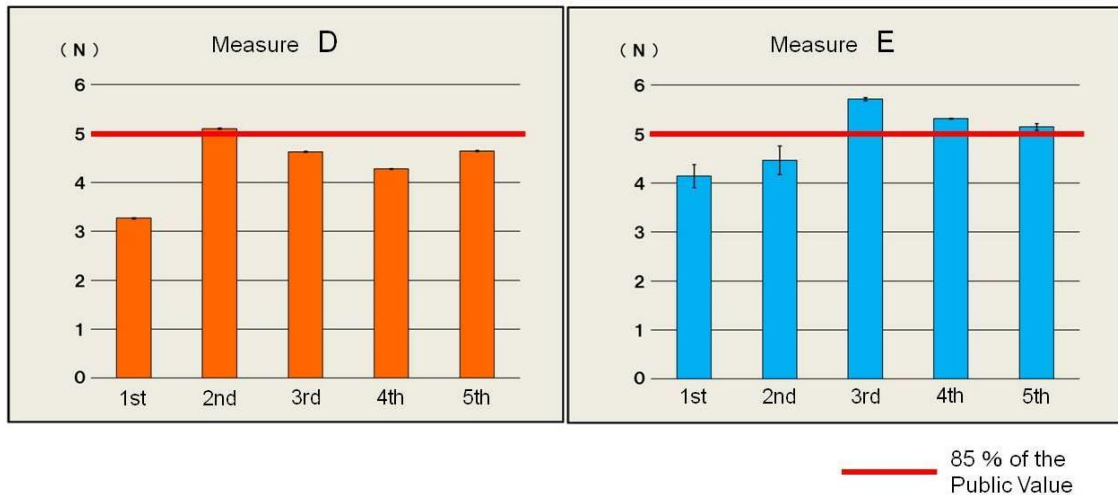


Fig. 5 Five measurements of Stage 1 by measurers D and E

Discussion

1. Measurement results

Measurement results of the measurers A, B, and C were consistent, showed small standard deviation, and exceeded 85% of the public value, suggesting that the measurers A, B, and C understood the contents of the proposed revision of the written standards before performing attractive force measurement (Fig. 3).

Stage 1 measurements of the measurers D and E showed high standard deviation. This was considered to be due to the fact that measurers did not fully understand the contents of the proposed revision. The more a measurement was repeated, the more consistent measurements became. This was considered to be due to the fact that measurers understood the contents after repeating the procedure.

Although the second measurement of the measurer D reached 85% of the public value, the results were back to low after the third measurement. It was found that the measurer damaged a magnetic assembly and keeper during the second removal, causing unstable results (Figure 4 and 5).

2. The contents of the proposed revision of the written standards

A feedback from measurers after the measurement showed that although the contents of the proposed revision of the written standards that are difficult to understand directly influence on the attractive force measurement value, they were understood by repeating the measurement. To improve the understanding, diagrams should be included in the proposed revision.

Conclusion

The results of the present study showed that a proposed revision of the written standards appears sufficient to standardize the attractive force measurement of a magnetic attachment internationally, suggesting an efficiency with revision of measurement instruction document contents.

References

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