Full Length Research Article
Advancements in Life Sciences – International Quarterly Journal of Biological Sciences

ARTICLE INFO

Date Received: 18/06/2023;
Date Revised: 30/07/2023;
Date Published Online: 20/10/2023;

Authors' Affiliation:
Department of Human Anatomy- Medical College / Al-Nahrain University - Iraq

***Corresponding Author:**
Firas Riyadh Muhammad
Email:
firasriad@gmail.com

How to Cite:
Muhammad FR (2023). Histological study of the parenchymatous cells in mice parotid salivary glands exposed to dental radiograph. Adv. Life Sci. 10S(1): 15-18.

Keywords:
Dental X-rays; Parotid salivary gland; Inflammatory destruction

Open Access

Histological study of the parenchymatous cells in mice parotid salivary glands exposed to dental radiograph

Firas Riyadh Muhammad

Abstract

Background: Ionizing radiation has been linked to an increased incidence of salivary gland cancers and xerostomia. Saliva has antibacterial and enzymatic properties, and the parotid glands are made up of serous acini. Myoepithelial cells are essential for acinar salivary secretion.

Methods: This research investigated the potential risks associated with dental X-rays and provided evidence-based recommendations for safe use. It was found that exposure to radiation causes a decline in hemoglobin binding to the erythrocyte membrane.

Results: Dental X-ray exposure causes acute inflammatory destruction, and alterations do not fully restore the parotid tissue histology.

Conclusion: Even low doses of radiation from dental X-rays can increase the risk of developing cancer and other health problems, and further studies are needed to mitigate these effects and improve patient outcomes.

Introduction

Ionizing radiation (IR) has been linked to an increased incidence of salivary gland cancers and xerostomia. Calponin is a regulatory protein that is highly expressed in malignant salivary gland tumors [1]. Saliva has a protective effect on the teeth and gums, and contains components that interact with bacteria and are responsible for determining the oral microbiota [2]. The parotid glands of humans are the largest main glands and begin to form during gestation. Stensen's duct is the primary excretory duct, and the glands are made up of serous acini responsible for producing aqueous saliva [3]. Secretory end pieces are composed of 8-12 serous cells surrounding a central lumen, with intercellular canaliculi and nuclei located at the bottom [4].

Mucous cells have a tubular form and a circular lumen, and secretions reach the end piece via intercellular canaliculi. The nucleus and endoplasmic reticulum are compressed against the basal cell membrane, and the Golgi complex is massive at the cell's base [5]. Acinar cells make up the terminal parts of the salivary gland and emit a complex fluid called saliva, which has antibacterial and enzymatic properties [6]. Myoepithelial cells are essential for acinar salivary secretion and have dual epithelial and contractile capabilities [7]. Intercalated ducts are the first to receive primary saliva while still hypotonic. Simple cuboidal epithelium cells produce this duct, which is partly covered by salivary-flowing contractile myoepithelial cells. It contains pluripotent and stem cells that can differentiate into acinar, myoepithelial, and ductal cells. Beta-1 integrin positive cells may represent progenitor cells in salivary gland morphogenesis [8].

The granular convoluted tubule (GCT) is a portion of the duct system present in all rodents and has the unique ability to synthesize a wide array of physiologically active polypeptides [9]. Hormonal regulation of GCT cells is well established in the mouse submandibular salivary gland. Myoepithelial cells are essential for acinar salivary secretion and have dual epithelial and contractile capabilities [10]. The current study aimed to investigate the radiographical effect of dental X-ray on the parenchymatous cells of the parotid salivary glands in mice model.

Methods

This study divided 75 adults male Wistar mice. aged 8-10 weeks aged, 20-22 grams weight, The environment in the cages was kept at temperature of 25 ± 2°C, humidity 55-60%, with a 12:12 h light/dark cycle, and the animals were fed standard pellets and fresh water. All animals were divided into three groups, 25 mice on each group: control group (15 mice), experimental group (EX1, EX2), and control group (EX15). Each group was exposed to dental x-ray at the ventral head region in different intervals. The animal was held in a fixed position and exposed to dental x-ray, with the EX1 group exposed to 4 times in the same session and the EX2 group exposed to 4 times in 4 sessions. The animals were scarified, decapitated, and inverted T shape incisions were made to expose salivary glands and obtain sample collection [11].

Tissue samples were kept in 10% Na2HPO4 (6gm) neutral buffered formalin PH: 7.H2O, Formalin, and Distilled Water. Infiltrated, paraffin-embedded tissues.5m-thick microtome sagittal sections. Section ribbons were collected on clean glass slides from 40°C hot water. Histology employed hematoxylin and eosin. The eosin counterstains show cell types and histology. Staining requires dewaxing, rehydrating, washing, staining, dehydrating, and mounting. Light microscopes examined frontal cortical histology [12].

Slide baking, deparaffinization, rehydration, hydrogen peroxide block, protein block, primary antibody, secondary antibody reagent, and streptavidine-HRP antibodies were performed overnight in a hot air oven at 60°C [13].

Results

The parotid gland is covered by a connective tissue capsule that sends fibrous septa into the interior. The lobules are made by serous acini that are drained by a system of ducts. Acinar cells are polyhedral and have a spherical nucleus with a granular cytoplasm. (Figure 1). The parotid tissue of the EX1A group showed irregular borders, wider spaces between the lobules, and congested blood vessels. The parotid acinar cells maintained their shape, but foamy cytoplasm appeared in some. The ducts in the EX1A group did not show any changes from the control group (figure 2). While other section illustrated that the parotid gland in EX1B group showing striated duct distortion and preductal edema, and intercalated duct (figure 3). Also, the section of parotid gland in EX2B group showing acinar vacuolations and peri-striated duct congestion (figure 4).

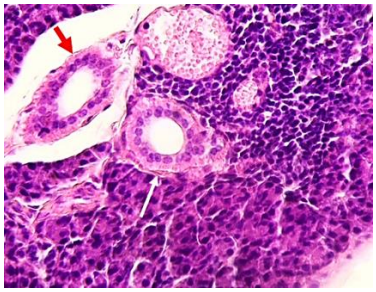

Figure 1: Histological section of parotid gland in control group showing the striated duct (white arrow) and interlobular duct (red arrow). H&E, X40.

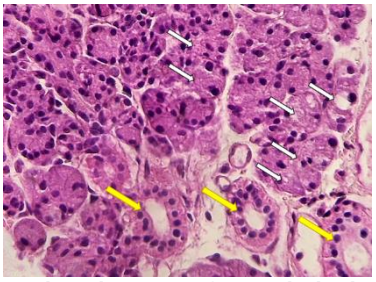

Figure 2: Histological section of parotid gland EX1A group showing striated duct (yellow arrows), foamy cytoplasm in acinar cells (white arrows) H&E, 40X.

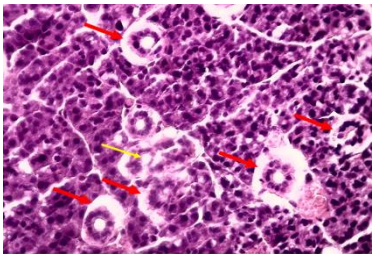

Figure 3: Section of parotid gland in EX1B group showing striated duct distortion and preductal edema (red arrows), intercalated duct yellow arrow), H&E, 40X.

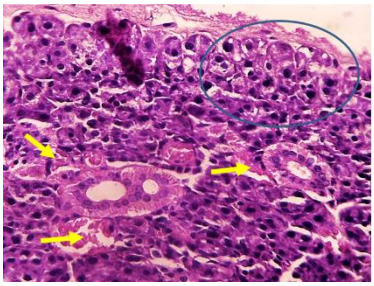

Figure 4: Section of parotid gland in EX2B group showing acinar vacuolations (blue circle), and peri-striated duct congestion (yellow arrows) H&E, X40.

Discussion

This research investigated the potential risks associated with dental X-rays and provided evidence-based recommendations for safe use. It found that exposure to radiation causes retardation in the incorporation of iron and a decline in hemoglobin binding to the erythrocyte membrane. We agree with [14]. The whole gland showed atrophic changes, shrinkage, derangement in secretory acini and capsular edema, with pyknosis and foamy cytoplasm of the acinar cell, we agree with [15]. The parotid acinar cells showed vacuolated cytoplasm, acinar atrophy, nuclear pyknosis, and striated ducts associated with peri-ductal congestion, this outcomes came in contact with the previous study mentioned by [16].

In addition, the histological sections of the acini of parotid glands exposed to one day successive doses of dental X-ray (group EX1A) showed early distorted histological criteria compared to the control group, agree with [17]. Most of the acini showed considerable early deterioration of the normal histological criteria upon exposure to the interrupted daily doses of dental radiation (group EX2A), agree with [18]. The late post-radiation histological changes found in the parotid acinar tissues during this experimental study were exaggerated, suggesting that dental X-ray exposure is associated with acute inflammatory destructive consequences, agree with [19]. The curative changes did not completely restore the normal histological pattern of the parotid tissues of group EX1B associated with multiple one-day radiation exposure, agree with [20].

This study suggested that the myoepithelial cells predicted were significantly decreased when comparing the experimental serous parotid and submandibular tissues of the EX1A and EX2A groups with that of the control group. These findings suggest that radiation therapy has a significant impact on the salivary glands, particularly on the myoepithelial cells. Further research is needed to explore potential interventions to mitigate these effects and improve patient outcomes.

This research investigated the potential risks associated with dental X-rays and provided evidence-based recommendations for safe use. It is important for dental professionals to weigh the benefits and risks before using diagnostic dental X-rays on their patients. Even low doses of radiation from dental X-rays can increase the risk of developing cancer and other health problems. Dental X-ray exposure causes acute inflammatory destruction, and alterations did not fully restore the group's parotid tissue histology.

Author Contributions

All author equally contributed in this study.

Competing Interest

The authors declare that there is no conflict of interest.

References

1. Chibly AM, Aure MH, Patel VN, Hoffman MPJPR. Salivary gland function, development, and regeneration. Physiological Reviews, (2022); 102(3): 1495-1552.
2. Chattopadhyay I, Verma M, Panda MJTicr, treatment. Role of oral microbiome signatures in diagnosis and prognosis of oral cancer. Technology in cancer research & treatment, (2019); 1815330338198673 54.
3. Gardner A (2020) The Influence of Salivary Metabolite Composition on Taste and Oral Perception: King's College London.
4. AL-Hashemi WH, Mansur ME, Homady MHJBCA. Intracomparative And Immunocytochemistry Study Of Parotid, Submandibular And Sublingual Gland In Domestic Rabbit Of Iraq. Biochemical & Cellular Archives, (2019); 19(1): 1069-1090.
5. Kanitakis JJEjod. Anatomy, histology and immunohistochemistry of normal human skin. European journal of dermatology, (2002); 12(4): 390-401.
6. Contreras-Aguilar MD, Gómez-García FJSiH, Present DT, Diagnosis FoaUSf. Salivary glands' anatomy and physiology.

Saliva in Health and Disease: The Present and Future of a Unique Sample for Diagnosis, (2020); 3-21.
7. Maldonado JO, Pérez Riveros P, Chiorini JA (2021). Myoepithelial Cell Function in Salivary Gland Physiology and Disease. Sjögren's Syndrome and Oral Health: Disease Characteristics and Management of Oral Manifestations: Springer. pp. 59-69.
8. de Paula F, Teshima THN, Hsieh R, Souza MM, Nico MMS, et al. Overview of human salivary glands: highlights of morphology and developing processes. The Anatomical Record, (2017); 300(7): 1180-1188.
9. Cano IP, Dionisio TJ, Cestari TM, Calvo AM, Colombini-Ishikiriama BL, et al. Losartan and isoproterenol promote alterations in the local renin-angiotensin system of rat salivary glands. PLoS One, (2019); 14(5): e0217030.
10. Song E, Smalley K, Oyelakin A, Horeth E, Che M, et al. Genetic study of Elf5 and ehf in the mouse salivary gland. Journal of Dental Research, (2023); 102(3): 340-348.
11. Bhat M (2021) A Clinical Study on the Efficacy of Jaloukavacharana and Siravyadha by Kutharika Shastra in the Management of Sirajagranthi WSR to Varicose Vein: Rajiv Gandhi University of Health Sciences (India).
12. Shalaby AM, Alnasser SM, Khairy DA, Alabiad MA, Alorini M, et al. The neuroprotective effect of ginsenoside Rb1 on the cerebral cortex changes induced by aluminium chloride in a mouse model of Alzheimer's disease: A histological, immunohistochemical, and biochemical study. Journal of Chemical Neuroanatomy, (2023); 129102248.
13. Hadi RJ (2020) Evaluation of Pulp Response to In-Office Bleaching Technique by Histological and Immunohistochemical (Substance P) Studies in Rats: College of Dentistry Evaluation of Pulp Response to In-Office Bleaching.
14. Skálová A, Gnepp DR, Lewis JS, Hunt JL, Bishop JA, et al. Newly described entities in salivary gland pathology. The American journal of surgical pathology, (2017); 41(8): e33-e47.
15. Thoolen B, Maronpot RR, Harada T, Nyska A, Rousseaux C, et al. Proliferative and nonproliferative lesions of the rat and mouse hepatobiliary system. Toxicologic pathology, (2010); 38(7_suppl): 5S-81S.
16. El-Naseery NI, Elewa YH, Arafa MA, Sabbah W, Dessouky AAJAoA-AA. Mesenchymal stem cells enhance AQP1 expression in the sublingual salivary gland of ovariectomized menopausal rat model. Annals of Anatomy-Anatomischer Anzeiger, (2021); 236151714.
17. Shredah MT, Nagy DAJEDJ. Effect of monosodium glutamate on the sublingual salivary glands of rats (histological and histochemical study). Egyptian Dental Journal, (2017); 63(4-October (Oral Medicine, X-Ray, Oral Biology & Oral Pathology)): 3263-3270.
18. Stewart F, Akleyev A, Hauer-Jensen M, Hendry J, Kleiman N, et al. ICRP publication 118: ICRP statement on tissue reactions and early and late effects of radiation in normal tissues and organs—threshold doses for tissue reactions in a radiation protection context. Annals of the ICRP, (2012); 41(1-2): 1-322.
19. Sheaff M (2011) The role of platelet-derived growth factor in radiation injury to the lower urinary tract: Queen Mary University of London.
20. Safak G, Celiker M, Tümkaya L, Mercantepe T, Rakici S, et al. Comparison of effects of dexmedetomidine and amifostine against X-ray radiation-induced parotid damage. Radiation and Environmental Biophysics, (2022); 61(2): 241-253.