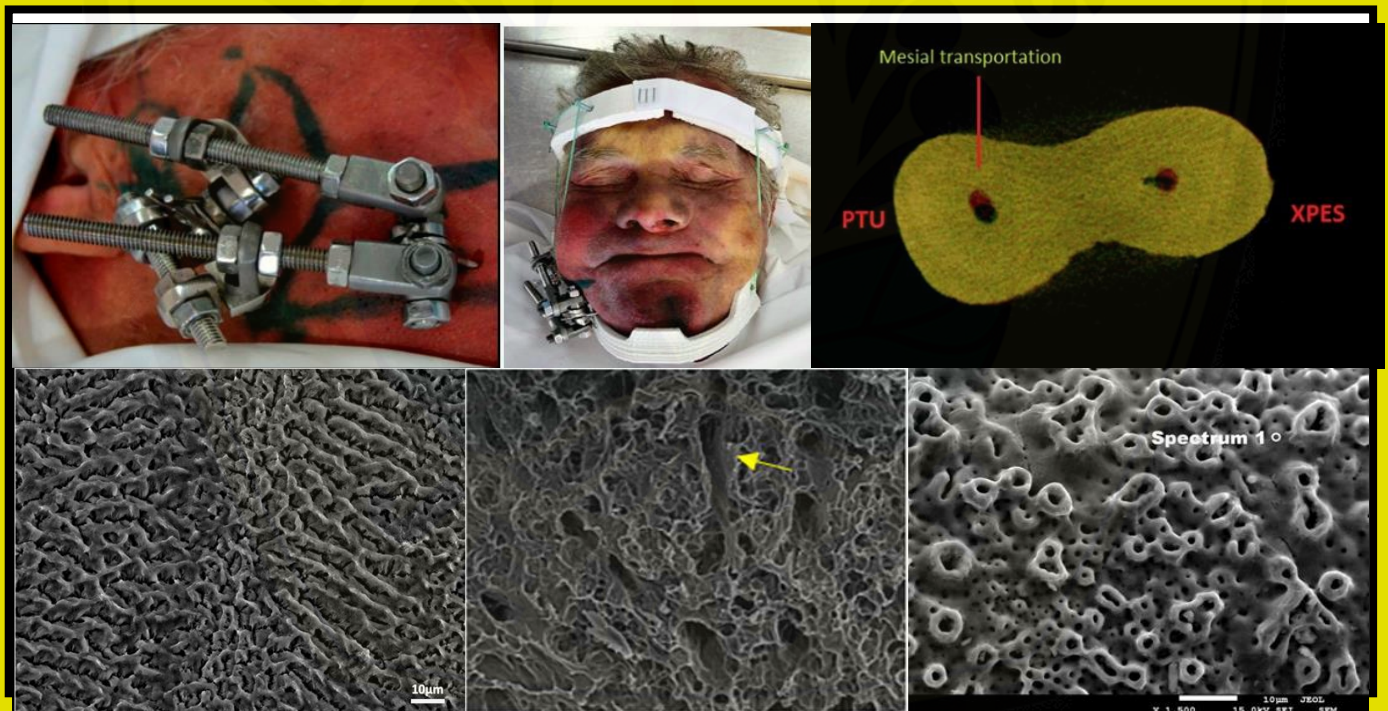


Journal of

International

Dental and Medical

Research



2020 - Vol. 13 – No. 2

<http://www.jidmr.com>

TABLE OF CONTENTS / 2020; 13 (2)

DENTISTRY

- | | |
|--|------------------------------------|
| <p>1. Mandible Exoskeleton - First Results of Development and Implementation
Alexandr A. Vorobyev, Denis Yu. Dyachenko, Yuliya A. Makedonova, Dmitriy V. Mikhailchenko,
Evgeniy V. Fomichev, Karen A. Sargsyan
Pages 400-406</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>2. Evaluation of the Shaping Ability of XP Endo Shaper: A Micro-Computed Tomography Study
Sarah Mubarak Alkahtany, Sara Suliman Alrumaih, Mona Abdullah Alhassan, Basmah Ahmad Alnashmi,
Ebtissam M. Al-Madi
Pages 407-411</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>3. Viability Test of Fish Scales Collagen from Oshphronemus Gouramy on Osteoblast Cell Culture
Agung Krismariono, Novia Wiyono, Chiquita Prahasanti
Pages 412-416</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>4. Isolation and Antimicrobial Activity of Lactic Acid Bacteria against Streptococcus Mutans
Nor Zaihana Abdul Rahman, Rohazila Mohamad Hanafiah, Siti Aisyah Abd Ghafar, Norafiqah Abdullah,
Nur Nabilah Azman
Pages 417-421</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>5. Clinical Control of Denture Base Acrylics Polymerization for the Quality Assurance: Pilot Study of Spectroscopic Approach
Yuriy Lokota, Ivan Paliichuk, Volodymyr Paliichuk, Myroslav Goncharuk-Khomyn
Pages 422-429</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>6. The Mangiferin (Mangifera Indica Linn) Effect Against the Calcium Degradation, Bones Resorption and Ossification of Rattus novergicus of Post-orthodontic treatment
Yenita Alamsyah, Nazruddin, Syafruddin Ilyas, Deddi Prima Putra
Pages 430-435</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>7. The Effect of Cranberry, Strawberry and Blueberry Juices on the Viability of Cariogenic Bacteria: An in Vitro Study
Md. Sofiqul Islam, Zainab Riaz, Anam Waqar, Mohannad Nassar, Ashfaque Hossain,
Muhammed Mustahsen Rahman
Pages 436-441</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>8. Effects of Different Aging Methods on Color Change of Bulk-Fill and Anterior Resin Composites
Effects of Aging Methods on Color Change of Composites
Makbule Tugba Tuncdemir, Kubra T. Kahraman
Pages 442-447</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>9. Efficiency of Cleaning the Various Types of Dental Implants' Surfaces (Tiu-Nite, Sla, Rbm) Using the Air-Flow Erythritol Method
Furtsev T.V., Zeer G.M.
Pages 448-452</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>10. Effect of Eucalyptus and Chloroform on Mineral Content of Radicular Dentin: an in vitro Study
Nexhmije Ajeti, Violeta Vula, Miranda Stavileci, Merita Barani, Agran Halimi, Lindihana Emiri
Pages 453-458</p> | <p>EXPERIMENTAL ARTICLE</p> |

TABLE OF CONTENTS / 2020; 13 (2)

- EXPERIMENTAL ARTICLE
- 11. Time Consumptions by Four Polishing Methods for in Vitro Removals of Orthodontic Adhesive Remnants**
Kiatanan Sugsompian, Thosapol Piyapattamin
Pages 459-462
- EXPERIMENTAL ARTICLE
- 12. The Microarchitecture and Atomic Mineral Composition of the Rats' Mandibular Condyle Varying Masticatory Functional Loads**
Nur Masita Silviana, Sri Andarini, Diana Lyrawati, Mohammad Hidayat
Pages 463-468
- EXPERIMENTAL ARTICLE
- 13. Scanning Electron Microscopic Evaluation for the Ability of Endovac and EnoActivator in Cleaning Root Canal Space Using EDTA and QMix™**
Manal M. Abdelhafeez
Pages 469-474
- EXPERIMENTAL ARTICLE
- 14. Radioprotective Effect of Spirulina Platensis on Head and Neck Radiation-Induced Xerostomia**
Sarianoferni, Dian Mulawarmanti, Indeswati Diyatri, Eha Renwi Astuti, Soetjipto
Pages 475-479
- EXPERIMENTAL ARTICLE
- 15. In vitro Analysis of Minimal Inhibitory Concentrations of NaOCl, CHX, MTAD, and EDTA against Enterococcus faecalis**
Donika Bajrami, Miranda Stavileci, Agime Dragidella, Blerim Kamberi, Nora Aliu
Pages 480-485
- EXPERIMENTAL ARTICLE
- 16. Influence of Root Canal Preparation with Different Tapers on Apical Leakage**
Remy Barazy, George Eshoa
Pages 486-490
- EXPERIMENTAL ARTICLE
- 17. RT-qPCR Gene Expression Analysis on the Irf6 Intron Polymorphism in Oral Epithelium of Non-Syndromic Oral Cleft Risk of Deutero-Malay Sub-Race Indonesian**
Saskia L. Nasroen, Ani Melani Maskoen, Hardisiswo Soedjana, Dany Hilmanto
Pages 491-496
- EXPERIMENTAL ARTICLE
- 18. Anti-Inflammatory Effect of Okra (Abelmoschus esculentus) Fruit Extract during Wound Healing Process after Tooth Extraction of Diabetic Wistar Rat**
Muhammad Luthfi, Tuti Kusumaningsih, Agung Sosiawan, Hasna Shabrina
Pages 497-502
- EXPERIMENTAL ARTICLE
- 19. Expression of Non-Metastatic Protein-23 And Metastatic Associated Protein-1 as a Molecular Target Therapy of an Oral Malignant Burkitt's Lymphoma Induced by Oligonucleotide P27 Sense**
Supriatno, Ana Medawati, Sartari Entin Yuletnawati
Pages 503-507
- EXPERIMENTAL ARTICLE
- 20. Enhancement of Osteogenesis Using a Combination of Hydroxyapatite and Stem Cells from Exfoliated Deciduous Teeth**
Chiquita Prahasanti, Agung Krismariono, Rifiana Takanamita, I Komang Evan Wijaksana, Ketut Suardita, Tania Saskianti, Diah Savitri Ernawati
Pages 508-512

TABLE OF CONTENTS / 2020; 13 (2)

- EXPERIMENTAL ARTICLE**
- 21. Pulpitis Induced Carotid Atherosclerosis**
Nadie Fatimatuzzahro, Rendra Chriestedy, IDA Susilawati, Wulandari Fajrin
Pages 513-518
- EXPERIMENTAL ARTICLE**
- 22. Potency of Okra Fruit Extract (*Abelmoschus esculentus*) Against *Porphyromonas Gingivalis* as the Cause of Chronic Periodontitis**
Yuliati, Muhammad Luthfi, Priyawan Rachmadi, Bella Primordio Cida, Elvina Hasna Wijayanti
Pages 519-524
- EXPERIMENTAL ARTICLE**
- 23. Combination of Anadara Granosa Shell-*Stichopus Hermanni* Gel on Osteoblast-Osteoclast and Blood Vessels in Femur Healing**
Rima Parwati Sari, Isnainy Nurlaily, Rizky Putri Heryana, Wahyu Fatmawati, Meinur Nur Ashrin
Pages 525-532
- EXPERIMENTAL ARTICLE**
- 24. Enamel Remineralization Effect using Dewaxed Shellac Varnishes with Added Carbonate Apatite and Tricalcium Phosphate**
Arief Cahyanto, Dena Fadhilah Marwa, Kesya Saragih, Veni Takarini, Zulia Hasratiningsih
Pages 533-538
- EXPERIMENTAL ARTICLE**
- 25. The Inhibitory Effect of Kaffir Lime Extract towards *Staphylococcus Aureus* Bacteria**
Sartika Puspita, Ovin Lutfialifta P
Pages 539-542
- EXPERIMENTAL ARTICLE**
- 26. Effectivity of Insulin Leaf Extract (*Tithonia Diversivolia*) on Mice Malondialdehyde (MDA) Levels**
Tuti Kusumaningsih, Mohammed Aljunaid, Abdul Hafid Fauzi Barmen, Tantiana, Retno Palupi, Yuliati
Pages 543-546
- EXPERIMENTAL ARTICLE**
- 27. The Expressions of Some Growth Factors as the Progressive Indicators of Pulmonary Arterial Hypertension**
Mahrus A. Rahman, I Ketut Alit Utamayasa, Agus Sunandar
Pages 547-552
- EXPERIMENTAL ARTICLE**
- 28. Corticosteroid Effects and Administration Time Difference on Mice Model of Biliary Atresia**
Bagus Setyoboedi, Anang Endaryanto, Sjamsul Arief
Pages 553-560
- CLINICAL ARTICLE**
- 29. The Role of Prooxidant-Antioxidant System in the Development of Alveolitis after Teeth Extraction**
Hutor N.S., Pidruchna S.R., Melnyk N.A., Avdeev O.V., Boykiv A.B., Kovtun N.Ya., Skochylo O.V., Tverdokhlib N.O., Goncharuk-Khomyn M.Y.
Pages 561-565
- CLINICAL ARTICLE**
- 30. The Infraorbital Ethmoid (Haller's) Cells in a Group of Thai Patients: Panoramic Radiographic Study**
Chutamas Deepho, Sirilawan Tohnak, Ruchadaporn Kaomongkolgit, Ronnayut Chansamat, Weeraya Tantanapornkul
Pages 566-570

TABLE OF CONTENTS / 2020; 13 (2)

- CLINICAL ARTICLE**
- 31. Comparative Evaluation of Treatment Efficiency of Inflammatory Complications after Orthopedic Treatment with Up-To-Date Methods of Pharmacotherapy**
Yuliya A. Makedonova, Dmitriy V. Mikhilchenko, Alexandr V. Zhidovinov, Denis Yu. Dyachenko, Sergej A. Veremeenko
Pages 571-576
- CLINICAL ARTICLE**
- 32. Stress-Related Oral Manifestations Disorders in A Population Sample of Patients Attending Ajman University Dental Clinics**
Ebtesam Khalil, Nihal A.Ibrahim, Maher Al Shayeb, Syed Kuduruthullah, Mawada Hassan
Pages 577-586
- CLINICAL ARTICLE**
- 33. Prevalence and Periodontal Treatment Needs of Aggressive Periodontitis, in Students of Specific part of Iran**
Hossein Assarzadeh, Zahra Baghani, Rahil Mahmoodi
Pages 587-594
- CLINICAL ARTICLE**
- 34. Retrospective Study of the Prevalence of Type 2 Diabetes Mellitus and Severity of Periodontal Disease in Chronic Periodontitis Patients**
Waleed Ahmed Ismail, Siti Lailatul Akmar Zainuddin, Romaisa Arshad Khokhar, Haslina Taib, Basaruddin Ahmad, Azlina Ahmad
Pages 595-600
- CLINICAL ARTICLE**
- 35. Social and Clinical Risk Determinants of Oral Lichen Planus – a Case Control Study**
Jolanta Aleksejuniene, Arunas Rimkevicius, Alina Puriene, Ruta Rasteniene
Pages 601-607
- CLINICAL ARTICLE**
- 36. Relationship between the Nasopharyngeal Width and Hyoid Bone Position in Skeletal Malocclusion**
Hilda Fitria Lubis, Lydia Irani Nainggolan, Alfrina Marwan
Pages 608-613
- CLINICAL ARTICLE**
- 37. Relapse in Modified Vacuum-Formed and Hawley Retainers for Transverse Expansion A Multicenter Randomized Control Trial**
Lew Xian, Asma Ashari, Alizae Marny Fadzlin Syed Mohamed, Rohaya Megat Abdul Wahab, Elavarasi a/p Kuppusamy, Malathi Deva Tata, Yeoh Chiew Kit, Sindhu Sinnasamy
Pages 614-621
- CLINICAL ARTICLE**
- 38. Evaluation of Masticatory Efficiency among subjects with Removable Partial Dentures: A Comparative Study**
Linda J Dula, Kujtim Sh. Shala, Arlinda Tmava-Dragusha, Zana Lila-Krasniqi, Teuta Pustina-Krasniqi, Teuta Bicaj
Pages 622-627
- CLINICAL ARTICLE**
- 39. Depression, Anxiety and Stress Among Pharmacy Students in Malaysia**
Ali Sabri Radeef, Ghasak Ghazi Faisal
Pages 628-632

TABLE OF CONTENTS / 2020; 13 (2)

- CLINICAL ARTICLE**
- 40. Increased Hsp-72 Expression in Oral Mucormycosis after treatment with Hyperbaric Oxygen (HBO)**
Fanny Margaretha Laihah, I Ketut Sudiana, M. Guritno S, Sumarno, Sunarjo, Retno Indrawati, Theresia Indah Budhy, Herjunianto, Titut Harnanik, Noengki Prameswari, Arya Brahmanta, Eddy Hermanto
Pages 633-638
- CLINICAL ARTICLE**
- 41. Miswak (Salvadora Persica) As an Alternative Oral Aid to Reduce Denture Induce Stomatitis on Edentulous Patients**
Nusima Mohamed, Norlela Yacob, Wan Nor Syariza Wan Ali, Aida Ali, Nor Azlina Ismail, Nasadila Nadhira Nasser
Pages 639-645
- CLINICAL ARTICLE**
- 42. Diagnostic Value of Panoramic Radiography in Completely Edentulous Patients**
Amaweya Abdulrahman Al-Sammarraie, Ayyam Khalid Abdulkareem
Pages 646-650
- CLINICAL ARTICLE**
- 43. Electromyography Activity of the Chewing Muscles During Adaptation among Complete Denture Wearers**
Kujtim Sh. Shala, Linda J Dula, Venera Bimbashi
Pages 651-658
- CLINICAL ARTICLE**
- 44. Increasing Salivary Flow Rate and Salivary Ph after Consuming Secang Drink (Caesalpinia Sappan L.) Related to Body Mass Index**
Winy Yohana, Sri Tjahajawati, Irna Sufiawati, Intan Safitri Kartika, Muhammad Iqbal Izdaulfikri
Pages 659-662
- CLINICAL ARTICLE**
- 45. Serum nitric oxide levels in smokers with chronic periodontitis**
Hytham N Fageeh, Wael I Ibraheem, Abdullah A Meshni, Reghunathan S Preethanath
Pages 663-668
- CLINICAL ARTICLE**
- 46. The Relationship between Sex and Age on Dental Arch Change after Treatment with the Reverse Pull Face Mask Appliance of Class III Malocclusion: a Randomized Clinical Trial**
Osama Bahaa Albajalan, Nawres Oraibi Alazzawi, Nor Ashikeen Mukti, A. R. Samsudin
Pages 669-673
- CLINICAL ARTICLE**
- 47. Sports-Related Dental Injury from the Perspective of Malaysian Athletes**
Aiemeeza Rajali, Nik Rahayyu Nik Zulkifeli, Ahmad Safwan Mohd Elias, Nur Al Huda Mansur, Nik Haziman Wan Hamat, Syamsul Rizal Abu Amin
Pages 674-681
- CLINICAL ARTICLE**
- 48. Influence of Smoking upon the Ki67 Expressions in Asymptomatic Fully Impacted Lower Third Molar Follicles**
Mhd Amer Alassfar, Mumdouh Almohareb, Haytham Bahhah
Pages 682-688
- CLINICAL ARTICLE**
- 49. Teeth and Soft Tissue Injuries as Well as Wound Healing Quality Patterns Among Primary School Students of Prishtina Region**
Naim Haliti, Ragip Shabani, Shefqet Mrasori, Fatmir Dragidella, Hrvoje Juric, Nora Shabani Behrami, Dafina Doberdoli, Fehim Haliti
Pages 689-696

TABLE OF CONTENTS / 2020; 13 (2)

- | | |
|---|------------------|
| | CLINICAL ARTICLE |
| 50. The Practice, Perception, and Awareness of Self-Medication for Dental Pain in Malaysian Dental Students
Mahyunah Masud, Zaty Ainaa Mohamed, Nur Farhaanah Azman, Mohd Aizat Abdul Rahim
Pages 697-703 | |
| | CLINICAL ARTICLE |
| 51. The Comparison between Acetaminophen and Ibuprofen Effectiveness for Ductus Arteriosus Closure Therapy in Premature Infants
Mahrus A. Rahman, I Ketut Alit Utamayasa, Agus Cahyono
Pages 704-707 | |
| | CLINICAL ARTICLE |
| 52. Effectiveness of Treatment with Reverse Twin-Block and Reverse Pull Face Mask on Dental Arches of Class III Malocclusion: A Randomized Clinical Trial
Osama Bahaa Albajalan, Nawres Oraibi Alazzawi, Nor Ashikeen Mukti, A.R. Samsudin
Pages 708-713 | |
| | CLINICAL ARTICLE |
| 53. Characteristics of Dental Health, Dentomaxillar Growth and Body Mass Index in 3-6 years old Children in Yahya Kindergarten Bandung
Winnie Yohana, Rosiliwati Wihardja
Pages 714-718 | |
| | CASE REPORT |
| 54. Dilemma of Orthodontic Treatment in Fluorosed / Hypomineralised Enamel Teeth: A Case Report
Noor Ayuni Ahmad Shafiai, Alizae Marny Mohamed
Pages 719-726 | |
| | CASE REPORT |
| 55. Neutral Zone Impression Technique in Atrophic Mandibular Ridge using a Modified Design of Lower Base Plate
Ayman Al Oulabi, Zuryati Ab-Ghani, Noor Huda Ismail, Nafij Jamayet
Pages 727-730 | |
| | REVIEW |
| 56. The Advantage and Basic Approach of Infrared Thermography in Dentistry
Abdillah Imron Nasution, Mikhail Nikolaevich Pankov
Pages 731-737 | |
| | REVIEW |
| 57. Intrinsic Dental Erosion: Review of Dental Management
Mohammed Sulaiman Alrutha
Pages 738-744 | |
| | REVIEW |
| 58. Patient Satisfaction Measuring Instrument—A Scoping Review
Krisnawati Erry Tarman, Diah Ayu Maharani, Miesje K. Purwanegara
Pages 745-751 | |
| | REVIEW |
| 59. Recent Updates of the Oral Benefits of Mangosteen Plant Extracts: Review
Mohammed Aljunaid, Ninuk Hariyani, Retno Indrawati Roestamadji, Rini Devijanti Ridwan, Tuti Kusumaningsih, Huda Rashad Qaid
Pages 752-757 | |

TABLE OF CONTENTS / 2020; 13 (2)

MEDICINE

- | | |
|---|------------------------------------|
| <p>60. The Effect of the Neurotransmitter Dopamine, Lead Acetate, L-NAME, and Verapamil on the Metabolic Pathway in the Longitudinal Smooth Muscle
Rahman Ferizi, Nora Shabani, Ragip Shabani, Naim Haliti
Pages 758-768</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>61. In Vitro Assay of Cornea Artificial Properties
Prihartini Widiyanti, Reni Prastyani
Pages 769-773</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>62. Smoke Effects of Disturbances Folliculogenesis (Mda, Gnrh, Hsp70, Apoptosis, and Follicles) in Ovarian on Mice Balb / C
Eny Susanti, I Ketut Sudiana, Hendy Hendarto
Pages 774-777</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>63. Lung Dendritic Cells Express Higher Stress Proteins on Higher Allergen Dose Exposure and Contribute to Allergen Tolerance Induction
Gatot Soegiarto, Agustina Tri Endharti, Wibi Riawan, Anang Endaryanto, Subijanto Marto Sudarmo
Pages 778-784</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>64. The Increasing Inflammatory Cells, Degeneration and Duodenal Necrosis on Infant Mice from Carbofuran Exposed Mothers
E. Z. Yanti, H. A. Hermadi, P. S. Rejeki, Y. Dhamayanti, Widjiati, E. M. Luqman
Pages 785-790</p> | <p>EXPERIMENTAL ARTICLE</p> |
| <p>65. The Effect of Serum and Follicular Fluid Vitamin D on Intracytoplasmic Sperm Injection Outcome
Israa Majeed, Mohammad Oda Selman, Ban J. Qasim, Ghasak Ghazi faisal
Pages 791-795</p> | <p>CLINICAL ARTICLE</p> |
| <p>66. Predictors of Time Delay in Commencing Primary Coronary Intervention in STEMI Kosova Case-Pilot Study
Hajdin Çitaku, Ramë Miftari, Fatmir Ferati, Xhevdet Krasniqi
Pages 796-800</p> | <p>CLINICAL ARTICLE</p> |
| <p>67. Profile of Predictive Factors of Response to Therapy in Patients with Diffuse Large B-cell Lymphoma in dr Soetomo General Teaching Hospital Surabaya
Mochammad Dilliawan, Siprianus Ugroseno Yudho Bintoro, Putu Niken Ayu Amrita
Pages 801-807</p> | <p>CLINICAL ARTICLE</p> |
| <p>68. Evaluating the Treatment of Patients with Appendicitis, Perspectives on Challenges Professional Work
Kadir Hysein, Valon Morina, Zeqir Hashani, Qenan Maxhuni, Rahman Ferizi
Pages 808-815</p> | <p>CLINICAL ARTICLE</p> |
| <p>69. Comparison Study between Angio CT and USG Doppler for Early Detection of Arterial Stenosis of Lower Extremities in University Clinical Center of Kosovo
Lavdim H. Ymeri, Vjosa A.Zejnullahu, Serbeze Kabashi Muqaj, Muharrem Sadiku, Valon A.Zejnullahu
Pages 816-823</p> | <p>CLINICAL ARTICLE</p> |

70. Curcumin as Adjuvant Therapy in COVID-19: Friend or Foe?

Jeanne Adiwinata Pawitan

Pages 824-829



Pulpitis Induced Carotid Atherosclerosis

Nadie Fatimatuzzahro¹, Rendra Chriestedy^{1*}, IDA Susilawati¹, Wulandari Fajrin¹

1. Department of Biomedical Science Faculty of Dentistry University of Jember, Jember, Indonesia.

Abstract

Atherosclerosis on head or neck artery is the primary cause of ischemic stroke which is the leading cause of death at any age in Indonesia. In the last few years, chronic inflammatory due to bacteria, such as pulpitis, has been known to play an important role in the onset of atherosclerotic pathogenesis. Pulpitis causes bacteremia which affects systemic inflammation. This condition may lead to endothelial cells defunct, elevated oxidation, and lipid deposition which increases the risk of atherosclerosis.

This research aimed to identify the formation of carotid atherosclerotic lesions in pulpitis rat models.

Ten rat samples are divided into 2 groups: a control group (K) without treatment and a pulpitis group (PU). The pulpitis group was established by inducing pulp perforation to the occlusal surface of mandibular first molar teeth. The pulp cavity was then induced with 0.05 ml (0.5 McF) of *Streptococcus mutans*, 3 times a week for 4 weeks. On the 29th day, rats were sacrificed, their carotid arteries were extracted and cross-sectionally cut. Histological preparations were performed and colored by Picrosirius Red and Sudan IV. Histomorphometric analysis began with morphological observation of carotid artery wall thickness, then statistically tested using Independent T-test. Histomorphology analysis began with endothelial disintegration, lipid deposition and atheroma, then statistically tested using Mann-Whitney method.

The arterial walls of pulpitis group were significantly thicker $102,85 \pm 3,37 \mu\text{m}$ than those of control group ($p < 0.05$). There is no significant difference in endothelial disintegration in each group.

The presence of lipid deposition and atheroma are seen at all samples in pulpitis group (100%). Pulpitis increases the risk of carotid atherosclerosis.

Experimental article (J Int Dent Med Res 2020; 13(2): 513-518)

Keywords: Carotid Atherosclerosis, Pulpitis, S. Mutans.

Received date: 06 January 2020

Accept date: 25 February 2020

Introduction

Carotid Atherosclerosis is the major cause of ischemic stroke.¹ Stroke, as one of non-contagious diseases, is the third leading cause of death in industrial countries after heart disease and cancer.² Atherosclerosis is the hardening and thickening of arterial walls that occurs due to the deposition of fat, complex carbohydrates, blood products, connective tissue and calcium. It is preceded by endothelial injury. Atherosclerosis is characterized by the protrusion of the local blood vessels intima called atheroma plaque.³

In the last few years, many studies proved the role of inflammation which is believed to be an important stimuli to cause atherosclerosis. Observational studies have shown that higher risk of atherosclerosis occurs in patients with pulp infection.⁴ *Streptococcus mutans* are the major cause of bacterial caries which, if not treated, can destroy enamel and dentine; they will eventually reach the pulp and cause pulp infection. Pulpitis causes bacteremia which affects systemic inflammation.^{5,6,7}

Numerous studies have demonstrated the existence of genomic DNA of some types of oral bacteria. *Streptococcus mutans* bacteria was found in atheroma plaque when analyzed using *Polymerase Chain Reaction* (PCR) through sequencing and alignment of the nucleotide (DNA). From the 27 atheroma plaques specimens analyzed using PCR methods, the detectable *S. mutans* was 74% whereas other

*Corresponding author:

Nadie Fatimatuzzahro,
Department of Biomedical Science Faculty of Dentistry
University of Jember,
Jember, Indonesia
E-mail: nadie.fkg@unej.ac.id

bacterial species, including those related to the cause of periodontitis, was detected with a much lower frequency of occurrence.⁸ Earlier report showed that *S. mutants* were detected with high prevalence in the atheroma plaque: 22.5% in younger patients (aged up to 27 years) and 44.4% in older patients (aged up to 67 years).⁹

Carotid artery bifurcation is susceptible to atherosclerosis. The blood flow located near the center of the carotid artery is turbulent and slow. The arterial wall receiving lower blood pressure (<4dyn / cm²) has been proven to be easily induced by endothelial injury due to increased intracellular permeability and prolonged existence of blood atherogenic particles in the area.¹⁰

Although it has been known that pulpitis is related to atherosclerosis, the causal relationship between pulpitis and atherosclerosis occurring in carotid arteries has not been widely studied. This prompted the authors to perform an experimental research to identify atherosclerotic lesions in carotid arteries pulpitis rat models.

Materials and methods

Ten healthy male Wistar rats aged 3-4 months were divided into 2 groups: control group (K) and the pulpitis group (PU) with 5 samples in each group.¹¹ Pulpitis rats were prepared by first administering them with anesthesia (IM) ketamine (KTM 1000) dose of 1 ml / KgBW.¹² Cavity was prepared by perforating the occlusal surface of mandibular first molar teeth. The resulting pulp cavity was then induced with 0.05 mL (0.5 McF) of *Streptococcus mutants*, 3 times a week for 4 weeks. The protocol applied to this animal experiment has been approved by the ethics committee of the Faculty of Medicine, Universitas Jember No. 771/H.25.1.11/KE/2016.

Histologic Sample Preparation On day 29, the rats were sacrificed. Surgery was performed on the neck to extract the carotid arteries. The arteries were then fixated by using the mixture solution of PBS and formalin 10% (9:1). The incision was performed using *Frozen Section* method producing 10 µm of thickness, stained with *Picrosirius Red* and *Sudan IV* and *counter Mayer's Hematoxilin*.¹³ Rats' lower jaws including the perforated teeth were removed to observe the signs of pulpitis.

Atherosclerosis Parameter The specimens were observed for atherosclerotic

lesions morphology, which consisted of the thickness of the arterial wall, the disintegration of the endothelium, lipid deposition and atheroma. Carotid artery wall thickness (µm) was measured from the intima to media on the histological specimens which had been painted with *Picrosirius Red*, under microscope with a 400x magnification. The analysis of atheroma was carried out by observing the same specimens with a magnification of 400x. Atheroma was characterized by the bulging of the inner the blood vessel wall (the intima).

The analysis of lipid deposition was performed using a light microscope with 1000x magnification. The carotid artery where lipid deposition occurred was marked by red color on the medial layer of subendothelial or on the endothelial specimens painted with *Sudan*. Endothelial disintegration was examined in the same specimens that have been painted with *Sudan* using *counter stain Mayer's Hematoxilin* which revealed the nucleus of endothelial cells, visible as purple-colored. Observations were performed using a light microscope with a magnification of 1000x. Endothelial disintegration was characterized by discontinuities or peeling-off of carotid artery endothelial cells (denudation).

Data Analysis Quantitative data from the arterial wall thickness measurements were tested for normality using Kolmogorov-Smirnov test, for homogeneity using Levene test and then analyzed with T-test. Disintegration of endothelial morphology, lipid deposition and atheroma were analyzed with *Mann-Whitney U* test.¹⁴

Results

The results showed the occurrence of pulpitis on the mandibular first molars in animals which had undergone pulp perforation and *Streptococcus mutants* injection. Pulpitis is characterized by the occurrence of deep cavities which led to pulp perforation. Inflammatory cells were also found in the pulp cavity which outnumbered those in the control group (Figure 1).

Clinical observation shows that *miller* needle can penetrate the cavity with a depth of ± 2mm. Radiology imaging results support this clinical conditions, revealing that *miller* needle penetrates down to the pulp chamber of the tooth (Figure 2).

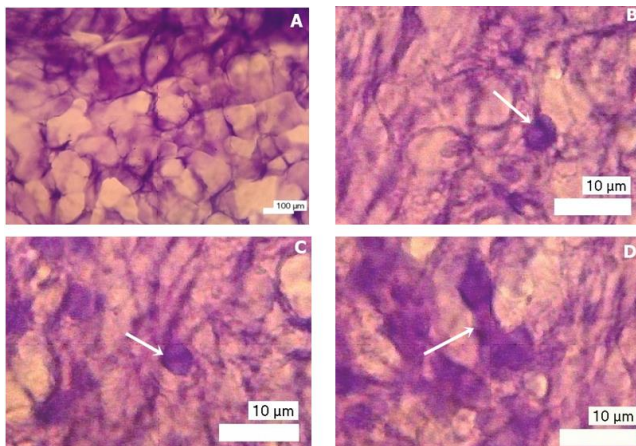


Figure 1. An overview of microscopic pulp chamber, with 1000X magnification. There were no inflammatory cells in control group (A). In pulpitis group, inflammatory cells (arrows) were found as PMN (B), lymphocytes (C), and macrophages (D).

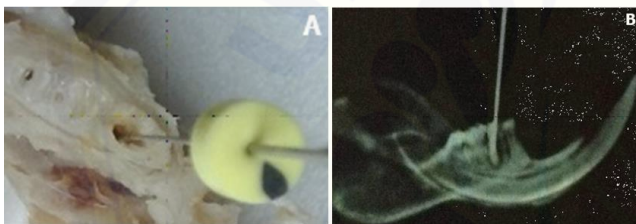


Figure 2. A. The clinical features of the lower left jaw cavity of pulpitis group. **B.** Radiology of the lower left jaw cavity of pulpitis group. There were deep cavities perforating the pulp as indicated by the entry of the *miller* needle.

Atherosclerosis Symptoms	Percentage (%)		Sig. (p)
	Control (n = 5)	Pulpitis (n = 5)	
Disintegration endothelial	100	100	1,000
lipid deposition	0	100	0,008*
Atheroma	0	100	0,008*

Table 1. Results of Mann -Whitney histomorfometric carotid atherosclerotic lesions.

Description:

n : the number of samples in one group

* : significant difference (p <0.05)

The signs of atherosclerotic lesions histomorphology in the carotid artery of the pulpitis group are more prevalent than those of the control group. The observed signs of atherosclerotic lesions consisted of disintegration of the endothelium, lipid deposition and atheroma.

Mann-Whitney test analysis (Table 1) showed that lipid deposition and atheroma differed significantly (p <0.05) between pulpitis and control groups. There was no significant difference in the endothelial disintegration (p > 0.05) between the groups.

Identification results of endothelial disintegration showed that the formation of endothelial disintegration occurred on all samples (100%) in both control and pulpitis groups. It is characterized by discontinuities or the peeling off of carotid artery endothelial cells (denudation) (Figure 3).

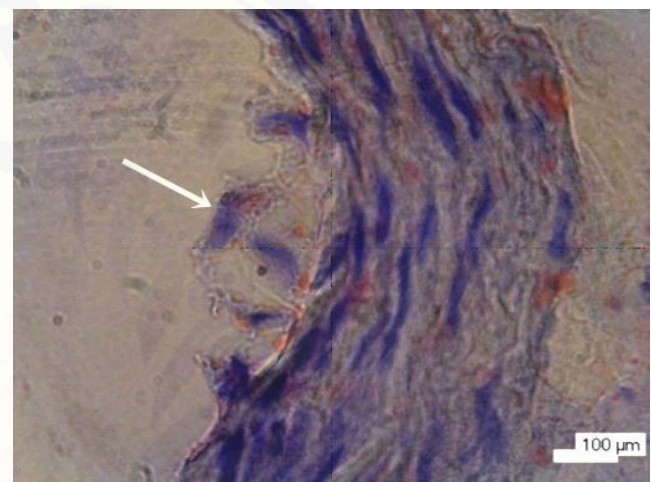


Figure 3. Endothelium Disintegration, with Sudan staining (1000X magnification). Endothelium disintegration (arrows) in the form of discontinuities and endothelial cells detachment from the walls of the carotid arteries.

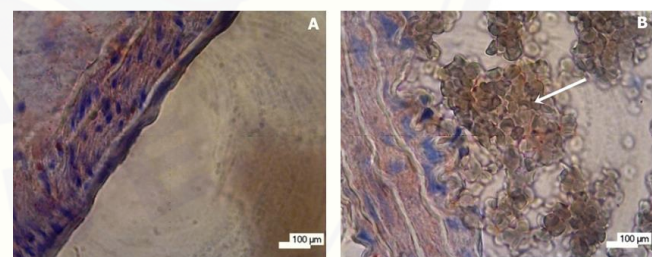


Figure 4. Lipid Deposition, with *sudan* staining (1000X magnification). No lipid deposition in the control group (A). Lipid deposition (arrow) in the sub-endothelial layer in pulpitis group (B).

The observation of lipid deposition showed that the formation of lipid deposition occurred in all samples (100%) in the pulpitis group, however it was not found in the control group (0%). Lipid deposition with *sudan staining* is characterized by reddish color around the layer of the intima (Figure 4).

With *Picrosirius Red* staining, atheroma formation was found in the whole sample of pulpitis group (100%), while none was found (0%) in the control group. Atheroma is characterized by artery wall (the intima) bulging toward the luminal (Figure 5).

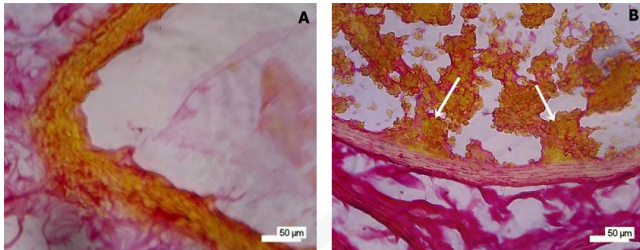


Figure 5. Atheroma, with *Picrosirius Red* staining (400X magnification). (A) Control group, the arterial wall appears regular, with no evidence of atheroma. (B) Pulpitis group, evidence of atheroma (arrows) as characterized by the protrusion of the wall toward the lumen and the irregular features of the wall.

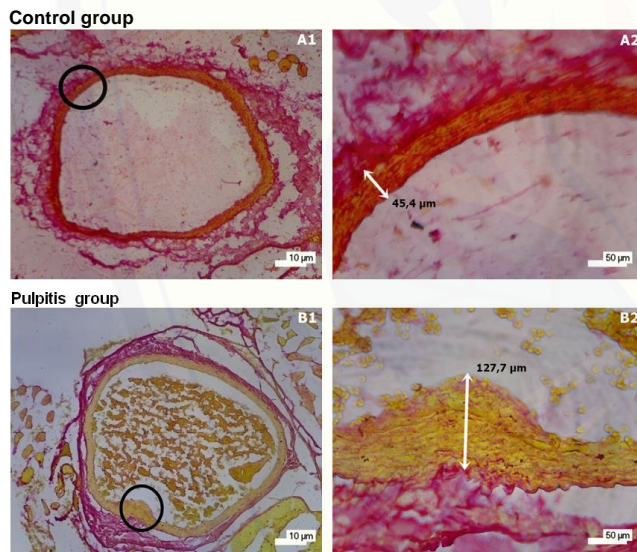


Figure 6. Wall thickness of Carotid Artery, with *Picrosirius Red* staining (100X and 400X magnification, respectively). The control group, no thickening of the arterial walls (A2) and regular shape of the walls (A1). Pulpitis group, thickened arterial walls (B2) and irregular walls (B1).

The measurements of the carotid artery wall thickness showed that the average thickness of carotid artery wall in pulpitis rat model was thicker than of the control group. (Figure 6). The test for normality and homogeneity yielded normal and homogeneous data ($p > 0.05$).

Independent-T test (Table 2) showed that the wall of the carotid artery in pulpitis groups were significantly thicker ($p < 0.05$) than the control group. The average thickness in the control group was $67.67 \pm 9.26 \mu\text{m}$, whereas $102.85 \pm 3.37 \mu\text{m}$ in pulpitis group.

Group	N	Wall Thickness X ± SD (μm)
Control	4	67.67 ± 9.26
Pulpitis	4	102.85 ± 3.37
T test Sig. (p)		0,000 *

Table 2. Test results: *Independent-T* carotid artery wall thickness (intima-media).

Description:
 n: number of specimens
 X: Average
 SD: standard deviation
 *: significant difference ($p < 0.05$)

Based on the histological features (Figure 6), carotid artery wall thickening and asymmetric / irregular luminal surface of the artery wall were found in pulpitis group, whereas the luminal wall surface of the control group appeared flat and without thickening. The thickening of the walls in the pulpitis group occurs in the layer of elastin fiber, which appeared yellow due to *Picrosirius Red* staining.

Discussion

The results showed that the carotid atherosclerotic lesions are significantly higher in the pulpitis group than those in the control group. They were analyzed by observing the symptoms of carotid atherosclerotic lesions which included histomorphometric in the form of arterial wall thickening and histomorphology in the form of disintegrating endothelium, lipid deposition, and atheroma. These results are supported by observational study which showed that patients with pulpitis had greater risk of atherosclerosis.⁴ *Streptococcus mutans*, the main bacteria that causes caries, are found in the atheroma plaques of blood vessel wall.^{8,18}

The spread of dental pulp infection to the blood circulation may occur immediately by the penetration through blood vessels contained within the pulp. *Metastatic infection*, the spread of bacteria to the blood circulation, occurred - hence causing bacteremia. *Metastatic inflammation*

associated with *host* immune system also occurred. The latter is when the antigen in the dental pulp spreads to the blood circulation and reacts with antibodies to form immune complexes that will trigger acute and chronic inflammatory reactions. This event is marked by phagocytes response, especially neutrophils that will become phagocyte which then destroy either the bacterial antigens or the whole bacteria. The bacteria destruction mechanism by neutrophils is performed by producing prooxidative toxic materials such as *Reactive Oxygen Species* (ROS) in the forms of oxidants and enzymes.^{15,16,17,19} *Streptococcus mutans* has a protein antigen c (PAC) associated with systemic virulence of the blood flow. The PAC level of phagocytosis by *polymorphonuclear* leukocytes is low, causing an imbalance in the amount of ROS produced by neutrophils with anti-oxidants in the body. This is called oxidative stress.⁸

The observations of carotid atherosclerotic lesions histomorphologic revealed that there was endothelial disintegration in all samples of carotid artery of both control and pulpitis groups as indicated by the endothelial denudation. In the pulpitis group, the chronic pulp infection by the *S. mutans* bacterium can indirectly stimulate a systemic inflammatory response causing oxidative stress. Oxidative stress may lead to decreased bioavailability of nitric oxide (NO), resulting in endothelial dysfunction by ways of peroxynitrite (ONOO) formation and NO synthesis pathway inhibition. The decreased levels of NO causes the endothelium to be more proatherogenic and proinflammatory thus it is prone to endothelial disintegration.^{20,21,22}

In this study, all samples in the control group also indicated endothelial disintegration. The underlying factor causing endothelial disintegration is thought to be carotid artery anatomical factors. According to *response to injury* hypothesis, blood flow can cause endothelial denudation in a certain region.²³

In this study, a part of the bifurcation of the carotid artery is used. In that particular region, there was a peculiar change to the typical blood flow: decreasing *shear stress* and increasing turbulence. The changes in blood flow will increase the gene expression of endothelial cells (*ICAM-1 gene*, *PDGF* and tissue factor) when there is a decrease in *shear stress*.²⁴

The area with low *shear force* (<4dyn / cm²) may induce endothelial injury. Another

suspected factor which could affect endothelial disintegration is age, specifically those mice in age group of 3-4 months. Disintegration of the endothelial walls of arteries begins early in life. Many of those factors affecting the initial lesion will progress to pathological or even just as symptomatic lesions, depending on individual hemostasis, metabolic, environmental, and genetic risk. Nevertheless, the main factor of the vulnerability of the atherosclerotic plaque formation is inflammation. In the control group, the lesions do not progress to more advanced atherosclerotic lesions because there is no inflammatory responses.¹⁰

The observation of lipid deposition showed that its formation was found in all pulpitis group samples but not in the control group. Oxidative stress occurring in the pulpitis group also causes blood vessels to become more permeable. Low-density lipoprotein (LDL) gains easier entry into blood vessel's autonomous muscles. The state of oxidative stress causes LDL to easily oxidize into LDL-ox. This LDL-ox will then be recognized by the *macrophage receptor Scavenge* that do not experience *down-regulation*. This leads to macropinositosis-the macrophages which constantly fagocytes LDL-ox which then form foam cells. These foam cells are those forming lipid deposition subendothelial.^{25,26,27}

In the research, atheroma formation was discovered and there was thickening of the carotid artery walls in the whole pulpitis sample group (100%). Those were not the cases in the control group. The state of pulpitis in the continuously treated group causes sustained inflammation. The situation then becomes increasingly chronic resulting in cytokines release and growth factor.²⁸

These outcomes can stimulate the proliferation and the migration of autonomous cells from the tunica media to the intima. The thickening of the arterial wall occurs when autonomous muscle cells migrate to the intima. The development of lesions which leads to the change of autonomous muscle cells function causes the formation of *fibrous cap*. When the *fibrous cap* is formed, the lesion is called atheroma. It then allows the protrusion of the arterial lumen causing the reduction of the lumen's diameter.¹⁰

Conclusions

Pulpitis increases the risk of formation of carotid atherosclerotic lesions which is characterized by the thickening of the carotid artery wall, the disintegration of the endothelium, lipid deposition and atheroma. Further research is needed to measure the degree of systemic inflammation, the degree of bacteremia and circulation antigen.

Acknowledgments

The author would like thank to Fundamental grant research from Ministry Research and higher education for all support.

Declaration of Interest

The author declare that there is no conflict of interest regarding the publication of this article.

References

- Sultana, Bari FA, Majumder KT *et al.* Duplex Study of Carotid Artery in Patients with Ischemia Stroke. *Bangladesh Journal of Neuroscience* 2012;28(20):67-73.
- World Health Organization. The Top 10 Leading Causes of Death in the World, 2000 and 2012. World Health Organization 2013.
- Themistocleus IC, Stefanakis M, Douda H. Coronary Heart Disease Part I : Pathophysiology and Risk Factor. *Journal of Physical Activity, Nutrition and Rehabilitation* 2017:167-74.
- Glodny, B. The occurrence of dental caries is associated with atherosclerosis. *Clinic* 2013;68(7):946-53.
- Sari INL, Fauziah E, Budiardjo BS *et al.* Antibacterial and Antifungal Effectiveness of Virgin Coconut Oil (VCO) Mousse Against *Streptococcus Mutans* and *Candida Albicans* Biofilms. *Journal of International Dental and Medical Research* 2013;12(3): 917-22.
- Sasaki H, Hirai K, Martins MC, Furusho H, Battaglini R, Hashimoto K. Interrelationship Between Periapical Lesion and Systemic Metabolic Disorders. *Curr Pham Des* 2016;22(15): 2204-15.
- Rezzani R, Favero G, Buffoli B, Rodella FL. *Atherosclerosis and Periodontal Disease*. SM G Books 2016.
- Nakano K, Inaba H, Nomura R, Nemoto H, Takeda M, Yoshioko H. Detection of cariogenic *Streptococcus mutans* in extirpated heart valve and atheromatous plaque specimens. *J Clin Microbiol* 2008;44:3313-17.
- Kozarov E, Sweier D, Shelburne C, Progulske Fox A, Lopatin D. Detection of bacterial DNA in atheromatous plaques by quantitative PCR. *Microbes Infect* 2006;8:687-93.
- Nicoalides A, Beach KW, Kyriacou E, Pattichis CS. *Ultrasound and Carotid Bifurcation Atherosclerosis*. Springer-Verlag London 2012;18:27-39.
- Indrayan A, Malhotra K R. *Medical Biostatistics* 7th edition. Canada : Chapman & Hall/CRC Press 2017.
- Raden, A. Effect Of Pegagan (*Centella Asiatica*) Extract in Ovariectomized Wistar-strain *Rattus norvegicus* On Epithelial Proliferation Of Vaginal Wall. *Media Veterinaria Medika* 2011;4(1):71-6.
- Mishra S, Gupta M, Bharat V, Bansal R. Qualitative Comparative Study of Frozen Section with Routine Histological Technique. *National Journal of Laboratory Medicine* 2016;5(2): 1-7.
- Notoatmodjo, S. *Metodologi Penelitian Kesehatan*. 7th Ed. Jakarta: Rineka Cipta.2014: 12-27.
- Abbas AK, Lichtman AH. *Cellular and Molecular Immunology*. Saunder, USA. 2015:345-55.
- Zhou J, Ma W, Wang X *et al.* Matrine Suppresses Reactive Oxygen Species (ROS)-Mediated MKKs/p38-Induced Inflammation in Oxidized Low-Density Lipoprotein (ox-LDL)-Stimulated Macrophages. *Med Sci Monit* 2019;25:4130-36.
- Masthan M K, Anitha N, Jacobina JJ, Babu A N. Oral Infections Causing Systemic Diseases. *Biomedical & Pharmacology Journal* 2016;9(2):863-66.
- Nahak MM, Tedjasulaksana R, Raiyanti AGI. Effectiveness of Using Toothpaste and Mouthwash of Beluntas Leaf Ethanol Extract in Reducing *Streptococcus mutans* Bacteria Number in Tooth Plaque. *Journal of International Dental and Medical Research* 2018;11(3):830-33.
- Jepsen S, Caton JG, Albandar JM *et al.* Periodontal manifestations of systemic diseases and developmental and acquired conditions: Consensus report of workgroup 3 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *J. of Clinical Periodontology* 2018; 45 (Suppl 20):219–29.
- Favero G, Paganelli C, Buffoli B, Rodella RF, Rezzani R. Endothelium and Its Alterations in Cardiovascular Diseases: Life Style Intervention. *Biomed Res Int Hindawi Publishing Corporation* 2014:1-28.
- Forstermann U, Xia N, Li H. Roles of Vasculer Oxidative Stress and Nitric Oxide in the Pathogenesis of Atherosclerosis. *Circ Res* 2017;120(4):713-35.
- Okumura K, Cheng WX. Endothelial function for the evaluation of anti atherosclerosis drugs. *Hypertension Research* 2010; 33:780–81.
- Daiber A, Steven S, Weber A *et al.* Targeting Vascular (Endothelial) dysfunction. *British Journal of Pharmacology* 2017;174:1591-1619.
- Bayturan O, Tuzcu EM, Lavoie A *et al.* The Metabolic Syndrome, its component Risk Factors, and Progression of Coronary Atherosclerosis. *Arch Intern Med*.2010;170(5):478-84.
- Wu Y M, Li C J, Hou F M, Chu Y P. New Insights into the Role of Inflammation in the Pathogenesis of Atherosclerosis. *Int J Mol Sci* 2017;18(10):1-18.
- Samson S, Mundkur L, Kakkar VV. Immune Response to Lipoproteins in Atherosclerosis. *Hindawi* 2012;12.
- Malekmohammad K, Sewell DER, Kopaei RM. Antioxidants and Atherosclerosis: Mechanistic Aspects. *Biomolecules* 2019;9(8)301-6.
- Koyama T, Watanabe H, Ito, H. The Association of Circulating Inflammatory and Oxidative Stress Biomarker Levels with Diagonal Earlobe Crease in Patients with Atherosclerotic Diseases. *Journal of Cardiology*. 2016;67:347-51.