Root analogue implant creation: Establishing procedures for the general dentist

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OBJECTIVES: The possibility of replacing damaged teeth with custom-made root analogue implants was initially suggested around 1969 and reintroduced by Lungren et al. in 1992. The latter authors created custom implants in titanium and reported good osteointegration and aesthetic results. Following this effort there has been an increasing focus on custom root analogue implants as a replacement for 'screw-type' implants. Given the availability of software to manipulate 3D image data and the rapid rise of 3D printing technology, the question arises as to whether a general dentist can produce their own implants. Here we test the feasibility of practitioners producing custom root analogue implants, detail some of the problems encountered, and provide suggestions to support implant creation by general dentists.

METHODS: We CT scanned a mandible on a GE LightScribe VCT scanner and reconstructed the data with a standard convolution kernel (0.3-mm isotropic voxels). We used Amira 3D software to create isosurfaces of the mandible and teeth and for thresholding and image segmentation. We used Fusion 360 to create sample abutments and Geomagic to merge the 3D tooth mesh and abutment models.

RESULTS: Initial efforts to create root analogues by completely untrained investigators showed that an initial training period was necessary for the production of acceptable models. The difficulty of creating analogues was directly influenced by the tooth type. Further complications arose in determining the location of the bone-gingival junction. Once the models were made we moved them to a CAD program to create and place an abutment. To complete the latter process, we encountered problems with the high number of triangles in the tooth meshes and the lack of compatibility between surface mesh and abutment file structures. This resulted in having to employ a third software program to create the analogue implant. Further issues included the shape and size of the abutment. Once these issues were resolved, we 3D printed root analogues of a premolar and a molar. Standard casting and wax-up methods were used to create replacement crowns.

CONCLUSIONS: We demonstrate that the process of creating one's own root analogue implants is well within the purview of a general dentist. Further, we show that the process of implant creation provides a significant increase in a student's ability to apply advanced imaging and 3D printing technologies to current trends in dentistry. It appears clear that root analogue implants will supplant 'screw-type' implants in many situations and that general dentists can both create and place these implants, thereby increasing their skill set and earning potential, as well as provide another tooth replacement option for patients.