The purpose of this study was the application of both digital three-dimensional image processing and virtual reality techniques in Endodontics. In order to achieve the above, three-dimensional volume representations of teeth have been constructed. Two teeth from each tooth category were used in this study; sixteen teeth in total. All these teeth were put in 3% NaOCl solution after their extraction and were washed under running water and were air-dried. They were then embedded in a two phase polyester resin and serial cross sections were taken from each tooth by using a special microtome (Isomet, Buehler, U.S.A.). The thickness of each section was 0.75 mm. Each section was studied under a stereoscopic microscope (Stemy SV8, Zeiss, Germany), and its microscopic image was directly digitized using a video-camera. The surfaces of hard dental tissues (enamel, cementum, dentine) were segmented from each section. Semiautomatic alignment and frame interpolation were performed on the sequence of each tooth sections, using appropriate image processing techniques. Three-dimensional volume representations were achieved in this project in order to produce the final 3D teeth models, on which virtual accesses of pulp cavities have been performed. The 3D tooth models can be rotated in any direction in the space. Dental bur simulators were used, in order to create the pulp chamber virtual accesses. The user can create a new, spherical, cylindrical or cylinder-conical bur tool with determination of its shape parameters. Alternatively, one can select a bur tool from the ones already available. The bur tool is then applied on the appropriate
point of the 3D tooth model by clicking on it with the mouse. Using this procedure, a hole having the shape of the bur tool is created in the 3D tooth model. The virtual tooth “drilling” is implemented as a series of successive morphological erosions on the 3D tooth volume. In conclusion, 3D teeth volume representations enable the detailed study of the external tooth morphology from different viewpoints. Furthermore, virtual tooth “drilling” could serve as a perfect educational tool for undergraduate and postgraduate students, under certain circumstances.