# Biomechanical analysis of the mandibular front in presence of a local gingival recession in combination with a tertiary crowding

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## Introduction

Tertiary crowding is a common finding in the mandible of adult patients (Fig. 1). This not only leads to displacements of the teeth, they are also often accompanied by attachment loss or gingival recession of a single incisor (Fig. 2). To prevent progression, orthodontic treatment may be considered.

The aim of this finite element (FE) simulation was to investigate the biomechanical behaviour of the mandibular incisors in the presence of a local gingival recession in combination with a tertiary crowding.

Fig. 1: Crowded teeth in the mandible

Fig. 2: Gingival recession at a front tooth

## Material und Method

Based on 3D datasets of a mandible (Viewpoint Data Labs, UK), a finite element (FE) model of a fully toothed mandible with surrounding periodontal ligament (PDL) was created. In the Marc / Mentat FE system (Fig. 3), a recession of approx. 4 mm was modelled with crowded teeth in the front. Various force / torque situations were applied. Material parameters from previous investigations (bone: E = 2 GPa, tooth: E = 20 GPa, both homogeneous, isotropic and PDL: bilinear elastic, varying material behaviour) were adapted. Pure couples of forces were applied to determine the location of the centres of resistance (CR) and the initial tooth movements. The results were compared with those of a model with crowed teeth and morphologically healthy PDL and bone.

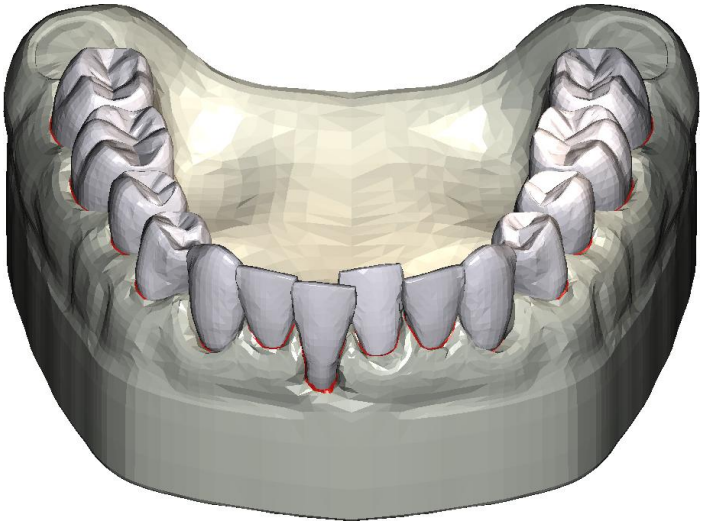

Fig. 3: Mandible model with bone, PDL and teeth with a tertiary crowding of about 4 mm between the canines and a recession of about 4 mm.

## Results

The orovestibular centre of resistance (CR) of the tooth 41 is shifted by about 1 mm (about 10%) to coronal in the presented model with crowded teeth without recession defect compared to a lower jaw model with regular anterior teeth. In the model with crowded teeth and recession defect, the CR is again at the same height as in the healthy model, i. e. it has again shifted apically by about 10%.

The initial deflections do not change by the recession, but due to a softer material behaviour of the PDL they are by two (tooth 31) to three (tooth 41) times as high as in the other models. The rotation on tooth 41 is about 25° in all models on the tooth crown. Although the initial strains due to the recession do not change, the periodontal elongation increases by about 30%. However, in a softer periodontium, the value for the strain doubles as much as the deflection.

## Conclusions

The risk of periodontal overloading of incisors with local gingival recessions can be reduced or even avoided by appropriate choices of force-torque ratios. The influence of the material parameters appears larger than the influence of the height of the recession defect.