Cone Beam Computed Tomography in Evaluations of Some Side Effects of Orthodontic Treatment

AKADEMISK AVHANDLING

som för avläggning av odontologie doktorsexamen vid Sahlgrenska akademin vid Göteborgs universitet kommer att offentligen försvaras i hörsal Arvid Carlsson, Sahlgrenska akademin, Medicinaregatan 3, Göteborg, fredagen den 2 december 2011, kl. 9.00

av
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leg tandläkare

Fakultetsopponent:
Professor Madeleine Rohlin, Malmö högskola, Malmö

Avhandlingen är baserad på följande delarbeten:

I Lund H, Gröndahl K, Gröndahl H-G.
Accuracy and precision of linear measurements in cone beam computed tomography Accuitomo® tomograms obtained with different reconstruction techniques.
Dentomaxillofacial Radiology 2009; 38:379-386

II Lund H, Gröndahl K, Gröndahl H-G.
Cone beam computed tomography for assessment of root length and marginal bone level during orthodontic treatment.
Angle Orthodontist 2010; 80:466-473

III Lund H, Gröndahl K, Hansen K, Gröndahl H-G.
Apical root resorption during orthodontic treatment: A prospective study using cone beam CT.
Angle Orthodontist 2011;doi: 10.2319/061311-390.1

IV Lund H, Gröndahl K, Gröndahl H-G.
Cone beam computed tomography evaluations of marginal alveolar bone before and after orthodontic treatment.
European Journal of Oral Sciences. Submitted September 2011

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Abstract

In the late 1990s a new imaging modality, Cone Beam CT (CBCT) that enables high quality three-dimensional imaging at lower doses than Computed Tomography (CT), was introduced in dento-maxillofacial imaging.

In 2005 the Swedish Council on Health Technology Assessment (SBU), in a review of scientific articles on Malocclusions and Orthodontic Treatment in a Health Perspective, found low or contradictive evidence for an association between orthodontic treatment and risks for negative side effects. It was apparent that some of the issues raised only could be addressed by the use of a radiographic technique enabling three-dimensional imaging with high accuracy and reproducibility.

A new medical technology needs to be evaluated before implemented in research. This was the aim of two initial studies that, *in vitro*, examined the accuracy and precision in CBCT imaging using a Plexglas® object and a dry human skull and, *in vivo*, assessed its reproducibility in 13 patients. The results showed small differences between actual values and those obtained from measurements in CBCT tomograms and high reproducibility in measurements of root lengths and marginal bone levels.

A prospective radiographic study aimed to investigate root resorption and marginal bone level alterations during orthodontic treatment was conducted on 152 adolescent patients with a common type of malocclusion. CBCT examinations were made before (Baseline) and after treatment (Endpoint) and, in a randomly chosen group of 97 patients, six months after treatment initiation.

Root lengths, from those of incisors to those of first molars, and the marginal bone height at root surfaces around the teeth were measured in multiplanar reconstructed tomograms. The results showed that 95% of the patients had at least one tooth with a root resorption >1mm. Maxillary lateral incisors and premolars were most often affected and showed the most severe resorptions. Resorptions were also found at buccal and palatal root surfaces, only accessible with a tomographic technique. Jaw, tooth group, and root length at the six-month examination were significantly associated with the degree of root resorption at Endpoint.

Before treatment start, large differences in marginal bone height were found, particularly between tooth surfaces. At the end of treatment large changes in bone height among teeth and tooth surfaces could be seen. The largest changes were found at lingual and buccal surfaces, that is, surfaces that cannot be evaluated in conventional radiographs. In contrast, proximal surfaces at posterior teeth, hitherto subjected to most research, showed only small changes. The decrease of marginal bone height was larger in the mandible than in the maxilla and larger in girls than in boys, with respect to palatal/lingual surfaces.

A high quality CBCT technique is well suited for research on root resorption and marginal bone level changes during orthodontic treatment as it provides access to anatomic structures that cannot be evaluated in conventional radiographs, high measurement accuracy and precision, and possibilities to reconstruct images to compensate for changes in tooth/root positions that occur during orthodontic treatment.

Keywords: Cone beam computed tomography, orthodontics, adolescents, root resorption, marginal bone height

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