EBD spotlight: Bio-mechanical efficiency of different implant-abutment connections

Manas Dave[1] shines a spotlight on another *Evidence-Based Dentistry* topic.

'Biomechanical efficiency of different implant-abutment connection: a systematic review of studies using photoelastic stress analysis' was published in *Evidence-Based Dentistry* this year.[1]

Background

Dental implants are a common treatment option for the replacement of a single or multiple missing teeth.[2] Once osseointegration – the process of bone remodelling around the

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placed dental implant creating a connection with the jaws – has taken place, the success of the dental implant relies on the stability of this connection and the stability of the implant to abutment connection system. For the latter, there are two types of systems: an internal connection which has an internal mechanism or geometry (hexagon, octagon or morse taper [internal conical]) connection or an external connection which involves a visible geometric structure such as a hexagon on the top surface of the implant fixture. The internal connection design allows for a larger surface area of contact between the implant and abutment and can minimise micro-gaps between the implant and abutment (this reduces the risk of bacterial infiltration and movement). The external connection was initially developed to facilitate rotational torque transfer during implant placement however can result in micro-gaps between the implant and abutment, leading to bacterial contamination and stress on the abutment screw. The aim of this systematic review was to evaluate the biomechanical efficiency of different abutment-implant connections studied through photoelastic stress analysis.

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Methods

An electronic database search of PubMed, Web of Science and Scopus was conducted for studies from 2010 to January 2023. Additionally, hand searching of journals (*Journal of Implant Dentistry*, *Clinical Oral Implant Research* and *Clinical Implant Dentistry*) was undertaken to identify studies that compared stress distribution in different abutment-implant connections. Studies that used Finite Element Analysis (FEA – a computational method of simulation) or those *in-vivo* were excluded. Quality assessment was not undertaken as the authors were mathematically estimating biochemical parameters.

Results

- Four studies were included which compared the biomechanical efficiency of different abutment implant connections (internal hexagon, internal taper, Morse taper and external hexagon)
- A total of 18 implants were analysed using the photoelastic stress analysis method across all studies
- Three studies compared the external connection with the internal connection and observed better stress distribution for the internal connection
- One study observed Morse taper (single unit crown) having a lower amount of stress compared to the external connection
- For off-centre loading, an internal connection offered a lower amount of stress followed by the internal tapered connection. The external connection offered the highest stress concentration
- For centre-loading, all implant connections showed similar findings.

Conclusions

The authors concluded:

'…the internal connection has better biomechanical efficiency as compared to the external connection as it offers better stress distribution and provides good stability to the implant-abutment connection but in the case of oblique loading, both connections [internal and external] show a similar patterns of stress…'

Commentary

This systematic review provided a clearly defined research question comparing the evaluation of implant-abutment connections using photoelastic stress analysis. The authors acknowledged the potential for publication bias given the limited number of studies (n = 4). The inclusion of studies using FEA might have provided more studies to support the results reported. Whilst photoelastic stress analysis is a valid technique to assess stress distribution, there are several other methods such as FEA, strain gauges (measuring deformation of materials), digital image correlation (measuring displacement and strain on the surface of materials), micro strain analysis (measuring movement between attached markers to implant components), 3D imaging etc. Each technique will have its limitations and results may not be comparable between techniques however inclusion of different methods could increase the number of included studies and in turn, the confidence of the conclusions which can be drawn.

References

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https://doi.org/10.1038/s41407-023-1951-x