

Guidelines for Direct Adhesive Composite Restoration

Society of Cariology and Endodontology, Chinese Stomatological Association (CSA)

Direct adhesive composite restoration, a technique to restore tooth defects by bonding composite resin materials, has been widely used in the restoration of dental caries or other tooth defects.

Retention of composite resin restoration mainly relies on bonding strength between the materials and dental tissue. The clinical outcomes rely greatly on the regulated clinical practice of dentists. In 2011, the Society of Cariology and Endodontology of Chinese Stomatological Association (CSA) published the 'Practices and evaluation criteria of composite resin bonded restoration (Discussion Version)'. Since then, opinions and comments regarding the 'Discussion Version' have been widely circulated within the Society. The final version of the guideline was based on systematic reviews of scientific literature and requirements for the edit of technical guidelines, and through several rounds of discussions, revisions and supplements. The society recommends this guideline for clinicians to use in their practices, when conducting direct composite restorations.

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1. Theoretical basis

Composed of polymer resin matrix and inorganic filler, the cured composite resins could meet functional and aesthetic requirements of the teeth. To achieve reliable bonding with dental tissue, special pre-treatments of the dental tissue are essential requirements. Different adhesive systems provide specific techniques to initiate formation of hybrid layers between bonding agents and dental tissues. The composite resins, via bonding to the hybrid layer, achieve a satisfactory bonding effect with the dental tissues.

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2. Indications

- 2.1 Restoration of dental caries or other tooth defects.
- 2.2 Aesthetic restoration of anterior teeth, including tetracycline pigmentation teeth, dental fluorosis, discoloured pulpless teeth, malformed teeth, rotated teeth etc.
- 2.3 Closure of the small space between anterior teeth.
- 2.4 Core buildup for foundational restoration.
- 2.5 Replacement of existing metal restorations.

3. Preoperative preparations

- 3.1 Diagnosis of the compromised tooth, full mouth examination, instructions regarding oral hygiene, primary oral care and treatment plans should have been completed.
- 3.2 Common dental problems such as gingival bleeding should be well-controlled.
- 3.3 Patients have no objections to the treatment plan.

4. Tooth preparation

- 4.1 Occlusion check
Determine the extent of the lesion and draft an outline form for tooth preparation.

4.2 Protection of the normal oral tissues

Accidental injuries should be prevented. Make sure that the dental burs and devices are in a normal state and the cooling system is effective. Always be cautious to prevent damage to normal pulp tissue, periodontal tissue and dental hard tissue during preparation.

4.3 Local anesthesia

Local anesthesia reduces pain and anxiety. It should be used on teeth with vital pulp or whenever the patient requires.

4.4 Removal of infected dental tissue

4.4.1 Carious tissues, especially in the enamel-dentinal junction region, should be removed, in order to stop caries progression and guarantee effective bonding to normal dental tissues.

4.4.2 Outer margins of the cavosurface should be free of carious tissue, in order to avoid micro-leakage and ensure bonding strength.

4.4.3 For the purpose of vital pulp protection, tiny bits of softened dentin could remain under indirect capping material, or removed by a stepwise excavation. The softened dentin might remineralise as expected. By any means, records and follow-up checks are suggested. When signs of pulp damage are apparent, endodontic treatment should be prescribed.

4.5 Retention form and resistance form

Proper tooth preparation helps the restoration to gain reliable retention and resistance. The following circumstances need to be considered carefully.

4.5.1 Retention of direct adhesive restoration mainly relies on the bonding strength. The bonding strength would increase with the bonding surface area.

4.5.2 Supplementary retention forms could help to ensure longer-lasting retention, but extra loss of healthy tooth structure might be a drawback for resistance. Pros and cons should be carefully considered.

4.5.3 Proper thickness of composite resin at load-bearing areas could be important to avoid fracture of the restoration.

4.5.4 The overhanging enamel from the load-bearing areas could remain.

4.5.5 Cusp coverage by restorations is recommended for the endodontically treated teeth.

4.6 Extension for prevention

Extension for prevention could be reduced or avoided by better oral health behaviours, application of fluoride, minimal invasive managements, regular oral examinations and through other means. On the other hand, it

should be well-understood that most of the restorative materials per se are not anti-caries. Secondary caries could only be prevented by comprehensive caries management.

5. Field isolation

A dry working field is essential for direct adhesive restoration. The bonding failure, also a common reason of secondary caries, may result from contamination of saliva, blood or water bonding to interfaces. Therefore, effective field isolation is suggested for resin restoration. The rubber dam technique is recommended. Alternatively, simple isolation could use cotton roll, saliva ejector and tongue plate. If the cavosurface is beneath the gingival margin, gingival retraction cords are recommended for controlling gingival contamination and for exposing the cavosurface margin.

The operation should only be started when the gingival inflammation and bleeding have been well-treated or controlled.

6. Placement of matrix band

6.1 A matrix band with matrix retainer and wedge should be used in the restoration of proximal contours and contacts. If the gingival wall is covered by extra gingival tissue or if gingival contamination cannot be avoided, a gingivectomy could be prescribed.

6.2 Sectional matrix system, wedges and separating rings are recommended for posterior restoration. The system helps to obtain good proximal contours and contacts.

6.3 Polyester films with wedges can be used in anterior restoration.

7. Pulp protection

For vital pulps, in addition to the aforementioned protective measures, the following are well-recognised.

7.1 Self-etch bonding agents, with little stimulation on vital pulp tissue, can be directly applied on dentine, closing the pulp.

7.2 The incremental layering technique can reduce polymerisation contraction stress.

7.3 Applying indirect pulp capping materials such as calcium hydroxide promotes formation of tertiary dentin, but with weak bonding strength to dental tissue, therefore, the coverage area should be as small as possible to ensure enough reliable bonding area.

8. Selection of composite resins

8.1 Shade selection

A variety of composite resin shades could be selected. A matched shade guide should be used in shade selection. The shade selection should be under natural light, after complete removal of carious tissues, and before field isolation. The shade of the material should match the shade of the tooth.

8.2 Resin types

Types of composite resins should be selected according to location and function of the teeth. More consideration of colour distribution should be taken for anterior teeth. Mixed use of different shades is acceptable. For posterior restoration, a combination of different types of materials can help to achieve a better clinical effect.

8.3 Tooth colour correction

Opaque resins could be applied in the restoration of severe discolouration. During pre-restoration, internal bleaching technique could be used when applicable.

9. Key points of a reliable adhesive

9.1 Core of adhesion

9.1.1 Acid etching: demineralise the hard tissues of the tooth, modify smear layer and increase bonding surface area.

9.1.2 Priming: promote penetration of resin.

9.1.3 Bonding: adhesives penetrate into the demineralised dentin and form a hybrid layer, during the bonding mechanism.

Different adhesive systems complete these steps by different mechanisms, so, the product instructions should be read carefully before use.

9.2 Adhesives

Two types of adhesive systems: etch-and-rinse (also called total etch) and self-etch. Either individual or combined application of the two systems depends on location and extent of the dental defect. Etching with phosphoric acid is recommended for uncut enamel, but not for dentin close to the vital pulp.

9.3 Key points for etch-and-rinse system

9.3.1 Etching

Demineralise and remove the smear layer: phosphoric acid (15% to 37%) is usually applied as the etchant. Etching time can be 15 to 60 s depending on the characteristics of different dental tissue, for example on dentin, less time is required.

9.3.2 Rinsing and drying

Excess acid should be thoroughly eliminated by water rinse and the water should be eliminated by air blowing. Overdrying may dehydrate the dentin,

inducing postoperative dentin sensitivity. Thorough drying or a little moisture (see in wet bonding) is required by a certain adhesive system, therefore, reading the instructions carefully is mandatory.

9.3.3 In 'wet bonding', the acid-etched dentin is kept hydrated before applying primer. Thus, the resin-containing primer can infiltrate more easily. The excess water will volatilise with the solvent, with no obligation to bonding.

9.3.4 For 'wet bonding', the adhesives should be preserved and applied properly. The product instructions should be followed in practice.

9.3.5 Priming and bonding

Classic etch-and-rinse technique includes three steps: Firstly, etch with phosphoric acid to demineralise the bonding area; secondly, rinse and dry for primer use, to modify the hydrophilic dentin and allow infiltration of the resin agent; and finally, apply bonding agent to form a hybrid layer. For the contemporary two-step system; the first step involves phosphoric acid etching, rinsing and drying; and the second step involves applying bonding agent (which consists of primer and bonding agent). After light curing, the composite resin could be placed.

9.3.6 Photopolymerisation

Enough light curing time and the correct angle are recommended for sufficient curing.

9.4 Key points for the self-etch system

9.4.1 Preparation of bonding area

After caries removal, cavity preparation and field isolation, the treatment of the bonding area should follow the manufacturer's instruction.

9.4.2 Etching, priming and bonding

There are two systems, which involve either two steps or one step. For the two-step system, etching and priming are mixed in one step, and bonding in another. After the first step, the excess water is removed and smear layer is dispersed by air blowing. For the one-step system, etchant, primer and bonding agents are applied in one step. The clinical outcomes depend very much on the performer's understanding of the use of adhesives. Therefore a careful study of the product introduction section is essential.

9.4.3 Photopolymerisation

Enough light curing time and the correct angle are recommended for sufficient curing.

9.5 Combination of etch-and-rinse and self-etching techniques

As the bonding strength of self-etching adhesive with uncut enamel is weak, etch-and-rinse technique is rec-

ommended for enamel bonding. For teeth with vital pulp, the etch-and-rinse system is suggested for use on enamel and a one-step self-etch system is suggested for use on dentin.

9.6 Regular inspection and maintenance of light curing units

To guarantee the clinical light curing outcomes, the power output of light curing units should be checked and cleaned regularly. The light guide should be as close as possible to the material being cured, to make light available for all curing materials.

10. Placement of composite resin

10.1 The amount of composite resin for one increment
The curing depths of light cure units are usually 2 to 3 mm, which is not deeper than 3 mm. Therefore, the depths of composite resin material placed into the cavities should be limited to this range. Always try to take a whole piece of the material and gently press it, in order to adopt the cavity walls.

10.2 Combined use of multiple types of resins

The combined use of multiple types of composite resins is recommended in restoring deep cavities of the posterior teeth. Flowable composite resins or glass ionomers could be applied as the first layer. Resins with good fracture resistance could be used for core buildup, while condensable resin could be used for restoration of the biting part. Many aesthetic items should be considered, for example, the shade differences between dentin and enamel, the colour transition from incisal to cervical, and the cohesion between the existing restoration and residual dental tissue. For large defects, layering technique and the combined use of various composite resins can achieve better clinical effects.

10.3 Placement method

The placement of composite resins should follow the anatomical morphology of the teeth and should be in proper increments to avoid time costs. The thickness of composite resin in load-bearing areas should be more than 1 mm to prevent fracture of the material. A bulk filling is suggested for cavity depths which are less than 2 mm. An oblique or vertical layering technique is recommended to reduce the polymerisation stress.

10.4 Light-curing

The light guide should be held as close as possible to the material, to make sure a reliable light source is irradiated to all material placed. To complement insufficient polymerisation, supplemental curing in the buccal-ligual direction is suggested after initial polymerisation and removal of matrix bands.

11. Finishing and polishing

11.1 Formation of anatomical morphology

The focus on anatomical morphology includes cusps, fissures, the convexity of the crown and embrasures.

11.2 Removal of excess material

After placement and polymerisation of composite resin, excess material should be trimmed under the guidance of the biting test. Excess material may be harmful to dental and periodontal health.

11.3 Biting adjustment

The cusp of elongated teeth could be adjusted according to actual situations, to regain the balance of occlusion. The patient's informed consent should be obtained before adjustment.

11.4 Sequence of finishing

The finishing process should be initiated with coarse diamond burs for the rough formation of contours, followed by fine diamond burs, for texture and microanatomy. The correct use of finishing burs increase the speed and accuracy of finishing.

11.5 Polishing

Polishing is the next step after finishing. Polishing disks, polishing cups and polishing pastes could be used during this step. Polishing strips can be used at the proximal surface. More attention should be paid on the region near the gingiva. The polishing process could be done immediately after restoration or arranged in a separate visit.

12. Postoperative instructions

12.1 Avoid hard biting and trauma.

12.2 See a dentist when a postoperative pain develops.

12.3 Insist on good oral hygiene habits to prevent dental caries and periodontitis.

12.4 Insist on annual oral examination for the general dental health, including the existing restorations.

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