Antimicrobial and Osteoinductive Hydrogel for Dental Applications

Tech ID: 31773 / UC Case 2019-698-0

SUMMARY

UCLA researchers in the Department of Chemical & Biomolecular Engineering developed osteoinductive and antimicrobial hydrogel adhesives for dental applications.

BACKGROUND

According to the American Academy of Implant Dentistry approximately 3 million Americans have received dental implants, and this number is growing by 500,000 each year. As dental implants have become the standard of care for tooth replacement, the number of patients affected by peri-implant diseases (PIDs) is increasing. Peri-implantitis (PI) is the most critical form of PIDs, which constitutes the leading cause of implant failure after osseointegration. In fact, PI refers to a severe inflammatory process affecting the soft and hard tissues surrounding an implant, which is characterized by a progressive loss of the supporting bone. PI development is likely associated with bacterial colonization and biofilm development on the implant surface which could lead to the degeneration of the bone structures supporting the implant. Recent clinical data indicates that PI could occur in up to 87.5% of patients. However, the lack of standard treatment protocols often leads to empirical selection of therapeutic strategies and marginally effective outcomes. Currently, there is no standard and effective treatment for PI,but is commonly treated with surgical procedures, including the use of autografts, allografts, and xenografts to promote the regeneration of the damaged tissues, and local delivery of antibiotics to prevent bacterial infections. However, their clinical efficacy has been limited by their inability to adhere to soft/hard tissues, prevent bacterial colonization (antibiotic resistant bacteria), and to promote bone tissue regeneration and implant re-osseointegration.Currently, there are no commercially available product that combine high adhesion to soft and hard oral tissues, and antimicrobial and osteoinductive properties; therefore, there is a need for new therapeutic approaches that combine these functionalities for clinical management of PI.

INNOVATION

UCLA researchers have developed osteoinductive and antimicrobial hydrogel adhesives that promote compartmentalized tissue healing and foster tissue regeneration in peri-implantitis (PI). The hydrogel precursors can be delivered in a minimally invasive manner to the PI site and be rapidly photocrosslinked *in situ* using dental curing lights. The bioadhesives can strongly adhere to soft/hard oral tissues, as well as implant surfaces in the presence of blood and saliva. The hydrogels have been prototyped and tested to show a 4.6-fold increase in adhesion strength to titanium surface in comparison to other surgical sealants. Moreover, tested in both small (rats/mice) and large (pigs) animals, the adhesive exhibits potent antimicrobial activity and can induce bone regeneration without the need for exogenous growth factors. Thus, these bioadhesive hydrogels demonstrate potential as adhesive, antimicrobial, and cell-supportive barriers that can support tissue healing and bone regeneration for the treatment of PIDs.

APPLICATIONS

- Peri-implantitis disease treatment
- Craniofacial and mandibular bone defects
- Wound healing

ADVANTAGES

- Minimally invasive, rapid delivery
- Strongly adhere to soft/hard oral tissues and implant surfaces in the presence of blood and saliva
- Potent antimicrobial activity

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OTHER INFORMATION

KEYWORDS

Peri-implant diseases, antimicrobial hydrogels, tissue adhesive, bioadhesives, dental implants, bone regeneration

CATEGORIZED AS

- **Materials & Chemicals**
  - Biological
  - Chemicals
  - Polymers
- **Medical**
  - Delivery Systems
  - Disease: Dental

RELATED CASES

2019-698-0

- Can induce bone regeneration

RELATED MATERIALS

- Sani, E.S., et al. An Antimicrobial Dental Light Curable Bioadhesive Hydrogel for Treatment of Peri-Implant Diseases. Matter, Volume 1, Issue 4, 2 October 2019, Pages 926-944.

PATENT STATUS

Patent Pending

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