2015

A Biomechanical Analysis of Lingualised Versus Bilateral Balanced Occlusion for Implant-Supported Overdentures in an East African Cohort

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DOI: https://doi.org/10.5281/zenodo.18533755

Abstract

Implant-supported overdentures are an important treatment for edentulous patients. The optimal occlusal scheme for biomechanical stability, particularly in resource-limited settings, remains uncertain. While lingualised and bilateral balanced occlusion are common designs, comparative data on stress distribution in two-implant mandibular overdentures within East African populations are lacking. This protocol describes a study to compare the biomechanical performance of lingualised occlusion with bilateral balanced occlusion for mandibular implant-supported overdentures on two locator attachments. The primary objective is to analyse and compare stress distribution on peri-implant bone and prosthetic components using three-dimensional finite element analysis. A comparative in silico study will be conducted. Three-dimensional finite element models of an edentulous mandible with two implants in the canine regions and a locator-retained overdenture will be developed from anonymised patient scans. Two distinct occlusal schemes —lingualised and bilateral balanced—will be simulated. Static loads simulating mastication will be applied. Stress distribution patterns and magnitudes on peri-implant bone, along with displacement of prosthetic components, will be analysed and compared between the two models. As this is a study protocol, no empirical results are available. The anticipated findings will detail the direction and magnitude of stress concentration,

indicating whether one scheme demonstrates a more favourable distribution. The study will provide a biomechanical rationale for selecting an occlusal scheme for two-implant overdentures in this cohort. Conclusions will be drawn from the comparative analysis of simulated stress and displacement data. Based on the findings, clinical recommendations will be made regarding the preferred occlusal scheme to optimise biomechanical performance and potentially improve prosthesis longevity in this setting. Dental implants; overdenture; finite element analysis; occlusion; biomechanics; Tanzania. This protocol outlines a novel investigation into occlusal scheme design for implant overdentures within an East African context. The findings will contribute biomechanical evidence to inform clinical practice in similar resource-limited environments.