



Polymerization Shrinkage Stress Reduction in Direct Occlusal Composite Restoration Placed Using Split-increment Horizontal Technique - Case Report

Corresponding Author:

Prof. Khamis Hassan,
Professor and Clinical Consultant of Operative Den, Restorative Dental Sciences Department, College of Dentistry, King Saud University, POB 60169, 11545 - Saudi Arabia

Submitting Author:

Prof. Khamis A Hassan,
Professor and Clinical Consultant of Operative Den, Restorative Dental Sciences Department, College of Dentistry, King Saud University, POB 60169, 11545 - Saudi Arabia

Article ID: WMC00626

Article Type: Case Report

Submitted on: 14-Sep-2010, 08:54:29 PM GMT **Published on:** 14-Sep-2010, 10:35:56 PM GMT

Article URL: http://www.webmedcentral.com/article_view/626

Subject Categories: DENTISTRY

Keywords: Posterior Composites, Polymerization Shrinkage, Stress Reduction, C-Factor, Split-Increment, Horizontal, Placement Technique

How to cite the article: Hassan K . Polymerization Shrinkage Stress Reduction in Direct Occlusal Composite Restoration Placed Using Split-increment Horizontal Technique - Case Report . WebmedCentral DENTISTRY 2010;1(9):WMC00626

Source(s) of Funding:

This is a non-funded article

Competing Interests:

There is no competing interests

Polymerization Shrinkage Stress Reduction in Direct Occlusal Composite Restoration Placed Using Split-increment Horizontal Technique - Case Report

Author(s): Hassan K

Abstract

Several incremental placement techniques have been introduced in an effort to reduce polymerization shrinkage stress associated with light curing of composite resins. In the horizontal technique, placement of each composite increment connects the cavity floor with the four surrounding walls and produces, upon light curing, the highest and the most unfavorable C-factor ratio of 5. Concern has been expressed when individual increments are placed to simultaneously contact opposing cavity walls before light-curing as the resulting polymerization shrinkage stress may cause the cusps to deform by bending toward each other. This stress may cause postoperative sensitivity and can be detrimental to the tooth and the marginal integrity over time.

In the presented split-increment horizontal technique, each horizontal increment was split into four triangular-shaped portions before curing, where each portion bonds only to one cavity wall and part of the floor. Then, one diagonal cut was completely filled with dentin shade composite and light-cured, followed by filling and curing of one half of the second diagonal cut at a time. This increment splitting would reduce the C-factor ratio from 5 to 0.5 and permit the shrinkage stress to be relieved by flow of the free composite surface at the diagonal cuts and not at the bonded interfaces, thus minimizing the adverse effects of the generated polymerization shrinkage stresses.

Introduction

There has been an increase in the use of composite resin for restoring posterior teeth in the past few years. It is well-known that all composite resins shrink during polymerization, and shrinkage presents several challenges during placement and light-curing. Upon resin curing, polymerization shrinkage stresses are generated which may initiate adhesive failure at the composite-tooth interface leading to gap formation between composite resin and cavity walls. Oral fluids containing bacteria may fill this gap and cause microleakage and secondary caries. Cohesive failure

may also occur in the form of microcracks of composite resin. In addition, coronal deformation may result from transfer of these shrinkage stresses to the tooth causing postoperative sensitivity and propagation of existing enamel microcracks.

The magnitude of these stresses depends on several factors including resin modulus of elasticity, rate of polymerization and restorative techniques as well as cavity configuration (C-factor). The C-factor is the ratio between bonded and unbonded surfaces where the higher the ratio, the higher is the polymerization stress.

Class I occlusal cavity preparations have the highest C-factor as they have only one free, unbonded surface which is able to deform as polymerization shrinkage occurs, causing the highest and most unfavorable stresses at the cavity walls and margins.

Practitioners and researchers are aware of the adverse effects of the shrinkage stresses. Several efforts have been made to decrease these stresses and were directed toward improving composite resin formulation, curing methods and restorative placement techniques.

Incremental placement techniques are widely recognized as a major factor in the reduction of shrinkage stresses. These techniques include the horizontal occluso-gingival layering, the wedge-shaped oblique layering, the successive cusp buildup technique, and the split-increment horizontal placement technique.

Clinicians realize that placing an "esthetic" high quality posterior composite resin restoration is demanding and technique-sensitive. In the present technique the clinicians need to sculpt only the last dentin increment and the enamel increment overlying it as well, while in the cusp successive buildup technique, the clinicians are required to place and sculpt several wedge-shaped oblique increments for building up each cusp separately. This would require considerably more of the chair-side time than that needed to place a similar restoration using the split-increment technique. The increased time would require an increased fee charged to the patient.

This paper reports a clinical case that presents a step-by-step demonstration of Class I occlusal composite resin restoration placed using the

split-increment horizontal placement technique. In this technique, each composite horizontal increment is split into four portions before curing. Each portion of the split-increment contacts only two cavity surfaces, not opposing each other, during light curing.

Case Report(s)

A 35-year old male patient presented with a defective large Class I occlusal amalgam restoration in tooth No. 37 (lower left second molar). The selected shade was A1. After anesthesia of the involved quadrant and rubber dam application, amalgam was removed and cavity was refined using standardized operative procedures.

Single Bond 2 adhesive system (3M ESPE, St Paul, MN, USA) was applied to the entire cavity following the manufacturer's directions. The first 2 mm increment (A2 dentin shade) of Filtek Supreme Plus nanofilled composite resin (3M ESPE, St Paul, MN, USA) was placed horizontally and adapted to the cavity floor. Before light curing, this increment was diagonally split into four portions, Figure 1, using a blunt hand instrument in push stroke. Then, the increment was light-cured for 40 seconds from occlusal direction using Elipar Highlight curing light unit (ESPE America, Inc., Norristown, PA, USA).

One diagonal cut was completely filled with the same chroma dentin shade composite, Figure 2, followed by light curing for 20 seconds from occlusal direction. The second diagonal cut was then filled with the same chroma dentin shade composite, Figure 3, and light-cured in the same manner.

The second increment of dentin shade composite (A1), which is one chroma less than the previous one, was placed horizontally to cover the first light-cured increment, Figure 4. This increment matching the selected shade was extended to the DEJ. Similar treatment of this increment was performed as described for the previous one, except that top 1/5 of the central area of the two diagonal cuts was left unfilled with composite. This area was used for internal characterization with brown Chroma Zone Color Stain (Kurary, New York, NY, USA).

Following the internal characterization, the enamel shade composite increment (A1), matching the selected shade was placed horizontally to replace the lost enamel and extended from DEJ to contact the preparation cavosurface margin. This increment was shaped to establish the occlusal morphology, then split into four portions and light-cured for 20 seconds each from buccal, lingual and occlusal directions, Figure 5. The final increment of highly translucent shade

composite (YT) was placed to cover the enamel shade composite split-increment, without touching the cavosurface margin and light-cured for 40 seconds from the occlusal direction. This increment was not split.

Occlusal contouring of composite resin was performed using composite modeling instruments with silicon tips. Finishing was completed with Astropol small flame rubber polisher (Ivoclar, Amherst, NY, USA). Figure 6 shows the finished restoration.

Conclusion

The split-increment horizontal technique introduced for placement of direct posterior composite resin in moderate-large occlusal Class I cavities offers several advantages. It would result in minimizing the detrimental effects of polymerization shrinkage stresses at the cavity walls and adhesive interface by the reducing the C-factor ratio from 5.0 to 0.5. Compared to the successive cusp build-up technique, the split-increment technique would make placement of composite resin in Class I occlusal cavities easier and faster and would encourage the less-experienced general practitioners to satisfy the esthetic dental needs of their patients by providing high-quality posterior composite restorations.

References

1. Walls AWG, McCabe JF, Murray JJ. The polymerization contraction of visible-activated composite resin. *J Dent* 1989; 16:177-181.
2. Davidson CL, de Gee AJ, Feilzer A. The competition between the composite-dentin bond strength and the polymerization contraction stress. *J Dent Res* 1984; 3:1396-1399.
3. Jensen ME, Chan DCN. Polymerization shrinkage and microleakage. In: *Posterior composite resin dental restorative materials*, 1985. Vanherle G, Smith DC, editors. Utrecht, The Netherlands; Peter Szulc Publishing Co., pp. 243-262.
4. Lai JH, Johnson AE. Measuring polymerization shrinkage of photoactivated restorative materials by a water-filled dilatometer. *Dent Mater* 1993; 9:139-143.
5. Opdam NT, Roeter FJ, Feilzer AJ, Verdonschot EH. Marginal integrity and postoperative sensitivity in Class II resin composite restorations in vivo. *J Dent* 1998; 26:555-562.
6. Feilzer AJ, de Gee AJ, Davidson CL. Setting stress in composite resin in relation to configuration of the restoration. *J Dent* 1987; 66:1636-1639.

7. Lutz F, Krejci I, Oldenburg TR. Elimination of polymerization stresses at the margins of posterior composite resin restorations: A new restorative technique. *Quintessence Int* 1986; 17:777-784.
8. McCullock AJ, Smith BGN. In vitro studies of cuspal movement produced by adhesive restorative materials. *Br Dent J* 1986; 161:405-409.
9. Segura A, Donly KJ. In vitro polymerization recovery following hygroscopic expansion. *J Oral Rehabil* 1993; 20:495-499.
10. Suliman AA, Boyer DB, Lakes RS. Cusp movement in premolars resulting from composite polymerization shrinkage. *Dent Mater* 1993; 9:6-10.
11. Spreafico RC, Gagliani M. Composite resin restorations on posterior teeth. In: Roulet JF, Degrange M. *Adhesion: The silent revolution in dentistry*. Chicago: Quintessence; 2000:253-276.
12. Lutz F, Krejci I, Barbakow F. Quality and durability of marginal adaptation in bonded composite restorations. *Dent Mater* 1991; 7:107-113.
13. Tjan AH, Bergh BH, Linder C. Effect of various incremental techniques on the marginal adaptation of Class II composite resin restorations. *J Prosthet Dent* 1992; 67:62-66.
14. Weaver WS, Blank LW, Pelleu GB. A visible-light-activated resin cured through tooth structure. *Gen Dent* 1988; 36: 236-237.
15. Liebenberg WH. Successive cusp build-up: an improved placement technique for posterior direct resin restorations. *J Can Dent Assoc* 1996; 62:501-507.
16. Liebenberg WH. The axial bevel technique: a new technique for extensive posterior resin composite restorations. *Quintessence Int* 2000; 31:231-239.
17. Vanini L. Light and color in anterior composite restorations. *Pract Periodontics Aesthet Dent* 1996; 8:673-682.
18. Hassan K, Khier S. Split-increment horizontal layering: A simplified placement technique for direct posterior resin restorations. *Gen Dent* 2005;53:406-409.

Illustrations

Illustration 1

The first horizontal increment of composite resin (A2 dentin shade) split into four triangular portions, before light curing.



Illustration 2

Following light curing of the split-increment, complete filling of one diagonal cut was made with the same chroma dentin shade composite and light cured.

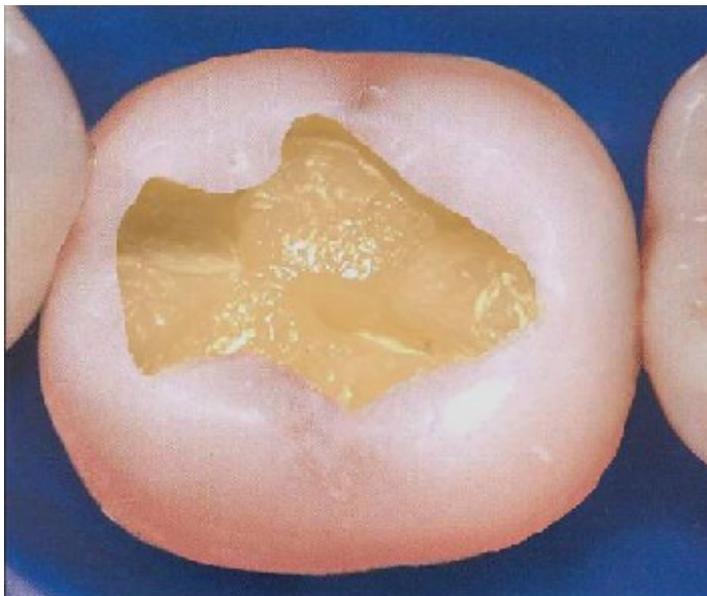


Illustration 3

The second diagonal cut was filled with the same chroma dentin shade composite and light cured.

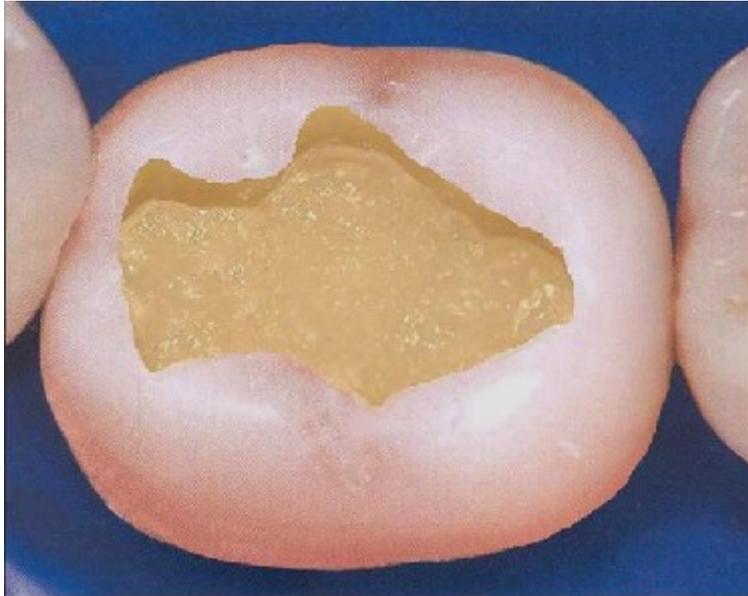


Illustration 4

The second horizontal increment of composite (A1 dentin shade) extended to the DEJ, similarly treated as the previous one, and internally characterized with brown chroma stain.



Illustration 5

The enamel shade composite increment (A1) was placed horizontally extending from DEJ to contact preparation cavosurface margin and establish occlusal morphology. It was then split into four portions and light-cured.

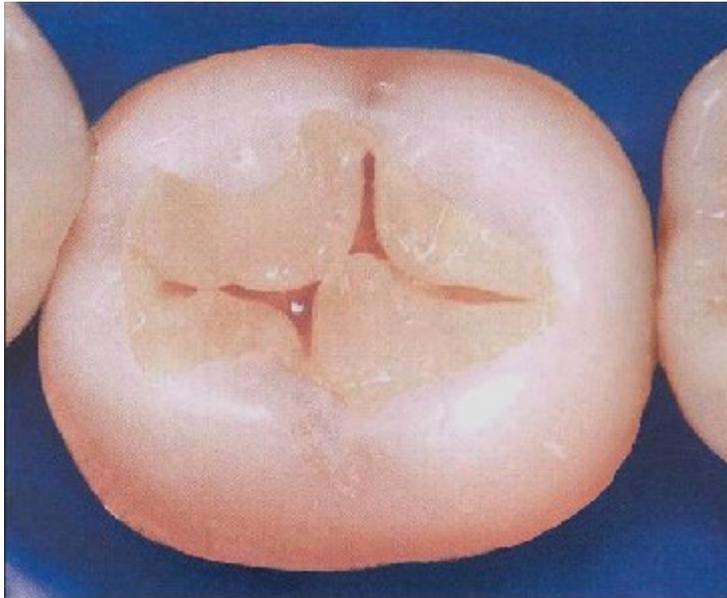
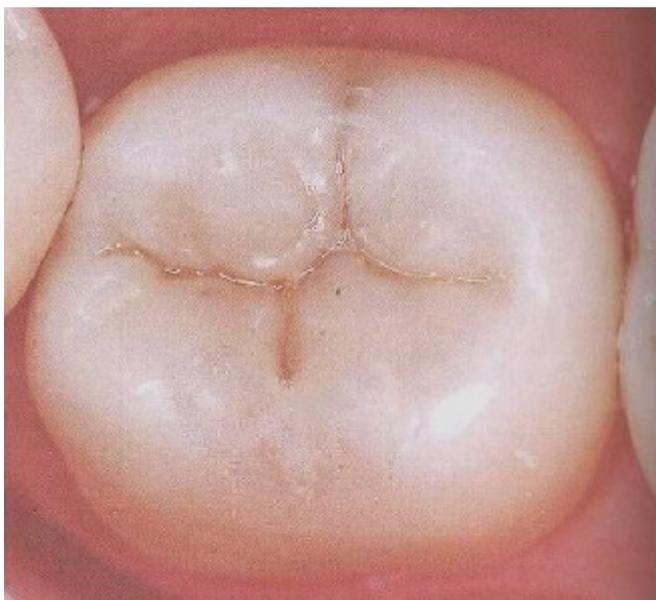


Illustration 6

The finished restoration showing the final increment of highly translucent shade composite (YT), after light curing.



Disclaimer

This article has been downloaded from WebmedCentral. With our unique author driven post publication peer review, contents posted on this web portal do not undergo any prepublication peer or editorial review. It is completely the responsibility of the authors to ensure not only scientific and ethical standards of the manuscript but also its grammatical accuracy. Authors must ensure that they obtain all the necessary permissions before submitting any information that requires obtaining a consent or approval from a third party. Authors should also ensure not to submit any information which they do not have the copyright of or of which they have transferred the copyrights to a third party.

Contents on WebmedCentral are purely for biomedical researchers and scientists. They are not meant to cater to the needs of an individual patient. The web portal or any content(s) therein is neither designed to support, nor replace, the relationship that exists between a patient/site visitor and his/her physician. Your use of the WebmedCentral site and its contents is entirely at your own risk. We do not take any responsibility for any harm that you may suffer or inflict on a third person by following the contents of this website.