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Anti-Swelling, Robust, and Adhesive Extracellular Matrix-Mimicking Hydrogel Used as Intraoral Dressing

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Due to the wet and dynamic environment of the oral cavity, the healing of intraoral wounds, such as tooth extraction wounds, requires stable and firm wound dressings. In clinical practice, cotton balls and gauzes, sponge plugs, or sutures are used to treat extraction wounds, but none of these means can continuously isolate the wound from the intraoral environment and facilitate ideal healing conditions. Herein, inspired by the natural extracellular matrix, a family of wound dressings is developed for intraoral wound repair. Infiltrating a ductile long-chain hydrogel network into a prefabricated, sturdy macromolecular meshwork and in situ crosslinking endowed the composite hydrogel with controllable swelling behaviors and robust mechanical properties. The macromolecular meshwork functioned as the backbone to support the composite and restricts the swelling of the long-chain hydrogel network. In vitro tests verified that this wound dressing can provide durable protection for intraoral wounds against complex irritations. Furthermore, accelerated wound healing occurred when the wound dressing is applied in vivo on a canine tooth extraction model, due to the effective reduction of acute inflammation. These results suggest that this family of bioinspired hydrogels has great potential for application as intraoral wound dressing.

1. Introduction

Dental extraction occurs frequently for a variety of reasons, including caries, periodontal disease, endodontic failure, orthodontic treatment, trauma, and prosthetic procedure.[1] However, the temporary hole left behind also frequently causes discomfort and postoperative complications as the area of trauma is exposed to various irritants from the complex oral environment in which it resides. In addition to poor dental hygiene, many activities, such as smoking, sucking behavior, spitting, rinsing, eating an improper diet, undergoing radiotherapy, or taking particular medications, such as bisphosphonate, have serious impacts on the healing of an extraction wound. Leaving cotton balls, gauzes, or sponge plugs on the wounds to promote blood clotting is the standard method clinically for treating extraction sockets; However, these temporary dressings cannot provide continuous protection or treatment for wound repair. Due to the lacking of available barrier dressings that prevent oral irritants from entering the socket, delayed wound healing, and other severe postoperative complications, including secondary hemorrhage, dry socket, infection, trismus, and osteonecrosis, often occur.[2] Suturing can help close the socket and control bleeding, but suturing in the confined area inside the oral cavity requires excellent operational skills and a long surgical time.[3] Therefore, it is imperative to develop an intraoral wound healing-specific dressing to provide durable and robust isolation from the wet, dynamic environment of the oral cavity.

Due to its softness and high-water content, hydrogel is a popular material for wound dressings. In dentistry, hydrogels, such as chitosan-poly(γglutamic acid),[4] collagen,[5] poly(lactic-co-glycolic acid),[6] and polyethyleneimine-poly(vinyl pyrrolidone)[7]

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