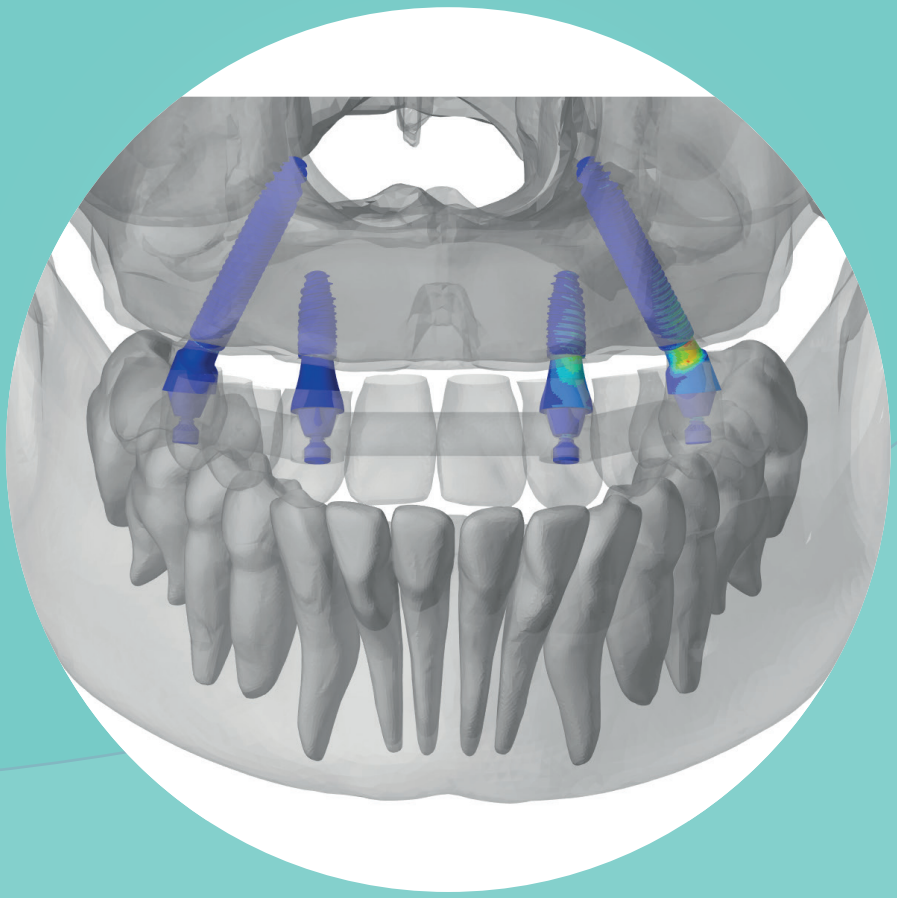
Kontact™

IMPLANT KONTACT™

LENGTHS 20 MM, 22 MM, 24 MM

Finite element analysis of stresses and deformations in the case of a 4-Load system at the maxilla with two 20mm-long Kontact™ implants.



ANALYSIS COMPLETED IN COLLABORATION WITH

Laboratoire de Biomécanique Appliquée

Aix*Marseille université

IFSTTAR

GLAD Medical

INTRODUCTION

In the case of complete restorations at the maxilla, the low bone density encountered may not provide enough primary implant stability to achieve immediate loading and will therefore postpone the treatment schedule.

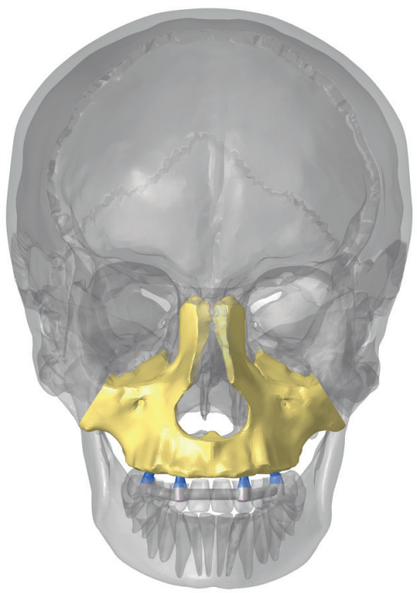
In such a case, one of the solutions is to fit longer implants (20, 22 or 24 mm) to anchor the apex of the implants in the floor of the nasal cavity.
The purpose of this study is therefore to verify whether the use of two long implants in a 4-load system at the maxilla provides superior implant stability.

METHODS

MODELLING OF THE MAXILLA

Modelling of a type 3/4 bone (patient with low bone quality) according to the Lekholm and Zarb bone classification (1985).

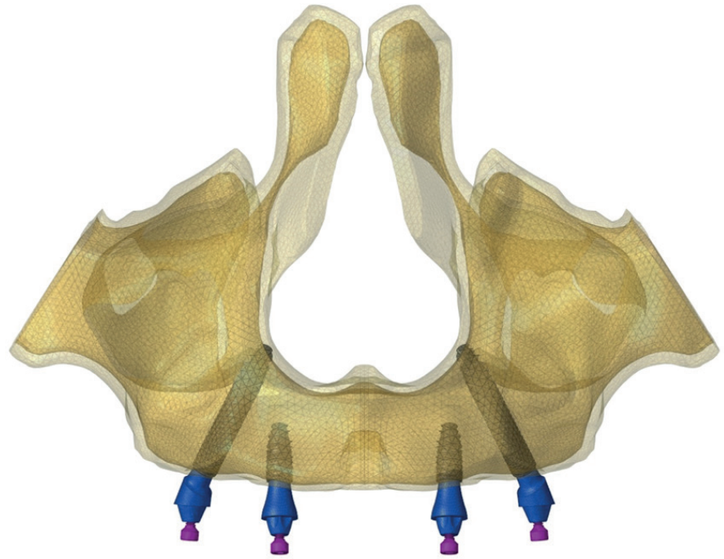
Modelling of a cortical bone thickness of less than 1 mm and weak mechanical properties for the cortical bone and cancellous bone.

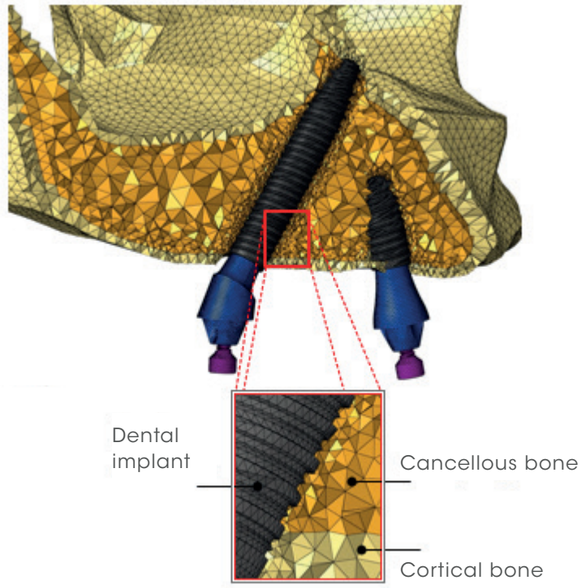


PLACEMENT OF THE IMPLANTS

Maxilla placement of two short Kontact™ implants – 8 mm long and 3.6 mm in diameter (ref. K3608) in positions 12 and 22.

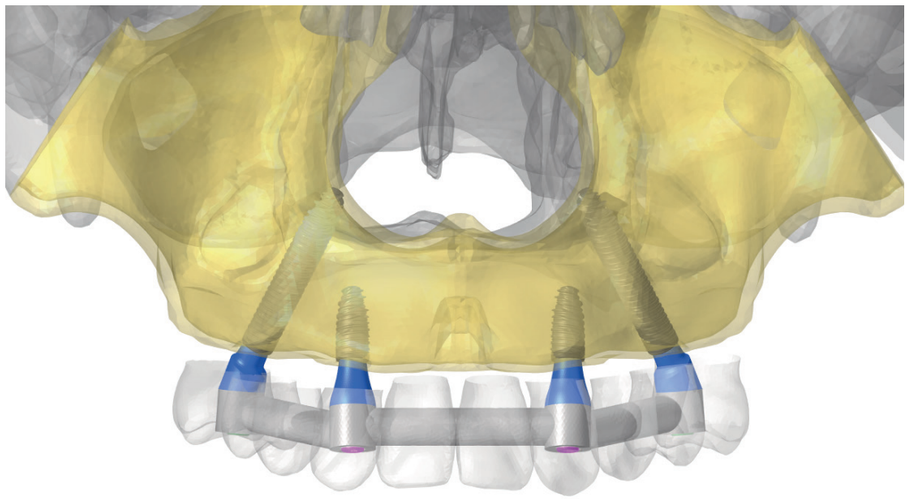
Maxilla placement of two Kontact™ implants – 20 mm long and 3.6 mm in diameter (ref. K3620) in positions 15 and 25, inclined so that their apexes are located in the floor of the nasal cavity.





PROSTHESIS REALIZATION

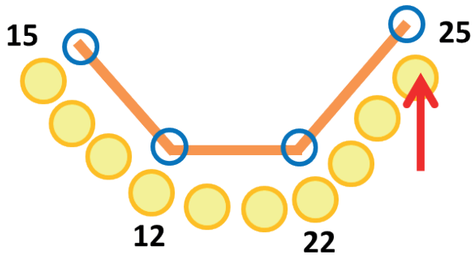
Short implants are associated with straight conical abutments and long implants with angulated conical abutments. A prosthesis of 10 teeth is then modelled.

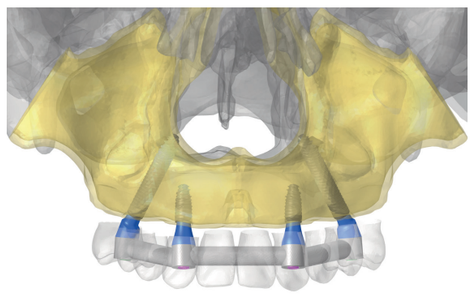


LOADING MODELLING

In order to be in a critical case, a single force of 185N (Hasan et al, 2016; de la Rosa et al, 2019) is applied on the tooth position 25.

The purpose of this single force on a long implant is to study its behaviour as well as its interaction with the surrounding tissues.



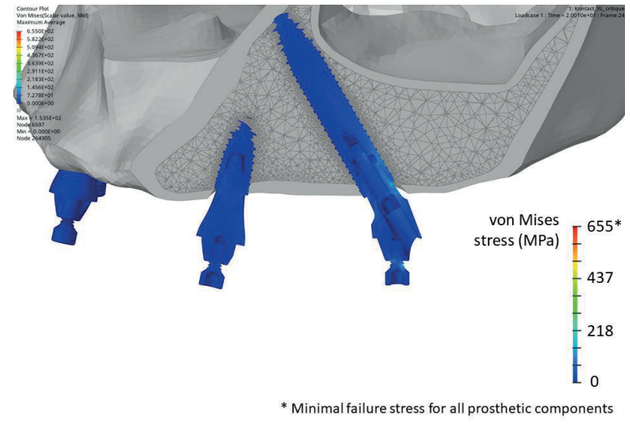


RESULTS

STUDY OF STRESSES IN IMPLANTS AND PROSTHETIC PARTS

The Von Mises maximum stresses in implants and prosthetic parts are studied in order to ascertain whether these elements are in danger of fracturing.

The stresses are very low at the level of the implants and prosthetic parts. The maximum stresses in each element studied are much lower than the maximum stress supported by the material. Under these loading conditions, there is no risk of the implants or prosthetic parts breaking.

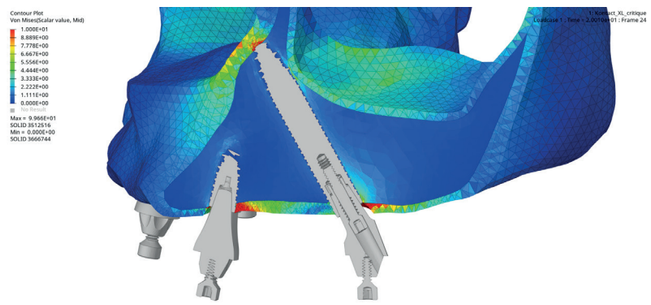


* Minimal failure stress for all prosthetic components

EVALUATION OF THE VON MISES MAXIMUM STRESSES IN THE CORTICAL BONE

The Von Mises maximum stress in the cortical bone is studied to ascertain whether the cortical bone is in danger of fracturing.
A concentration of stress can be observed at the cortical anchorage. This is due to the pressure that the implant exerts on the cortical bone.

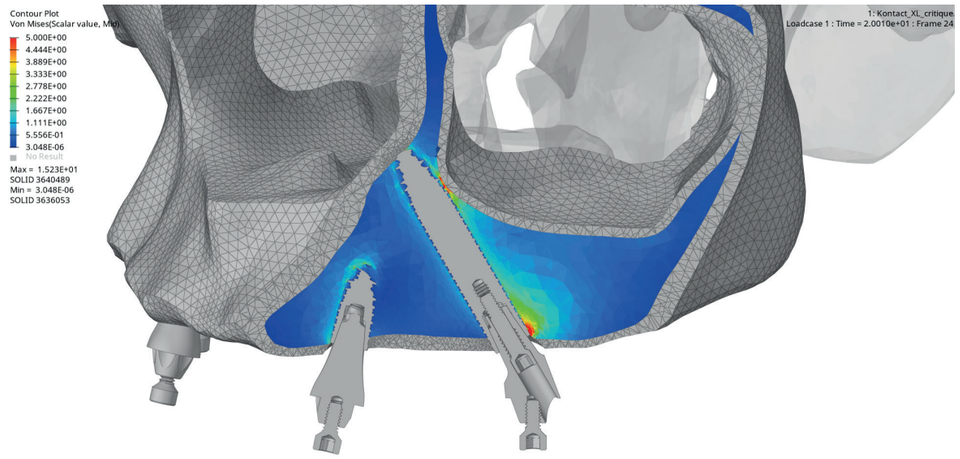
These concentrations of stress show that long implants have a double cortical anchorage. The maximum stress (99 MPa) obtained in the cortical bone is less than the maximum stress supported by the cortical bone before breaking (105 MPa). Consequently, the risk of a fracture of the cortical bone, under these loading conditions, is very low.



EVALUATION OF THE VON MISES MAXIMUM STRESSES IN THE CANCELLOUS BONE

The Von Mises maximum stresses in the cancellous bone are studied to ascertain whether the cancellous bone is in danger of fracturing.

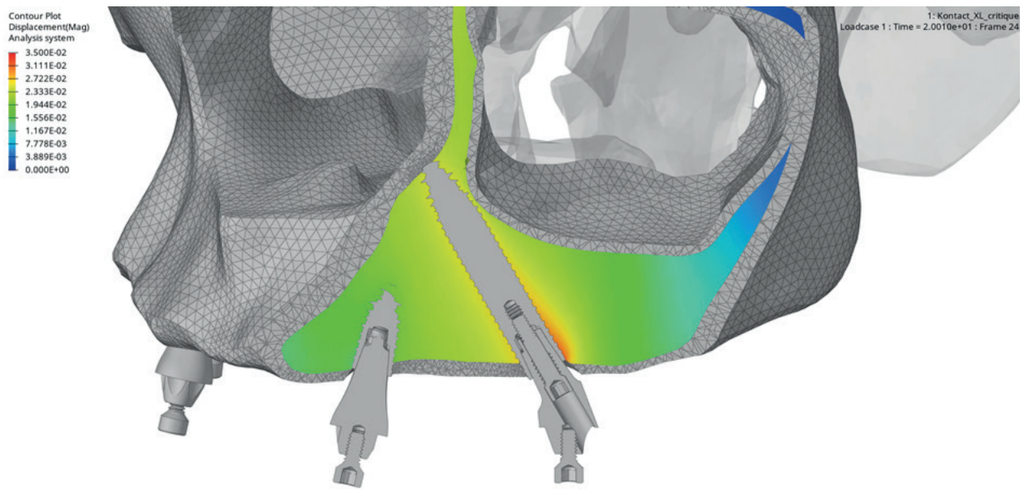
There is a concentration of stresses in the cancellous bone at the neck of the implant and a homogeneous distribution of stresses all along the body of the implant.



EVALUATION OF MOVEMENTS AT THE BONE TISSUE LEVEL

The study of movements shows in general very small movements as well as around long implants.

The resulting deformations to the bone are very slight (maximum deformation of 5823 $\mu\varepsilon$). This therefore guarantees good primary stability of the implants even in low density bone, such that, under these conditions, immediate loading is possible.



CONCLUSION

The finite element analysis carried out on a 4-load system at the maxilla with two long implants revealed that the stresses and deformations associated with the implants, prosthetic parts and bone tissues were compatible with immediate loading. This also applied in the case of a low density bone.

SOURCES

[1] I. Hasan et al., « Changes in biting forces with implant-supported overdenture in the lower jaw: A comparison between conventional and mini implants in a pilot study », Ann. Anat. - Anat. Anz., vol. 208, p. 116 122, nov. 2016.

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[3] R. Al Nazer, J. Lanovaz, C. Kawalilak, J. D. Johnston, et S. Kontulainen, « Direct in vivo strain measurements in human bone—A systematic literature review », J. Biomech., vol. 45, no 1, p. 27 40, janv. 2012.

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