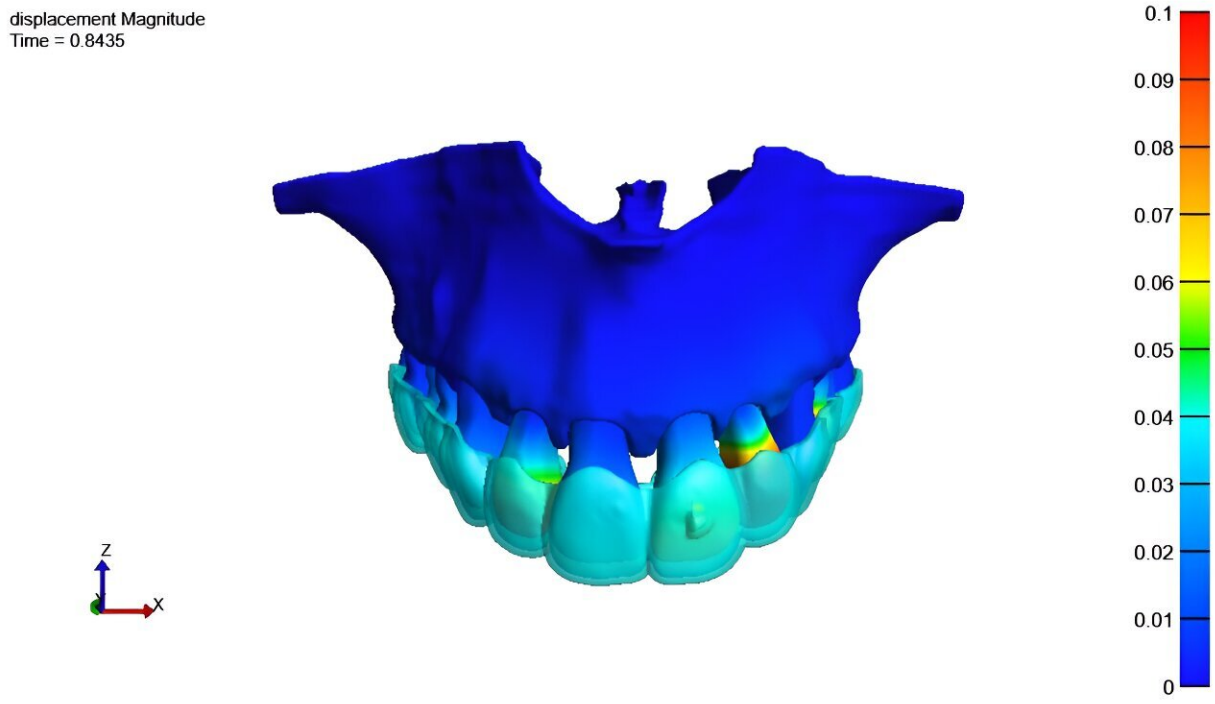
# Straightening teeth? AI can help

March 13 2024, by Michael Skov Jensen




A digital twin of a patient's jaw created through the integration of AI solutions and computational modeling, enabling precise simulation of anticipated teeth movements under specific conditions. The color map visually represents the extent and direction of teeth movement, with warmer colors indicating higher teeth movements. Credit: University of Copenhagen

A new tool being developed by the University of Copenhagen and 3Shape will help orthodontists correctly fit braces onto teeth. Using artificial intelligence and virtual patients, the tool predicts how teeth will

move so as to ensure that braces are neither too loose nor too tight.

Many of us remember the feeling of having our braces regularly adjusted and retightened at the orthodontist's office. And every year, about 30 percent of Danish youth up to the age of 15 wear braces to align crooked teeth. Orthodontists use the knowledge gained from their educations and experience to perform their jobs, but without the possibilities that a computer can provide for predicting final results.

A new tool, developed in a collaboration between the University of Copenhagen's Department of Computer Science and the company 3Shape, makes it possible to simulate how braces should fit to give the best result without too many unnecessary inconveniences.

The tool has been developed with the help of scanned imagery of teeth and bone structures from human jaws, which artificial intelligence then uses to predict how sets of braces should be designed to straighten a patient's teeth best.

"Our simulation is able to let an orthodontist know where braces should and shouldn't exert pressure to straighten teeth."

"Currently, these interventions are based entirely upon the discretion of orthodontists and involve a great deal of trial and error. This can lead to many adjustments and visits to the orthodontist's office, which our simulation can help reduce in the long run," says Professor Kenny Erleben, who heads IMAGE (Image Analysis, Computational Modelling, and Geometry), a research section at UCPH's Department of Computer Science.

## Helps predict tooth movement

It's no wonder that it can be difficult to predict exactly how braces will

move teeth because teeth continue shifting slightly throughout a person's life. And, these movements are very different from mouth to mouth.

"The fact that tooth movements vary from one patient to another makes it even more challenging to predict how teeth will move for different people accurately. Which is why we've developed a new tool and a dataset of different models to help overcome these challenges," explains Torkan Gholamalizadeh, from 3Shape and a Ph.D. from the Department of Computer Science.

As an alternative to the classic bracket and braces, a new generation of clear braces, known as aligners, has gained ground. Aligners are designed as a transparent plastic cast of the teeth that patients fit over their teeth.

Patients must wear aligners for at least 22 hours a day, and they need to be swapped for new and tighter sets every two weeks. Because aligners are made of plastic, a person's teeth also change the contours of the aligner itself, something that the new tool also takes into account.

"As transparent aligners are softer than metal braces, calculating how much force it takes to move the teeth becomes even more complicated. But it's a factor that we've taught our model to take into account so that one can predict tooth movements when using aligners as well," says Gholamalizadeh.

## Digital twins can improve treatment

Researchers created a computer model that creates accurate 3D simulations of an individual patient's jaw, and which dentists and technicians can use to plan the best possible treatment.

To create these simulations, researchers mapped sets of human teeth using detailed CT scans of teeth and of the small, fine structures between

the jawbone and the teeth known as periodontal ligaments—a kind of fiber-rich connective tissue that holds teeth firmly in the jaw.

This type of precise digital imitation is referred to as a digital twin—and in this context, the researchers built up a database of 'digital dental patients.'

But they didn't stop there. The researchers' database also contains other digital patient types that could one day be of use elsewhere in the health care sector.

"Right now, we have a database of digital patients that, besides simulating aligner designs, can be used for hip implants, among other things. In the long run, this could make life easier for patients and save resources for society," says Kenny Erleben.

The area of research that makes use of digital twins is relatively new, and, for the time being, Professor Erleben's database of virtual patients is a world leader. However, the database will need to get even bigger if digital twins are to really take root and have benefit the health care sector and society.

"More data will allow us to simulate treatments and adapt medical devices so as to target patients across entire populations more precisely," says Professor Erleben.

Furthermore, the tool must clear various regulatory hurdles before it is rolled out for orthodontists. This is something that the researchers hope to see in the foreseeable future.

The findings are published in the journal *IEEE Access*.

**More information:** Peidi Xu et al, Deep-Learning-Based Segmentation of Individual Tooth and Bone With Periodontal Ligament Interface Details for Simulation Purposes, *IEEE Access* (2023). DOI: 10.1109/ACCESS.2023.3317512

Provided by University of Copenhagen

Citation: Straightening teeth? AI can help (2024, March 13) retrieved 27 April 2024 from https://medicalxpress.com/news/2024-03-straightening-teeth-ai.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.