Improving oral implant osseointegration in a murine model via Wnt signal amplification.

Journal: J Clin Periodontol

Publication Year: 2014

Authors: Sylvain Mouraret, Daniel J Hunter, Claire Bardet, Antoine Popelut, John B Brunski, Catherine Chaussain, Philippe Bouchard, Jill A Helms

PubMed link: 24164629

Funding Grants: Enhancing healing via Wnt-protein mediated activation of endogenous stem cells

Public Summary:
Dental implants are important substitutes for missing teeth, but a key feature of whether they are functional or not is if they integrate into the bone. This process is called osseointegration. We developed a mouse model of implant osseointegration and then demonstrated how implants can fail. This failure in implant osseointegration could be effectively reversed by amplifying the body's natural level of Wnt signaling.

Scientific Abstract:
AIM: To determine the key biological events occurring during implant failure and then we use this knowledge to develop new biology-based strategies that improve osseointegration. MATERIALS AND METHODS: Wild-type and Axin2(LacZ/LacZ) adult male mice underwent oral implant placement, with and without primary stability. Peri-implant tissues were evaluated using histology, alkaline phosphatase (ALP) activity, tartrate resistant acid phosphatase (TRAP) activity and TUNEL staining. In addition, mineralization sites, collagenous matrix organization and the expression of bone markers in the peri-implant tissues were assessed. RESULTS: Maxillary implants lacking primary stability show histological evidence of persistent fibrous encapsulation and mobility, which recapitulates the clinical problems of implant failure. Despite histological and molecular evidence of fibrous encapsulation, osteoblasts in the gap interface exhibit robust ALP activity. This mineralization activity is counteracted by osteoclast activity that resorbs any new bony matrix and consequently, the fibrous encapsulation remains. Using a genetic mouse model, we show that implants lacking primary stability undergo osseointegration, provided that Wnt signalling is amplified. CONCLUSIONS: In a mouse model of oral implant failure caused by a lack of primary stability, we find evidence of active mineralization. This mineralization, however, is outpaced by robust bone resorption, which culminates in persistent fibrous encapsulation of the implant. Fibrous encapsulation can be prevented and osseointegration assured if Wnt signalling is elevated at the time of implant placement.