

Clinical and Radiographical Assessment of Topical Application of Collagen Fibrils on Tooth socket Healing

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الخلاصة

الأهداف: يهدف البحث الى تقييم تأثير الياف الكولاجين والتي يتم وضعها في التجويف السني بعد القلع مباشرة على ايقاف تدفق الدم ومنع حدوث الالتهابات الخمجية وتقييم تأثيرها على نمو الانسجة الرخوة والانسجة العظمية في منطقة القلع. **المواد وطرائق العمل:** شملت مجموعة الدراسة عشرة مرضى راجعوا كلية طب الاسنان / شعبة جراحة الفم والوجه والفكين وكانوا يعانون من التهاب خمجي مزمن وتحطم في أكثر من سن في الفك العلوي او السفلي والذي يستوجب قلعها. تم اجراء عملية قلع اثنان من الاسنان في نفس الفك (اما علوي او سفلي) بعد اعطاء المريض التخدير الموضعي وتم مباشرة بعد القلع وضع مادة الدراسة التي تتكون من تركيز عالي من الياف الكولاجين في جهة الدراسة بينما ترك التجويف السني الاخر ليملاً بالخثرة الدموية. تمت متابعة المرضى بالفحص السريري والتصوير الشعاعي ابتداء من وضع المادة ويفترات معتمدة على نوع الفحص ولمدة ستة اسابيع. **النتائج:** اظهرت النتائج ان هناك فرقا معنويا كبيرا في وقف تدفق الدم من التجويف السني بين جهة الدراسة والجهة الاخرى كما اظهرت نتائج التصوير الشعاعي ان هناك فرقا معنويا كبيرا في كثافة العظم في جهة الدراسة مقارنة بالجهة الاخرى. **الاستنتاجات:** نستنتج من هذه الدراسة ان الياف الكولاجين تلعب دورا مهما في السيطرة على تدفق الدم من التجويف السني بعد قلع الاسنان ومنع حدوث الالتهابات الخمجية بعد القلع وله اهمية كبيرة في مساعدة التام الجروح والتقليل من ضمور العظم السنخي والعمل على زيادة كثافة العظم المتكون في التجويف السني.

ABSTRACT

Aims: To evaluate the effect of collagen fibers that placed immediately in alveolar bone socket after tooth extraction on homeostasis, quality and quantity of bone formation and their complications. **Materials and Methods:** The study group consists of 10 patients who attend to Oral and Maxillofacial Department in Dentistry College of Mosul University. The patients complained from chronic periapical lesions in badly carious two teeth in the same jaw (upper or lower jaw) that indicated for teeth extraction. Every patient underwent teeth extraction after receive local anesthesia with vasoconstriction, immediately after teeth extraction we put highly concentrated collagen material PARASORB® Dental Cones: 1 collagen cone contains 22.4 mg native equine collagen fibrils (RESORBA Wundversorgung GmbH & Co. KG, Germany) in one tooth socket (study site) and leave the other tooth socket to fill with blood clot (control group). Follow up the patients clinically and radiographically were done immediately after placement the material followed by different interval depending on the using test until six weeks. **Results:** The clinical assessment showed there is high significant difference ($p\text{-value} \leq 0.01$) in the haemostatic condition between the study and control sites while there is no significant difference ($p\text{-value} > 0.05$) in infection involvement of both study and control sites. The radiographical assessment of bone formation showed significant difference in bone density between study sites and control sites after two weeks ($p\text{-value} \leq 0.05$), and high significant difference at fourth and sixth weeks ($p\text{-value} \leq 0.001$). **Conclusions:** The collagen fibril play important role in control of hemorrhage following tooth extraction, prevent infection at the surgical site, promote granulation tissue formation and wound healing, reduce alveolar ridge resorption after tooth extraction (socket preservation) and enhance bone formation.

Key words: collagen fibrils, alveolar bone resorption.

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INTRODUCTION

Alveolar process is a tooth-dependent tissue that develops in conjunction with the eruption of the teeth that anchored to the jaws via the bundle bone into which

the periodontal ligament fibers invest. The volume as well as the shape of the alveolar process is determined by the form of the teeth, their axis of eruption and eventual inclination.⁽¹⁾

Alveolar bone is a complex and con-

stantly changing tissue which is capable of self-repairing and adaptation to new loads. Pushing and pulling stimuli that performed by the presence of dental elements will allow the maintenance of bone shape and density (Wolff's Law)⁽²⁾ and this bone is particularly fragile and labile and it is in a constant state of change, since replacement of old bone by new bone is a normal physiologic process.⁽³⁾

Tooth extraction is a common procedure in dentistry.⁽⁴⁾ Subsequent to the removal of teeth, the alveolar process will undergo atrophy.⁽⁵⁻⁷⁾ The bundle bone at the site obviously will lose its function and disappear.⁽⁸⁻¹⁰⁾ The greatest amount of bone loss is in the horizontal dimension and occurs mainly on the facial aspect of the ridge. There is also loss of vertical ridge height, which has been described to be most pronounced on the buccal aspect.⁽¹¹⁻¹³⁾

The maintenance of the dento-alveolar bone after teeth extraction depends on the attentive surgery procedure and the use of materials capable to maintain the prior space and be helpful in bone tissue healing.⁽¹⁴⁾ The typical wound healing process after tooth extraction includes several important biological reactions. The collagen fiber, which is the main organic component of connective tissue, plays an important role in the formation of granulation tissue and also bone tissue.^(15,16)

Collagen in various forms has now become a successful and widely used medical material. It has gained widespread clinical and consumer acceptance, being seen as a safe material with properties that can be adapted to meet a range of different clinical applications.⁽¹⁷⁾

In surgery, collagen based sutures (which have been used since historic times) and hemostats are available.⁽¹⁸⁾ For wound management, a range of wound

dressings is now available^(19,20), while for tissue augmentation, collagen pastes have been used extensively in dermal applications.⁽²¹⁾

This study aims to evaluate the effect of collagen fibers that placed immediately in alveolar bone socket after tooth extraction on homeostasis, soft tissue healing, quality and quantity of bone formation and their possible complications.

MATERIALS AND METHODS

The study group consists of 10 patients attended to Oral and Maxillofacial Department in Dentistry College of Mosul University. The patients complained from chronic periapical lesions in badly carious two teeth in the same jaw (upper and lower jaw) that indicated for teeth extraction. The period of study extend from the first of December 2011 to the last of May in 2012. The age of the patient's were ranges between 24-65 years, 5 patients were male and 5 patients were female that have no any systemic diseases with different social and education levels. For every patient in this study a standard case sheet was filled. All patients were informed about the purpose of this study and asking them to sign a consent form.

Every patient underwent teeth extraction after receive local anesthesia with vasoconstrictor, immediately after teeth extraction we put highly concentrated collagen material PARASORB® Dental Cones: 1 collagen cone contains 22.4 mg native equine collagen fibrils (RESORBA Wundversorgung GmbH & Co. KG, Germany) (Figure 1) in one tooth socket (study site) and leave the other tooth socket to fill with blood clot (control group) (Figure 2), place wet cotton pack over both sides and we asked the patients to take paracetamol tablet 500 mg on need. Follow up the patients clinically and radiographically were done.



Figure (1): Highly concentrated collagen material PARASORB® Dental Cones.

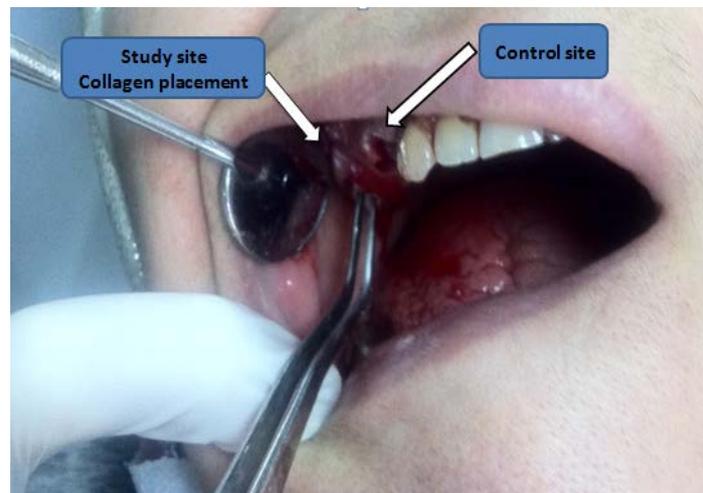


Figure (2): Collagen fibres insertion in one tooth socket (study site).

1-Clinical assessment

In all patients, the cotton pack were removed after fifteen minutes to assess the haemostatic condition, one and seven days after teeth extraction, all patients have been examined for signs and symptoms of infection (pain, fever, ecchymosis, wound dehiscence and dry socket) and evaluate the amount of granulation tissue formation by comparing the study site with control site.

A-Bleeding assessment scale:

Depending on Brennan MT et al 2002 that reported the oral bleeding time was range 0-20 minutes we choose the 15th minute after tooth extraction (which mostly the bleeding still continue) to examine the effect of study material on bleeding in study site comparing with control site, the scale included:

Grade 1: hemorrhage stopped before fifteen minutes.

Grade 2: hemorrhage stopped after fifteen

minutes.

B-Infection assessment scale:

Depending on signs and symptoms of wound infection (cellulitis, swelling, pus discharge, pain, fever, haemorrhage) that reported by David Wray et al 2003, the scale included:

Grade 1: There is no one or more of signs and symptoms of infection.

Grade 2: There is one or more of signs and symptoms of infection.

C-Granulation tissue assessment scale:

Unfortunately, we did not find method to evaluate size of granulation tissue formation, so we compare the granulation tissue formation in both sites by measuring the distance from crest of alveolar bone to the roof of granulation tissue in the tooth socket.

Grade 1: granulation tissue filling of socket in study site more than control site.

Grade 2: granulation tissue filling of socket in control site more than study site.

2-Radiographical assessment of bone formation.

Computed digital radiographic machine (planmeca,Finland), was used after two weeks (Figure 3), four weeks (Figure 4) and lastly after six weeks (Figure 5) following teeth extraction to

take computed digital periapical radiograph for the study and control sockets to evaluate the density of bone formation at the both sites and given scales according to the brightness of pseudocoloring as the following:

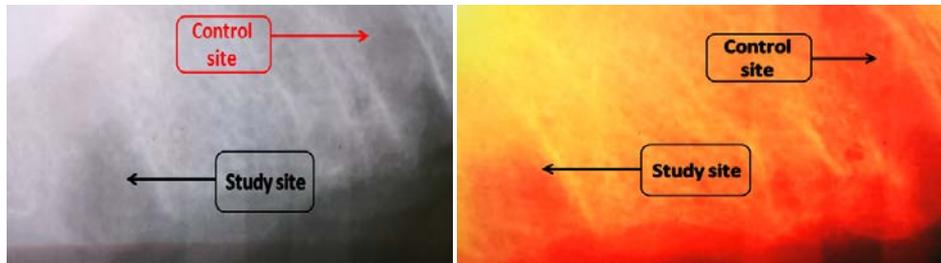


Figure (3): Radiographical assessment after two weeks.

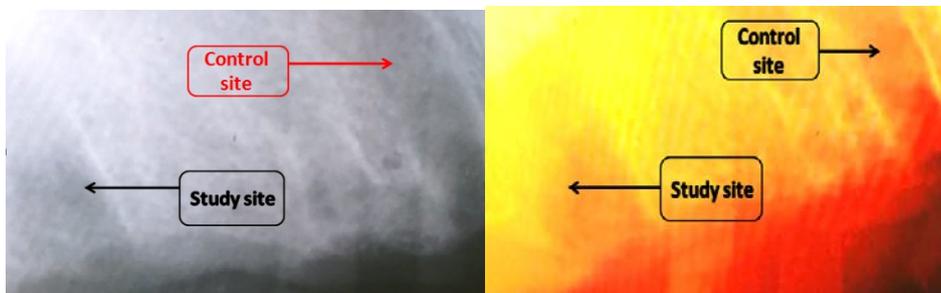


Figure (4): Radiographical assessment after four weeks.

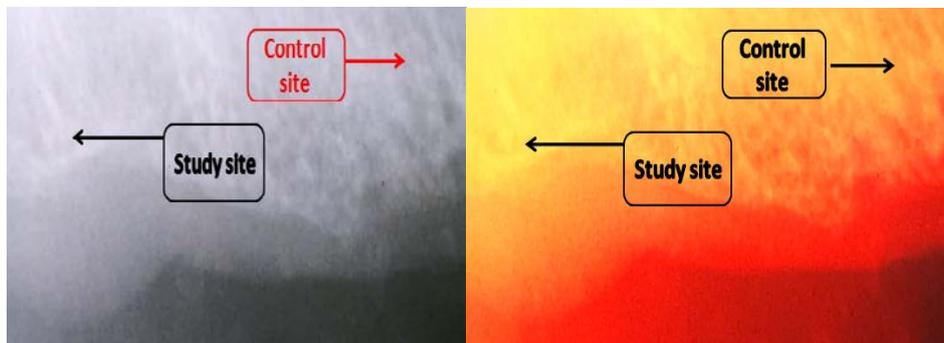


Figure (5):Radiographical assessment after six weeks.

Grade 1: dark red (low density of bone formation).

Grade 2: light red (moderate density of bone formation).

Grade 3: light yellow (high density of bone formation).

Grade 4: dark yellow (very high density of bone formation).

Data were collected and managed by SPSS System (Statistical Package for Social Science) on Pentium Four

computer. The (Wilcoxon Signed Ranks Test) and (Mann- Whitney Test) were done for study groups. The differences were considered as significant when the probability (p) level was equal to, or less than 0.05 ($p \leq 0.05$). When values were less than 0.01 ($p < 0.01$) the results were regarded as highly significant (H.S); while values less than 0.001 ($p < 0.001$) were regarded as very highly significant (V.H.S).

RESULTS

1- Clinical assessment

A-Bleeding assessment

The results showed that hemorrhage from the wounds of study sites in nine cases (90%) had been stopped before fifteen minutes while only two cases (20%) in con-

trol sites showed stopped hemorrhage before fifteen minutes. The statistical analysis showed there is high significant difference (p-value 0.008) in the haemostatic condition between the study and control sites. (Table1)

Table (1): Bleeding assessment scale.

Patient Grade	Study Group	%	Control Group	%	P-value
Grade 1	9	90%	2	20%	
Grade 2	1	10%	8	80%	
Total	10	100%	10	100%	**0.008

Grade 1: hemorrhage stopped before fifteen minutes.

Grade 2: hemorrhage stopped after fifteen minutes.

**Highly significant difference

B-Infection assessment

The results showed that there were no sign and symptoms of infection in study sites in all cases (100%) while there was dry socket in one case of control site and pain for

three days in other cases. The statistical analysis showed there is no significant difference (p-value 0.157) in infection between the study and control sites. (Table 2)

Table (2): Infection assessment scale.

Patient Grade	Study Group	%	Control Group	%	p-value
Grade 1	10	100%	8	80%	
Grade 2	0	0%	2	20%	
Total	10	100%	10	100%	0.157

Grade 1: There is no one or more of sign and symptoms of infection.

Grade 2: There is one or more of sign and symptoms of infection.

C- Granulation tissue assessment

The results showed that the granulation that filled the socket of study sites were more than control sites in all cases (100%) after one week from teeth extraction. The statistical analysis showed there is high significant difference (p-value 0.002) between granulation formation in study and control sites.

2- Radiographical assessment of bone formation

The results showed that the increase of bone density in study site more than control site in second, fourth and six weeks. The statistical results showed significant difference in bone density between study sites and control sites after two weeks (p-value 0.025), and high significant difference at fourth week (p-value 0.002) and sixth week assessment (0.004) respectively. (Table3)

Table (3): Comparison of radiographical grades between study and control sites (Brightness of pseudocoloring test)

Period (weeks)	Group Grade	Study site		Control site		p-value
		No.	%	No.	%	
2	1	2	20%	5	50%	**0.025
	2	4	40%	3	30%	
	3	4	40%	2	20%	
	Total	10	100%	10	100%	
4	1	0	0%	2	20%	***0.002
	2	1	10%	5	50%	
	3	6	60%	3	30%	
	4	3	30%	0	0%	
6	Total	10	10%	10	100%	***0.004
	1	0	0%	2	20%	
	2	0	0%	3	30%	
	3	3	30%	5	50%	
	4	7	70%	0	0%	

Grade 1: dark red (low density of bone formation)

Grade 2: light red (moderate density of bone formation)

Grade 3: light yellow (high density of bone formation)

Grade 4: dark yellow (very high density of bone formation)

*Significant difference

**Highly significant difference

In the study sites, the statistical study showed high significant difference (p-value 0.009) in the increase of bone density between second and fourth week assessment and showed very high significant difference between second and sixth week assessment (p-value 0.000) while there was no significant difference between fourth and sixth week assessment (p-value 0.067). In the control sites, the statistical analysis showed there were no significant difference in bone density between second, fourth and sixth week assessment respectively (p-value 0.243, 0.118, 0.516). (Table 3)

DISCUSSION

The study showed that the collagen fibrils (study material) has ability to enhance haemostatic effect in 90% of all cases and this may be due to ability of this material to absorb large amounts of fluids on account of their sponge-like structure and has positive influence on blood coagulation (after contact with the blood, thrombocytes aggregate at the collagen fibers and trigger a coagulation reaction)

which agree with Silverstein 1981 who reported that the haemostatic based on collagen are significantly more effective than gelatinous sponges or cellulose which rapidly and completely absorbed by the body, while the native collagen promotes granulation and epithelization, so this mention also support our result that showed that the collagen has ability to enhance granulation tissue formation in all cases.

The results showed that there were no signs and symptoms of infection in study sites in all cases (100%) while showed dry socket in control site in one case and pain in other case which may be due to ability of collagen fibril to stabilizes the blood clot in the alveolar cavity, so this study agree with Singh et al 2011 that reported that the collagen is a natural product, therefore it is used as a natural wound dressing and it is resistant against bacteria, which is of vital importance in a wound dressing so it helps to keep the wound sterile and fight infection, also when collagen is used as a burn dressing, healthy granulation tissue is able to form

very quickly over the burn, helping it to heal rapidly.

Also the study showed that collagen fibril are able to enhance the strength of bone formation in the sockets which may be due to ability of study material to stimulate the Angioconductive process (rapid revascularisation of the bone crest) and Osteoconductive process (promotes complete bony healing of the alveolar cavity) which agree with S. Viguet-Carrin et al 2006 when they reported that the bone is a composite material with complex relationships between mineral and collagen that influence bone strength. A change in collagen properties may alter the amount and disposition of the mineral, which would by itself affect bone mechanics so the rate of turnover of bone collagen may be important in determining bone strength because it influences the pattern of mature/immature cross-linking in bone.

CONCLUSION

The collagen fibril play important role in control of hemorrhage following tooth extraction and preventing the infection in the surgical site, also it promote the granulation tissue formation for wound healing, in addition to reduce the alveolar ridge atrophy after tooth extraction (socket preservation) and enhance strength of bone. So it is preferable to be used routinely in the socket after tooth extraction.

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