

## Three dimensional teeth designs generated by NURBS modeling

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**INTRODUCTION:** Nonuniform rational B-spline (NURBS) is a mathematical model commonly used in computer aided design, manufacturing and engineering. It was introduced in dentistry through CAD/CAM systems. CAD is mainly used for detailed 3D models but it is also used throughout the manufacturing process, from conceptual design, through strength and dynamic simulation analyses. The aim of the study was to achieve 3D models in order to develop applications for didactic and basic research use, to design and optimize dentures or denture components.

**METHODS:** For most situations, a single scan will not produce a complete model of the object. Multiple scans, from many different directions are usually required to obtain information about all sides of the object. Therefore different normal plaster teeth were scanned rotary and from a single plane using a laser scanner PLX 1200. These scans were brought in a common reference system, a process that is usually called alignment, and then merged to create a complete model. Resulted files were imported in Rhinoceros NURBS modeling program, where the point clouds from the teeth surfaces were cleaned and assembled. The collected data were used to construct three dimensional models. These points were used to extrapolate the shape of the subject, a process called reconstruction (Fig. 1). Reconstruction involves finding and connecting adjacent points in order to create continuous surfaces.

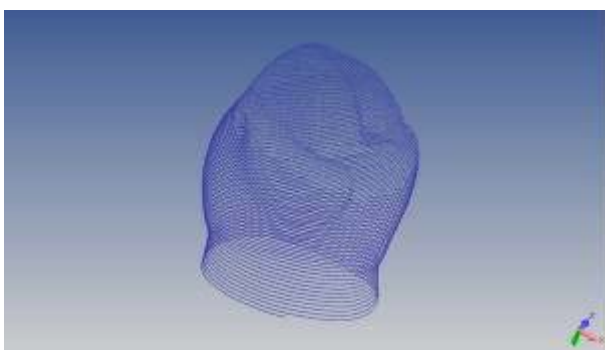


Fig. 1. Point clouds from the teeth surface.

Because of the complex teeth geometry, a nonparametric program was chosen for modeling.

The parts resulted from the scanning were assembled by the superposition of the points. After that a triangular mesh was constructed as uniform as possible, using Open Source programs. Surfaces and solids were generated.

**RESULTS:** NURBS modeled resulted solids (Fig. 2) have a properly designed morphology and can be used for a wide variety of applications.

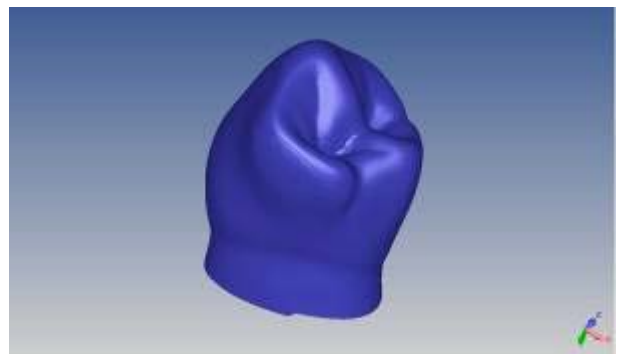


Fig. 2. Three dimensional model of a premolar.

**DISCUSSION & CONCLUSIONS:** The working methods are laborious, they involve a lot of working steps and specific knowledge. They can be used in a wide variety of applications, for finite element analyses, for computer aided machines and for didactic purpose. The exactness of the models obtained by three dimensional scanning is higher than those obtained using other modeling methods.

**REFERENCES:** <sup>1</sup> P. Ausiello, A. Apicella, C. L. Davidson, S. Rengo (2001) 3D-finite element analysis of cusp movements in a human upper premolar, restored with adhesive resin-based composites, *Journal of Biomechanics*, 34, pp. 1269–77. <sup>2</sup> L. Sandu, N. Faur, C. Borțun (2003) *Finite Element Analysis of Stress Distribution in the Abutment Teeth involved in the Treatment with Removable Partial Dentures*. Proceedings of the 6th International Conference on Boundary and Finite Element, Ed. Politehnica, Timișoara, pp. 189-94.

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