SCIENTIFIC REPORT

Admira Fusion x-tra – Cusp deformation / marginal integrity

VOCO GmbH, Knowledge Communication Department

Anton-Flettner-Str. 1-3
27472 Cuxhaven
Germany

Tel.: +49 (0)4721 719-1111
Fax: +49 (0)4721 719-109

info@voco.de
www.voco.com

With Admira Fusion x-tra, the fast-track version of Admira Fusion, VOCO has introduced the first ceramic restorative material with a pure ORMOCER® resin base, thereby setting a new standard in the dental industry yet again. Following many years of research and development, Admira Fusion x-tra now unites two outstanding, innovative systems in one material: Nanohybrid and ORMOCER® technology. VOCO first employed ORMOCER® technology back in 1999, in Admira. However, in the new Admira Fusion, the resin matrix has been further developed, allowing conventional methacrylate monomers to be dispensed with entirely.
In this new, pure ORMOCER® resin, the inorganic backbone is exclusively composed of silicon oxide structures, as are the fillers, meaning that Admira Fusion is based on pure silicate technology. It is compatible with all adhesive systems. In addition to the very low polymerisation shrinkage of just 1.25% by volume and the very low shrinkage stress, the biocompatibility of Admira Fusion x-tra is another outstanding characteristic.
Innovative products such as Admira Fusion x-tra, which represents a new generation of restorative material, need to bear comparison with the established products and prove their reliability as a restorative material with long-term marginal integrity. For this reason, the team led by Dr. Fleming at the University of Dublin tested the strength of different restorative materials developed especially for fillings with a layer thickness of 4 mm in terms of cusp movement and cervical marginal integrity.[1]

Examination of cusp deformation / marginal integrity

Human maxillary premolars free from caries, hypoplasia defects and fractures were used for the *in vitro* study. The buccal-palatal width of the teeth was between 8.4 and 8.8 mm. For the study, identical MOD cavities were prepared in accordance with defined criteria and then treated with three different, packable restorative materials (n = 8) using the bulk fill technique. Two increments were placed for each restoration and cured for 20 seconds layer by layer. The universal adhesive Futurabond U (VOCO) was used in all cases, in the self-etch mode. The three restorative materials studied are listed in Table 1.

Table 1: Overview of the studied restorative materials

Restorative material	Description	Resin technology used	Filler content (% by weight)
Admira Fusion x-tra (VOCO)	Fast-track version of Admira Fusion, layers of up to 4 mm	ORMOCER®	84
Beautifil Bulk Restorative (Shofu)	Composite for bulk fill technique, layers of up to 4 mm	Conventional methacrylates	87
Tetric EvoCeram Bulk Fill (Ivoclar Vivadent)	Composite for bulk fill technique, layers of up to 4 mm	Conventional methacrylates	79

The buccal and palatal cusp deformations were measured during the light-curing of each individual increment and for up to three minutes afterwards. To determine the cervical marginal integrity, the restored teeth were subjected to artificial ageing by means of thermocycling (500 cycles, 4 °C – 65 °C) and then immersed in a magenta fuchsine solution for 24 hours to allow the dye to penetrate any marginal gaps. The teeth were then split from mesial to distal and the cervical marginal integrity assessed under a microscope using a scale from 0 to 4. The type and depth of penetration of the concentrated fuchsine solution were used as the index, with 0 corresponding to no dye penetration and thus a restoration with optimal marginal integrity. The highest value on the scale, 4, corresponded to dye penetration into the pulp chamber. A precise explanation of this scale with additional illustration can be found in Table 2.

Results

Figure 1 shows the measured cusp deformations of the three materials studied: Admira Fusion x-tra, Beautifil Bulk Restorative and Tetric EvoCeram Bulk Fill. The graph shows clearly that the innovative nanohybrid ORMOCER® restorative material Admira Fusion x-tra stands out in comparison with Tetric EvoCeram Bulk Fill and Beautifil Bulk Restorative and induces a cusp movement of just 5.5 µm during curing. In contrast, the cusp deformations induced by Tetric EvoCeram Bulk Fill and Beautifil Bulk Restorative, at 6.7 µm and 6.5 µm respectively, are around 20 % higher.

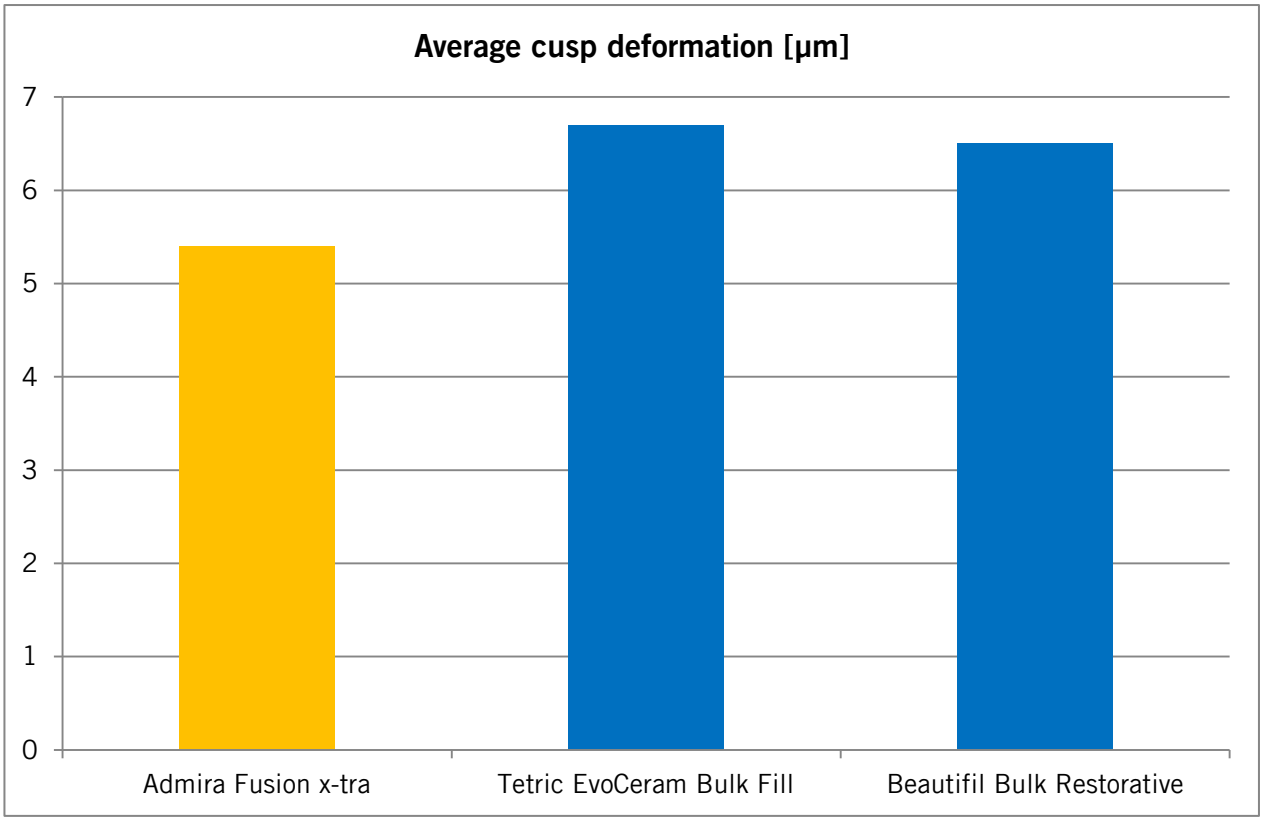
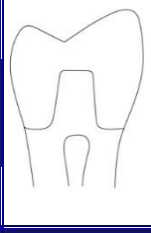
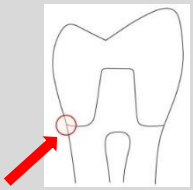
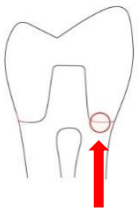
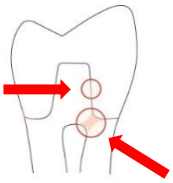
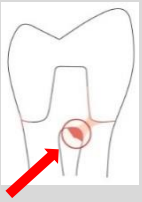


Figure 1: Average cusp movement in µm

Following the measurement of cusp movement of the cured materials, the cervical marginal integrity was classified based on the above scale of 0 to 4. The lower the number, the higher the marginal integrity of a material. The results can be found in Table 2.

Table 2: Average cervical marginal integrity of the studied restorative materials

Studied restorative material		**- Admira Fusion x-tra - - Beautifil Bulk Restorative -**			**- Tetric EvoCeram Bulk Fill -**
Type of dye penetration observed	No dye penetration	Superficial penetration (not beyond the enamel-dentine junction)	Penetration along the gingival floor	Penetration to the axial wall, as far as the pulp	Penetration into the pulp chamber
Schematic illustration of dye penetration					
Classification based on points	**0**	**1**	**2**	**3**	**4**

All in all, Admira Fusion x-tra and the bulk fill material from Shofu produced good results in the marginal integrity study. Admira Fusion x-tra and Beautifil Bulk Restorative displayed only superficial penetration (evaluated as 1) on average, whereas Tetric EvoCeram Bulk Fill showed an average penetration as far as the pulp (evaluated as 3). These results are consistent with the preceding cusp deformation results, where Tetric EvoCeram Bulk Fill displayed the largest cusp movement.

Conclusion: With Admira Fusion x-tra, the world's first purely ceramic-based restorative material, VOCO avoids the addition of conventional methacrylate monomers completely. In this test, this innovative technology not only had to bear comparison with established restorative materials, but actually surpassed them. The dentist can therefore rest assured that Admira Fusion allows permanently stable restorations, not least because of its extremely low shrinkage of just 1.25%. The combined Nanohybrid ORMOCER® technology and the resulting excellent biocompatibility mean that VOCO has once again succeeded in setting a new benchmark in the dental industry.

[1] Tomaszewska IM, Kearns JO, Ilie N, Fleming GJP, *Journal of Dentistry*, 43, 309-316, **2015**.