Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 04, pp.49441-49444, April, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

THE ROLE OF INTERNAL LAYER OF PERIOSTEUM IN A NEW BONE FORMATION IN THE DYNAMIC PERIOSTEAL DISTRACTION: AN EXPERIMENTAL STUDY IN THE RABBITS

[*,1]Ahmad Al Nashar, [1]Hekmat Yakoob and [2]Elias Boutrous

[1]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Tishreen University, Syrian Arab Republic
[2]Faculty of Dentistry, Al Andalus University for medical sciences, Syrian Arab Republic

ARTICLE INFO

Article History:
Received 14th January, 2017
Received in revised form
08th February, 2017
Accepted 21st March, 2017
Published online 30th April, 2017

Key words:
Bone formation,
Osteogenesis,
Periosteal distraction,
Periosteum.

ABSTRACT

Purpose: The purpose of this study is to evaluate the role of internal layer of periosteum in a new bone formation in the dynamic periosteal distraction.

Materials and methods: A custom-made dynamic periosteal distraction device consisted of titanium plate fixed to the lateral surface of the mandible in 10 adult rabbits. The plate was perforated in 5 rabbits (group1) and non-perforated in the others (group 2). Periosteal distraction was started 7days after placement of the periosteal distraction device. Then the device was activated at a rate of 0.25 mm every12 hours for 5 days. The animals were sacrificed after of 8 weeks of consolidation period. The specimens were then fixed, decalcified, and stained with hematoxylin and eosin.

Results: In group 1, Histological evaluation of control specimens showed a various amount of new bone formation with large spaces between bone trabeculae. On the other hand, a thin layer of a newly osteoid bone under the titanium mesh was detected in group 2 after 8 weeks.

Conclusion: The results of the present study indicated that the internal layer of periosteum has important role in bone formation in the dynamic periosteal distraction.

Citation: Ahmad Al Nashar, Hekmat Yakoob and Elias Boutrous, 2017. "The role of internal layer of Periosteum in a new bone formation in the dynamic Periosteal distraction: An experimental study in the rabbits", *International Journal of Current Research*, 9, (04), 49441-49444.

INTRODUCTION

Dynamic periosteal distraction osteogenesis (PDO) is a relatively new technique, and its potential for producing new bone was first reported by Schmidt *et al*. (2002). This method is based on the concept that tensile strain on the periosteum, which causes tenting of the subperiosteal capsule, is sufficient to produce bone formation, without corticotomy or local harvesting of the bone (Oda *et al*., 2009). The most recent concept of PDO based on the potential of the Periosteal Mesenchymal Stem Cells to differentiate into osteoblasts to fill the space over the underlying bone (Schmidt *et al*., 2002). However, other studies showed that the newly formed bone was mainly produced from the basal bone, not from the periosteum. (Zakaria *et al*., 2012) Sencimen *et al*. (2007) and Altug˘ *et al*. (2011) reported that the newly formed bone by periosteal distraction is rich in interstitial fatty tissue. The role of the mesh-perforations is still a matter of debate (Al Nashar *et al*., 2016). In the dynamic PDO, it seems to be important to have sufficient communication between the periosteum and the underlying bone with appropriate mechanical strength against the overlying soft tissue to encourage new bone formation (Yamauchi *et al*., 2013). On the other hand, it has been reported that elevation of periosteum with collagen membrane covering the perforated titanium plate produces more new bone compared to the elevation with the perforated titanium plate alone (Saulacic *et al*., 2012). The purpose of this study is to evaluate the role of internal layer of periosteum in a new bone formation in the dynamic periosteal distraction.

****Corresponding author:*** **Ahmad Al Nashar,**
Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Tishreen University, Syrian Arab Republic

MATERIALS AND METHODS

Experimental animals

Ten adult male rabbits with a mean weight of 2.4 ± 0.35 kg were used as the animal model. Experimental protocols were approved by University of Al Andalus University Committee of Animal Research. The animals were equally divided into two groups. In group 1 the plate of distraction device was perforated and non -perforated in group 2.

Device description

The device is consisted of a titanium plate either perforated or non-perforated. The lower part of the plate has two holes for fixation screws (3mm length and 1mm diameter mini-screws) and the upper part has one serrated hole for distraction screw (titanium elevation screw with 10 mm length and 2 mm in diameter). Fig(1)

Surgical procedure

All surgical procedures were performed under general anesthesia with a combination of 35 mg/kg intramuscular ketamine and 5 mg/kg subcutaneous xylazine. Local anesthesia, consisting of 2% lidocaine with 1:100,000 epinephrine was infiltrated into the lateral surface of the mandibular body. The surgical site was shaved, prepared with 10% povidone-iodine solution, and draped to maintain aseptic conditions. A 1.5-cm-long incision in the skin was made along the inferior border of the mandible, and dissection was performed through the subcutaneous and muscle layers. The periosteum was carefully elevated to expose the lateral aspect of the mandibular body and the buccal cortex was porously perforated by drilling with fissure bur. The device was placed over the perforated area and then fixed to the bone surface from one end by 2 mini screws then the periosteum was sutured covering the whole plate finally the skin flaps were sutured with 4-0 silk. Soft tissue incision of 2mm in length was made over the activation screw and then the screw was rotated 360° to elevate the plate 1mm. Postoperative analgesics included ketorolac (0.5 mg/kg by mouth) and buprenorphine (0.3 mg intramuscular). After latency period of 7 days the screw was activated to elevate 0.25 mm twice a day for 6 days. Fig (2) After healing periods of 8 weeks, animals were sacrificed by an intravenous overdose of pentobarbital sodium. The mandibular distraction areas, including peripheral soft tissues, and distraction devices were carefully removed. All resection materials were kept in a 10% neutral buffered formalin solution for at least 3 days. Next, each distraction device was removed. The specimens were then decalcified in the formic acid solution. When sufficiently soft, tissue samples were processed and embedded in paraffin for histological examination. Standard 4–5-mm sections were prepared and transferred onto slides for each block of tissue. All slides were stained with haematoxylin and eosin and evaluated using a light microscope.

RESULTS

All animals resumed normal dietary habits during the first 24 hours after the operation, and none of the animals had a weight loss during the experimental study.

Group 1: The histological evaluation showed a various amount of new bone formation with large spaces between bone trabeculae. The bonewas covered by a lining of osteoblasts and characterized by an increase in the number of osteocytes per unit area. The new bone is separated from the original bone by a high vascularity thin layer of connective tissue and a layer of periosteal proliferation. Fig (3,4)

Group 2: The histological evaluation showed a thin layer of a newly osteoid boneunder the titanium mesh, the bone was covered by a lining of osteoblasts. The new bone is separated from the original bone by a thick connective tissue which is rich in collagen fibers, cells, new blood vessels and a layer of periosteal proliferation. Fig(5,6)

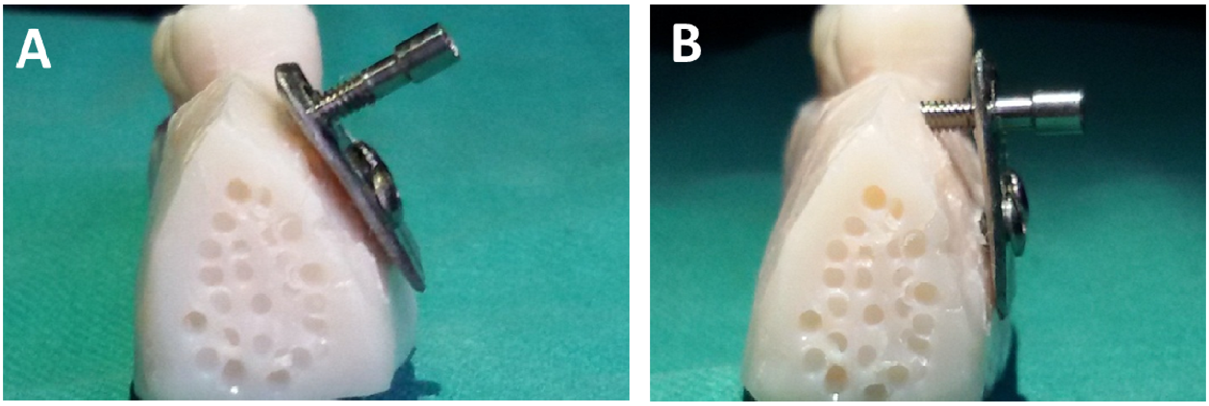
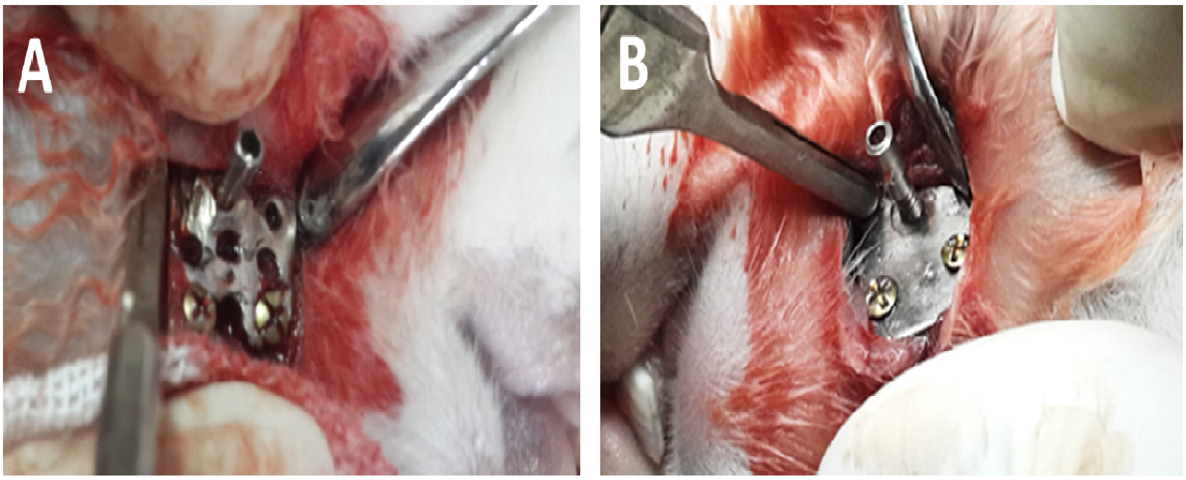
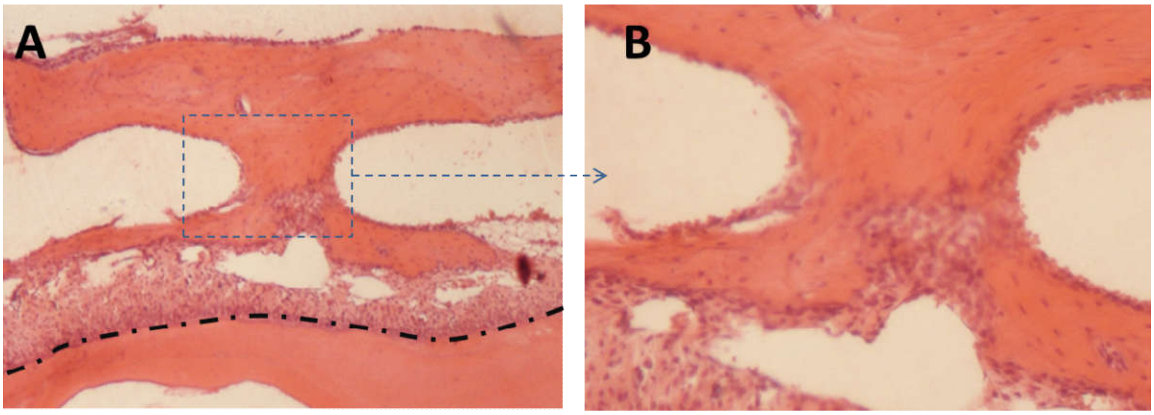


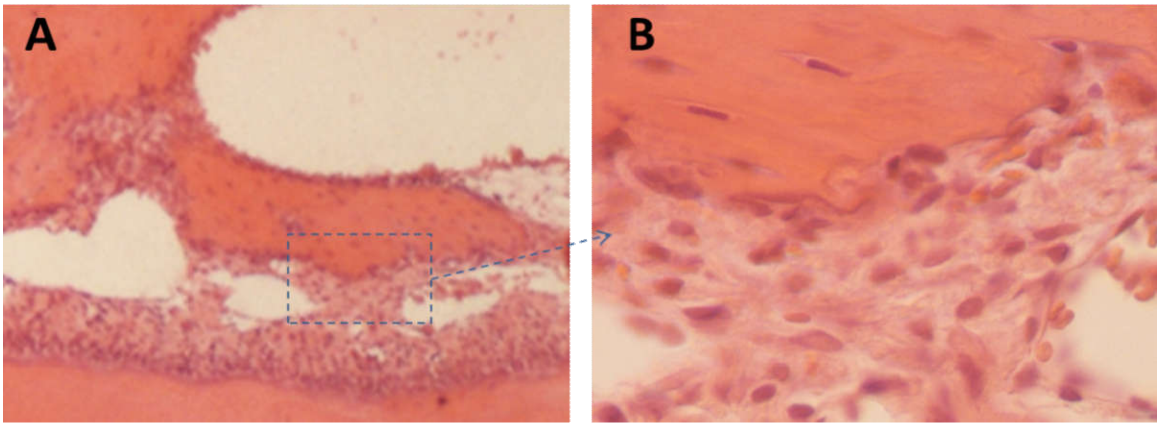
Fig.(1). The periosteal distraction device, A: before activation 1, B: at the end of activation



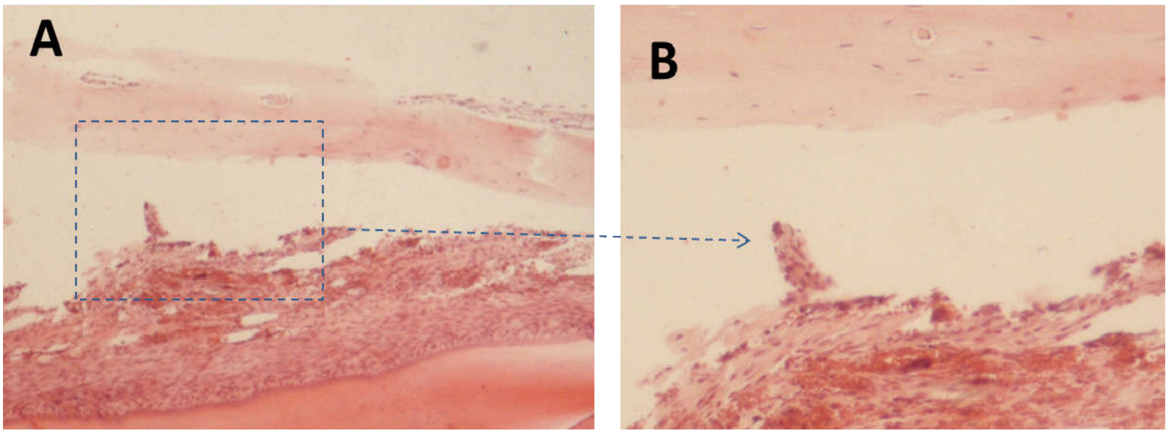
Fig(2). Intraoperative photograph, A: group 1, B: group 2



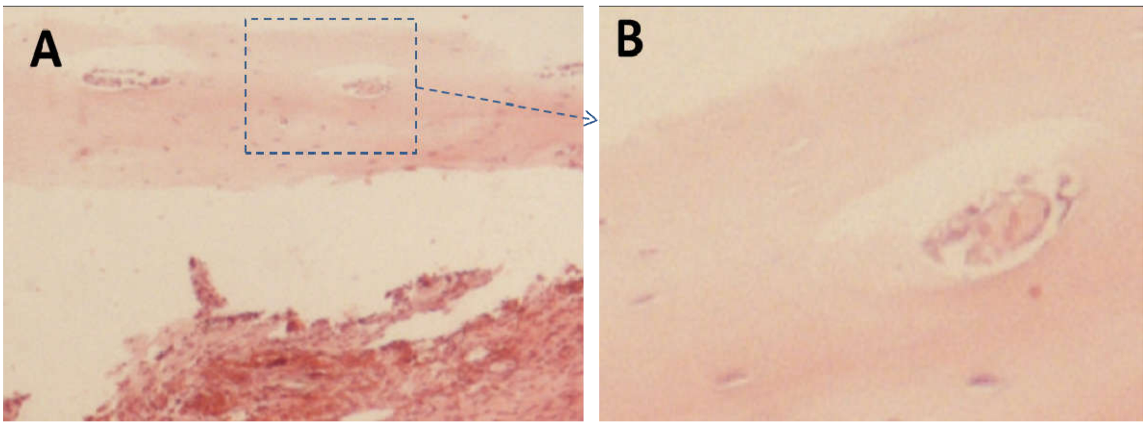
Fig(3). Histologic analyses of 8 weeks biopsy sample of group 1: A: (H&E staining, X 40), B: (H&E staining, X 100)



Fig(4). Histologic analyses of 8 weeks biopsy sample of group 1: A: (H&E staining, X 100), B: (H&E staining, X 400)



Fig(5). Histologic analyses of 8 weeks biopsy sample of group 2: A: (H&E staining, X 40), B: (H&E staining, X 100)



Fig(6). Histologic analyses of 8 weeks biopsy sample of group 1: A: (H&E staining, X 100), B: (H&E staining, X 400

DISCUSSION

The purpose of this study was to evaluate the role of internal layer of periosteum in a new bone formation in the dynamic periosteal distraction. The results of this study showed that using non perforated plate hinders the bone formation. The histological evaluation showed that the bone formation was limited to a thin layer of a newly under the titanium mesh, on the other hand, a wider area of a new bone formation have been detected under perforated plate which confirm the role of internal layer in this process. These results are in contrast with the results of Zakaria *et al*, they evaluated the gradual elevation of the barrier membrane which is initially placed on the bone surface and they concluded that gradually increasing the space over the bone could produce new bone efficiently without sharing of periosteum (Zakaria *et al*., 2012). The same results were confirmed by saulacic *et al*, they reported that elevation of periosteum with collagen membrane covering the perforated titanium plate, produces more new bone compared to the elevation with the perforated titanium plate alone, which clarify the benefit of using a barrier membrane over distraction device (Saulacic *et al*., 2012). However, in the previous reports, most of the devices for the dynamic PDO technique had perforated meshes without standardization of their number or size (Zakaria *et al*., 2012; Sencimen *et al*., 2007; Kessler *et al*., 2007). In agreement with study Yamauchi K *et al* confirmed that in the dynamic periosteal distraction, it seems to be important to have sufficient communication between the periosteum and the underside of the device to encourage new bone formation (Yamauchi *et al*., 2013).

Conclusion

The results of the present study indicated that the internal layer of periosteum has important role in bone formation in the the dynamic periosteal distraction.

REFERENCES

Al Nashar, A., Yakoob, H, Boutres, E. 2016. Induced Osteogensis by Periosteal distraction in Cranio-maxillofacial region: A systematic review. *International Journal of Current Researc*h, 8(06), 32707-32714.

Al Nashar, A., Yakoob, H., Boutres, E. 2016. Periosteal distraction in cranio-maxillofacial region. *International Dental Journal of Student Research*, 4(2), 75-78.

Altug HA, Aydintug YS, Sencimen M. 2011. Histomorphometric analysisof different latency periods effect on new bone obtained by periostealdistraction: an experimental study in the rabbit model. *Oral Surg OralMed Oral Pathol Oral Radiol Endod*., 111:539–46.

Kessler P, Bumiller L, Schlegel A, Birkholz T, Neukam FW, Wiltfang J. 2007. Dynamic periosteal elevation. *Br J Oral Maxillofac Surg*., 45:284–287.

Oda T, Kinoshita K. and Ueda M. 2009. Effects of cortical bone perforation onperiosteal distraction: an experimental study in the rabbit mandible. *J Oral Maxillofac Surg*., 67:1478–85.

Saulacic N, Schaller B, Bosshardt DD, Buser D, Jaun P, Haeniwa H. 2012. Periosteal distraction osteogenesis and barrier membrane application: an experimental study in the rat calvaria. *J Periodontol*., 83(6): 757e765.

Schmidt BL, Kung L, Jones C, Casap N. 2002. Induced osteogenesis by periosteal distraction. *J Oral Maxillofac*., 60:1170-5.

Sencimen M, Aydintug YS, Ortakoglu K, Karslioglu Y, Gunhan O, Gunaydin Y. 2007. Histomorphometrical analysis of new bone obtained by distraction osteogenesis and osteogenesis by periosteal distraction in rabbits. *Int J Oral Maxillofac Surg*., 36:235–242.

Yamauchi K, Takahashi T, Tanaka K, Nogami S, Kaneuji T, Kanetaka H, Miyazaki T, Lethaus B, Kessler P. 2013. Self-activated mesh device using shape memory alloy for periosteal expansion osteogenesis. *J Biomed Mater Res B Appl Biomater*., 101(5):736-42

Zakaria O, Kon K, Kasugai S. 2012. Evaluation of a biodegradable novel periosteal distractor. *J Biomed Mater Res B Appl Biomater*., 100(3):882-9.

Zakaria O, Madi M. and Kasugai S. 2012. A novel osteogenesis technique: The expansible guided bone regeneration. *J Tissue Eng*., 3(1):2041731412441194

Zakaria O, Madi M. and Kasugai S. 2012. Induced osteogenesis using a new periosteal distractor. *J Oral Maxillofac Surg*., 70(3): 225-34.

****