Literature Review

Volumetric determination of the amount of misfit in CAD/CAM and cast implant frameworks: A multicenter laboratory study

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Why Was This Research Done?

Clinicians have struggled for decades to formulate a clear definition of an acceptable clinical fit between implants and frameworks. Jemt in 1991 found distortions between frameworks and osseointegrated dental implants of up to several hundred microns. When he and Book prospectively studied prosthesis misfit in 14 patients, they found the mean centerpoint misfit was 111µm (SD 59) and 91µm (SD51) for the 1- and 5-year groups, respectively, with a range of 275µm. The corresponding mean marginal bone loss was 0.5 and 0.2mm for the two follow-up groups. Although findings such as these have been replicated by numerous researchers around the world, agreement over clinical acceptability has never been reached.

What Was Done?

The authors sought to evaluate the accuracy of implant-supported frameworks made with two different processes: CAD/CAM (computer-aided design/computer-aided manufacturing) and traditional lost-wax casting. The CAD/CAM approach involved using tactile scanning; a sophisticated computer-software program recorded and measured the volumetric differences between CAD/CAM-fabricated and conventionally cast frameworks and implants. As framework misfits typically are three-dimensional, the authors felt that measuring and comparing the components volumetrically would yield new insights into the question of framework-to-implant fit.

How Was It Done?

Three residents from three different prosthodontic residency university programs agreed to use the same protocol. Plastic patient models were fabricated (one for each university) that simulated a mandibular edentulous patient with five interforaminal implants. Impressions, master casts, and verification indexes were made. One set of casts was scanned, and one set of casts was used to fabricate metal frameworks conventionally. All the frameworks were made to similar specifications. Five BellaTek™ Bars (formerly known as CAM StructSURE® Precision Milled Bars) (BIOMET ***3i***) were made for one group of casts. Conventional one-piece castings with silver-palladium alloys were made for the second group of casts. The restorative platforms of the implants were scanned, as were the restorative platforms of each of the frameworks. A software engineer who performed "virtual one-screw tests" then manipulated the digitized data. The results were tabulated, and the volumetric spaces between the frameworks and implants were compared.

What Were the Results?

The CAD/CAM frameworks fit significantly better than the cast gold frameworks ($P<.0001$). On average, the volumetric misfit between the CAD/CAM framework platforms and the implants was 2.25mm^3 less (better) than the corresponding volumetric misfit between the implant-restorative platforms of the castings and the implants.

Clinical Relevance

In this laboratory study, the CAD/CAM technologies featured resulted in implant-supported frameworks that were significantly more accurate than conventionally fabricated cast frameworks. The software used in this study was able to accurately interpret the digital data relative to the small volumetric differences between implants and implant-restorative platforms of the cast and CAD/CAM-fabricated frameworks. The linear differences were on the order of 10-20 microns--significantly better than the misfits described in the 1990s. However, this was a laboratory study, the question as to what are clinically acceptable fits remains unanswered. Also not answered by this research is the question of how important an accurate passive fit between implants and frameworks is and how much of a framework misfit can be biologically tolerated. These questions deserve further study.

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