The increase of VEGF expressions and new blood vessels formation in Wistar rats induced with post-tooth extraction sponge amnion

by Indah Listiana Kriswandini

Submission date: 10-Feb-2020 07:11PM (UTC+0800)
Submission ID: 1254692690
File name: Wistar_rats_induced_with_post-tooth_extraction_sponge_amnion.pdf (1.16M)
Word count: 2983
Character count: 16328

Dental Journal
Majalah Kedokteran Gigi

Dental Journal
(Majalah Kedokteran Gigi)
2018 March; 51(1): 1–4

Research Report

The increase of VEGF expressions and new blood vessels formation in Wistar rats induced with post-tooth extraction sponge amnion

Moh. Basroni Rizal,[1] Elly Munadziroh,[2] and **Indah Listiana Kriswandini[3]**
[1] Department of Dental Material, Faculty of Dentistry, Universitas Hang Tuah
[2] Department of Dental Material, Faculty of Dental Medicine, Universitas Airlangga
[3] Department of Oral Biology, Faculty of Dental Medicine, Universitas Airlangga
Surabaya - Indonesia

ABSTRACT

Background: *Tooth extraction is the process of removing a tooth from the oral cavity potentially triggering a wound healing response in the body. As a result, many methods have been applied to improve the wound healing process, especially in wounds resulting in complications. One such method involves the application of amniotic membrane which has anti-inflammatory, anti-bacterial, anti-fibrosis, anti-scarring properties with low immunogenicity, epithelialization effects, and secretory leukocyte protease inhibitor (SLPI). it also contains collagen, various growth factors, transferrin, fibronectin, nidogen, proteoglycans, hyaluronan and laminin.* ***Purpose:*** *This study aimed to determine the effects of sponge amnion on the number of VEGF expressions and new blood vessels in post-tooth extraction wounds of Wistar rats.* ***Methods:*** *Sponge amnion was produced by mixing freeze-dried amnion membrane from the Tissue Bank at RSUD Dr. Soetomo with 1% gelatin before freeze drying the mixture. Wistar rats were then divided into two groups. In Group 1, referred to as the control group, the post-extraction wounds of the rats received no treatment. Meanwhile, in Group 2, the treatment group, the subjects' post-extraction wounds were treated with sponge amnion. The rats of both groups were sacrificed on day 3 to allow observation of the number of VEGF expressions and new blood vessels. A statistical analysis test, a t-test, was subsequently conducted.* ***Results:*** *There was a significant difference in the number of new blood vessels in the control group and that of the treatment group with a p value of 0.018 ($p<0.05$). There was also a significant difference in VEGF expression between the two groups with a p value of 0.000 ($p <0.05$).* ***Conclusion:*** *Sponge amnion can generate a number of VEGF expressions and new blood vessels in the post-extraction wounds of Wistar rats.*

Keywords: *sponge amnion; angiogenesis; socket healing; VEGF expressions*

Correspondence: Elly Munadziroh, Department of Dental Material, Faculty of Dental Medicine, Universitas Airlangga. Jl. Mayjend. Prof. Dr. Moestopo no. 47 Surabaya 60132, Indonesia. E-mail: emunadziroh@yahoo.com; m.basroni.rizal@gmail.com;

INTRODUCTION

Tooth extraction is a common procedure performed by dentists with a prevalence rate in Indonesia of 38.5%.[1] Nevertheless, the process can lead to complications in 37.6% of cases. Fractures are the most common complication at 30.4% prevalence. The tooth extraction socket may be considered as a form of bone fracture which can cause disruption to the wound healing process, possibly triggering a wound healing response from the body.[2]

In general, the wound healing process can be divided into three phases, namely; inflammatory, proliferative and remodeling.[3] The inflammatory phase initiates a condition in which macrophages secret cytokines and regulatory factors. These consist of vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF) and transforming growth factor-beta1 (TGF-β1), all of which play an important role in the wound healing process.[4] New blood vessels formed through a process of angiogenesis play a role in maintaining the continuous function of various tissues and organs affected by the wound[5] by subsequently supplying oxygen and nutrients useful for the formation of new tissues.[6]

Currently, various methods of improving wound healing have been implemented, one of which involves placing an amniotic membrane on the wound. Amniotic membrane

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.
 Available at http://e-journal.unair.ac.id/index.php/MKG
DOI: 10.20473/j.djmkg.v51.i1.p1–4

is known to contain collagen types I, III, IV, V and VI, fibronectin, nidogen, proteoglycans, hyaluronan, laminin and secretory leukocyte protease inhibitor (SLPI).[7,8] Moreover, it also contains various growth factors, such as epidermal growth factor (EGF), keratinocyte growth factor (KGF), hepatocyte growth factor (HGF) and transforming growth factor (TGF-α).[9] In fact, amniotic membranes have widely been employed as biomaterials within various clinical applications due to the fact that it is flexible and semi-transparent, protects the wound, reduces pain and has a re-epithelization effect.[7,10,11] Therefore, this research aimed to assess the application of amnion sponge on post-extraction wounds by observing the number of VEGF expressions and new blood vessels formation as indicators of the angiogenesis process.

MATERIALS AND METHODS

This research constituted a laboratory-based experimental investigation using ten male Wistar rats weighing 200–250 grams. The subjects were obtained from the Biochemistry Laboratory of the Faculty of Medicine, Universitas Airlangga. They were then divided into two groups of five. In group 1, referred to as the control group, the Wistar rats' post-tooth extraction wounds remained untreated. Meanwhile, in group 2, known as the treatment group, such wounds were given sponge amnion.

The Wistar rats were anesthetized intramuscularly, their mandibular incisors subsequently being extracted using lower anterior forcep. In the control group, suturing was conducted post-tooth extraction. Meanwhile, in the treatment group, after extraction, amnion sponge was applied to the extraction sockets, before suturing was performed.

Sponge amnion was produced by smoothing freeze-dried amnion membranes (<24 hours) from Biomaterials Center / Tissue Bank / Dr. Soetomo Hospital with a sterile aquadest at a ratio of 1: 1. After becoming amnionic porridge, it was added to 1% gelatin at a ratio of 1:1, and then freeze dried (Lyophilizer) for 2 x 24 hours to induce the formation of sponge. On the third day, both groups of Wistar rats were sacrificed. Their mandibular tissue, together with the extraction socket, was removed and soaked in fixation solution for 48 hours. The two were then decalcified until the bone became sufficiently tender to be cut.

Thereafter, paraffin blocks were prepared and cut to a thickness of 4–5µ. Histologic preparations were made incorporating the use of both imunohistochemical imaging (IHC) to enable observation of VEGF expression and hematoxylin-eosin (HE) staining to highlight the number of new blood vessels. Data calculations were then performed under a light microscope at 400x magnification on the 1/3 apical socket area of the tooth extraction. The VEGF expressions measured were the number of endothel cells emitted a brownish color on immunohistochemical staining with anti-VEGF polyclonal antibodies (abcam product, ab46154). The number of blood vessels, on the other hand, was determined by the prevalence of luminal formations surrounded by a layer of endothelial cells. The data obtained was then analyzed by means of a parametric test using an independent t-test with a significance level of 95% (0.05).

RESULTS

The results of this research confirmed that VEGF expressions in one third of the tooth extraction apical sockets of the treatment group were higher than those in the control group. Figure 1 illustrates VEGF expressions after IHC staining on one third of the tooth extraction apical sockets at a magnification of 400x.

Moreover, the results indicated that the number of new blood vessels in one-third of the tooth extraction apical sockets of the treatment group were higher than those of the control group. Figure 2 demonstrates that the appearance of a lumen-formed image surrounded by a layer of endothelial cells in one-third of the tooth extraction apical socket preparations after HE staining at a magnification of 400x.

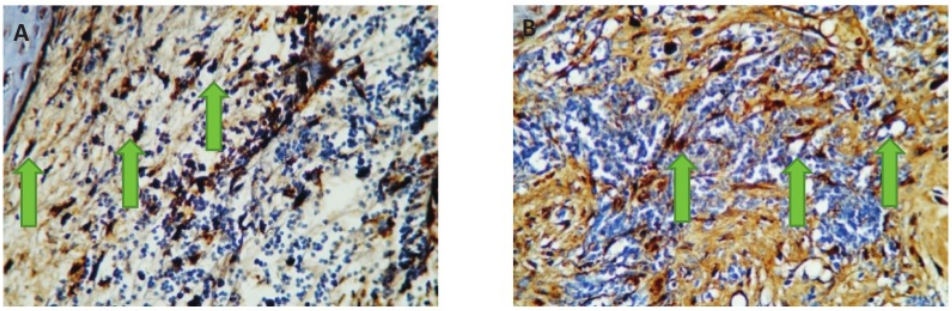

Figure 1. VEGF Expressions. (a) VEGF expressions in the control group on day 3. (b) VEGF expressions in the treatment group on day 3. Arrows show the endothelial cells expressing VEGF (brown color) after the IHC staining at a magnification of 400x.

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.

DOI: 10.20473/j.djmkg.v51.i1.p1–4

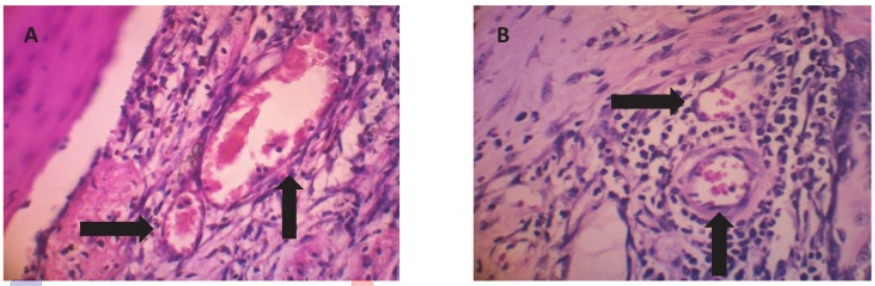

Figure 2. The number of new blood vessels. (a) The number of new blood vessels in the control group on day 3. (b) The number of new blood vessels in the treatment group on day 3. The arrows show the lumen of the new blood vessels after the HE staining at a magnification of 400x.

Table 1. Distribution of normality

	VEGF expressions	Number of new blood vessels
Number of samples	10	10
Kolmogorov-Smirnov Z	0.634	0.704

Table 2. The mean, standard deviation, and p value of VEGF expressions and new blood vessels in the control and treatment groups

Groups	VEGF expressions	Number of new blood vessels
Control	3.60 ± 0.89	7.60 ± 2.07
Treatment	11.80 ± 2.05	12.60 ± 3.13
P Value	0.000	0.018

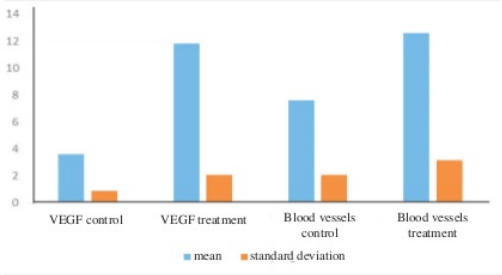

Figure 3. The mean and standard deviation of VEGF expressions and new blood vessels in the control and treatment groups.

With regard to normality test results, a Kolmogorov Smirnov test produced a p value of 0.634 (p>0.05) for VEGF expressions and a p value of 704 (p>0.05) for the new blood vessels. These results indicated the data to be normally distributed (Table 1). The mean of VEGF expressions in the treatment group was also confirmed to be higher than that in the control group. There was a significant difference in VEGF expressions between the control and treatment groups with a p value of 0.000 (p<0.05). The mean number of new blood vessels in the treatment group was also higher than that in the control group. Similarly, there was a significant difference in the number of new blood vessels between the control group and the treatment group with a p value of 0.018 (p<0.05) (Table 2).

DISCUSSION

Bone tissue engineering innovation has focused on biomaterial applications, including scaffolds, being developed. Sponge-shaped scaffolds with a porous structure are suitable for cell attachment, cell proliferation, cell differentiation and specific tissue formation.[12] In this research, amniotic and gelatin membrane biomaterials were made of sponge with the objective of their being more easily applied to the post-extraction socket and of reducing post-extraction bleeding.

Amniotic membranes have anti-inflammatory, anti-bacterial, anti-fibrosis and anti-scarring properties with low immunogenicity, re-epithelialization effects, several growth factors, SLPI, collagen, fibronectin, nidogen, proteoglycans, hyaluronan, and laminin.[7–9,13] The availability of almost infinite amniotic membranes and the process of obtaining them easily and cheaply for therapeutic purposes cause them to be regarded as having greater potential as biomaterials.[14] Various growth factors are also found in amniotic membranes, including: EGF, KGF, HGF, FGF, TGF-α and TGF-β.[9]

The results of this research showed that there was a significant difference in VEGF expressions between the control and treatment groups. VEGF expressions are generally influenced by stimulation of the host, such as estrogen, nitric oxide (NO), various growth factors (bFGF, PDGF, TNF-α, TGF-β, EGF, and IGF1), as well as inflammatory cytokines (IL-6).[15,16] In the early phase, post-extraction inflammation will occur, in which lactate levels increase and oxygen concentration is between 0-10 mmHg. The increased activity of inflammatory cells then leads to a hypoxic atmosphere and elevated lactate levels.

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.

DOI: 10.20473/j.djmkg.v51.i1.p1–4

The latter, together with oxygen concentration at 0-10 mmHg, will attract young macrophages and fibroblasts migrated to the extraction sockets. Thereafter, macrophages in the wound will elaborate growth factors, known as macrophage-dependent angiogenic factors, resulting in chemotactic for endothelial cells. Endothelial cells then lead to the injury, and then release VEGF playing a role in angiogenesis and vasculogenesis.[5]

The results of this research also showed that the average number of new blood vessels in the treatment group was statistically higher than that in the control group. In other words, there was a significant difference in the number of new blood vessels between the control group and the treatment group. The results also revealed that the amniotic membrane was able to increase the number of new blood vessels since it contains FGF and TGF-β, two of the angiogenic factors.[9] Angiogenic factors comprising VEGF, FGF, TNF-α, TGF-β, and PDGF bind to endothelial cell receptors around the site of the old blood vessels before activating, as well as generating, signals sent to the nucleus to produce protease enzymes which play an important role in the degradation of the extracellular matrix.[5] Migration of endothelial cells then occurs to strengthen the branching structures of blood vessels, followed by the formation of new ones. Therefore, amniotic membranes can increase the number of new blood vessels.[17]

Several studies have shown that TGF-β plays a role in inhibiting the proliferation of endothelial cells in vitro and in vivo since TGF-β induces angiogenesis and stimulates VEGF expressions by attracting inflammatory cells.[5] In infant rats, the administration of TGF-β at a dose of 1 µg even can stimulate the occurrence of increased production of macrophages, fibroblasts, and collagen, as well as the formation of new capillaries.[5] TGF-β may also regulate VEGF expressions through the apoptotic process of endothelial cells by activating TGF-β derived from vascular endothelial growth factor receptor-2 (VEGFR-2). The apoptotic process of endothelial cells is required for the formation of lumen within blood vessels.[18]

14 FGF, on the other hand, is known not only to stimulate endothelial cell proliferation in vitro (at concentrations of 1 to 10 ng / ml), but also to stimulate an in vivo angiogenic process leading to new blood vessel growth during the wound healing process by increasing the reendothelialization process in damaged blood vessels.[5] Growth factors affecting VEGF expressions and existing in the amniotic membrane are FGF and TGF-β. Finally, it can be concluded that amnion sponge can increase the expressions of VEGF and the number of new blood vessels in the post-tooth extraction wounds of Wistar rats.

REFERENCES

1. Kementerian Kesehatan Republik Indonesia. Riset kesehatan dasar (Riskesdas). Jakarta: Badan Penelitian dan Pengembangan Kesehatan Republik Indonesia; 2007. p. 135.
2. Dani FR. Potensi ekstrak umbi teki (Cyperus rotundus L.) dalam menurunkan jumlah limfosit jaringan granulasi setelah sencabutan gigi tikus wistar jantan. Scription. Jember: Unversitas Jember; 2012. p. 14.
3. Li J, Chen J, Kirsner R. Pathophysiology of acute wound healing. Clin Dermatol. 2007; 25(1): 9–18.
4. Larjava H. Oral wound healing: cell biology and clinical management. Singapore: Wiley-Blackwell; 2012. p. 1–82.
5. Frisca, Sardjono CT, Sandra F. Angiogenesis: patofisiologi dan aplikasi klinis. J Kedokteran Maranatha. 2009; 8(2): 174–87.
6. de Mendona RJ. Angiogenesis in Wound Healing. In: Davis J, editor. Tissue Regeneration - From Basic Biology to Clinical Application. InTech; 2012. p. 93–108.
7. Niknejad H, Peirovi H, Jorjani M, Ahmadiani A, Ghanavi J, Seifalian AM. Properties of the amniotic membrane for potential use in tissue engineering. Eur Cell Mater. 2008; 15: 88–99.
8. Munadziroh E. Isolation and identification of java race amniotic membrane secretory leukocyte protease inhibitor gene. Dent J (Maj Ked Gigi). 2008; 41(3): 123–7.
9. Effendi RG, Suhendro G, Handojo I. Perbedaan kadar epidermal growth factor pada selaput amnion tanpa preservasi dan dengan cryopreservation (penelitian eksperimental laboratoris). J Oftalmologi Indonesia. 2009; 7(1): 1–5.
10. Hennerbichler S, Reichl B, Pleiner D, Gabriel C, Eibl J, Redl H. The influence of various storage conditions on cell viability in amniotic membrane. Cell Tissue Bank. 2007; 8(1): 1–8.
11. Parolini O, Alviano F, Bagnara GP, Bilic G, Bühring H-J, Evangelista M, Hennerbichler S, Liu B, Magatti M, Mao N, Miki T, Marongiu F, Nakajima H, Nikaido T, Portmann-Lanz CB, Sankar V, Soncini M, Stadler G, Surbek D, Takahashi TA, Redl H, Sakuragawa N, Wolbank S, Zeisberger S, Zisch A, Strom SC. Concise review: isolation and characterization of cells from human term placenta: outcome of the first international workshop on placenta Derived stem cells. Stem Cells. 2008; 26(2): 300–11.
12. Niu X, Fan Y, Liu X, Li X, Li P, Wang J, Sha Z, Feng Q. Repair of bone defect in femoral condyle using microencapsulated chitosan, nanohydroxyapatite/collagen and poly(L-lactide)-based microsphere-scaffold delivery system. Artif Organs. 2011; 35(7): E119–28.
13. Andriani I, Sudibyo. Perbedaan efektivitas antara bedah flap posisi koronal dengan dan tanpa membran amnion pada perawatan resesi gingiva. Thesis. Yogyakarta: Universitas Gadjah Mada; 2010. p. 18.
14. Ihsan I, Prijanto P. The difference of epidermal growth factor concentration between fresh and freeze-dried amniotic membranes. J Oftalmologi Indonesia. 2009; 7(2): 62–6.
15. Obianime AW, Uche FI. The phytochemical screening and the effects of methanolic extract of phyllanthus amarus leaf on the biochemical parameters of male guinea pigs. J Appl Sci Environ Manag. 2008; 12(4): 73–7.
16. Istvan S. Investigation of incident and development of spontaneous tumours typical of crl: CD BR rat strain in two carcinogenicity studies performed under similar circumstance. Disertation. Keszthely: Keszthely; 2008.
17. Kleinsmith LJ. Understanding cancer and related topics understanding angiogenesis. 2008. Available from: http://cancer.gov/cancertopics/understandingcancer. Accessed 2008 Oct 20.
18. Ferrari G, Cook BD, Terushkin V, Pintucci G, Mignatti P. Transforming growth factor-beta 1 (TGF-β1) induces angiogenesis through vascular endothelial growth factor (VEGF)-mediated apoptosis. J Cell Physiol. 2009; 219(2): 449–58.

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.
 Available at http://e-journal.unair.ac.id/index.php/MKG
DOI: 10.20473/j.djmkg.v51.i1.p1–4

The increase of VEGF expressions and new blood vessels formation in Wistar rats induced with post-tooth extraction sponge amnion

ORIGINALITY REPORT

23%	13%	21%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Iwan Sahrial Hamid, Eduardus Bimo Aksono, Mohammad Sukmanadi, Muhammad Thohawi Elziyad Purnama. "Antiangiogenesis activity test of tin leaf (Ficus carica L.) on the number of blood vessels and VEGF expression of chorioallantoic membrane of embryonated chicken eggs", European Journal of Oncology Pharmacy, 2018 Publication	2%
2	ijbs-udayana.org Internet Source	2%
3	Keith A Horvath, Elaine Chiu, Dipen C Maun, Jon W Lomasney, Rodney Greene, William H Pearce, David A Fullerton. "Up-regulation of vascular endothelial growth factor mrna and angiogenesis after transmyocardial laser revascularization", The Annals of Thoracic Surgery, 1999 Publication	2%

4	doaj.org Internet Source	1%
5	Sri Wigati Mardi Mulyani, Eha Renwi Astuti, Otty Ratna Wahyuni, Diah Savitri Ernawati, Nastiti Faradilla Ramadhani. "Xerostomia Therapy Due to Ionized Radiation Using Preconditioned Bone Marrow-Derived Mesenchymal Stem Cells", European Journal of Dentistry, 2019 Publication	1%
6	Maria-Angeles Aller. "Pathological axes of wound repair: Gastrulation revisited", Theoretical Biology and Medical Modelling, 2010 Publication	1%
7	Ira Arundina, S. Theresia Indah Budhy, Intan Nirwana, Retno Indrawati, Muhammad Luthfi. "Toxicity Test n-Hexane: Ethyl Acetate (3:7) Fraction of Sudamala (Artemisia vulgaris L.)", Procedia Chemistry, 2016 Publication	1%
8	alexandriadentaljournal.com Internet Source	1%
9	Zahid Lalani, Mark Wong, Eric M. Brey, Antonios G. Mikos, P.J. Duke, Michael J. Miller, Carol Johnston, Dina Montufar-Solis. "Spatial and Temporal Localization of FGF-2 and VEGF in Healing Tooth Extraction Sockets in a Rabbit	1%

Model", Journal of Oral and Maxillofacial Surgery, 2005
Publication

---

10 Wu-Xun Peng, Lei Wang. "Adenovirus-Mediated Expression of BMP-2 and BFGF in Bone Marrow Mesenchymal Stem Cells Combined with Demineralized Bone Matrix For Repair of Femoral Head Osteonecrosis in Beagle Dogs", Cellular Physiology and Biochemistry, 2017 — 1%
Publication

---

11 Murat Ferhat Ferhatoglu, Taner Kıvılcım, Kazım Senol, Gurcan Vural et al. "The Positive Effects of the Human Amniotic Membrane on the Healing of Staple Line After Sleeve Gastrectomy Applied Long-Evans Rat Model", Obesity Surgery, 2019 — 1%
Publication

---

12 Rinastiti, M.. "Histological evaluation of rabbit gingival wound healing transplanted with human amniotic membrane", International Journal of Oral & Maxillofacial Surgery, 200603 — 1%
Publication

---

13 Navid Jallali, Hyder Ridha, Christopher Thrasivoulou, Peter Butler, Timothy Cowen. "Modulation of Intracellular Reactive Oxygen Species Level in Chondrocytes by IGF-1, FGF, and TGF-β1", Connective Tissue Research, — 1%

2009
Publication

14	Anne Quirinia, Andrus Viidik. "THE EFFECT OF RECOMBINANT BASIC FIBROBLAST GROWTH FACTOR (bFGF) IN FIBRIN ADHESIVE VEHICLE ON THE HEALING OF ISCHAEMIC AND NORMAL INCISIONAL SKIN WOUNDS", Scandinavian Journal of Plastic and Reconstructive Surgery and Hand Surgery, 2009 Publication	<1%
15	eprints.poltekkesjogja.ac.id Internet Source	<1%
16	www.jbc.org Internet Source	<1%
17	"Biomaterials for Implants and Scaffolds", Springer Science and Business Media LLC, 2017 Publication	<1%
18	kanazawa-u.repo.nii.ac.jp Internet Source	<1%
19	Bruna Romana-Souza. "β-1 and β-2, but not α-1 and α-2, adrenoceptor blockade delays rat cutaneous wound healing", Wound Repair and Regeneration, 03/2009 Publication	<1%

20	dx.doi.org Internet Source	<1%
21	Jianping Ye. "Regulation of stem cell differentiation in adipose tissue by chronic inflammation : Regulation of ASC by inflammation", Clinical and Experimental Pharmacology and Physiology, 12/2011 Publication	<1%
22	ethos.bl.uk Internet Source	<1%
23	Jenny Sunariani, Christian Khoswanto, Wahyuning Ratih Irmalia. "Difference of brain-derived neurotrophic factor expression and pyramid cell count during mastication of food with varying hardness", Journal of Applied Oral Science, 2019 Publication	<1%
24	Arofi Kurniawan, Shintya Rizky Ayu Agitha, Mieke Sylvia Margaretha, Haryono Utomo et al. "The applicability of Willems dental age estimation method for Indonesian children population in Surabaya", Egyptian Journal of Forensic Sciences, 2020 Publication	<1%
25	Janet Gould, Carlos Aramburo, Marie Capdevielle, Colin G. Scanes. "angiogenic	<1%

activity of anterior pituitary tissue and growth hormone on the chick embryo chorio-allantoic membrane : A novel action of GH", Life Sciences, 1995
Publication

26	K. Sahu. "Non-invasive assessment of healing of bacteria infected and uninfected wounds using optical coherence tomography", Skin Research and Technology, 03/2010 Publication	<1%
27	pt.scribd.com Internet Source	<1%
28	I Amelia, E Herda, Y K Eriwati. "Sealing ability of zinc oxide eugenol and non-eugenol-based temporary filling", Journal of Physics: Conference Series, 2018 Publication	<1%
29	bmcvetres.biomedcentral.com Internet Source	<1%
30	repository.ugm.ac.id Internet Source	<1%
31	Zhigang, W.. "Ultrasound-mediated microbubble destruction enhances VEGF gene delivery to the infarcted myocardium in rats", Clinical Imaging, 200411/12 Publication	<1%

32	journal.unair.ac.id Internet Source	<1%
33	I Gusti Aju Wahju Ardani, Bintiana Susanti, Irwadi Djaharu'ddin. "Force degradation trend of latex and nonlatex orthodontic elastics after 48 hours stretching", Clinical, Cosmetic and Investigational Dentistry, 2018 Publication	<1%
34	S. Cruet-Hennequart, A.M. Prendergast, F.P. Barry, M.P. Carty. "Human Mesenchymal Stem Cells (hMSCs) as Targets of DNA Damaging Agents in Cancer Therapy", Current Cancer Drug Targets, 2010 Publication	<1%
35	Stuart K. Williams, Leigh B. Kleinert, Kris M. Hagen, David L. Clapper. "Covalent modification of porous implants using extracellular matrix proteins to accelerate neovascularization", Journal of Biomedical Materials Research Part A, 2006 Publication	<1%
36	"Abstracts 18th European Congress of Pathology Berlin, Germany, September 8–13, 2001", Virchows Archiv, 2001 Publication	<1%

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		

The increase of VEGF expressions and new blood vessels formation in Wistar rats induced with post-tooth extraction sponge amnion

GRADEMARK REPORT

FINAL GRADE

/100

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4