ABSTRACT

Numerous efforts have been made towards three-dimensional (3D) radiographic imaging in all fields of dentistry, ranging from oral surgery to orthodontics. Although computerized tomography (CT) has been available for quite some time now, its use in dentistry has always been limited because of cost, access, and dose considerations. In orthodontics, diagnosis and treatment planning has been based traditionally on 2D imaging, mainly cephalometric and panoramic radiographs. The introduction of cone-beam computed tomography (CBCT) represented a true revolution in dento-maxillofacial radiology, and a shift from 2D to 3D data acquisition, image reconstruction, and visualization. Therefore, CBCT has now been introduced in different areas of orthodontic diagnostic procedures and treatment planning: Evaluation of cleft palate patients, airway and soft tissue analysis, temporomandibular joint morphology assessment, diagnosis of bony asymmetry, localization of impacted teeth and detection of resorption of adjacent teeth. This book chapter gives an overview of the current literature regarding the present use of CBCT in the localization of impacted teeth for orthodontic purposes. The potential, advantages and disadvantages in the diagnosis of impacted teeth will be discussed, also using case examples from the clinical practice.

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INTRODUCTION

The incidence of fully impacted teeth is reported to vary between 5-20% in the general population (Grover & Lorton L, 1985, Frank, 2000). The overwhelming majority of impacted teeth involve third molars, followed by maxillary canines and mandibular second premolars. While most of the other teeth in the upper and lower jaws can also be affected, the incisors and first molars in the mandible are very rarely impacted (Grover & Lorton L, 1985, Dachi & Howell 1961).

A special category of impacted teeth are supernumerary teeth that can be present in various forms and in any region of the mandible or maxilla, but have a predisposition for the anterior maxilla (Scheiner & Sampson, 1997). The prevalence of supernumerary teeth in the permanent dentition has been reported to be between 0.1% and 3.8% (Rajab & Hamdan, 2002, Schulz et al., 2009). The most widely accepted pathogenetic theory is that the tooth bud splits into two (dichotomy) equal or different-sized parts, developing into two teeth of normal size, or one normal and one dysmorphic type, as a result of local, independent, conditioned hyperactivity of the dental lamina (Taylor, 1972). Supernumerary teeth can occur as single, multiple, unilateral or bilateral entities in one or both jaws and are classified according to location-related, size-related or shape-related characteristics (Ooshima et al., 1996).

Principally, the treatment of impacted teeth is based on four concepts: observation, intervention, relocation or extraction (Frank, 2000, Kokich & Mathews, 1993). Observation implies no treatment for a specific period of time. This time period can be further subdivided in a preimpaction and postimpaction phase. Trained dentists are therefore able to either predict tooth impaction (during the preimpaction observation period) or anticipate pathological sequelae associated with impacted teeth (in the postimpaction observation period). Intervention involves orthodontic procedures to establish adequate space in the dental arch that enables eruption. These procedures are often performed in combination with removal of hard- and soft-tissue obstructions form the eruption path of the impacted teeth (Ohman & Ohman, 1980, Shapira et al. 1996). Relocation implies active orthodontic movement of the impacted teeth or even surgical reposition (autotransplantation; Schatz & Joho, 1994). Finally, if impacted teeth cannot be repositioned in the alveolar process using treatment strategies mentioned above, their removal might be indicated.

In orthodontics, three-dimensional (3D) structures have been routinely analyzed using two-dimensional (2D) imaging. Besides conventional intraoral radiographs, cephalometric imaging and panoramic views were applied on a routine basis for diagnostic and treatment planning purposes (Hechler, 2008). To diagnose and to locate impacted teeth accurately, periapical and occlusal radiographs were the radiographic methods of choice for decades. Orthodontists have used the tube shift technique to compare two periapical radiographs taken at different beam angles to determine the facial/oral position of impacted teeth, and also to base surgical and/or orthodontic treatment planning upon. Although the „same lingual, opposite buccal“ rule is helpful in determining whether the impacted tooth is positioned buccal or oral to the roots of the neighbouring teeth, it has clear limitations when assessing the exact angulation of the impacted tooth and possible crown/root proximities with or without resulting root resorptions (Jacobs, 1999).

Although computerized tomography (CT) has been available for quite some time, its use in dentistry has always been limited because of cost, access, and exposure to radiation (White & Pharoah, 2008). The introduction of cone-beam computed tomography (CBCT) represented an important new development in dento-maxillofacial radiology, and precipitated a shift from two- to three-dimensional data acquisition, image reconstruction, and visualization. In contrast to conventional CT scanning, CBCT imaging captures the
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