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A comparative study to evaluate the effect of implant support on complete fixed dental prosthesis fabricated with Co-Cr framework, when implants placed in all-on-4 and all-on-6 situation, by strain gauge analysis and finite element analysis- an in vitro study

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Running head: Decoding All on 4 and All on 6 using Co-Cr framework for an ISCFDP(Implant supported complete fixed dental prosthesis)

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ABSTRACT

Purpose:

To evaluate and compare the strain development and stress distribution around maxillary implant supported complete fixed dental prosthesis(ISCFDP) with Co-Cr superstructure , when implants placed in All-on-4 (2 straight & 2 distally tilted) and All-on-6(2 straight, 2 distally tilted and 2 tilted implants placed at pterygoid area) situation using strain gauge and a three dimensional finite element analysis.

Methodology: Two clinical models was 3D printed by scanning the skull with maxillary edentulous jaw.

MODEL 1 (M1) – Edentulous maxilla with 4 implants

MODEL 2 (M2) – Edentulous maxilla with 6 implants

Preparation of M1 – using surgical guide, two straight implants was placed at the incisor area, two tilted implants was placed at premolar area.

Preparation of M2 – using surgical guide, two straight implants was placed at the incisor area, two tilted implants was placed at premolar area and two tilted implants placed at maxillary tuberosity area.

Fixed dental prosthesis framework was fabricated on both M1 and M2.

Strain gauge sensors were placed on both the models M1 and M2 at the neck of each implant. The loads on the implants beneath the fixed dental prosthesis were measured with strain gauge attached to the neck of the implants. The occlusal surface of the prosthesis was defined for applying the loads.


Two clinical models fabricated were scanned and respective mesh models were made. Number of nodes and elements was identified using Finite Element Analysis.

Results: The mean maximum overall stress observed in M1 v/s M2 due to application of 100N load was compared. It was found that there is marginal significant difference existed in mean maximum overall stress observed at M1 v/s M2 due to application of load on the Co-Cr maxillary ISCFDP. The mean maximum overall stress observed in M2 was 19.42 ± 4.85 which was lesser than the mean maximum overall stress observed in M1 i.e., 39.35 ± 13.12 with a mean difference of 19.93 ± 8.27 .

Conclusion: Within the limitations of the present study, the following conclusions can be drawn:

- The tilted implants in the premolar region exhibited more stress than the straight implants in incisor region in All on 4 situation.
- The implant placed in pterygoid area dissipated stress resulting in lower overall strain in tilted implants placed in premolar region and straight implants placed in incisor region in All on 6 situation.
- The area of stress distribution was found to be much wider in implants placed in All on 6 situation when compared to implants placed in All on 4 situation.
- Co-Cr framework in All on 4 situation had 18.9% higher stress than the Co-Cr framework placed in All on 6 situation

Keywords: Co-Cr, All on 4, All on 6, ISCFDP (Implant supported complete fixed dental prosthesis), pterygoid area.

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