

# Core build-up using a dual-curing composite and treatment with all-porcelain restorations

Dr Jürgen Manhart presents a case report demonstrating core build-up using a core composite and subsequent permanent treatment with glass porcelain restorations

All-porcelain restorations produce esthetically superior anterior and posterior restorations. However, excellent esthetics are only one important feature that has led to the ever-increasing popularity of these restorations. As the porcelain materials are highly biocompatible, all-porcelain restorations are also well tolerated by patients.

When fabricating crowns or bridges, it is often necessary to use a core material before preparation to reconstruct extensive sections of lost tooth structure caused by large carious lesions or previous dental treatment. Various materials are used for building up the tooth core. While the use of amalgams was common in the past, glass ionomer cements and related materials or composites are now mainly used. Composite adhesive cores in particular are becoming increasingly popular, because an excellent bond can be achieved with the tooth structure when they are used in conjunction with a suitable adhesive system. Parapulpal posts for retaining the core material to vital teeth are no longer required. This method not only saves time but also provides a safer form of treatment, as drilling preparation for parapulpal posts tends to cause iatrogenic damage to the pulp or perforation of the root surface. The options provided by the adhesive technique mean that, in numerous clinical situations, root canal posts are no longer required when preparing endodontically-treated teeth. Further information on this can be found in a joint report published in 2003 by the DGZMK (German Maxillofacial Surgery Association), the DGZPW (German Society for Dental Prosthetics and Materiology) and the DGZ (German Society for Conservative Dentistry) dealing with the build-up of endodontically-treated teeth.

Composite cores can either be fabricated using conventional light-curing filling composites, but the curing thickness of these composites is limited and larger defects require a time-consuming, incremental build-up, or using core composites specially developed for larger defects. Core composites are either chemically curing or dual-curing (the use of core composites that are purely light-curing is restricted to small defects). Different types of core composites also have very different rheological properties. High viscosity composites have to be mixed from two pastes by the dental nurse and applied to only partially visible cavities by condensing with manual instruments to ensure all the surfaces are covered, while flowable types can be applied directly intra-orally to fill the defect using a handy cartridge system with an integrated spiral mixer. Low viscosity core composites provide excellent coverage for the tooth structure and also root canal posts and screws, if required. Core composites are normally supplied in a dentin shade, used under translucent all-porcelain restorations, as well as in a contrasting shade to the tooth (e.g. blue or white), which facilitates assessment of the gap between the margin of the core

## CPD Aims and objections

This clinical article aims to present a case report to show core build-up using a dual-curing composite and treatment with all-porcelain restorations

## Expected outcomes

Correctly answering the questions on page XX, worth one hour of verifiable CPD, will demonstrate that you understand core build-up using a dual-curing composite and treatment with all-porcelain restorations.



material and the preparation margin. Blue contrasting shades are recommended only for use with metal-based restorations: white-opaque core composites provide a contrast to the tooth structure without impairing the aesthetics of all-porcelain restorations.

The requirements of a core material are summarized as follows:

- Adequate bond with the tooth structure (prevents marginal gaps, does not require parapulpal posts)
- Easy and quick to use (even with large defects)
- Good coverage (fills undercuts without bubbles)
- Low setting temperature (prevents irritation of the pulp)
- Short setting time (can be prepared shortly after application)
- High final hardness, similar to dentin (easy to trim)
- Adequate mechanical properties (e.g. compressive strength)
- Radiopacity
- Opacity (masks root posts and screws)
- Fluoride-releasing (prophylaxis against secondary caries)
- Broad range of applications.

## Clinical case history

The following case history of a 27-year-old female patient demonstrates the build-up of two premolars step-by-step using a core composite and subsequent permanent treatment with glass porcelain restorations. The initial situation shows the mirror image of teeth 24 and 25 with long-term temporary restorations fabricated from glass ionomer cement (Figure 1). Both teeth were sensitive to the cold stimulus of carbon dioxide snow and were not percussion sensitive. Large surface areas with softened carious dentin were evident in both premolars after removal of the fillings

Dr Jürgen Manhart, DDS, Priv-Doz, Dr med dent, is an associate professor at the department of restorative dentistry, periodontology and pediatric dentistry at the Dental School of the Ludwig-Maximilians-University in Munich, Germany.



Figure 1: Initial situation: glass ionomer cement fillings in teeth 24 and 25



Figure 2: The teeth after removal of the old fillings showing the tooth structure affected by caries



Figure 3: After placing the rubber dam



Figure 4: The palatal cusp of tooth 25 fractured during excavation



Figure 5: Pinpoint perforation of the pulp at the buccal cusp



Figure 6: After explaining the situation to the patient, the pulp was capped directly. First an aqueous calcium hydroxide suspension was applied to the perforated area



Figure 7: The calcium hydroxide was carefully adapted using a clean cotton pellet



Figure 8: A hardening calcium hydroxide solution (Calcimol, Voco) was applied over the aqueous suspension. Because of the extent of the caries the mesial surface of tooth 24 was included in the cavity preparation



Figure 9: Placing a steel matrix at tooth 25



Figure 10: A 37% phosphoric acid gel was first applied selectively to the enamel of the cavity margins



Figure 11: After approx. 15s the whole cavity was filled with etching gel and the enamel and dentin were conditioned for a further 15 s (total etch)

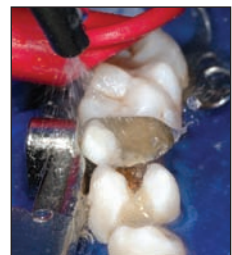


Figure 12: Rinsing off the etching gel and loosened fragments of tooth structure using the compressed air and water spray



Figure 13: The cavity was carefully dried with oil-free compressed air. It is essential to avoid over-drying the dentin



Figure 14: Application of Solobond Plus primer (Voco) to the enamel and dentin for 30 s using a disposable brush



Figure 15: Excess is carefully blown off using oil-free compressed air



Figure 16: Application of Solobond Plus adhesive (Voco) to the enamel and dentin for 15 s using a disposable brush



Figure 17: Excess is carefully blown off using oil-free compressed air



Figure 18: The bonder was light-cured for 20 s



Figure 19: Filling the defect with a dual-curing core composite (Rebuilda DC, Voco) from the mini-cartridge using an angled application tip with a 360° rotation



Figure 20: The cavity was slowly and carefully filled with core material avoiding the inclusion of air bubbles



Figure 21: The defect completely filled with core composite



Figure 22: The surface of the dual-curing core composite was light-cured for 40 s using a light-curing lamp



Figure 23: Placing a steel matrix at tooth 24



Figure 24: A 37% phosphoric acid gel is first applied selectively to the enamel of the cavity margins



Figure 25: After approx. 15 s the whole cavity was filled with etching gel and the enamel and dentin were conditioned for a further 15 s (total etch)



Figure 26: Rinsing off the etching gel and loosened fragments of tooth structure with the compressed air and water spray



Figure 27: The cavity was carefully dried with oil-free compressed air. It is essential to avoid overdrying the dentin

(Figure 2). Due to the proximity of the defect to the pulp at tooth 25, a rubber dam was placed as a prophylactic measure before excavation of the caries to prevent any infection from the saliva, if the pulp chamber were to be exposed (Figure 3). The palatal cusp of the second premolar, which had a large undercut, fractured during removal of carious tooth structure (Figure 4). Further removal of the caries resulted in a small, pinpoint perforation of the pulp at the buccal cusp (Figure 5). The situation was explained to the patient and, as there was no evidence of tooth pain, the exposed pulp was capped directly. After cleaning and disinfecting the surface with a 3% hydrogen peroxide solution, a permanently soft calcium hydroxide

solution was applied to the perforated area (Figure 6) and adapted carefully using a small, clean cotton pellet (Figure 7). The area was completely covered with a hardening calcium hydroxide solution and, because of the extent of the caries the mesial surface of the first premolar was included in the cavity preparation (Figure 8). After placing a steel matrix around the extensive defect at tooth 25 for the subsequent build-up (Figure 9), a 37% phosphoric acid gel was first applied selectively to the enamel margin of the cavity (Figure 10).

After allowing a reaction time of approximately 15 seconds, the whole cavity was filled with etching gel and the enamel and dentin were conditioned for a further 15 seconds, according to



Figure 28: Application of Solobond Plus primer (Voco) to the enamel and dentin for 30 s using a disposable brush



Figure 29: Excess was carefully blown off using oil-free compressed air



Figure 30: Application of Solobond Plus adhesive (Voco) to the enamel and dentin for 15 s using a disposable brush



Figure 31: Excess was carefully blown off using oil-free compressed air

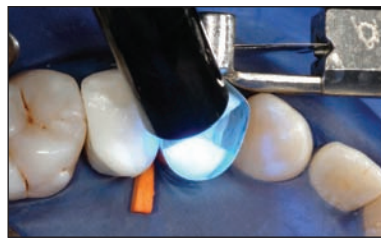


Figure 32: The bonder was light-cured for 20 s



Figure 33: Filling the defect with a dual-curing core composite (Rebilda DC, Voco)



Figure 34: The cavity was slowly and carefully filled with core material avoiding the inclusion of air bubbles

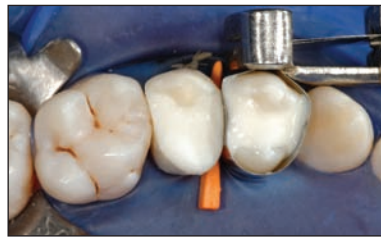


Figure 35: The defect completely filled with core composite



Figure 36: The surface of the dual-curing core composite was light-cured for 40 s using a light-curing lamp



Figure 37: After removal of the matrix



Figure 38: After removal of the rubber dam



Figure 39: The core fillings were prepared with finishing diamonds and prepolished with rubber composite polishers

the total-etch technique (Figure 11). After thoroughly rinsing off the etching gel and loosened fragments of tooth structure using the compressed air and water spray (Figure 12), the cavity was carefully dried using oil-free compressed air (Figure 13). It is essential to avoid overdrying the dentin at this stage, as this would result in the collapse of the three-dimensional woven collagen fibers in the conditioned dentin, making it extremely difficult for the subsequent adhesive application to penetrate, with the risk of a poor bond and increased risk of postoperative sensitivity.

The primer of the Solobond Plus adhesive system (Voco) was applied to the enamel and dentin with a disposable brush and massaged into the dentin for 30 seconds (Figure 14). After

blowing off the excess carefully and evaporating the acetone solvent using oil-free compressed air (Figure 15), adhesive was applied uniformly to all the prepared enamel and dentin surfaces with a new disposable brush and massaged in for 15 seconds (Figure 16). The adhesive was then finely dispersed and thinned to form a uniform film (Figure 17). The adhesive was cured for 20 seconds using a halogen lamp (Figure 18).

A white shade of Rebilda DC dual-curing core composite (Voco) was applied directly into the defect from the mixing tip of the cartridge system, to which an angled intraoral tip with a 360° rotation can be attached (Figure 19).

Starting at the cavity floor, the cavity was slowly and carefully filled with the core material avoiding the inclusion of air



Figure 40: Checking the static and dynamic occlusion for high spots and interference



Figure 41: The core fillings were polished to a high-luster with composite polishing paste to minimize plaque build-up until permanent treatment of the teeth with all-porcelain restorations. The teeth are dehydrated and lightened due to a reversible water loss caused by the use of the rubber dam



Figure 42: After one week in situ the teeth have regained their natural shade



Figure 43: All-porcelain crown and porcelain inlay on the unsectioned plaster model



Figure 44: Close-up view of the porcelain restorations



Figure 45: Preparation for an all-porcelain crown with circumferential shoulder on tooth 25 and for a porcelain inlay on tooth 24



Figure 46: The restorations after being placed using the adhesive technique

bubbles (Figure 20). Figure 21 shows the defect completely filled with core composite. The dual-curing core composite was light-cured for 40 seconds using a halogen lamp (Figure 22). The first premolar was then built up using the same procedure as described above (Figures 23-36).

After removing the matrices, but before removing the rubber dam, the build-up was checked again to ensure that it was not short in any area and that there were no marginal gaps (Figure 37). Figure 38 shows both core build-ups before trimming. The cores were trimmed and all excess material carefully removed with finishing diamonds before pre-polishing with rubber composite polishers (Figure 39). The static and dynamic occlusion was checked for high spots and interference using colored foil (Figure 40). As the core build-ups were to be used as long-term temporaries until permanent treatment of the

teeth with all-porcelain restorations, the surfaces were polished to a high luster using composite polishing pastes to minimize plaque build-up. The teeth were dehydrated due to reversible water loss caused by the use of the rubber dam, and as a result the shade of the teeth was definitely lighter (Figure 41). At the follow-up appointment a week later to check for sensitivity of the second premolar the teeth had regained their normal shade (Figure 42). Figure 43 shows the all-porcelain restorations, which were fabricated almost three months later. A glass porcelain crown was fabricated for tooth 25 and an MOD porcelain inlay was fabricated for tooth 24 (Figure 44). Figure 45 shows the two prepared teeth immediately prior to the restorations being placed using the adhesive technique. Following adhesive placement, the two restorations restore the function and natural esthetics in the dental arch (Figure 46). **EP**

## References

- Bonilla ED, Mardrossian G, Caputo AA (2000) Fracture toughness of various core build-up materials. *J Prosthodont* **9**: 14-18
- Chutinan S, Platt JA, Cochran MA, Moore BK (2004) Volumetric dimensional change of six direct core materials. *Dent Mater* **20**: 345-351
- Combe EC, Shaglouf AM, Watts DC, Wilson NH (1999) Mechanical properties of direct core build-up materials. *Dent Mater* **15**: 158-165
- Duke ES (2000) Advances in restorative core materials. *Compend Contin Educ Dent* **21**: 976-978
- Duke ES (2002) Reinforced core build-up materials. *Compend Contin Educ Dent* **23**: 328-9, 332
- Foley J, Saunders E, Saunders WP (1997) Strength of core build-up materials in endodontically treated teeth. *Am J Dent* **10**: 166-172
- Giovannone T, Migliau G, Bedini R, Ferrari M, Gallotini L (2007) Bond strength to deep coronal dentin: effect of bonding strategies. *Minerva Stomatol* **56**: 105-114
- Ishii T, Ohara N, Oshima A, Koizumi H, Nakazawa M, Masuno T, Matsumura H (2008) Bond strength to bovine dentin of a composite core build-up material combined with four different bonding agents. *J Oral Sci* **50**: 329-333
- Moosavi H, Maleknejad F, Kimyai S (2008) Fracture resistance of endodontically-treated teeth restored using three root-reinforcement methods. *J Contemp Dent Pract* **9**: 30-37
- Schmage P, Nergiz I, Sito F, Platzer U, Rosentritt M (2009) Wear and hardness of different core build-up materials. *J Biomed Mater Res B Appl Biomater* **91**: 71-79
- Stavridakis MM, Kakaboura AI, Krejci I (2005) Degree of remaining C=C bonds, polymerization shrinkage and stresses of dual-cured core build-up resin composites. *Oper Dent* **30**: 443-452
- Stober T, Rammelsberg P (2005) The failure rate of adhesively retained composite core build-ups in comparison with metal-added glass ionomer core build-ups. *J Dent* **33**: 27-32