

Comparison of filler morphology, mechanical strength and milling characteristics of different CAD/CAM blocks for Sirona inLab MC XL milling system

Cornelia Kopfmann*, David Zweifel#, Ralf Böhner*
 *Coltene AG, Switzerland
 #David Zweifel, Private Dental Laboratory, Switzerland

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COLTENE



Objective

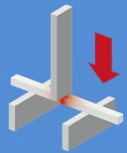
Comparison of mechanical characteristics, morphological differences and milling behavior of four different CAD/CAM blocks with different composition. IPS Empress CAD (IvoclarVivadent) as Leucite Ceramic, Vita Enamic (Vita Zahnfabrik) as hybrid material and two polymer based materials Lava Ultimate (3M ESPE), Coltene Experimental (Coltene AG) were selected.

Methods

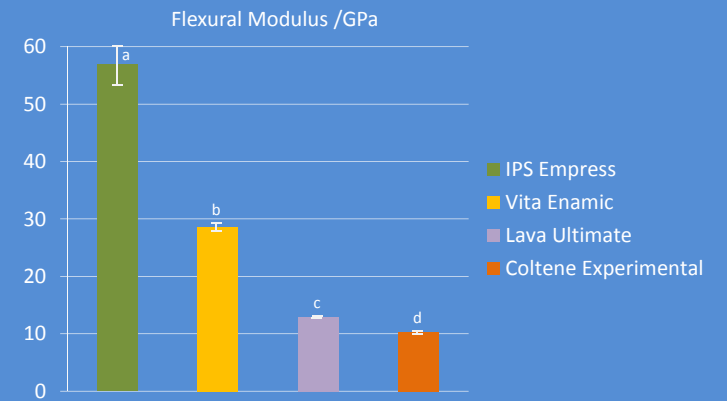
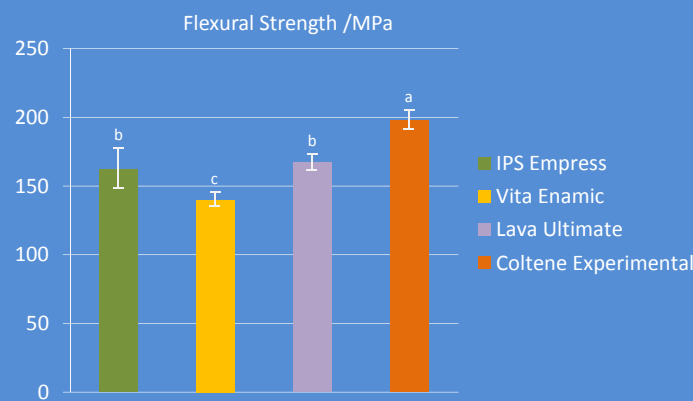
Samples for flexural strength (1x1x18 mm) were cut wet with an Isomet 1000 diamond saw from 14L sized blocks. The sticks were stored in water for 24h at 37 °C. After storage a three point bending test (Zwick Z020, crosshead speed 0.5mm/min, span width 10 mm, n=7) was done. Data were analyzed with a one way ANOVA (p<0.05).

Posterior crowns and wedges (thickness at the wedge end 0.1 mm) were milled wet with a Sirona inLab MC XL, equipped with diamond stepbur 12 respective 12S. SEM pictures were taken with a Hitachi TM3000 table top microscope without sputtering.

The samples for morphological investigations were cut wet with an Isomet 1000 diamond saw from 14L sized blocks. The surface was treated with a 1000 grit sand paper. SEM pictures were taken with a Hitachi TM3000 table top microscope without and with sputtering.

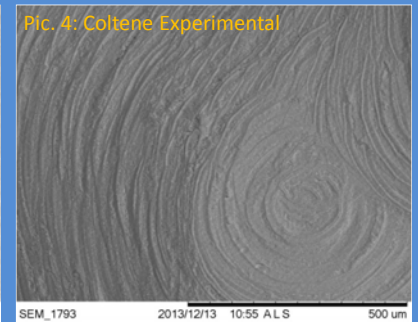
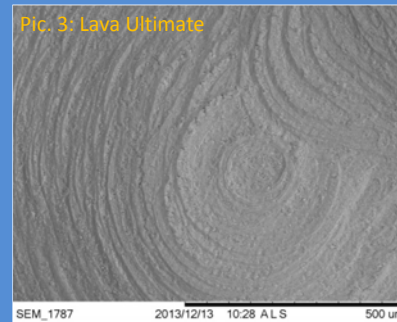
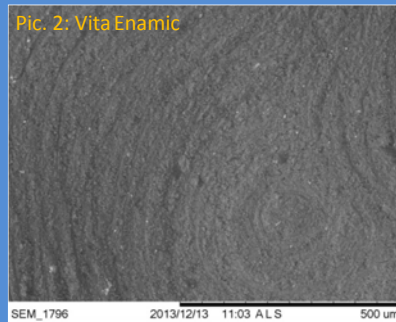
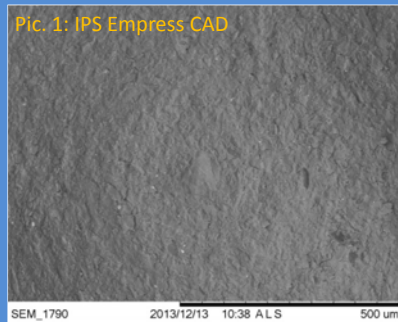


| | Flexural Strength /MPa | Flexural Modulus /GPa |
|------------------|------------------------|------------------------|
| IPS Empress CAD | 162 ±29 ^b | 56.9 ±6.8 ^a |
| Vita Enamic | 140 ±10 ^c | 28.6 ±1.3 ^b |
| Lava Ultimate | 167 ±12 ^b | 12.9 ±0.4 ^c |
| Coltene Exp. CEX | 198 ±14 ^a | 10.3 ±0.5 ^d |



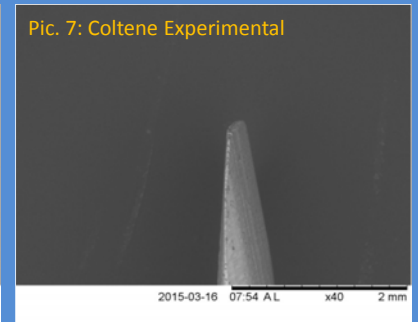
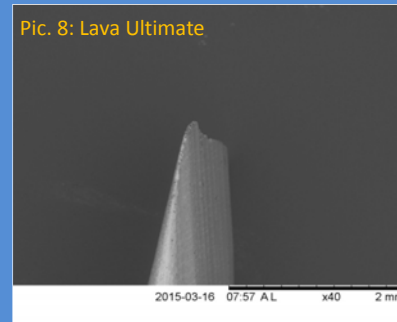
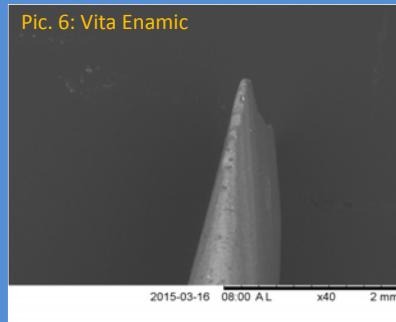
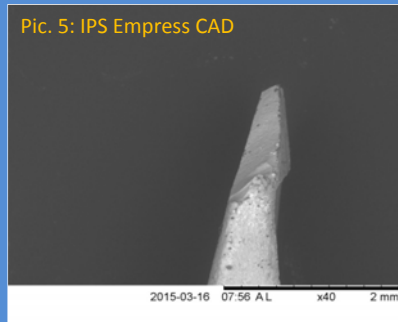
Milled Crowns

Milling is done in steps. IPS Empress CAD shows no milling traces because of the brittleness of the material. Vita Enamic, because of the polymer penetrated porous ceramic, shows milling steps, but is still influenced by the ceramic part of the material. Lava Ultimate and Coltene Experimental, the composite based materials show the milling steps clearly, because of less brittleness of these materials.



Accuracy

The milling of a wedge peaked with 0.1 mm shows the accuracy of the different materials in respect of brittleness and filler composition.



Morphology

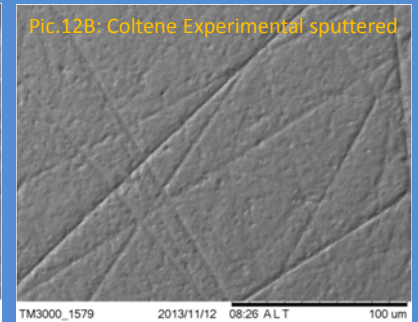
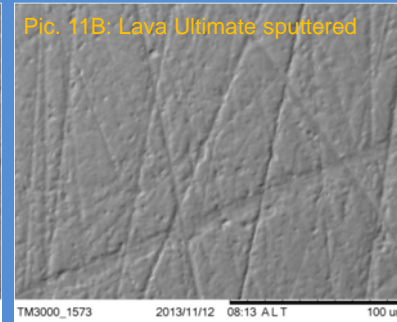
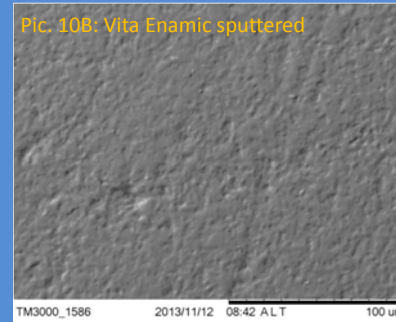
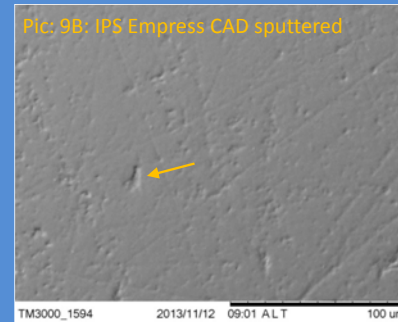
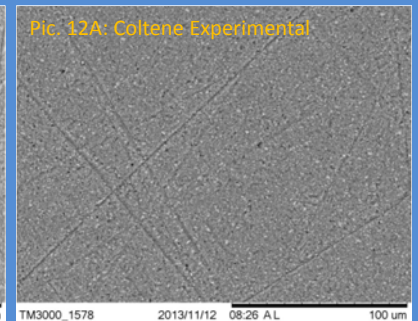
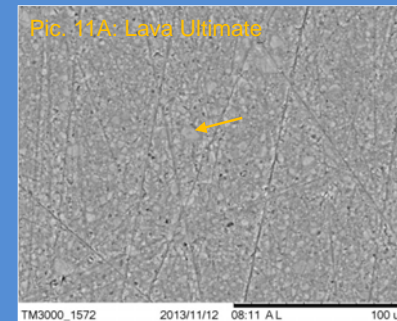
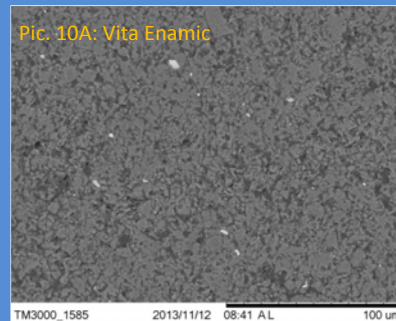
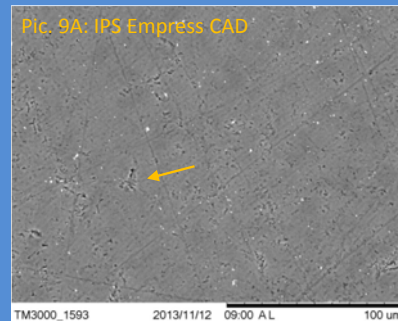
Sample preparation was done with a 1000 grit sand paper. SEM were done without and with sputtering to show both the filler and the surface texture. The scratches make it easier to find exactly the same sector before and after sputtering.

IPS Empress (Pic 9A/B): Small porosities are visible.

Vita Enamic (Pic. 10A/B): Polymer infiltrated ceramic where the ceramic (bright areas) and the polymer (dark areas) are clearly visible. Sand paper preparation abrades more the polymer than the ceramic material.

Lava Ultimate (Pic 11A/B): Large cluster filler are visible. Small porosities below 5µm are also present.

Coltene Experimental (Pic. 12A/B) Some small porosities below 5µm and smaller filler compared to Lava ultimate are visible.



Conclusion

Polymer based composite blocks (Lava Ultimate, Coltene Experimental) for permanent restorations show equal or better mechanical strength than an established Leucite Ceramic. The milling accuracy of polymer based materials is a visible advantage compared to Leucite Ceramic (IPS Empress CAD) and hybrid material (Vita Enamic). Further investigations have to prove whether restorations made from polymer based CAD/CAM blocks are a valid alternative to full ceramics.

Addendum

12th of June 2015 3M ESPE withdrew the indication crown for lava Ultimate because of loss of restorations. The origin seems not to be a problem of the material. Investigations are running to evaluate whether adhesion is influenced by the luting / cementing protocol