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PILOT STUDY

EFFECTS OF RECOMBINED HUMAN BONE MORPHOGENETIC PROTEIN-2 AS ALVEOLAR RIDGE PRESERVATION ON PAIN REDUCTION AND SOFT TISSUE HEALING PROCESS: A SPLIT MOUTH DESIGNED PILOT STUDY

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Abstract

Background: The alveolar ridge undergoes physiological bone resorption following tooth extraction. Several alveolar ridge preservation (ARP) techniques have been researched and developed in an effort to reduce this process and maintain a favorable volume and morphology of the alveolar ridge for appropriate implant placement.
Bone morphogenetic proteins (BMPs) are proteins derived from a subgroup of the transforming growth factor β family that accelerates ossification by controlling essential factors of the bone induction cascade, resulting in the proliferation of osteoblasts from mesenchymal stem cells and the biosynthesis of bone matrices. One of these BMPs is recombinant human bone morphogenetic protein-2 (rhBMP-2) that has been authorized to be used for ARP.
Objective: This study aims to evaluate the effect of rhBMP-2 on the healing process and the level of pain following dental extraction.
Methods: In this split-mouth pilot study, 11 patients underwent extractions of a minimum of two teeth, and randomly, one of the alveolar sockets was filled with a hemostatic sponge while the other was filled with a hemostatic sponge embedded with rhBMP-2. Both sockets were sutured using the X technique. Wound healing measurements were done on days 3, 7, and 14, and each participant was requested to document his pain experience using the Numerical Rating Scale (NRS).
Results: In accordance with clinical evidence, it was observed that the mean pain score was at its peak on day 0 and progressively diminished in the subsequent days. Notably, this decline was more pronounced in the rhBMP-2 group compared to the control group. Importantly, a statistically significant reduction in pain level was detected on day 3 within the rhBMP-2 group, in contrast to the control group (P-value < 0.05). This indicated that the application of rhBMP-2 led to a noteworthy and meaningful alleviation of pain on the third day after treatment, surpassing the impact observed in the control group. For the wound healing changes, it uncovered statistically significant mean differences across various time intervals: day 0 and day 3, day 0 and day 7, day 0 and day 14, day 3 and day 7, and day 7 and day 14 (P-value < 0.0001). These significant differences strongly suggest dynamic changes in wound closure rates over time. Furthermore, the observed differences were more pronounced in the rhBMP-2-treated group compared to the control group. This augmentation of differences indicates that the utilization of rhBMP-2 for ARP within a fresh socket site resulted in a heightened acceleration of the wound healing process.
Conclusion: Our results suggest that rhBMP-2 can decrease post-operative pain after tooth extraction and accelerate the soft tissue healing process.

Keywords: *Human bone morphogenetic protein-2; rhBMP-2; alveolar ridge preservation; pain reduction; soft tissue healing.*

Introduction

Tooth extraction affects masticatory efficiency and causes homeostatic and structural changes in periodontal tissues, leading to alveolar ridge resorption that may jeopardize esthetics and complicate functional rehabilitation.[1-3] Alveolar ridge preservation (ARP) is a method of decreasing bone resorption and facilitating prosthetically-driven implant placement by eliminating the need for bone augmentation procedures.[4] It also reduces the risk of complications and the cost of the treatment.[5]

The use of autogenous bone for alveolar augmentation and preservation has been considered the gold standard.[6] However, complications, including donor site comorbidity, a limited amount of harvest, resorption after grafting, and difficulty in harvesting because of anatomical and underlying diseases make this technique difficult. To avoid some of these complications, autogeneous bone has been replaced by allogenic, xenogeneic, and alloplastic materials, but all of them are osteoconductive materials. Recently, many efforts have been made to improve bone regeneration by combining various growth factors with bone substitutes.[7]

Bone morphogenetic protein (BMP), which was discovered by Urist in 1965,[8] has been extensively investigated in the field of bone regeneration as an effective enhancer of osteogenesis. BMP belongs to the large transforming growth factor-β (TGF-β) superfamily. It has high osteoinductive capacity resulting from the chemotaxis, proliferation, and differentiation of mesenchymal stem cells. Recombinant human BMP-2 (rhBMP-2) is a BMP-2 that can be produced with recombinant technology. It is highly osteoinductive and has been used to enhance bone regeneration and ARP.[9,10]

Post-teeth extraction pain is common; however, the pain is a subjective response that is registered as a conscious experience unique to the patient.[11]

After tooth extraction, the healing process begins with a blood clot formation to fill the socket and fulfill homeostasis and coagulation.[12] From the first day, erythrocytes and mesenchymal cells take place in the apical zone, and granulation tissue gradually replaces the clot, followed by fibrous and osteogenic tissues.[13] After the first month of the extraction, the site is full of trabecular bone that matures gradually.[14] During the healing process, dimensional alterations have been reported to cause a ridge width reduction of up to 50% during the first year following tooth loss in premolar and molar sites, where two-thirds of the total changes take place within the first 3 months post-extraction.[15] A systematic review showed a loss of 2.6–4.5 mm in width and 0.4–3.9 mm in height of healed sockets.[10]

Many studies have compared bone resorption, pain management, and wound healing at the extraction site using different techniques of ridge preservation. A study conducted by Ma et al.[16] evaluating the effect of interactions between neuropeptides and rhBMP-2 on human osteoblasts revealed that rhBMP-2 enhanced gap junction intercellular communication between osteoblasts in vivo and could be physiologic activators of bone formation through regulating the proliferation and activation of osteoblasts by promoting signal transmission among bone cells. To our knowledge, no other study has compared hemostatic sponges embedded with rhBMP-2 with regular hemostatic sponges in socket preservation techniques. Our primary objective is to determine the effect of rhBMP-2 on the pain during the healing process, as well as to evaluate the soft tissue healing in both techniques.

Materials and methods

This study has been approved by the Neuroscience Research Committee at the Lebanese University Faculty of Medical Sciences. The surgeries were made by JN from February until June 2023 under the recommendations of the Declaration of Helsinki for human subjects.

Trial design and participants

This is a split-mouth clinical trial design with a minimum of two teeth to be extracted for each patient from both sides of the jaw to compare the outcome of the two techniques on ridge preservation. We included in this study male and female healthy patients, aged 18 to 70 years old. Exclusion criteria were: a) heavy smokers (≥20 cigarettes per day); b) HIV-positive patients; c) patients taking bisphosphonate; d) pregnant and lactating women; e) patients with systemic disorders (diabetes mellitus, hyperthyroidism, etc.) interfering with the healing

process. Patients needing extraction of wisdom teeth were also excluded from the study.

Study outcome

The Numerical Rating Scale (NRS) was used to subjectively evaluate the postoperative pain of the patient on days 1, 3, and 7. It has good sensitivity and generates data that can be statistically analyzed for audit purposes. The NRS is an 11-point scale where the end points are the extremes of no pain and pain as bad as it could be, or worst pain. The numbers are often enclosed in boxes, and the scale is referred to as an 11-box scale depending on the number of levels of discrimination offered to the patient.[17] The baseline pain perception was recorded in the clinic before the treatment, and the pain perception was noted before any analgesic medication was taken.

For the soft tissue healing, we used the periodontal probe Kohler® (Germany) to measure the distance between the soft tissue margins. On the day of the extraction, after pulling out the tooth, the distance between soft tissue margins was measured bucco-lingually and palatally on days 0, 3, 7, and 14 after surgery (Figure 1).

Figure 1. *Soft tissue healing measurement*
A) *bucco-palatal distance measure at day 0 after tooth extraction;*
B) *bucco-palatal distance measure at day 7 after surgery;*
C) *bucco-palatal distance measure at day 14 after surgery*

Preoperative phase

Each patient included in the study was informed about details concerning the surgery, and a written consent form containing information about the procedure, the product used, and the benefits and precautions of the surgery was carefully read and signed by the patient. All patients underwent intraoral photographs before, during, and after the surgical procedure. In addition, periapical X-rays were made at the sites of extractions. Moreover, the patient was not informed about the exact site imbedded with rhBMP-2, and this was essential for precise results for the pain scale later on.

Surgical phase

Under infiltration anesthesia, using Septanest® (Septodont, France), which contains articaine hydrochloride with 1:100,000 adrenaline, a minimally flapless invasive extraction was made to preserve the surrounding soft and hard tissues. A syndesmotomy using a surgical blade (No. 15C) for intrasulcular incision was performed to preserve the papilla and the gingival margins.

When the tooth of interest had one root, we used the periotome after the syndesmotomy, thus trying to mobilize the tooth. Then, we made slow movements of rotation and pulling using adequate forceps to cut the fibers in the periodontium and pull out the tooth from the socket with minimum damage to the surrounding soft and hard tissues (Figure 2).

When the extracted tooth had multiple roots, a carbide burs on a high-speed turbine was used to section the tooth into two or three parts, thereby preserving as much as possible the surrounding bone and soft tissues, and the roots were finally pulled out of the socket without any damage (Figure 3).

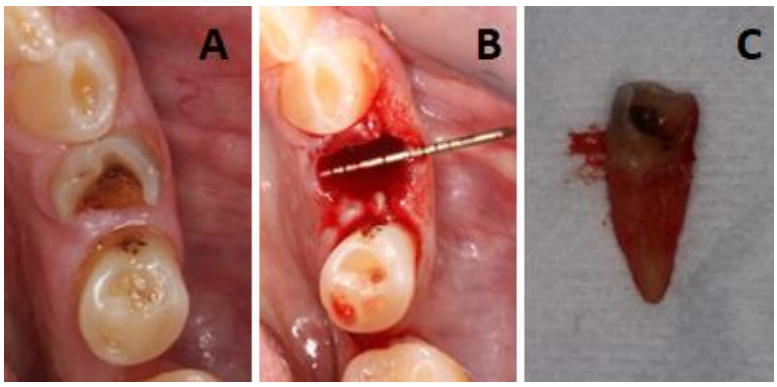

Figure 2. *Atraumatic extraction of a single root*
A) *pre-operative image of the lower right first premolar;*
B) *atraumatic extraction of the lower right first premolar showing the continuity and integrity of the soft tissues around it;*
C) *the lower right first premolar pulled out from the socket*

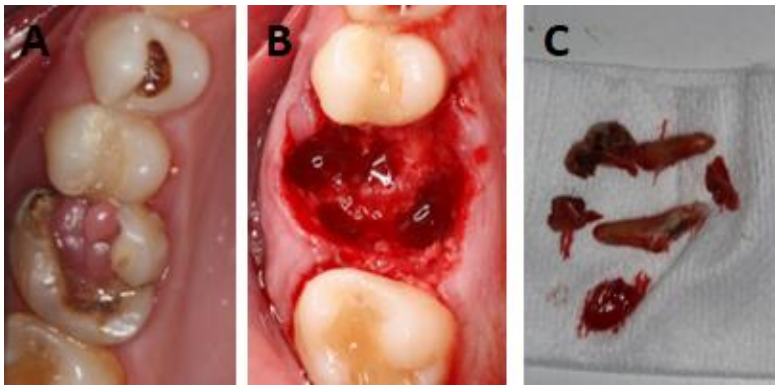

Figure 3. *Atraumatic extraction of multiple roots with sectioning of the tooth*
A) *pre-operative image of the upper right first molar;*
B) *atraumatic extraction of the upper right first molar, showing the continuity and integrity of the soft and hard tissues;*
C) *showing roots sectioned and pulled out from the sockets*

After pulling out the teeth, we used curettes of small and medium sizes to eliminate all the remaining fibers of the periodontal ligament and the granulation tissues. The remaining bony walls were checked using a probe. Finally, we irrigated the socket with a sodium chloride solution, and randomly and based on allocation concealment, one of the alveolar sockets was filled with the standard hemostatic sponge, while the other was filled with hemostatic sponge embedded with rhBMP-2, followed by a conventional X suture (Figure 4).

Figure 4. *Extraction and insertion of the hemostatic sponge embedded with rhBMP-2 on the first side and extraction and insertion of the standard hemostatic sponge on the second side followed by a conventional X suture*

Postoperative phase

The patients were instructed on proper brushing, flossing, and using the mouthwash. In fact, each patient was given Eludrilpro® (Pierre Fabre medicament production, France), which is a mouthwash containing 0.5 ml of chlorhexidine digluconate and 0.5 g/100 ml of chlorobutanol hemihydrate. They were advised to use it twice per day for 10 days.

Statistical analysis

Data entry and analysis were performed using the statistical software SPSS, version 22.0. Descriptive statistics were reported using means and standard deviations (SD) for continuous variables and frequency with percentages for categorical variables. The two-way repeated measures ANOVA test was used to compare the mean pain scores between the rhBMP-2 side and the control side, and the significance level was set at 0.05.

The one-way repeated measures ANOVA test was used to compare the mean bucco-palatal distance of soft tissue margins between the rhBMP-2 side and the control side, and the significance level was set at 0.0001.

Results

A total of 30 patients were assessed for participation. Of these patients, 10 didn't meet our inclusion criteria, 5 refused to participate, and 4 didn't come to the follow-up appointment. The remaining 11 patients fulfilled all the inclusion criteria. The total sample included 6 men (54.5%) and 5 women (45.5%). The study patient's age range varied between 24 and 64 years, and the mean age was 49.4±11.14.

The two-way repeated measures ANOVA statistical test was used, and the analysis revealed that there were no statistically significant differences in the mean pain scores at day 0 between the rhBMP-2 side and the control side (P-value = 0.641). Moreover, the mean pain scores for days 1 and 2 on the rhBMP-2 side were found to be lower than the mean pain scores on the control side, although these differences were not statistically significant, with P-values of 0.349 and 0.183, respectively (Figure 5).

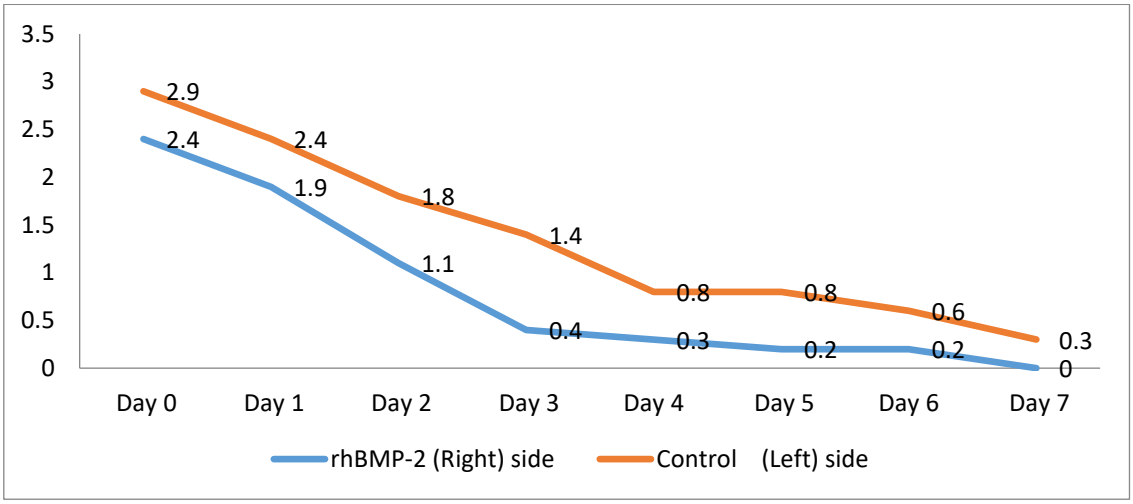

Figure 5. *A graph showing the mean pain scores between the rhBMP-2 side and the control side*

Interestingly, a statistically significant difference in the mean pain score at day 3 between the two groups emerged (P-value = 0.028), indicating that the pain scores diverged significantly on that particular day, favoring the rhBMP-2 side. This difference was statistically significant, as P-value (0.028) was less than the defined alpha level of 0.05. For days 4, 5, 6, and 7, the analysis showed that there were no statistically significant differences between the rhBMP-2 side and the control side, as the calculated P-values were all greater than 0.05. These findings suggest that from day 4 onwards, there were no significant disparities in pain scores between the two sides (Table 1).

Table 1: Comparison of the pain score between the rhBMP-2 side and the control side.

	rhBMP-2 side Mean (SD)	Control side Mean (SD)	Mean Difference (Both sides)	P-value
Pain score Day 0	2.4 (2.2)	2.9 (2.3)	-0.5	0.641
Pain score Day 1	1.9 (1.2)	2.4 (1.4)	-0.5	0.349
Pain score Day 2	1.1 (0.8)	1.8 (1.5)	-0.7	0.183
Pain score Day 3	0.4(0.5)	1.4(1.4)	-1.1	**0.028***
Pain score Day 4	0.3(0.5)	0.8(1.2)	-0.5	0.19
Pain score Day 5	0.2(0.4)	0.8(1.4)	-0.6	0.163
Pain score Day 6	0.2 (0.6)	0.6(1.1)	-0.4	0.250
Pain score Day 7	0(0)	0.3(0.5)	-0.3	0.067

SD: standard deviation; a P-value less than 0.05 is considered significant

Across the groups, in accordance with clinical evidence, it was observed that the mean pain score was at its peak on day 0 and progressively diminished in the subsequent days. Notably, this decline was more pronounced on the rhBMP-2 side compared to the control side. Importantly, statistically significant reductions in pain levels were detected on day 3 within the rhBMP-2 group, in contrast to the control group (P-value < 0.05). This signified that the application of rhBMP-2 led to a noteworthy and meaningful alleviation of pain on the third day after treatment, surpassing the impact observed in the control group.

To assess the rate of wound closure, we employed measurements of the space between the bucco-palatal soft tissue margins (mm) on both the rhBMP-2-treated side and the control side.

The one-way repeated measures ANOVA test yielded compelling results. It uncovered statistically significant mean differences across various time intervals: day 0 and day 3, day 0 and day 7, day 0 and day 14, day 3 and day 7, and day 7 and day 14 (P-value < 0.0001). These significant differences strongly suggest dynamic changes in wound closure rates over time.

Furthermore, the observed differences were more pronounced on the rhBMP-2-treated side compared to the control side, as indicated in Table 2. This augmentation of differences indicates that the utilization of rhBMP-2 as ARP within a fresh socket site resulted in a heightened acceleration of the wound healing process.

Collectively, these findings lead us to a conclusive inference: the incorporation of rhBMP-2 in ARP can substantially expedite the wound healing process, as evident by the increased rate of wound closure.

Table 2: Comparison of the mean of bucco-palatal distance (mm) of soft tissue margins between rhBMP-2 side and control side

BP measurement (mm)	rhBMP-2 side	P-value	Control side	P-value
Day 0 Mean (SD)	7.8(2.5)		7.8(2.3)	
Day 3 Mean (SD)	5.3(1.6)		5(1.7)	
Day 7 Mean (SD)	3.1(0.9)		2.8(1.2)	
Day 14 Mean (SD)	0.1(0.3)		0.05(0.2)	
Difference in BP between Day 0 and Day 3	2.9(0.2)	<0.0001	2.5(0.3)	<0.0001
Difference in BP between Day 3 and Day 7	2.2(0.2)	<0.0001	2.2(0.3)	<0.0001
Difference in BP between Day 7 and Day 14	2.7(0.3)	<0.0001	3.0(0.3)	<0.0001
Difference in BP between Day 0 and Day 7	5.1(0.4)	<0.0001	4.7(0.6)	<0.0001
Difference in BP between Day 0 and Day 14	7.8(0.5)	<0.0001	7.7(0.8)	<0.0001
P-value	<0.0001			<0.0001

BP: bucco-palatal distance in mm of the soft tissue margin at the extracted site; SD: standard deviation

Discussion

The post-extraction healing process was the subject of much research in terms of pain and ARP. Postoperative pain is a stressful condition that the patient faces, and the oral surgeons try to reduce it by prescribing analgesics and non-steroidal anti-inflammatory drugs. As for ARP, many clinical studies have evaluated the induction and repair of bony defects in a variety of indications.[5,18,19] In this context, they compared bone resorption, pain management, and wound healing at the extraction sites using different techniques of ridge preservation.[15,16] The present study investigates the effect of rhBMP-2 embedded in a hemostatic sponge as ARP on reducing postoperative pain as well as its efficacy on the soft tissue healing process. To our knowledge, no other study compared hemostatic sponges embedded with rhBMP-2 with hemostatic sponge alone as ridge preservation techniques. Howell et al. used an absorbable collagen sponge filled with rhBMP-2 and found that it was well tolerated locally and systemically with no complications in ARP.[19]

For the postoperative pain, the rhBMP-2 was not significantly efficient during the 7 days except for the third one. The fact that there is no significant difference in pain rating scores between the rhBMP-2 and control sides may be due to the low sample size used in this study, but we noticed that the mean pain scores of the rhBMP-2 sides were less than the mean pain scores of the control sides during the 7 consecutive days.

Concerning the soft tissue healing process, our study concluded that rhBMP-2 induced faster soft tissue healing, but definite conclusions must be delayed until future research with a larger sample validates our results.

Conclusion

Within the limits of our study, we can conclude that rhBMP-2 can decrease post-operative pain after tooth extraction and accelerate the soft tissue healing process.

Declarations

Conflict of interest and financial disclosure

The author declares that he has no conflict of interest and there was no external source of funding for the present study. None of the authors have any relevant financial relationship(s) with a commercial interest.

Ethical approval

Research protocol was approved by the local Ethical Committee (2018/23) and in accordance with those of the World Medical Association and the Helsinki Declaration.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Source of Funding

Non funding.

Availability of Data and Materials

Not applicable.

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ՄԱՐԴՈՒ ՈՍԿՐԱՅԻՆ ՄՈՐՖՈԳԵՆԵՏԻԿ ՊՐՈՏԵԻՆ-2-Ի ՎԵՐԱՀԱՄԱԿՑՎԱԾ ԱԶԴԵՑՈՒԹՅՈՒՆԸ ՈՐՊԵՍ ԱԼՎԵՈԼԱՅԻՆ ԳԱԳԱԹԻ ՊԱՀՊԱՆԱՆ, ՑԱՎԻ ՆՎԱԶԵՑՄԱՆ և ՓԱՓՈՒԿ ՀՅՈՒՍՎԱԾՔՆԵՐԻ ԲՈՒԺՄԱՆ ԳՈՐԾԸՆԹԱՑԻ ՎՐԱ. ՊԻԼՈՏԱՅԻՆ ՓՈՐՁԱՐԱՐԱԿԱՆ ՀԵՏԱԶՈՏՈՒԹՅՈՒՆ

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[2] Ստոմատոլոգիայի և դիմածնոտային ճառագայթաբանության ամբիոն, Ստոմատոլոգիական բժշկության ֆակուլտետ, Լիբանանի համալսարան, Բեյրութ, Լիբանան:
[3] Նյարդաբանության հետազոտությունների կենտրոն, Լիբանանի համալսարանի բժշկական գիտությունների ֆակուլտետ, Բեյրութ, Լիբանան

Ամփոփում

Ներածություն. Ատամի հեռացումից հետո ատամնաբնային ելունում գնում է ոսկրային ֆիզիոլոգիական ռեզորբցիայի պրոցես:

Հետազոտվել և մշակվել են ատամնաբնային ելունի պահպանման (ARP) մի քանի տեխնիկա՝ այս գործընթացը նվազեցնելու և իմպլանտների համապատասխան տեղադրման համար բարենպաստ ատամնաբնային ելունի ծավալի և մորֆոլոգիայի պահպանման համար:

Ոսկրային մորֆոգենետիկ սպիտակուցները (BMPs) սպիտակուցներ են, որոնք ստացվում են փոխակերպող աճի գործոնի ընտանիքի ենթաբազմությունից, որոնք արագացնում են ոսկրացումը՝ վերահսկելով ոսկրերի ինդուկցիայի կասկադի հիմնական գործոնները՝ հանգեցնելով օստեոբլաստների տարածմանը մեզենխիմային ցողունային բջիջներից և ոսկրային մատրիցայի կենսասինթեզից: Այս BMP-ներից մեկը մարդու ոսկրերի ռեկոմբինանտ մորֆոգենետիկ սպիտակուց-2-ն է (rhBMP-2), որը հաստատված է ARP-ում օգտագործման համար:

Նպատակը. Այս հետազոտության նպատակն է գնահատել rhBMP-2-ի ազդեցությունը ատամի հեռացումից հետո բուժման գործընթացի և ցավի մակարդակի վրա:

Մեթոդներ. Այս պիլոտային հետազոտության ընթացքում 11 հիվանդի առնվազն երկու ատամ են հանել և պատահականորեն լցրել մեկ ալվեոլային խոռոչը հեմոստատիկ սպունգով, իսկ մյուսը՝ rhBMP-2 պարունակող հեմոստատիկ սպունգով: Երկու անցքերն էլ կարվել են X-տեխնիկայի միջոցով: Վերքերի բուժման չափումներ կատարվեցին 3-րդ, 7-րդ և 14-րդ օրերին, և յուրաքանչյուր մասնակցի խնդրվեց փաստաթղթավորել իրենց ցավի փորձը՝ օգտագործելով թվային գնահատման սանդղակը (NRS):

Արդյունքները. Համապատասխան կլինիկական տվյալներին, նկատվեց, որ ցավի միջին միավորը հասել է գագաթնակետին 0-րդ օրը և աստիճանաբար նվազել հաջորդ օրերին: Հատկանշական է, որ այս կրճատումն ավելի ցայտուն էր rhBMP-2 խմբում՝ համեմատած հսկիչ խմբի հետ: Կարևոր է նշել, որ 3-րդ օրը rhBMP-2 խումբը, ի տարբերություն հսկիչ խմբի, ցույց է տվել ցավի մակարդակի վիճակագրորեն զգալի նվազում (P արժեքը < 0,05): Սա ցույց տվեց, որ rhBMP-2-ի օգտագործումը հանգեցրել է նկատելի և նշանակալի ցավազրկման բուժումից հետո երրորդ օրը, ինչը գերազանցում է վերահսկիչ խմբում նկատված ազդեցությունը: Ինչ վերաբերում է վերքերի բուժման փոփոխություններին, վիճակագրորեն նշանակալի միջին տարբերություններ են հայտնաբերվել տարբեր ժամանակային ընդմիջումներով՝ օր 0 և 3 օր, օր 0 և օր 7, օր 0 և օր 14, օր 3 և օր 7, օր 7 և օր 14 (P- արժեքը < 0,0001): Այս էական տարբերությունները վճռականորեն ենթադրում են ժամանակի ընթացքում վերքերի փակման արագության դինամիկ փոփոխություններ: Ավելին, նկատված տարբերություններն ավելի ցայտուն էին rhBMP-2-ով բուժված խմբում, համեմատած վերահսկիչ խմբի հետ: Տարբերությունների այս աճը ցույց է տալիս, որ RhBMP-2-ի օգտագործումը ARP-ի համար թարմ վարդակի տեղում հանգեցրել է վերքերի բուժման գործընթացի արագացման:

Եզրակացություն. Մեր արդյունքները ցույց են տալիս, որ rhBMP-2-ը կարող է նվազեցնել հետվիրահատական ցավը ատամի հեռացումից հետո և արագացնել փափուկ հյուսվածքների ապաքինման գործընթացը:

ВЛИЯНИЕ РЕКОМБИНИРОВАННОГО МОРФОГЕНЕТИЧЕСКОГО БЕЛКА-2 ЧЕЛОВЕЧЕСКОЙ КОСТИ В КАЧЕСТВЕ КОНСЕРВАЦИИ АЛЬВЕОЛЯРНОГО ГРЕБНЯ НА УМЕНЬШЕНИЕ БОЛИ И ПРОЦЕСС ЗАЖИВЛЕНИЯ МЯГКИХ ТКАНЕЙ: РАЗДЕЛЕННОЕ ПИЛОТНОЕ ИССЛЕДОВАНИЕ

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Абстракт

Введение: После удаления зуба альвеолярный отросток подвергается физиологической резорбции кости. Несколько методов сохранения альвеолярного отростка (ARP) были исследованы и разработаны с целью уменьшить этот процесс и сохранить благоприятный объем и морфологию альвеолярного отростка для соответствующей установки имплантата.

Костные морфогенетические белки (BMP) представляют собой белки, полученные из подгруппы семейства трансформирующих факторов роста, которые ускоряют оссификацию путем контроля основных факторов каскада индукции кости, что приводит к пролиферации остеобластов из мезенхимальных стволовых клеток и биосинтезу костного матрикса. Одним из этих BMP является рекомбинантный костный морфогенетический белок-2 человека (rhBMP-2), который разрешен к использованию для ARP.

Цель: Целью данного исследования является оценка влияния rhBMP-2 на процесс заживления и уровень боли после удаления зуба.

Методы: В этом пилотном исследовании с разделенным ртом 11 пациентам были удалены как минимум два зуба, и случайным образом одна из альвеолярных лунок была заполнена гемостатической губкой, а другая - гемостатической губкой, содержащей rhBMP-2. Обе лунки были ушиты по Х-технике. Измерения заживления ран проводились на 3, 7 и 14 дни, и каждому участнику было предложено документировать свои ощущения боли, используя числовую рейтинговую шкалу (NRS).

Результаты: В соответствии с клиническими данными было замечено, что средний показатель боли достиг своего пика в день 0 и постепенно уменьшался в последующие дни. Примечательно, что это снижение было более выраженным в группе rhBMP-2 по сравнению с контрольной группой. Важно отметить, что на 3-й день в группе rhBMP-2 в отличие от контрольной группы было выявлено статистически значимое снижение уровня боли (значение $P < 0,05$). Это указывало на то, что применение rhBMP-2 привело к заметному и значимому облегчению боли на третий день после лечения, превосходя эффект, наблюдавшийся в контрольной группе. Что касается изменений в заживлении ран, были выявлены статистически значимые средние различия в различных временных интервалах: день 0 и день 3, день 0 и день 7, день 0 и день 14, день 3 и день 7, день 7 и день 14 (P- значение < 0,0001). Эти существенные различия убедительно свидетельствуют о динамических изменениях скорости закрытия ран с течением времени. Более того, наблюдаемые различия были более выраженными в группе, получавшей rhBMP-2, по сравнению с контрольной группой. Это увеличение различий указывает на то, что использование rhBMP-2 для ARP в свежем участке лунки приводило к повышенному ускорению процесса заживления ран.

Заключение: Наши результаты показывают, что rhBMP-2 может уменьшить послеоперационную боль после удаления зуба и ускорить процесс заживления мягких тканей.

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