

ORIGINAL RESEARCH

Evaluation of Compressive Strength for a Combination of Glass Ionomer Cement and Antibiotics

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ABSTRACT

Aims and objectives: Since atraumatic restorative treatment (ART) involves removal of carious lesions with manual instruments, there are more chances of residual bacteria under the glass ionomer restoration which might lead to secondary caries. Hence improving the antibacterial effect of glass ionomer cement helps in achieving better success rate. This study aimed to evaluate the compressive strength of glass ionomer cement containing different antibiotics.

Materials and methods: Conventional restorative glass ionomer cement (Fuji IX) was used as control group. The experimental groups used were as follows: group 1: (Ciprofloxacin 50 mg + Cefuroxime 50 mg + metrogyl 50 mg) + GIC 9850 mg. Group 2: (ciprofloxacin 100 mg + cefuroxime 100 mg + metrogyl 100 mg) + GIC 9700 mg. Group 3: cetrimide 100 mg + GIC 9900 mg. Group 4: cetrimide 200 mg + GIC 9800 mg. Cylindrical specimens of dimensions 6 mm of length and 5 mm in diameter were prepared. The specimens were subjected to compressive loading using Instron universal testing machine at a crosshead speed of 1 mm/minute.

Results: The experimental groups showed lower compressive strength when compared to the control group. No significant difference was found between control group and group 1. The compressive strength of groups 2, 3 and 4 was significantly less when compared to control group and group 1.

Keywords: Atraumatic restorative technique, Glass ionomer cement, Ciprofloxacin, Cefuroxime, Metrogyl, Cetrimide.

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INTRODUCTION

Dental caries is the most prevalent noncommunicable diseases in the world. Tooth loss due to extraction is mainly due to extensive caries with loss of the maximum amount of tooth structure and its sequelae including failed conservative procedures. Incidence of caries is more in low and middle income populations and in the countries with minimal facilities of dental care, like scarcity of dental professionals, electricity, equipment and awareness of oral health. Lack of proper dental care causes more of extraction of teeth rather than restorative treatment which affects the quality of life of the population.

The restoration/extraction ratio in Tanzanian population was found to be 0.04, indicating that dental professionals

rarely restore the teeth.¹ In a study carried out in a dental teaching institution in South India, it was found that 39.5% of the teeth were extracted due to dental caries and its sequelae.²

To combat with caries, a minimally invasive technique has been introduced in the last two decades, atraumatic restorative technique (ART) which is a combination of both a preventive and a restorative procedure. There is increasing worldwide interest in the usage of conservative atraumatic restorative technique for the restoration of primary and permanent teeth. This is an approach to the management of carious lesions that uses only hand instruments to remove decalcified tooth tissue and to restore the tooth involved with an adhesive restorative material.

Conventional restorative procedures require the use of dental materials, expensive equipments, instruments and electricity. This makes dental restorations costly and limits the availability and accessibility of the service to areas where these facilities are available. ART has been an economical, effective method for preventing and controlling caries in vulnerable populations.³ This technique is promising for treating caries in developing countries where resources are scarce.

The ART technique is strongly recommended for management of small, occlusal carious lesions in primary and permanent teeth.⁴ It is also gaining acceptance in developed countries for the management of caries in children, mentally challenged patients and in geriatric patients.

ART technique advocates removal of caries with hand instruments alone. In such cases carious dentin may be inadvertently or deliberately left *in situ*. It has been shown that hand excavation is less effective in removal of caries when compared to the rotary burs.^{5,6} The bacteria in this residual caries may lead to secondary caries over a time and cause failure of the restoration. This problem can be solved to some extent by usage of restorative materials that inhibit the bacterial growth effectively.

Conventional glass ionomer cement is the most commonly recommended dental restorative material for the ART approach.⁷ The caries preventive effect of ART sealants using high-viscosity glass-ionomer is very high.⁸ Glass ionomer cement presents a broad anticariogenic effect and may be of value in preventing secondary caries, even under conditions of a high caries risk.⁹

Glass ionomer cement presents a broad anticariogenic effect and is of great value in preventing secondary caries,

even under conditions of a high caries risk.¹⁰ This property made glass ionomer cement as the choice of restorative material for atraumatic restorative technique. However, whether the caries-inhibitor influence is sufficient to completely arrest the caries process is still doubtful.

Studies have shown the presence of residual bacteria under the glass ionomer restorations.^{11,12} For increasing the success rate of ART, along with effective removal of caries a best restorative material should be used which will inhibit the residual bacterial growth after sealing of the carious lesion. In this attempt many researchers incorporated various antibacterial agents into glass ionomer cement or into varnish before restoring the cavity to increase the antibacterial activity. The various antibacterial agents in trials are tetracyclines, fluoroquinolones, cephalosporins, metronidazole, bioactive glass, chlorhexidine dihydrochloride, chlorhexidine diacetate, cetylpyridinium chloride, cetrimide, benzalkonium chloride, zinc phosphate.

Glass ionomer cement containing antibiotics were recommended for the treatment of carious lesions which reduced the total number of viable bacteria.¹³

Incorporation of these agents had increased the antimicrobial affect, but their effect on the physical and mechanical properties of the glass ionomer cement needs further research.

This study evaluated the compressive strength of glass ionomer cement containing different antibiotics.

MATERIALS AND METHODS

Conventional restorative glass ionomer cement (Fuji IX) was used as control group.

The experimental groups used were as follows:

- Group 1 : (Ciprofloxacin 50 mg + cefuroxime 50 mg + metrogyl 50 mg) + GIC 9850 mg
- Group 2 : (Ciprofloxacin` 100 mg + cefuroxime 100 mg + metrogyl 100 mg) + GIC 9700 mg
- Group 3 : Cetrimide 100 mg + GIC 9900 mg
- Group 4 : Cetrimide 200 mg + GIC 9800 mg

Teflon mold was made of dimensions 6 mm of length and 5 mm in diameter. Cylindrical shaped GIC specimens were prepared as per the above mentioned ratios. The specimens were allowed to set and then stored in distilled water for 7 days. The specimens were then subject to compressive loading using Instron universal testing machine at a crosshead speed of 1 mm/minute. Comparison of means between groups was done using 't' test. A p-value < 0.05 was considered significant for all statistical analyses.

RESULTS

The experimental groups showed lower compressive strength when compared to the control group. No significant

difference was found between group 1 and control group. The compressive strength of groups 2, 3 and 4 was significantly less when compared to control group and group 1. There was significant difference between groups 2, 3 and 4 (Graph 1).

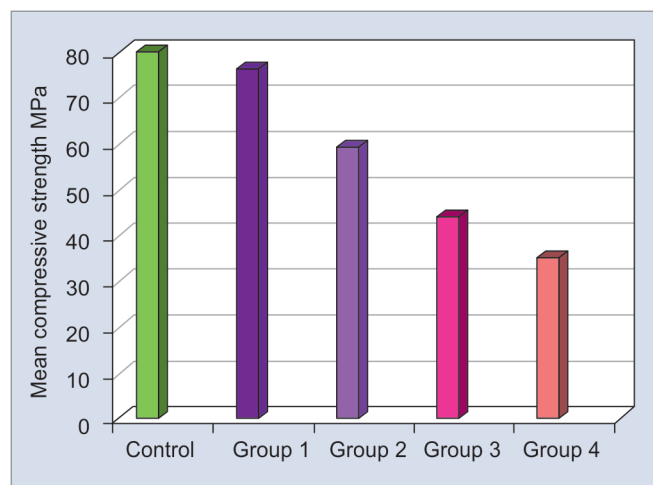
DISCUSSION

ART technique is less traumatic to the patient when compared to conventional techniques with rotary instruments.^{14,15} In an Oral Health Care program at Zimbabwe that was carried out among secondary school students during a period of 3 years showed that, ART with glass ionomer restorative material provided high quality preventive and restorative dental care.¹⁶ A 3 years study conducted in Brazilian school children showed that the teeth affected by caries can be retained without extraction in 94.7% of the restored teeth in high cries risk population.¹⁷

Survival rates of single-surface ART restorations in permanent posterior teeth, using high-viscosity glassionomers, do not differ significantly from comparable traditional restorations using amalgam.^{18,19} ART restorations using high-viscosity glass-ionomers were more cost-effective after 2 years than comparable amalgam restorations.²⁰

The ability of a restorative material to inhibit caries formation is an important clinical therapeutic property. Restriction of nutrients to the residual bacteria within the carious lesion and release of fluoride form the glass ionomer cement were proposed to be caries inhibiting. But whether this influence is sufficient to completely arrest the carious process is still doubtful.¹¹

The antibacterial activity of high-viscosity glass-ionomers used with ART has recently been investigated. Both freshly mixed²¹ and 1-week-old high-viscosity glassionomers²² showed antibacterial properties against various microorganisms.



Graph 1: Mean compressive strengths after 7 days

The fluoride level in plaque growing on glass ionomer is high which decreases the level of Mutans streptococci in dental plaque.¹⁰ Freshly-mixed glass ionomer cements are antimicrobial against *S. mutans* and the mechanism of action is probably because of both fluoride and pH.²³ One study showed that there was no antibacterial activity despite the presence of fluoride in the agar around the set materials.²⁴ Hence some antibacterial additives need to be incorporated within the glass ionomer cement for successful ART therapy.

It was showed that use of GIC-containing antibiotics for sealing the carious lesion will reduce the viable bacteria.²⁵

In the current study when compared with the control specimens, the compressive strength of the groups having increasing concentration of antibiotics was significantly lower. Compressive strength of group 1 was not significantly lower when compared to control group. The compressive strength of group 2 was much lower when compared to group 1 and control group, but was still under acceptable limits.

Compressive strength of groups 3 and 4 was lower when compared to groups 1 and 2. In group 3 and 4 in spite of higher concentration of the original glass ionomer cement, the strength was compromised. This might be due to some additional reaction occurring between the glass ionomer cement and cetrimide. Additionally it was also observed the setting time of the glass ionomer cement in groups 3 and 4 was increased when compared to the control group, groups 1 and 2.

CONCLUSION

The results of this *in vitro* study demonstrated that addition of antibiotics to conventional GIC decreased the compressive strength in all the groups. But the reduction in compressive strength in the group containing 1.5% of triple antibiotics was acceptable. However, long term clinical studies are still required investigating the antimicrobial strength, setting time, bonding to dentin, etc.

REFERENCES

- Kikwilu EN, Frencken JE, Mulder J. The impact of the atraumatic restorative treatment (ART) on the treatment profile in Government Dental Clinics in Tanzania. *BMC Oral Health* 2009;9:14.
- Anand PS, Kuriakosei S. Causes and patterns of loss of permanent teeth among patients attending a dental teaching institution in south india. *J Contemp Dent Pract* 2009;10(5): E057-64.
- Frencken JE, Pilot T, Songpaisan Y, Phantumvanit P. Atraumatic restorative treatment (ART): rationale, technique, and development. *Journal of Public Health Dentistry* (1996);56(3 Spec No):135-140; discussion 161-163.
- Motsei SM, Kroon J, Holtshowsen WS. Evaluation of atraumatic restorative treatment restorations and sealants under field conditions. *SADJ* 2001 Jul;56(7):309-315.
- Smales RJ, Fang DT. In vitro effectiveness of hand excavation of caries with the ART technique. *Atraumatic restorative treatment. Caries Res* 1999 Nov-Dec;33(6):437-440.
- Weerheijm KL, Groen HJ. The residual caries dilemma. *Community Dent Oral Epidemiol.* 1999 Dec;27(6):436-441.
- Holmgren CJ Frencken JE. Painting the future for ART. *Community Dentistry and Oral Epidemiology* 1999;27(6) 449-453.
- Van't Hof MA, Frencken JE, van Palenstein Helderma WH, Holmgren CJ. The ART approach for managing dental caries: a meta-analysis. *Int Dent J* 2006;56:345-351.
- Benelli EM, Serra MC, Rodrigues AL Jr, Cury JA. In situ anticariogenic potential of glass ionomer cement. *Caries Res* 1993;27(4):280-284.
- Forss H, Jokinen J, Spets-Happonen S, Seppä L, Luoma H. Fluoride and mutans streptococci in plaque grown on glass ionomer and composite. *Caries Res* 1991;25(6):454-458.
- Van Amerongen WE. Dental caries under glass ionomer restorations. *J Public Health Dent* 1996;56(3 Spec No):150-154; discussion 161-163.
- Weerheijm KL, de Soet JJ, van Amerongen WE, de Graaff J. The effect of glass-ionomer cement on carious dentine: an in vivo study. *Caries Res* 1993;27(5):417-423.
- Pinheiro SL, Simionato MR, Imparato JC and Oda M. Antibacterial activity of glass ionomer cement containing antibiotics on caries lesion microorganisms *Am J Dent* 2005;18(4):261-266.
- van Amerongen WE, Rahimtoola S. Is ART really atraumatic? *Community dentistry and oral epidemiology* 2000;27(6): 431-435.
- Schriks MCM, van Amerongen WE. Atraumatic perspective of ART. Psychological and physiological aspects of treatment with and without rotary instruments. *Community Dent Oral Epidemiol* 2003;31:15-20.
- Frencken JE, Makoni F, Sithole WD. ART restorations and glass ionomer sealants in Zimbabwe: survival after 3 years. *Community Dentistry and Oral Epidemiology* 1999;26(6):372-381.
- Wang L, Lopes LG, Brescians E, Lauris JR, Mondelli RF, Navarro MF. Evaluation of class I ART restorations in Brazilian school children : three-year results. *Spec Care Dentist* 2004 Jan-Feb;24(1):28-33.
- Frencken JE, van't Hof MA, van Amerongen WE, Holmgren CJ. Effectiveness of single-surface ART restorations in the permanent dentition: a meta-analysis. *J Dent Res* 2004;83: 120-123.
- Frencken JE, Taifour D, van't Hof MA. Survival of ART and amalgam restorations in permanent teeth after 6.3 years. *J Dent Res* 2006;85:622-626.
- Estupinan-Day S, Milner T, Tellez M. Oral health of low income children. Procedures for Atraumatic Restorative Treatment. Final Report. Washington: Pan American Health Organization 2006.
- Da Silva RC, Zuanon AC, Spolidorio DM, Campos JA. Antibacterial activity of four glass ionomer cements used in atraumatic restoration 557-564 ve treatment. *J Mater Sci Mater Med* 2007;18:1859-1862.
- Davidovich E, Weiss E, Fuks AB, Beyth N. Surface antibacterial properties of glass ionomer cements used in atraumatic restorative treatment. *J Am Dent Assoc* 2007;138:1347-1352.
- DeSchepper EJ, White RR, von der Lehr W. Antibacterial effects of glass ionomers. *Am J Dent* 1989 Apr;2(2):51-56.
- Yap AU, Khor E and Foo SH. Fluoride release and antibacterial properties of new-generation tooth-colored restorations. *Operative Dentistry* 24(5):297-305.
- Pinheiro SL, Simionato MR, Imparato JC and Oda M. Antibacterial activity of glass ionomer cement containing antibiotics on caries lesion microorganisms *Am J Dent* 2005;18(4):261-266.

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