Indexing the Spacial Accuracy of Newly-Developed Impression Materials

O. Schäfer, M. Schmidt, R. Göbel and H. Küpper
Jena University Hospital, Center for Dental Medicine, Policlinic and Department of Prosthetic Dentistry and Material Science, An der Alten Post 4, 07740 Jena, Germany

Objectives:

The accuracy of dental impressions determines the possible success of oral restaurations. However, that parameter is still described by examing linear dimension changes with no respect to the dental morphology. This study measured, compared and quantified the spacial accuracy of duplicate gypsum dies made with different impression materials.

Materials and Methods:

Using a real aluminum and virtual CAD model of a first upper molar as reference, five one-stage and two-phase impressions were taken with each of the materials listed below. Corresponding dies were made of a type IV gypsum(Opti Rock, WhipMix Germany), optically digitized(figure 1) and aligned to the virtual reference. Dimensional differences were calculated(figure 2).

Token	Name	Light-Bodied Material	Heavy-Bodied Material	Manufacturer	Chemistry
IDE	Identium	Light	Heavy	Kettenbach	Vinylsiloxanether
EXA	EXA'lence	Light	Heavy	GC	Vinylpolyethersilicone
PAN	Panasil	Initial Contact Light	Tray Soft Heavy	Kettenbach	Vinylpolysiloxane
RSI	R-SI Line	Light SH	Heavy Matic	R-Dental	
HYD	Hydrorise	Light	Monophase	Zhermack	
AQU	Aquasil Ultra	Light LV	Heavy Deca	Dentsply Detrey	
IMP	Impregum	Garant L DuoSoft	Penta H DuoSoft	3M Espe	Polyether

Table 1: Used Impression Materials

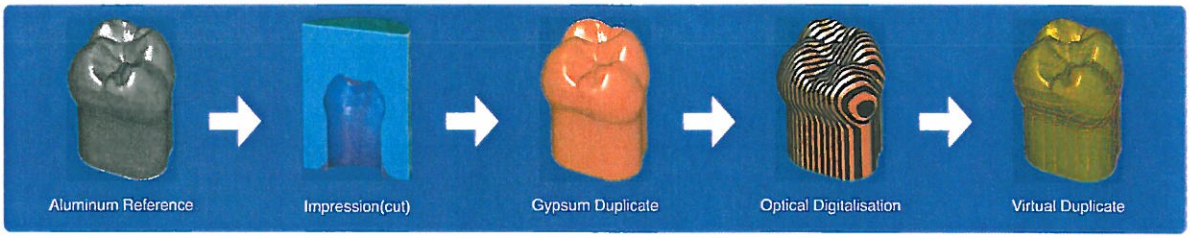

Figure 1: Digitalisation Process

After extending the virtual CAD by 16 occlusal contact points according to Payne and Lundeen, dimensional differences were again computed. The percentage of points deviating within a 10μm tolerance limit(PDP_{10}) was defined as an index for spacial accuracy(figure 3). Results were displayed graphically and tested for significance using Kruskal-Wallis-Test.

Results:

Analyzing the mean PDP_{10}-values(figure 4, units in %) PAN(91±11) and IDE(77±4) performed best, followed by EXA(61±9) and RSI(47±16), whereas HYD(37±14), AQU(27±8) and IMP(29±3) achieved the least accuracy. PAN and IDE performed significantly (n=5; α=0,05) better then all other tested materials.

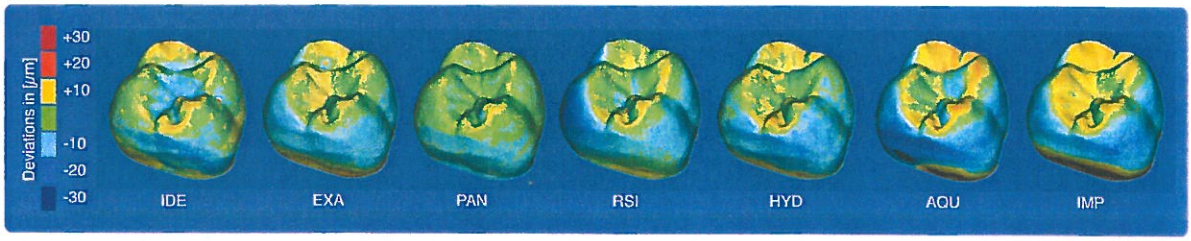

Figure 2: Color-coded difference images for qualitative deviation analysis

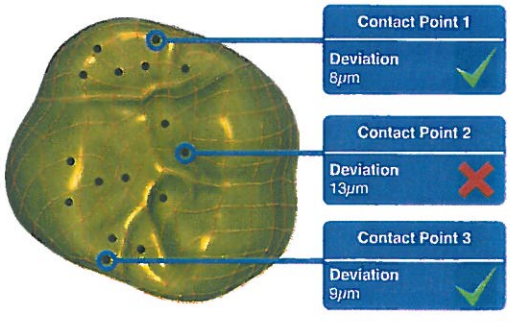

Figure 3: Virtual duplicate with occlusal contact points

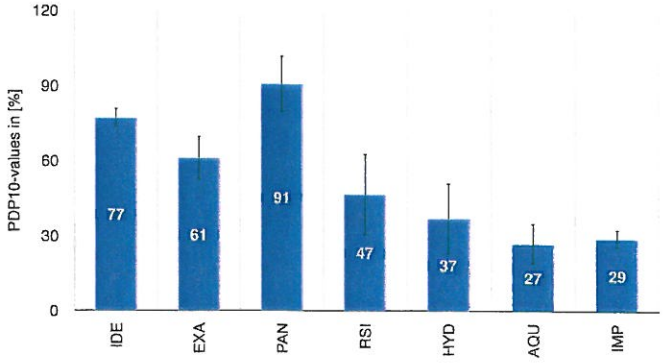

Figure 4: Mean PDP_{10}-values for quantitative deviation analysis

Conclusions:

Only a precise impression leads to restaurations which interfere neither in the statical nor the dynamical occlusion. The newly suggested PDP_{10}-index considers the complex tooth-anatomy when quantifying spacial dimensions. Impression materials with high PDP_{10}-values such as PAN or IDE reproduce spacial dimensions accuratly.