Spatial Fit of Ceramic Restorations: Digital versus Conventional Impressions

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Objectives

Marginal and internal fit of ceramic restorations have been described in one or two dimensions, whereas it is most desirable to evaluate adaption spatially, in three dimensions. The authors conducted a study to investigate the influence of digital and conventional impressions on the spatial fit of ceramic partial crowns (CPCs).

Methods

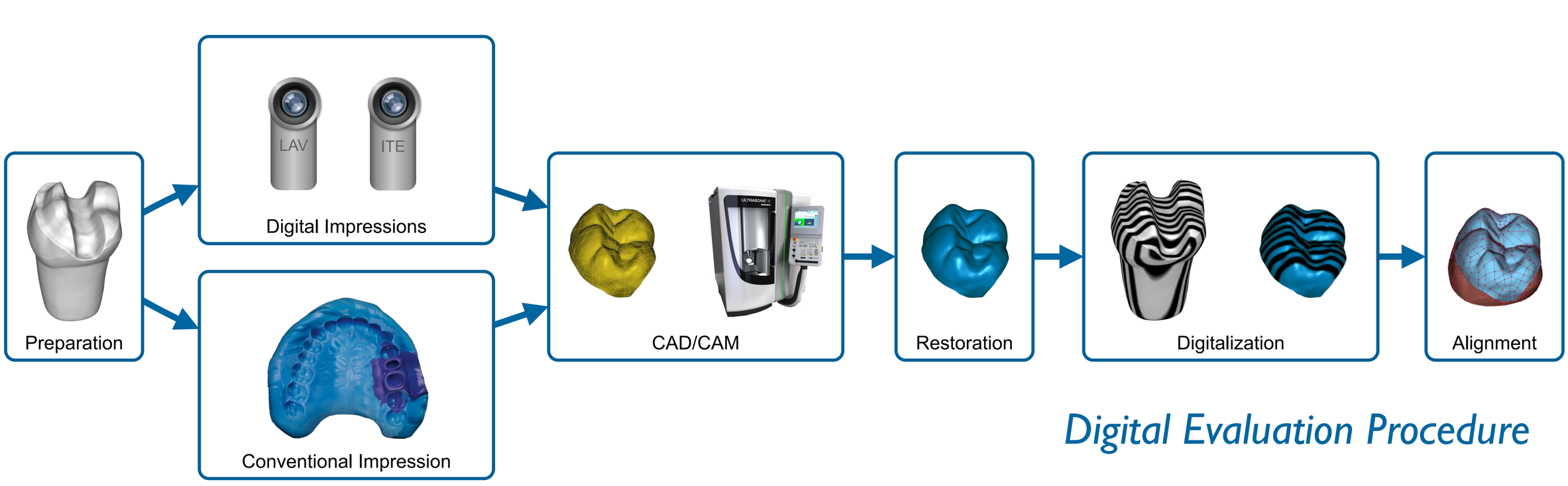
An acrylic model of a lower left first molar was prepared to receive a CPC and was captured by either digital or conventional impressions. LAV and ITE data were exported directly to a common design software (*Dental Designer 2010, 3 Shape, Copenhagen, Denmark*), while in case of IDE, plaster models were cast and laser-scanned (*7 Series, Dental Wings, Montreal, Canada*) to realize virtual datasets. CPCs were designed and machined (*Ultrasonic 20, Sauer, Stipshausen, Germany*) from prefabricated lithium dislicate blanks (*IPS e.max CAD, Ivoclar Vivadent, Schaan, Liechtenstein*). The tooth model and the machined ceramics were digitized by a structure-light-scanner (*FLEX 3A, Otto Vision Technology, Jena, Germany*), virtually superimposed one on the other and subjected to computer-aided-inspection. Mean quadratic deviations (RMS) were computed separately for marginal and internal surfaces and were analyzed with a one-way ANOVA and Scheffé post-hoc comparisons (n=5, α=0.05).

Table 1 Impression systems used in the present study

Token	Name	System	Technology	Accuracy	Manufacturer
LAV	Lava Chairside Oral Scanner	Digital	Active Wavefront Sampling	40 µm[a]	3M Espe
ITE	iTero	Digital	Parallel Confocal Imaging	-	Cadent
IDE	Identium Light and Heavy	Conventional	Vinylsiloxanether	4 µm[b]	Kettenbach

a Ender A, Mehl A. Full arch scans: conventional versus digital impressions – an in-vitro study. International Journal of Computerized Dentistry 2011;14:11-21.

b Schaefer O, Schmidt M, Goebel R, Kuepper H. Qualitative and quantitative 3-dimensional accuracy of a single tooth captured by elastomeric impression materials: An in vitro study. Journal of Prosthetic Dentistry 2012;108(3):165-172.



Digital Evaluation Procedure

Results

Differences among RMS-values were statistically significant for marginal (*P*=0.022) and internal surfaces (*P*<0.001). Qualitatively, LAV and ITE showed undersized internal dimensions at buccal and oral cusps, while areas with strong curvature (preparation-finish-line, outer approximal grooves) were oversized. IDE featured partially undersized areas of the buccal wall and the occluso-oral junction of the occlusal box. Approximal grooves and buccal parts of the preparation-finish-line were enlarged.

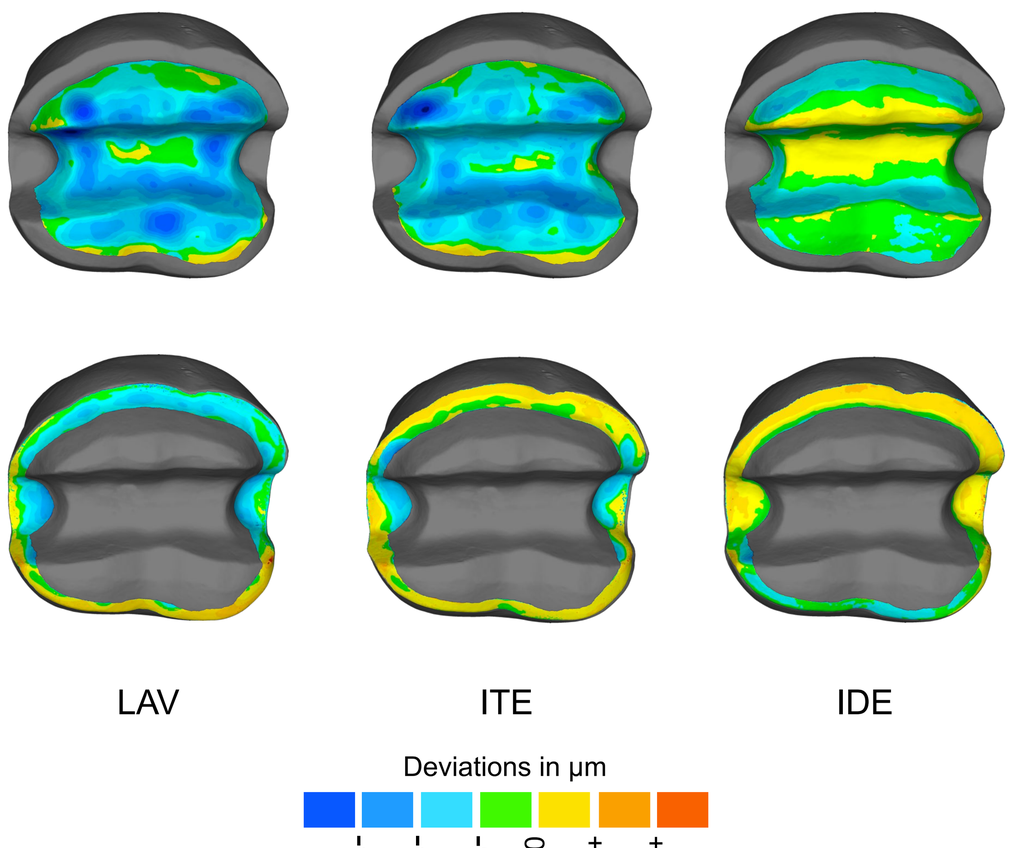


Figure 2 Color-coded difference images for qualitative deviation-analysis of internal and marginal surfaces. Blue shades indicate negative deviations (smaller crown), whereas yellow to red shades indicate positive deviations (larger crown).

System	Internal Surfaces	Marginal Surfaces
LAV	93 (9)[a]	109 (9)[a]
ITE	92 (8)[a]	90 (12)[a,b]
IDE	32 (2)[b]	83 (3)[b]

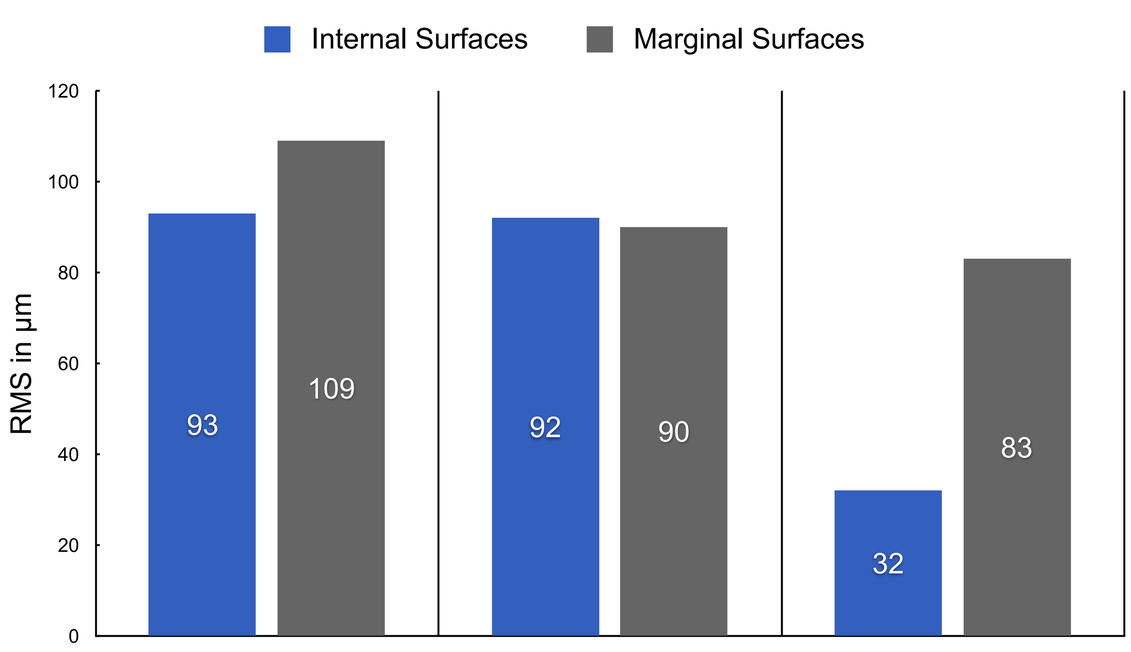


Figure 3 RMS-results for internal and marginal surfaces. Means and standard devitions (in brackets) from n=5. Different superscript letters indicate statistically significant differences at *P*<0.05

Conclusion

The spatial fit of CPCs is influenced by the applied impression technique. When compared to current digital procedures, conventional impressions still resulted in better fit, especially at internal surfaces.