

# On the use of radiography and radiation dose consideration in orthodontic treatment

Akademisk avhandling

som för avläggande av odontologie doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentligen försvaras i Hörsal Arvid Carlsson, Sahlgrenska Akademien, Medicinargatan 3, fredagen den 17 december 2021, klockan 9.00.

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## Avhandlingen baseras på följande delarbeten

- I. Granlund C, Thilander-Klang A, Ylhan B, Lofthag-Hansen S, Ekestubbe A. *Absorbed organ and effective doses from digital intra-oral and panoramic radiography applying the ICRP 103 recommendations for effective dose estimations*. Br J Radiol. 2016 Oct;89(1066):20151052. doi:10.1259/bjr.20151052. Epub 2016 Jul 25.
- II. Granlund CM, Lith A, Molander B, Gröndahl K, Hansen K, Ekestubbe A. *Frequency of errors and pathology in panoramic images of orthodontic patients*. Eur J Orthod. 2012 Aug;34(4):452-7. doi:10.1093/ejo/cjr035. Epub 2011 Apr 21.
- III. Stervik C, Lith A, Westerlund A, Ekestubbe A. *Choice of radiography in orthodontic treatment on children and adolescents: A questionnaire-based study performed in Sweden*. Eur J Oral Sci. 2021 Aug;129(4):e12796. <https://doi.org/10.1111/eos.12796>. Epub 2021 Jun 6.
- IV. Stervik C, Lith A, Ekestubbe A. *Radiation exposure during orthodontic treatment: risk to children and adolescents*. In manuscript.

**SAHLGRENKA AKADEMIN  
INSTITUTIONEN FÖR ODONTOLOGI**



# On the use of radiography and radiation consideration in orthodontic treatment

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## Abstract

The aims of this thesis were to analyse the use of radiography and radiation risk associated with orthodontic treatment.

**Study I** measured absorbed doses to radiosensitive organs in the head and neck in an anthropomorphic phantom head using thermoluminescent dosimeters (TLDs) from digital intra-oral and panoramic radiography. Effective doses were calculated. **Study II** retrospectively evaluated panoramic radiographs of children and adolescents to determine positioning errors and pathological findings. A web-based questionnaire in **Study III** queried orthodontists about their use of radiographic examinations. **Study IV** retrospectively analysed the radiographs used in orthodontic treatment at two specialist clinics. **Results:** The salivary glands and the oral mucosa received the highest absorbed doses in intra-oral full-mouth and panoramic radiography and effective doses were  $15\mu\text{Sv}$  and  $19\text{--}75\mu\text{Sv}$ , respectively. Positioning errors were found in 96% of the panoramic radiographs, 24% of the errors may have influenced diagnostic accuracy. The number of pathologies and anomalies were 1,221 in 558 (43%) patients, mainly in tooth-bearing regions. Only 63 (5%) of the findings may have influenced treatment outcome. Questionnaire respondents stated that radiographic examinations were mainly used in treatment planning stage, the most common were panoramic radiographs. Local radiographic guidelines were often applied while little need for national guidelines was expressed. Preliminary results confirmed the use of radiographs predominantly during treatment planning and estimated radiation risk was comparable to approximately a week of natural background radiation in Sweden. **In summary**, effective doses were higher than previously reported in panoramic radiographs. Positioning errors in panoramic radiographs were common. Pathologies or anomalies were mainly found in the dentoalveolar regions, indicating that the radiation field could be limited in panoramic radiography. Panoramic radiographs are frequently used in orthodontic treatment. Even though radiation risk at the individual level is low, the risk at the population level is not negligible.

**Keywords:** effective dose, errors, estimated risk, intra-oral radiograph, organ dose, orthodontic treatment, orthodontists, panoramic image, questionnaires, radiation doses.