

The Measurement of Surface Hardness of Mineral Trioxide Aggregate Material (MTA) using Two Techniques of Condensation.

Maha A. Al-Murad
BDS, MSc (Assist Lect)

Department of Conservative Dentistry
College of Dentistry, University of Mosul

ABSTRACT

Aims: This in vitro study was conducted to exam the effect of condensation technique on surface hardness of MTA. **Materials and Methods:** In this study, 20 acrylic blocks were used. In each block a cubic shape cavity 4 mm in width and 4 mm in depth was prepared. The first group which involve ten samples were filled with MTA using hand condensation method. The other ten samples were filled with MTA using hand method followed by ultrasonic activation for one second after each increment. All sample after setting were prepare for Vickers Hardness Test. The first group subjected to a load started from 0.5 Kg and show fatigue at 1 kg using the Vickers Hardness Machine. The second group subjected to a load started from 0.5 Kg and increased the load until showed fatigue of the material at 3 Kg using the Vickers Hardness Machine. All the samples were examined using stereo microscope the magnification power about 200x to perform hardness number. **Results:** Samples condensed with hand method followed by ultrasonic condensation showed more surface hardness than samples condensed with hand method only. There was highly significant difference between samples. **Conclusions:** Because OF use MTA as pulp capping is import to use Ultrasonic condensation for placement of MTA. **Key words:** Surface hardness, condensation, MTA.

Al-Murad MA. The Measurement of Surface Hardness of Mineral Trioxide Aggregate Material (MTA) using Two Techniques of Condensation. . *Al-Rafidain Dent J.* 2008; 8(2):266-269.

Received: 7/5/2008

Sent to Referees: 7/5/2008

Accepted for Publication: 7/10/2008

INTRODUCTION

Mineral trioxide aggregate (MTA) developed in 1993, is a potential alternative to the traditional materials⁽¹⁾.

MTA is designed to seal all possible communications between the tooth and the external surface and has been recommended as a material for use in perforation repair and retrograde filling. Recently, MTA has been suggested for vital pulp capping^(2,3) and apical plug formation of open apex⁽⁴⁾.

Studies^(5,6) have demonstrated cemental repair, formation of bone and regeneration of the periodontal ligament when MTA is used in endodontics. It has been shown to be biocompatible by several researches^(7,8).

Leakage studies indicated that MTA provide a superior seal even when placed under adverse conditions, such as in the presence of moisture and blood^(9,10).

Several in vitro and in vivo studies have showed that the sealing ability and biocompatibility of MTA are superior to that of amalgam, IRM and super-EBA.⁽⁴⁾ However, it is not easy to handle, and obtain consistent result in clinical applications. The particles size, powder to liquid ratio, environmental

temperature and presence of air in the mixture may all affect the physical properties of MTA⁽⁴⁾.

Mineral trioxide aggregate (MTA) was introduced as a cement that may have some potential as a root canal obturating material. Some investigators have suggested using MTA to obturate the entire root canal system^(11,12).

In 2004 Vizgirda *et al.*⁽¹³⁾ evaluated the potential of using MTA as a root canal filling by comparing its apical sealing ability with that of laterally condensed gutta percha with sealer and higher temperature thermo-plasticized gutta percha with sealer in the extracted bovine teeth. MTA was placed onto the canal using a lentulo spiral until the material reached the canal orifice. Their results suggested that gutta percha obturation might provide an apical seal that was superior to MTA. A possible explanation of MTA was difficult to place and condense it in the apical portion of the root canal conceivably, the use of ultrasonic activation might improve this phenomenon.

In 2003 Amonoshariae *et al.*⁽¹⁴⁾ examined the adaptability of MTA to the walls of

plastic tubes simulating root canal walls when placed from an orthograde approach using hand placement and ultrasonic methods. Twelve samples were evaluated with a light microscope and radiograph for the degree of adaptability of MTA to the tube wall and for the presence of voids within the MTA material itself. They found that hand condensation result in a better adaptation to the tube walls and fewer voids than the ultrasonic method.

Up to date, there has been only studies quantitatively comparing the surface hardness of MTA produced by hand condensation and ultrasonic activation. The purpose of this study is to quantitatively compare the surface hardness of MTA produced by two different placement.

MATERIALS AND METHODS

twenty acrylic blocks were used. In each block a cubic shape cavity about 4 mm in width and 4 mm in depth were prepared (Figure 1).



Figure (1): Samples

These 20 blocks were divided into two groups.

The MTA (ProRoot Dentsply, Tulsa Dental, Tul –sa, ok) (Figure 2) was mixed with sterile water at powder to liquid ration 3:1 and the mixture was incrementally placed and condensed by condenser in the first ten samples using hand method only.

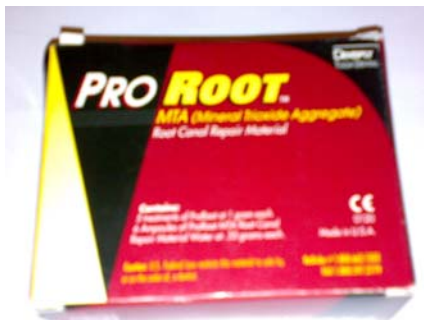


Figure (2): MTA material

For the 2nd group the ultrasonic method, after each MTA increment was condensed with a hand condenser, it was activated for one second with ultrasonic tip DS –007 INSERT F (Piezon Master 400 EMS) (Figure 3).



Figure (3): Piezon Master 400 EMS.

Vickers Hardness test using Vickers hardness mashine (Figure4) (Wolpert, Germany) consists of indentation the test material with a diamond indenters in the form of a right pyramid with a square base and an angle of 136 degree between opposite faces subjected to a load of 1 to 100 kg. The load is normally applied for 10 to 15 seconds.



Figure(4): Vickers hardness mashine

The load is normally applied for 10 to 15 seconds. The two diagonals of the indentation left in the surface of the material after removal of the load are measured using stereomicroscope (Germany) (Figure5) the magnification of 200x and their average calculated.



Figure (5): Stereomicroscope

The used of this formula to calculate the Vickers Hardness number (VHN) in Kg/mm²:

$$VHN = 1.854 \text{ p/d}^2$$

Where:

P= load

D= average of diagonals.

The results were analyzed statistically using t – test to determine whether there were any statistically significant differences

between the groups at the 5% level of significance (p< 0.05).

RESULTS

The sample of ultrasonic method resulted in a greater surface hardness than using hand condensation only. So, the mean of hand condensation about 4.8880 Kg/mm² while the mean for ultrasonic method about 46.3100 Kg/mm². (Table 1).

Table (1): Comparison of mean surface hardness of MTA between groups.

Group	No. of teeth	Mean (Kg/mm ²)	SD
Hand condensation	10	4.8880	1.127
Ultrasonic condensation	10	46.3100	7.024

Significant difference at P< 0.05.

Table (2) represented the t –test between the groups. There was a statistically significant difference of MTA in ultrasonic

condensation (p< 0.0001) over the hand condensation group.

Table (2): T – test between groups.

Group	T – value	df	P – value
Hand condensation	– 18.412	18	0.000
Ultrasonic condensation			

Significant difference at p< 0.05

DISCUSSION

Although the measurement of surface hardness for root canal filling is not needed as those for coronal restoration like amalgam, composite, but when used MTA as pulp capping^(2,3) is wise to determine the best method for placement,

In this study, when used hand condensation only the load applied for Vickers Hardness Number is begin at 0.5 Kg/mm² and increase until show fatigue of the material at 1 Kg/mm². This could be explained by using the formula for surface hardness: VHN= 1.854 p/d². While, when the used hand condensation followed by ultrasonic activation the load is begin in 0.5 Kg/mm² and increased until show the material fatigue at 3 Kg/mm².

CONCLUSION

1. Hand condensation for MTA is accepted method.

2. Ultrasonic method of condensation increase it is surface hardness.
3. It is preferable to use ultrasonic condensation .

REFERENCES

1. Camlleri J. A review of the methods used to study biocompatibility of Portland cement –derived materials used in dentistry. *Malta Med. J.* 2006; 18: 9 –14.
2. Alexandra MD, Sada A, Mario RL, Paulo N, Assed B. MTA and calcium hydroxide for pulp capping. *J. Applied Oral Sci.* 2005; 13: 1 –10.
3. Abedi HR, Torabinejad M, Pitt Ford TR, Bakland LK. The use of mineral trioxide aggregate on direct pulp capping agent. *J. Endodon.* 1996; 22: 199.
4. Torabinejad M, Chivian N. Clinical applications of mineral trioxide aggregate. *J. Endodon.* 1999; 25: 197 –205.

5. Torabinejad M, Hong CU, McDonald F, Pitt Ford TR. Physical and chemical properties of a new root –end filling material. *J. Endodon.* 1995; 21: 349 – 353.
6. Pitt ford TR, Torabinejad M, McKendry DJ, Hong CU, Kariyawasam SP. Use of mineral trioxide aggregate for repair of furcal perforations. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.* 1995; 79: 756 – 763.
7. Kettering JD, Torabinejad M. Investigation of mutagenicity of mineral trioxide aggregate and other commonly used root end filling materials. *J. Endod.* 1995; 21: 537 – 542.
8. Torabinejad M, Pitt ford TR, Abedi HR, Kariyawasam SP, Tang H. Tissue reaction to implanted root –end filling materials in the tibia and mandible of guinea pigs. *J. Endodon.* 1998; 24: 468 – 471.
9. Torabinejad M, Higa RK, McKendry DJ, Pitt ford TR. Dye leakage of four root – end filling materials: effect of blood contamination. *J. Endodon.* 1994; 20: 159 – 163.
10. Torabinejad M, Rastegar AF, Kettering JD, Pitt ford TR. Bacterial leakage of mineral trioxide aggregate as a root end filling material. *J. Endodon.* 1995; 21: 109 – 112.
11. Koh ET, Pitt Ford TR, Kariyawasam SP. Prophylactic treatment of dens evaginatus using mineral trioxide aggregate. *J. Endodon.* 2001; 27: 540 – 542.
12. O'Sullivan S, Hartwell GR. Obturation of a retained primary mandibular second molar using mineral trioxide aggregate: a case report. *J. Endodon.* 2001; 27: 703 – 705.
13. Vizgirda J, Liewehr FR, Patton WR, McPherson JC, Buxton TB. A comparison of laterally condensed gutta percha, thermoplasticized gutta percha and mineral trioxide aggregate as a root canal filling materials. *J. Endodon.* 2004; 30: 103 – 106.
14. Amonoshariae A, Hartwell GR, moon PC. Placement of mineral trioxide aggregate using two different techniques. . *J. Endodon.* 2003; 29: 679 – 682.
15. Prisilla C. Comparison the fill density of MTA in simulated root canal using two placement method. . *J. Endodon.* 2003: 15 – 40.