ABSTRACT

Background: Tooth extraction commonly results into bone resorption along with occasional infection, swelling and pain. Maresin 1 (MaR1) is an anti-inflammatory and pro-resolving lipid mediator produced by macrophages that promotes regeneration and relieves pain. The aim of this study was to examine the effects of MaR1 on wound healing and bone regeneration.

Materials and methods: The maxillary right first molars of Sprague-Dawley rats were extracted and gelatin scaffolds were placed into the sockets with normal saline (vehicle) or MaR1 (0.5, 0.05, 0.01 µg/ul). Wound closures were evaluated every 2 days from day 6-14. Post-operative pain was evaluated utilizing Grimace scale (0-8), tube chewing score (1-4), and modified burrowing time. At day 10 and 21, the maxillae were harvested and scanned by microCT to evaluate bone fill and buccal ridge height. Histological analysis was done to assess epithelialization process. Immunohistochemistry staining of CD68 and CD206 were performed to differentiate M1/M2-like macrophages.

Results: Local application of MaR1 accelerated wound closure. At day 10, complete wound closure was observed in 75% of the animals with MaR1 application compared to vehicle (34%). Under microCT, MaR1 dose-dependently stimulated bone fill compared to the vehicle (54 vs. 42%, p<0.05) at day 10 and less buccal bone vertical resorption (0.44 vs. 0.63 mm, p<0.06) was observed at day 21. Histological analysis indicated less wound opening and thicker epithelium with MaR1 treatment. Application of 0.01 µg/ul MaR1 resulted in an increased CD206+ to CD68+ macrophages ratio (0.98 vs. 0.72, p<0.05) compared to control. MaR1 reduced post-operative pain, observed via grimace scale (2.8 vs. 4.2, p<0.05), tube-chewing scores (3.1 vs. 2.2, p<0.01), and modified burrowing time (54 vs. 92 secs, p<0.05).

Conclusion: Local delivery of MaR1 accelerated extraction wound healing, promoted socket bone fill, reduced buccal ridge height and post-op pain scores.

METHODS & RESULTS

Figure 1. Study design and timeline

Figure 2. (A) Rat Grimace Scale. (B) Tube chewing score. (C) Modified burrowing time.

Figure 3. Maresin 1 reduces post-operative pain scores (A) Grimace Scale. (B) Tube chewing score. (C) Modified burrowing time.

Figure 4. Maresin 1 stimulates extraction socket bone fill and preserves alveolar ridge. (A) Socket bone fill percentage. (B) 3-D image and sagittal view of alveolar ridge. (C) Alveolar ridge width. (D) Alveolar bone loss.

Figure 5. MaR1 accelerates tooth extraction wound healing. (A) Clinical evaluation & (B) Histological evaluation (C) Complete wound closure percentage (D) Remaining wound opening and epithelium thickness.

Figure 6. Maresin 1 regulates macrophage M1/M2 polarization in a dose-dependent manner. (A) Histology examination. (B) CD206/CD68 percentage. (C) CD206 number. (D) CD68 number.

ABSTRACT

Background: Tooth extraction commonly results into bone resorption along with occasional infection, swelling and pain. Maresin 1 (MaR1) is an anti-inflammatory and pro-resolving lipid mediator produced by macrophages that promotes regeneration and relieves pain. The aim of this study was to examine the effects of MaR1 on wound healing and bone regeneration.

Materials and methods: The maxillary right first molars of Sprague-Dawley rats were extracted and gelatin scaffolds were placed into the sockets with normal saline (vehicle) or MaR1 (0.5, 0.05, 0.01 µg/ul). Wound closures were evaluated every 2 days from day 6-14. Post-operative pain was evaluated utilizing Grimace scale (0-8), tube chewing score (1-4), and modified burrowing time. At day 10 and 21, the maxillae were harvested and scanned by microCT to evaluate bone fill and buccal ridge height. Histological analysis was done to assess re-epithelialization process. Immunohistochemistry staining of CD68 and CD206 were performed to differentiate M1/M2-like macrophages.

Results: Local application of MaR1 accelerated wound closure. At day 10, complete wound closure was observed in 75% of the animals with MaR1 application compared to vehicle (34%). Under microCT, MaR1 dose-dependently stimulated bone fill compared to the vehicle (54 vs. 42%, p<0.05) at day 10 and less buccal bone vertical resorption (0.44 vs. 0.63 mm, p<0.06) was observed at day 21. Histological analysis indicated less wound opening and thicker epithelium with MaR1 treatment. Application of 0.01 µg/ul MaR1 resulted in an increased CD206+ to CD68+ macrophages ratio (0.98 vs. 0.72, p<0.05) compared to control. MaR1 reduced post-operative pain, observed via grimace scale (2.8 vs. 4.2, p<0.05), tube-chewing scores (3.1 vs. 2.2, p<0.01), and modified burrowing time (54 vs. 92 secs, p<0.05).

Conclusion: Local delivery of MaR1 accelerated extraction wound healing, promoted socket bone fill, reduced buccal ridge height and post-op pain scores.

METHODS & RESULTS

Figure 1. Study design and timeline

Figure 2. (A) Rat Grimace Scale. (B) Tube chewing score. (C) Modified burrowing time.

Figure 3. Maresin 1 reduces post-operative pain scores (A) Grimace Scale. (B) Tube chewing score. (C) Modified burrowing time.

Figure 4. Maresin 1 stimulates extraction socket bone fill and preserves alveolar ridge. (A) Socket bone fill percentage. (B) 3-D image and sagittal view of alveolar ridge. (C) Alveolar ridge width. (D) Alveolar bone loss.

Figure 5. MaR1 accelerates tooth extraction wound healing. (A) Clinical evaluation & (B) Histological evaluation (C) Complete wound closure percentage (D) Remaining wound opening and epithelium thickness.

Figure 6. Maresin 1 regulates macrophage M1/M2 polarization in a dose-dependent manner. (A) Histology examination. (B) CD206/CD68 percentage. (C) CD206 number. (D) CD68 number.

ABSTRACT

Background: Tooth extraction commonly results into bone resorption along with occasional infection, swelling and pain. Maresin 1 (MaR1) is an anti-inflammatory and pro-resolving lipid mediator produced by macrophages that promotes regeneration and relieves pain. The aim of this study was to examine the effects of MaR1 on wound healing and bone regeneration.

Materials and methods: The maxillary right first molars of Sprague-Dawley rats were extracted and gelatin scaffolds were placed into the sockets with normal saline (vehicle) or MaR1 (0.5, 0.05, 0.01 µg/ul). Wound closures were evaluated every 2 days from day 6-14. Post-operative pain was evaluated utilizing Grimace scale (0-8), tube chewing score (1-4), and modified burrowing time. At day 10 and 21, the maxillae were harvested and scanned by microCT to evaluate bone fill and buccal ridge height. Histological analysis was done to assess re-epithelialization process. Immunohistochemistry staining of CD68 and CD206 were performed to differentiate M1/M2-like macrophages.

Results: Local application of MaR1 accelerated wound closure. At day 10, complete wound closure was observed in 75% of the animals with MaR1 application compared to vehicle (34%). Under microCT, MaR1 dose-dependently stimulated bone fill compared to the vehicle (54 vs. 42%, p<0.05) at day 10 and less buccal bone vertical resorption (0.44 vs. 0.63 mm, p<0.06) was observed at day 21. Histological analysis indicated less wound opening and thicker epithelium with MaR1 treatment. Application of 0.01 µg/ul MaR1 resulted in an increased CD206+ to CD68+ macrophages ratio (0.98 vs. 0.72, p<0.05) compared to control. MaR1 reduced post-operative pain, observed via grimace scale (2.8 vs. 4.2, p<0.05), tube-chewing scores (3.1 vs. 2.2, p<0.01), and modified burrowing time (54 vs. 92 secs, p<0.05).

Conclusion: Local delivery of MaR1 accelerated extraction wound healing, promoted socket bone fill, reduced buccal ridge height and post-op pain scores.

METHODS & RESULTS

Figure 1. Study design and timeline

Figure 2. (A) Rat Grimace Scale. (B) Tube chewing score. (C) Modified burrowing time.

Figure 3. Maresin 1 reduces post-operative pain scores (A) Grimace Scale. (B) Tube chewing score. (C) Modified burrowing time.

Figure 4. Maresin 1 stimulates extraction socket bone fill and preserves alveolar ridge. (A) Socket bone fill percentage. (B) 3-D image and sagittal view of alveolar ridge. (C) Alveolar ridge width. (D) Alveolar bone loss.

Figure 5. MaR1 accelerates tooth extraction wound healing. (A) Clinical evaluation & (B) Histological evaluation (C) Complete wound closure percentage (D) Remaining wound opening and epithelium thickness.

Figure 6. Maresin 1 regulates macrophage M1/M2 polarization in a dose-dependent manner. (A) Histology examination. (B) CD206/CD68 percentage. (C) CD206 number. (D) CD68 number.