A Pre-clinical model for the assessment of the osseointegration of dental implants

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Abstract

The replacement of missing teeth with dental implants is considered the gold standard of dental treatment[1]. Several new materials have been approved by the Food and Drug Administration (FDA) as potential implant materials. However, the effectiveness of these implant materials has not been proven clinically, particularly as dental implants. Various approaches have been developed to assess the osseointegration of dental implants in animal models[2,3,4]. Satisfactory results in preclinical research are essential prior to the translation into clinical application. Thus, the challenge to find a viable novel approach to assess the osseointegration of new dental implants remains open.

There is a need for a model where the new implant and the gold standard implant could be inserted and tested using a split-mouth design which allows the random allocation of the experimental and control material within the oral cavity[5]. This will offer several advantages which include the marked reduction of the environmental variabilities to draw a robust conclusion[6]. In this study, we describe the first rabbit model that utilised a split-mouth design to study osseointegration in the oral cavity.

METHODS & RESULTS: The study was carried out on adult New Zealand white rabbits, each received two implants; an experimental on one side, and a control on the opposite side. The implants were 8 mm long and 2 mm wide and were inserted in the extraction sockets of the secondary incisors of the anterior part of the maxilla (Figure 1).

Results:

All rabbits tolerated the surgical procedures and recovered without complications.

DISCUSSION & CONCLUSIONS: The described model is safe, reproducible, standardised, requires minimal surgical skills and can be achieved using basic surgical instruments. The design lends itself for the evaluation of new dental implants including compromised conditions such as osteoporosis, poorly controlled diabetes and other immunocompromised states.

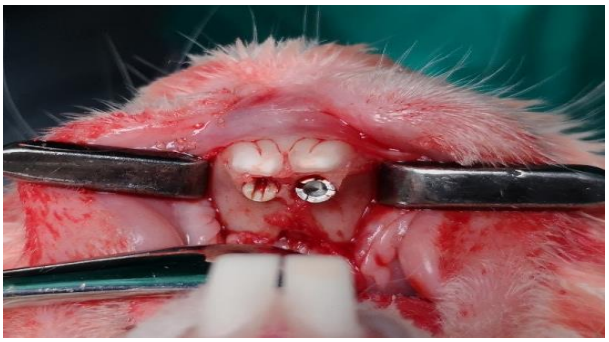


Figure1: A pre-clinical model. Illustration of placement of the implants in the maxilla of the rabbit.

References

1. Zhou, P., He, F., Liu, B. & Wei, S. Nerve electrical stimulation enhances osseointegration of implants in the beagle. Sci. Rep. (2019). doi:10.1038/s41598-019-41471-z
2. Stadelmann, V. A. et al. In vivo MicroCT monitoring of osteomyelitis in a rat model. Biomed Res. Int. (2015). doi:10.1155/2015/587857
3. Nakahara, I. et al. Interfacial shear strength of bioactive-coated carbon fiber reinforced polyetheretherketone after in vivo implantation. J. Orthop. Res. 30, 1618–1625 (2012).
4. Webster, T. J., Patel, A. A., Rahaman, M. N. & Sonny Bal, B. Anti-infective and osteointegration properties of silicon nitride, poly(ether ether ketone), and titanium implants. Acta Biomater. 8, 4447–54 (2012).
5. Pandis, N., Walsh, T., Polychronopoulou, A., Katsaros, C. & Eliades, T. Split-mouth designs in orthodontics: An overview with applications to orthodontic clinical trials. European Journal of Orthodontics (2013). doi:10.1093/ejo/cjs108
6. Pozos-Guillén, A., Chavarría-Bolaños, D. & Garrocho-Rangel, A. Split-mouth design in Paediatric Dentistry clinical trials. Eur. J. Paediatr. Dent. (2017). doi:10.23804/ejpd.2017.18.01.13