

## Chapter V Summary and conclusions

The aim of this work was to explore some of the potential clinical applications of CBCT in dentistry. The emphasis was to assess the efficacy of CBCT for selected clinical applications in the fields of orthodontics and endodontics.

**Chapter I** starts with an introduction to three-dimensional imaging in medicine and dentistry followed by a technical description of the principles of CBCT imaging. The clinical applications of CBCT in dentistry are then discussed as evidenced in the literature. Several important applications in different dental specialities are detailed including tooth impaction, TMJ imaging, maxillofacial surgery, jaw defects, dental implant rehabilitation, endodontics and orthodontics.

In **Chapter II** in orthodontics, the aims were to assess the accuracy of 3D CBCT models of the dental arches and the maxillofacial skeleton for orthodontic diagnosis and treatment planning. *In part 2.1* the accuracy of CBCT 3D models reconstructions was assessed by comparing linear measurements made on 3D models against physical measurements made on dry skulls. The results showed high correlation between the radiographic and physical measurements suggesting high accuracy of CBCT 3D reconstructions. However, on further analysis *in part 2.2*, several scanning and reconstruction parameters including scan FoV and voxel size selections had significant influence on the quality of 3D reconstructions of the alveolar bone and the visibility of the occlusal surfaces of teeth. This was further confirmed *in part 2.3* when the CBCT 3D teeth and occlusal surfaces reconstructions were quantitatively compared against microCT as a reliable gold standard. Again, it was found that scan FoV and voxel size selections have significant influence on 3D models quality and accuracy and this has corroborated our subjective findings in part 2.2. Most CBCT systems currently available provide many scanning and reconstruction parameters to choose from. Scan FoV, which determines the volume coverage of the anatomical region of interest, has significant influence on image quality in CBCT. Smaller FoV selections are recommended to improve spatial resolution and to improve the visibility of anatomical structures.

In **Chapter III** in endodontics, the aims were to assess the feasibility of CBCT in detection of vertical root fractures (VRFs) and in assessment of endodontic treatment outcomes. *In part 3.1*, the accuracy of CBCT in detecting VRFs was compared to that of conventional 2D periapical radiographs (PR) against a reliable gold standard (microscopy). CBCT was found significantly more accurate than PR in detecting VRFs. *In part 3.2*, however, the accuracy of five clinical CBCT systems for detecting VRFs was compared and large differences in detection accuracy among the different systems were found. Significant differences exist in the visibility of small structures among the different CBCT systems and across the different scanning and reconstruction settings. *In part 3.3* CBCT was used to follow-up a sample of dogs with periapical lesions to assess the changes in the size of the lesions after endodontic treatment. Interestingly, the study found that in several cases, endodontic treatment did not reduce the size of the lesion leading to unfavourable outcome. CBCT was more accurate than conventional 2D PR images in detecting post-treatment lesions and it also permitted accurate assessment of the volume of the lesion pre and post operatively.

**Chapter IV** discusses the results of the published studies and comments on the limitations of the methodologies employed in this work. Also proposals for future research directions are made. The underlying conclusion is that CBCT is a promising technology that can provide new insights in diagnosis and treatment planning for many dental applications. Future CBCT fundamental and clinical research coupled with rapid advances in image processing and high performance computing will most certainly revolutionize modern dental practice. However, several issues with respect to image quality, scanning and reconstruction protocols need to be addressed first before the full-potential of this modality can be realized.