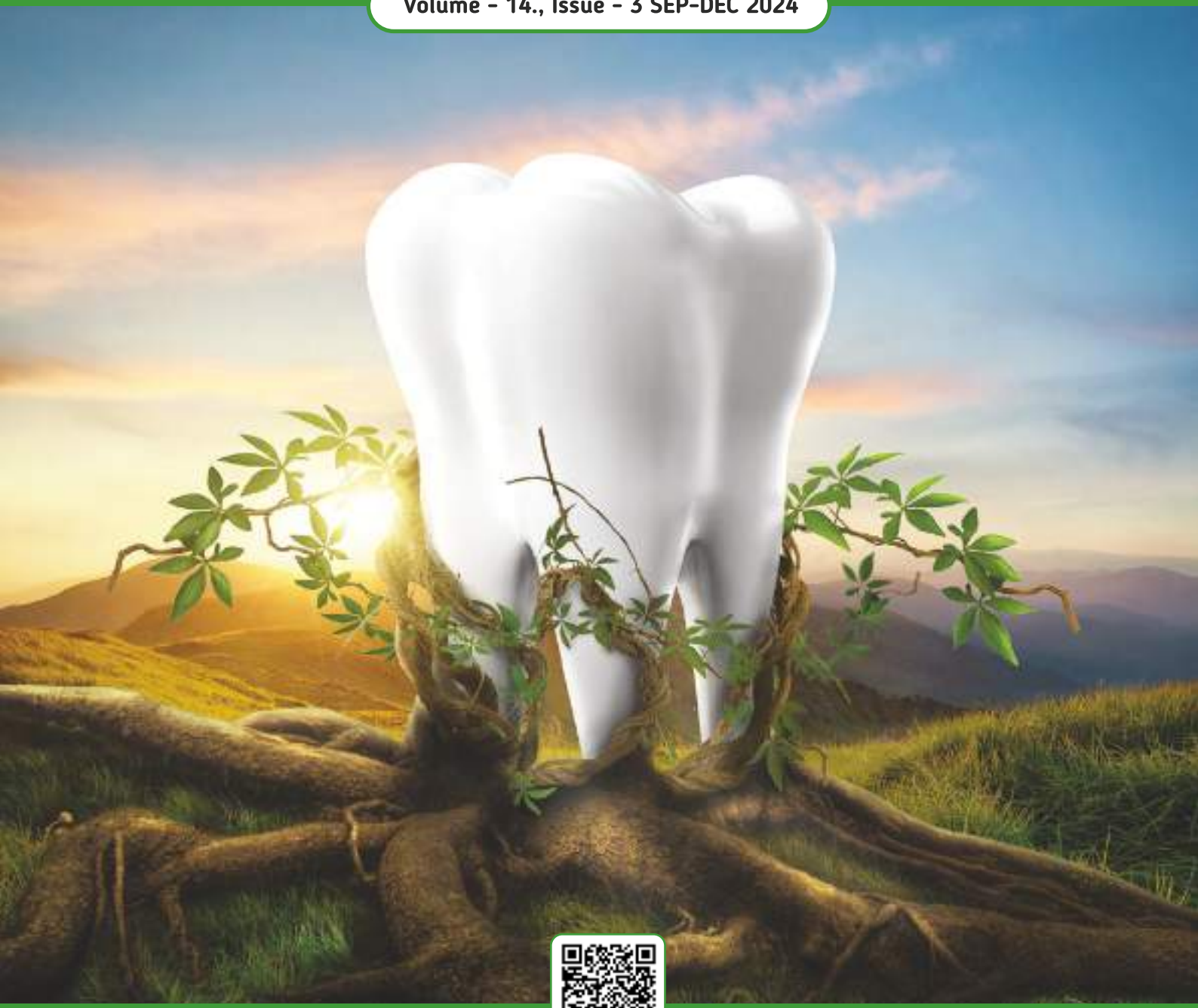
IMPRESSIONS

JOURNAL OF INDIAN DENTAL ASSOCIATION ATTINGAL BRANCH

Volume - 14., Issue - 3 SEP-DEC 2024



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SEPTEMBER-DECEMBER 2024, VOLUME 14, ISSUE 3.

IDA ATTINGAL BRANCH

IDA Attingal Branch was established on January 14th, 2001. Since then, the branch has symbolized unity. The harmony among its members made the branch popular. Over time, the untiring efforts of eminent office bearers and members reached the branch to its current heights. The branch is always promised to deliver something to the community. Certainly, the plethora of programs organized by the branch over the past two decades has impacted the community's oral health. The branch and its members are always there to share knowledge among the dental fraternity and are the torchbearers of ethical dental practice.

IDA Attingal branch is involved in all the national and state activities of the association with great spirit and won many titles too. The branch organizes a multitude of programs including oral health screening camps, oral cancer detection camps, oral health awareness talks, free denture camps for the needy, continuing dental education programs and workshops for the dentists, training programs for the dental assistants, fun activities for its members, observance of important days, distribution of pamphlets and public awareness materials to the community, spreading awareness talks and videos via various social media platforms, financial support to the poor and a free active dental clinic at an orphanage. The branch is always committed to dental excellence and our journal 'Impressions' is its humble attempt to spread scientific communications among the dental fraternity.

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IMPRESSIONS
JOURNAL OF INDIAN DENTAL ASSOCIATION ATTINGAL BRANCH

MESSAGE

Dr. Deepa. G
President,
IDA Attingal Branch

Dear Members,

As the President of the Indian Dental Association, Attingal Branch, I'm happy to connect with you through this edition. Our field of dentistry is evolving, and it's important for us to adapt while staying true to the values of kindness and empathy in our work. By listening to our patients and treating them with care and kindness, we build trust and make them feel safe.

Beyond our work in the clinic, we also have a responsibility to give back to the community. As members of the Indian Dental Association, we can make a real difference by participating in free dental camps and outreach programs. These efforts help provide dental care to those who may not have access to it otherwise. I would love to encourage everyone to get involved in these initiatives and make a positive impact.

Let's remember that compassion, kindness, and helping others are what truly define us as dental professionals. Together, we can make a lasting difference in the lives of our patients and our community.

Best regards,

Dr. Deepa. G

IMPRESSIONS
JOURNAL OF INDIAN DENTAL ASSOCIATION ATTINGAL BRANCH

MESSAGE

Dr. Roshith S. Nath
Hon. Secretary,
IDA Attingal Branch

Season's Greetings,

Wishing all our members, their families, loved ones and readers a joyous Christmas and a happy, prosperous New Year. May this festive season bring you peace, happiness, and time to recharge.

As we bring out the final volume of our branch journal for the year, I would like to take this opportunity to express my heartfelt gratitude and appreciation to our Hon. Editor and his team. Congratulations to the fabulous year of publications! Your dedication, hard work, and editorial expertise have made our journal a resounding success. Your commitment to showcasing our members' achievements and industry insights has been exceptional.

Thank you to our outgoing office bearers for their tireless efforts and leadership. Your contributions have been invaluable, and we appreciate the time and energy you invested in our branch.

As we embark on a new year, we look forward to your continued cooperation and support. We rely on your contributions, feedback, and participation to make our branch thrive.

Thank you once again, and wishing you an exciting and successful New Year!

Dr. Roshith S. Nath

AUTHOR GUIDELINES

About the Journal : Impressions is the official scientific publication of IDA Attingal Branch, which publishes in every four months period.

Aims and Scope : The aim of Impressions is to publish all forms of scientific articles including systematic reviews, original articles, case reports, and review articles pertaining to dentistry. Those articles bring new knowledge to the field are welcomed.

Ethical Considerations : Manuscripts submitted for publication must comply with the following ethical considerations: Written informed consent must be obtained from the subjects before their data included in the study and the informed consent must be archived with the authors. Any data from the patient must be submitted by hiding their identity. All the research should be carried out with prior approval from the institutional or national ethics committee and should be in accordance with the Helsinki Declaration of 1964 (revised in 2008). If animals are using for the research, the authors must follow the institutional or national guidelines for the care of use of laboratory animals.

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Abstract : Must include an abstract of not more than 250 words that describe the significance of the article.

Manuscripts : The manuscripts should be of maximum of 3500 words excluding the references.

Illustrations : High-quality digital images must be submitted with a file name matching the manuscript reference.

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Editor Office Address : Dr. Nripan. T, Editor-in-Chief, Impressions-Journal of Indian Dental Association, Attingal Branch, Crystal Dental, Oyoor, Kollam-691510. Mobile: +91 7907184241.

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JOURNAL OF INDIAN DENTAL ASSOCIATION ATTINGAL BRANCH

EDITORIAL

Dr. Nripan. T
Editor-in-Chief
Impressions

LACUNAE IN EARLY DETECTION OF ORAL CANCER

Cancer is a devastating disease causing significant morbidity, mortality, and emotional and economic crises to the patient as well as to their family. Even though with the treatment advances, unlike other diseases the treatment of cancer itself causes significant deformities. Oral cancer is an easily preventable disease compared to many other cancers. A routine visual examination biannually can detect potentially malignant diseases early and their treatment can reduce the risk of development of oral cancer. Unfortunately, there is a lack of awareness among the public regarding oral cancer risk hinders them from seeking dental care in the early phases. Inadequate training or lack of interest of dentists in detecting early pre-cancerous changes and other oral mucosal pathologies also contributes to the trouble. The easily detectable and preventable oral cancer is still in the first five lists of most common cancers in India is unfortunate. The entire dental fraternity should stand against the menace. Practising dentists should try to gain more knowledge in diagnosing and managing oral mucosal pathologies including oral cancer. It is high time to create awareness among the common people regarding pre-cancerous diseases and oral cancer.

Spreading scientific knowledge among the dental fraternity itself benefits the larger public by creating better doctors. The editorial team of Impressions humbly presents the third and last issue of the 14th volume of our journal to the readers.

Enjoy reading, Enjoy learning!

Dr. Nripan. T

TRAUMATIC ULCERATIVE GRANULOMA WITH STROMAL EOSINOPHILIA: A CASE REPORT

[1] Aparna Anilkumar, [2] Roshith S Nath

ABSTRACT

Traumatic Ulcerative Granuloma with Stromal Eosinophilia is a rare, benign ulcerative condition affecting the oral cavity with a worrisome clinical picture which may cause confusion to the patient as well as the clinician. Here we report a case of Traumatic Ulcerative Granuloma with Stromal Eosinophilia in a 62-years old female patient. The history revealed trauma from a sharp tooth and the ulcer is of one month duration. The patient was treated by cauterizing the ulcer with electrocautery after taking incisional biopsies.

Keywords : TUGSE, traumatic ulcer, eosinophilic ulcer

INTRODUCTION

Traumatic ulcerative granuloma with stromal eosinophilia (TUGSE) is a rare entity characterized by non healing ulcers after a trauma usually on the tongue.[1] Since it is a non-healing ulcer and may show induration, it may be mistaken for oral squamous cell carcinoma (OSCC).1 A correct diagnosis is required for the management as well as to relieve the patient from anxiety of being diagnosed with cancer. Clinicians should give attention while dealing with chronic ulcers, and should seek the help of biopsy and histopathology wherever required. Here we present a case of TUGSE on the lateral border of the tongue in an elderly female.

CASE REPORT

A 62-year-old female patient came to the dental office with a chief complaint of a non-healing ulcer on her tongue noticed for one month. The patient revealed a history of the sharp cusp of a tooth causing trauma to the tongue. The intra-oral examination revealed an ulceration of 0.5 cm x 0.5 cm in size with a white elevated border(Figure 1). On palpation, the ulcer is firm in consistency, painless, and non-indurated. The lingual cusps of the left permanent mandibular second molar were sharp and were found to be traumatizing the ulcerated area. The medical history and dental history of the patients were non-contributory.

[1] Undergraduate student, Amrita School of Dentistry, Kochi. [2] Chief Dental Surgeon, Care well Dental Clinic, Pallickal, Trivandrum

Correspondence : Aparna Anilkumar.,

Email: aparnaanilkumar1001@gmail.com

How to cite this article : : Anilkumar A., Nath RS. Traumatic Ulcerative Granuloma with Stromal Eosinophilia: A Case Report. Impressions. 2024;14(3): Page No. 10-12

Source of support : Nil,

Conflict of Interest : None declared.

An incisional biopsy was performed on the ulceration after anaesthesia. After incisional biopsy, the entire ulcer was cauterized.

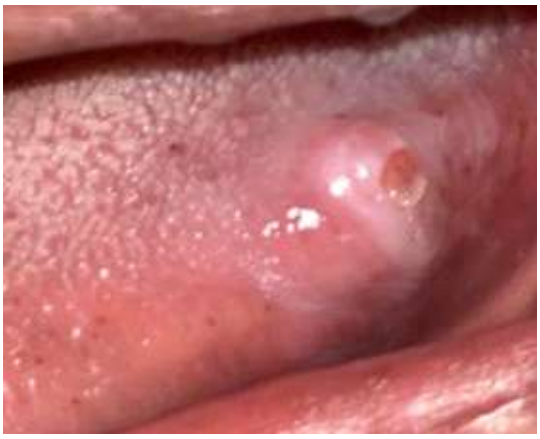

Figure 1: TUGSE on left side of the tongue

The histopathological examination confirmed the diagnosis of TUGSE. The microscopic findings showed parakeratinized stratified squamous epithelium, which shows area of ulceration. The underlying fibrovascular connective tissue showed dense mixed inflammatory infiltrate, chiefly lymphocytes, plasma cells and eosinophils (Figure 2 and 3).

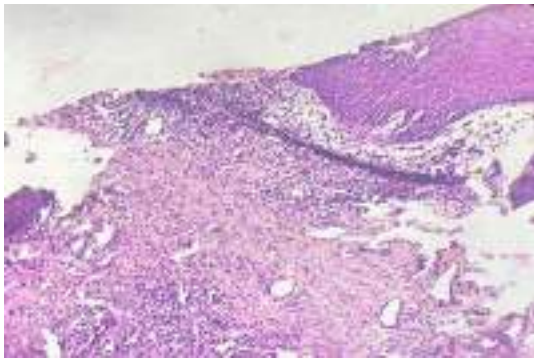

Figure 2:
Photomicrograph showing ulcerated epithelium with mixed inflammatory infiltrate (H&E Stain, 10x Magnification)

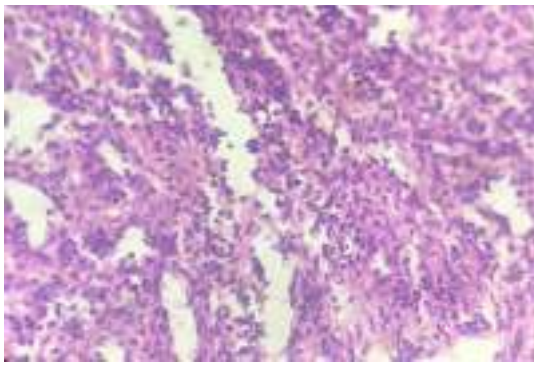

Figure 3:
Photomicrograph showing mixed inflammatory infiltrate with lymphocytes and eosinophils (H&E Stain 40x Magnification)

DISCUSSION

TUGSE is a rare benign entity infamous for its worrisome clinical picture mimicking oral squamous cell carcinoma. TUGSE is also known as 'eosinophilic granuloma'.[2] It is clinically seen as an isolated elevated ulcer with a yellowish base, usually seen on the tongue followed by buccal mucosa, palate, gingiva, and floor of the mouth.[3] The exact etiopathogenesis of the disease is unknown attributed to chronic trauma.[4] The microscopic picture classically reveals an ulcerated epithelium with a mixed inflammatory cell infiltration consisting of chiefly eosinophils, lymphocytes, histiocytes, and macrophages.[5] The large mononuclear cells are usually CD30-positive in immunohistochemistry. The other differential diagnoses of TUGSE other than malignancy include infectious diseases like syphilis, HIV, or EBV infections. The majority of the cases reported in the literature showed a spontaneous healing of the ulcers after a surgical manipulation like the scalpel biopsy without any complications.[1,2,6]

CONCLUSION

Since TUGSE mimics oral cancer and is indurated sometimes, a thorough clinical examination followed by a biopsy is mandatory to reach the correct diagnosis. Clinicians should emphasize non-healing ulcers and should reach the correct diagnosis histopathologically to remove the dilemma in diagnosis of these lesions.

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PLATLET RICH PLASMA IN MAXILLOFACIAL SURGERY: CURRENT ASPECTS AND FUTURE PERSPECTIVES

[1]Arya Arun, [2]Dhanush Shaji, [3]Deepa G

ABSTRACT

Platelet-rich plasma is a concentrated mixture of platelets, growth factors, and cytokines derived from human blood which can be utilized for multiple medical therapies. Since it is a concentration of one's blood, it has advantages over allogenous materials. This article provides a brief review of the various aspects of platelet-rich plasma, emphasizing its applications in oral and maxillofacial surgery.

Keywords : Platelet rich plasma, PRP, Platelet rich fibrin, PRF

INTRODUCTION

A recent innovation in dentistry is the preparation and use of platelet rich plasma, a concentration of platelets and growth factors found in platelets. These polypeptide growth factors as well as other bioactive substances are released from platelets upon activation, which play a pivotal role in initiating and sustaining wound healing and tissue repair mechanism.[1]

Platelet Rich Plasma (PRP) - An Insight

PRP was first introduced to oral surgery community by Whitman et al in their 1997 article entitled "Platelet Gel: An autologous alternative to fibrin glue with application in Oral & Maxillofacial Surgery." The authors thought that through activation of the platelets in within the gel and the resultant release of growth factors, enhanced wound healing should be expected". PRP enjoyed a great deal of popularity in Oral & Maxillofacial Surgery after the publication of a landmark article by Marx et al in 1998.[2]

Marx et al study showed that combining PRP with autogenous bone in mandibular continuity defects resulted in significantly faster radiographic maturation and histomorphometrically denser bone regenerate. It certainly seemed as though a new age in bone grafting had begun. Platelet rich plasma can be procured in the immediate preoperative period by various techniques.[3]

[1]Oral & Maxillofacial Surgeon Miracle Dental and Cosmetic Clinic. [2]Chief Dental Surgeon, Miracle Dental and Cosmetic Clinic. [3]Dental Surgeon, Dr Subramony's Suparna Dental Clinic. Nedumangad, Trivandrum.

Correspondence : Arya Arun.

Email: aryaarun1492@gmail.com

How to cite this article : Arun A., Shaji D. Platelet Rich Plasma in Maxillofacial Surgery: Current Aspects and Future Perspectives. Impressions. 2024;14(3): Page No. 13-18

Source of support : Nil,

Conflict of Interest : None declared.

In the literature, techniques of PRP preparation vary from using 10 cc of a patient blood and spinning it in a lab centrifuge, to utilizing a unit of blood (350-500) that is put through a cell separator that sequester and concentrate the platelets. Platelet rich plasma [PRP] offers up to a 2.16 times increases in the maturation rate and substantially greater density of a bone graft regenerate.[2]

Soft tissue healing is also substantially improved through the application of PRP, by increasing collagen content, promoting angiogenesis and by early wound strength PRP has been shown to contain various growth factors, including platelet derived growth factor, transforming growth factor-β (TGF-β), vascular endothelial growth factor (VEGF), platelet derived endothelial growth factor (PDEGF) and fibroblast growth factor (FGF).[4]

These polypeptide growth factors as well as other bioactive substances are released from platelets upon activation and play a pivotal role in initiating and sustaining wound healing and tissue repair mechanism.[4] The activation of PRP mimics the final stages in the clotting cascade and results in a gelatinous substance known as PRP gel. This activation of PRP can be done by various means to form PRP gel or can be used on its own.[5]

The PRP can be activated by calcium alone, or autologous whole blood and some autogenously cancellous bone, both containing thrombin, or a mixture of 10% CaCl2 and bovine thrombin. However, few studies have reported hyper sensitivity reaction with the use of bovine thrombin.

What are PRP and Platelet Gel?

Platelet Rich Plasma is an autologous concentration of human platelets in a small volume of Plasma. True PRP is always autologous and is not homologous. Homologous platelets are not viable and could not possibly secrete bioactive growth factors. Homologous platelets are also antigenic due to their abundance of cell membranes.[6] Certainly, antiplatelet antibodies could develop from this product and second set reactions would follow.

How does PRP work?

Platelets are our primary mechanism for hemostasis. They circulate in our bodies looking for exposed endothelium. They then aggregate to the site of injury and further platelet degranulization occurs. The release various growth factors can also aid in the healing process. Platelet gel mimics the final stages in the clotting cascade.[3-5] The platelet rich plasma in the presence of thrombin activates platelets, converts fibrinogen to fibrin and stimulates further platelet aggregation. Calcium chloride is added to counteract the anticoagulant citrate, rapidly forming gelatinous, platelet-rich glue platelet aggregation.

PRP works via the degranulation of the alpha granules in platelets which contain the synthesized and prepackaged growth factors. The active secretion of these growth factors is initiated by the clotting process of blood and begins within 10 minutes after clotting. Therefore PRP must be developed in an anticoagulated state and should be used on the graft, flap, or wound within 10 minutes of clot initiation. Like most growth factors such as bone morphogenic protein, the growth factors within the alpha granules of platelets are incomplete because they must be soluble.[7]

As the clotting process activates the platelets, the growth factors are secreted from the cell through cell membrane. (In this process, the alpha granules fuse to the platelet cell membrane where the protein growth factor is completed to a bioactive state by the addition of histones and carbohydrate side chain to these proteins.)

The secreted growth factors immediately bind to the external surface of the cell membrane of various cells in the graft, flap or wound via trans - membrane receptors.[7]

Studies have shown that adult mesenchymal stem cells, osteoblasts, fibroblasts, endothelial cells and epidermal cell express cell membrane receptors to growth factors in PRP. These transmembrane receptors in turn induce an activation of an endogenous internal signal protein, which causes the expression of a normal gene sequence of the cell such as cellular proliferation, matrix formation, osteoid production collagen synthesis etc.[8]

After the initial burst of PRP related growth factors, the platelets synthesize and secrete additional growth factors for the remaining 7 days of their life span. Once the platelets are exhausted and die off, the macrophages arrive at the region and assume the function of wound healing regulation by secreting some of the growth factors as well as others. Therefore the number of platelets in the blood clot within the graft, wound, or adherent to a flap sets the rate of wound healing.[9]

The positive effects of PRP as reported in literature are:

"Jump-starts" the cascade of osteogenesis in a bone graft.

Promotes early consolidation of the graft.

Speeds up mineralization of the graft.

Improves trabecular bone density.

Allows placement of implants into the graft at an earlier time.

Provides earlier availability of growth factors and BMP.

Enhances osteoconduction.

APPLICATIONS OF PRP IN ORAL & MAXILLOFACIAL SURGERY

Split Thickness Skin Graft Donor Sites:

PRP has demonstrated efficacy in the healing of split thickness skin graft (STSG) donor sites. The revascularization is quickly enhanced by the angiogenic activity of PDGF and TGFß.

Sinus Lift Grafts:

PRP Gel also improves the handling of particulate graft apart from enhancing the osteogenesis of graft.

Ridge Augmentation Graft:

Both vertical and horizontal ridge augmentation procedures will benefit from PRP. If either a cortical-cancellous block or a strictly cancellous marrow graft is used the PRP is incorporated into and on the surface of the graft.

Continuity Defects in the Jaws:

In the context of continuity defects these grafts are accomplished in an operating room setting. The PRP should be developed prior to the infusion of large fluid volumes which will dilute blood components and prior to any significant tissue wounding which will sequester platelets in the wound.[10] The PRP may remain on the sterile field in an anticoagulated state for up to 8 hours. However, once "activated" with calcium and a clot initiator, it should be directly used.

The nature of large continuity grafts recommends incorporating the PRP into the graft during placement with a layering technique. That is, small amounts of PRP gel are added to the graft as it is placed. It is then best to place some on the graft surface. About 20 cc's to 35 cc's of PRP are usually required depending on the size of the graft.[11]

The activated PRP gel may be made into a bio-resorbable membrane which will last for approximately five to seven days. This is accomplished by "activating" the PRP into a gel and placing 3 ml to 4 ml on a smooth surface. After approximately five minutes the PRP gel can be taken off the surface as a membrane. membrane will consist of fibrin, in which is enmeshed the platelets. It may be used over sinus lift windows, to cover sinus membrane perforations, or over dental implant fixtures.[5,8]

Periodontal Surgery:

A study was conducted in which the freeze dried cortical bone allograft was grafted into wide three wall, two wall, and one wall combination furcation defects. The authors concluded that out of 97 defects treated, 23 manifested complete bone regeneration, 30 showed greater than 50%, 24 less than 50% osseous repair and 12 defects failed to demonstrate any regeneration, of which nine were furcation involvement.[12]

PRP Added to Commercial Membranes:

Commercial Membranes such as Collatape®, Resolute®, or Osseoquest®, have a texture which will absorb the "activated" PRP gel. This will allow the clinician to apply growth factors to longer lasting membranes so as to gain the benefit of each.

Extraction sockets:

A study on 117 patients was done in which platelet rich plasma was placed in the extraction sockets after third molar surgery. The result showed a decrease rate of alveolar osteitis in sockets treated with PRP.[13] The PRP treated sockets also showed better hemostasis, faster soft tissue flap healing, and decreased swelling post operatively. One month postoperative radiographs showed subjectively more dense bone fill and radioopacity in the PRP treated sockets.

Alveolar Bone Grafting:

In a study on 7 Cleft lip and palate patients, the cleft alveolus was grafted with autologous iliac cancellous bone incorporated with platelet rich plasma (PRP). The bone regenerate at the cleft site was quantitatively evaluated using 3 dimensional computed tomography scans at 5 or 6 months postoperatively. The results showed a higher volume ratio of regenerated bone to alveolar cleft in cases treated with PRP than in controls.[13]

PRP in Implant surgeries:

In a case presented by Thor A in the year 2002, particulated autogenous bone, platelet gel, and a titanium mesh were used for alveolar bone reconstruction of the anterior maxilla prior to implant placement. After 4-5 months of healing the mesh was removed and titanium implants were placed. The results showed that the healing was uneventful, and the anterior maxilla had increased in height and width during the initial healing. All implants became integrated and supported a fixed dental bridge for over 3 years with no dramatic dimensional changes of the graft. It was concluded that the autogenous growth factors in the gel possibly contributed to the positive outcome.[7,9]

Distraction osteogenesis:

Robiony M, Polini F, Costaf, Poloti M evaluated a new method on restoring severe atrophic mandible using plateletrich plasma (PRP) during distraction osteogenesis. During the surgery, a mixture of autologous iliac bone graft and an autologous platelet concentrate filled the distraction gap. This mixture constituted an autologous bone-platelet gel that was used to create a useful bony scaffold for distraction regenerate.

After a latency period of 15 days, a distraction run of 0.5 mm/d, and a 60 day period of consolidation, the distraction device was removed and implants were placed simultaneously. The results showed that in all the treated patients, planned distraction height was achieved with a considerable enhancement of bony regeneration, and in all cases it was possible to place implants at a planned time. The study concluded that the combination of these recent and innovative regenerative methods seems to be effective in restoring the severe atrophic mandible.[14]

PRP in patients with anti-coagulants:

Antonio Della Valle et al in their study had put PRP gel in the extraction socket in 40 patients on anti coagulant drugs (suspended 36 hrs prior to the extraction). The results showed that only 2 patients reported hemorrhagic complications (5%). Sixteen patients (40%) had mild bleeding that was easy to control with hemostatic topical agents.[9] The remaining 22 patients (55%) presented with adequate hemostasis. Thus it was concluded that, oral surgery in cardiac patients under oral anticoagulant therapy might be facilitated with PRP gel. This biological and therapeutical improvement can simplify systemic management and help avoid hemorrhagic and/or thromboembolic complications.[15]

CONCLUSION

Platelet-rich plasma is having multitude of applications in different fields of medicine. Although many studies reported promising results with PRP, there are some conflicting results from other studies also reported in the literature. Despite this, there are ongoing research about the potential uses of PRP and the popularity of this is increasing day to day basis.

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COLOUR MATCHING IN DENTISTRY: AN UPDATE

[1]Aarathi Vijayan, [2]Sandeep K Shibu

ABSTRACT

The success of dental treatment is evaluated according to functional and aesthetic results. To achieve aesthetics, four basic determinants are required: viz., position, contour, texture, and colour. The knowledge of the concept of colour is essential for achieving good aesthetics. Colour matching is influenced by several factors, and if not performed properly, it can it can have unsatisfactory results for both the clinician and the patient This review discusses colour science, factors associated with colour perception, and colour matching techniques.[1]

Keywords : colour scheme, chroma, hue, value, shade matching, shade selection

INTRODUCTION

An understanding of the nature of light and how the eye perceives and the brain interprets light as colour is important for successful aesthetic restorations, particularly when metal-ceramic or all-ceramic restorations are being made.[2] Colour and shape determine the aesthetics of both restored and natural teeth. The importance of colour research in dental science has improved significantly over the last decades. To provide aesthetic prosthesis, the dentist should consider the colour's scientific basis as well as the artistic aspects of colour matching. Because of the great variety of natural teeth colour, obtaining a close colour match of a prosthesis with the natural teeth is a complex procedure. The dentist needs an understanding of colour, light, and characteristics of resin and porcelain in addition to the ability to communicate with the technicians to achieve a natural-looking prosthesis.[3] The understanding of the light's nature, how the eye perceives the light, and how the brain interprets light as colour is essential for a favourable aesthetic prosthesis.[4] Colour can be described by three primary attributes of colour which are hue, Chroma, and value. To facilitate communication with the technician, the dentist should be thoroughly familiar with these terms and their definitions. Colour determination and replication are the greatest challenging parts of dental aesthetic.[5] Tooth colour is determined using

[1]Professor and Head, Department of Public Health Dentistry, Azeezia College of Dental Science and Research, Kollam. [2]Intern, Azeezia College of Dental Sciences and Research, Kollam

Correspondence : Sandeep K. Shibu.

Email : sandeepkshibu1999@gmail.com

How to cite this article : Vijayan A., Shibu SK. Colour Matching in Dentistry: An Update. Impressions. 2024;14(3): Page No. 19-24

Source of support : Nil,

Conflict of Interest : None declared.

either instrumental or visual methods The most common technique for colour matching is the visual method using a shade guide.[6] Shade guides have been used to determine and communicate the colour of tooth and prosthesis to obtain an optically satisfying prosthesis but misunderstanding could often happen since every human-eye is not capable to perceive it in a standardized way.[7,8] Additionally, visual colour matching relies on many subjective elements such as translucency, surface structure, lighting conditions, and the optical character of the material used.[9] Since visual colour matching relies on an individual assessment, which is subjective and consequently a clinically challenging procedure. So, this is one of the causes of developing standards for communicating shades and instruments. That make it easier to measure them.[10] However, instrumental colour matching is concerned to be useful and reliable in obtaining colour for clinical colour matching in dentistry. The recommended protocol for visual and instrumental colour matching should be followed for a better understanding of the difficulties involved in it.[11]

RATIONALE

Dental shade-matching instruments have been brought to market to reduce or overcome imperfections and inconsistencies of traditional shade matching. The most commonly used shade-matching method is the visual method, whilst Vitapan Classical (Vita Zahnfabrik, Bad Säckingen, Germany) and its derivations are probably the most commonly used shade guides. The coloured tabs of distinctive shades organize the empiric-based Vita chart.[12-15] In addition, unequivocal findings were reported on colour consistency amongst shade guides from the same manufacturer.[16,17] Introduction of evidence-based Vitapan 3D-Master shade guides, Tooth guide, Bleach guide and particularly Linear guide by the same manufacturer correspond to colour of human teeth and therefore increase chances for successful shade matching.[18,19]

COLOUR

Colour is a property of light. Objects have no colour of their own; they just reflect a particular wavelength from the colour spectrum. For example a blue object absorbs all of the wavelengths, except for blue. The remaining wavelengths enter our eyes and this is what we see.

BASIC COLOUR SCHEMES

The colour wheel or colour circle is the basic tool for combining colours. The first circular colour diagram was de- signed by Sir Isaac Newton in 1666. Over the years, many variations of the basic design have been made, but the most common version is a wheel of 12 colours, the primary colours being red, yellow and blue. Three secondary colours (green, orange and purple) are created by mixing two primary colours. Six tertiary colour are created by mixing the primary and secondary colours. The colour circle can be divided into warm and cool colours. Warm colour are vivid and energetic, and tend to advance in space. Cool colours give an impression of calm, and create a soothing impression. White, black and grey are considered to be neutral.[1]

MUNSELLS COLOUR SYSTEM

Prof. Albert D. Munsell presented a colour wheel that contains the dimension of Value, Chroma, and Hue at the beginning of the 20th century.20 The colour quality that differentiates one colour from another is called hue. Hue is the name of a colour, e.g. red, orange, or yellow. Hue is represented on the Vita Classic shade guide by A, B, C, or D. Chroma define as the strength, intensity, or

saturation of the hue. On the Vita Classic Shade Guide, the higher numbers represent increased chroma. Value is the colour relative lightness or darkness or the object's brightness. According to Munsell, value is described as a black to white grayscale. Often the most important dimension of colour is the value, as the value decreased, the chroma is increased; value and chroma are inversely related.

DESCRIPTION OF COLOUR

The most popular method for describing colour is the Munsell system. The three attributes of colour in this system are called Hue, Chroma and Value.[19]

Hue: It is defined as the particular variety of a colour. "Hue" is the quality that distinguishes one family of colour from another. It is specified as the dominant range of wave- lengths in the visible spectrum that yields the perceived colour, even though the exact wavelength of the perceived colour may not be present. Hue is a physiologic and psychologic interpretation of a sum of wavelengths. Hue is rep- resented by A, B, C or D on the commonly used Vita Classic shade guide.

Chroma: "Chroma" is the saturation, intensity or strength of the Hue.[24] If any dye (say red) is added into a glass of water and the same dye is added again and again, the intensity increases, but the colour remains the same (hue). As more dye is added, the mixture appears darker; thus, the increase in chroma has a corresponding change in value. As chroma is increased, the value is decreased; chroma and value are inversely related. Higher numbers on the Vita Classic shade guide represent increased chroma.

Value: : "Value," or brightness, is the amount of light returned from an object. Munsell described value as a white-to- black grey scale. Bright objects have lower amounts of grey and low-value objects have larger amounts of grey and will appear darker. The brightness of a crown is usually increased in two ways: by lowering chroma or by increasing the reflectivity of the surface. Lowering value means less light returns from the illuminated object and the remaining light is being absorbed or scattered elsewhere.

There are two types of colour, additive and subtractive.

Additive Colour: These are the colour obtained by emitted light and are associated with television and computer displays. The primary additive colours are Red, Blue and Green and the secondary additive colours are Cyan, Yellow and Magenta. When additive primary colours are combined they produce White.

Subtractive Colour: These are the colours associated with reflected light and are used in pigments for making paints, inks, fabrics etc. The primary subtractive colours are Red, Yellow, and Blue and the secondary subtractive colours are Green, Violet and Orange. When subtractive primary colours are combined they produce Black.[19]

COLOUR PERCEPTION

Eyes can't see alone. Our eyes and brain have to work together to make a sense of light and colour. Light goes through the pupil and splashes on the rods and cones of the retina. There, the light causes a chemical reaction. The optic nerve connects eyes to the brain. It understands the chemical reaction and carries a message to the brain. There the colour perception takes place.[17,18]

Eyes: The initial process occurs in the retina of the eye. The retina contains millions of cells called photoreceptors that are sensitive to light. There are two types of photoreceptors, some shaped like rods and some like cones. These photoreceptors process light into nerve impulses and pass them along to the cortex of the brain via the optic nerve. 120 million RODS in the outer edges of the retina help eyes adjust when one enters a dark room. They are good for detecting motion and for seeing in low light-levels. At low light levels, the rods of the human eye are more dominant than the cones and colour perception is lost. As the brightness becomes more intense, colour appears to change (BEZOLD-BRUCKE EFFECT). There are 6 million CONES in each eyeball which are sensitive to colour. There are three types of cone cells, each sensitive to the long, medium or short wavelength of light (red, blue and green colour respectively).[20]

SHADE SELECTION

Quality of Light: Energy distribution of a light has definite effects on the type of colour being perceived. The clinician should try and use a source of light that contains full spectrum of rays without the dominance of any wavelength; because when an object is viewed under lights dominating in particular wavelengths (colour bands), that specific colour becomes dominant to the observer. There are three types of light sources.[16]

1. Incandescent Light: Emits high concentration of yellow waves. It is not suitable for shade matching. It has low Colour Rendering Index (CRI).

2. Fluorescent Light: Emits high concentration of blue waves. It is not suitable for shade matching. It has CRI of 50-80.

3. Natural Daylight: Northern daylight is considered the best because it is closest to emitting the full spectrum of white light. It is used as the standard by which to judge other light sources. It has CRI close to 100.

Most dental offices are fitted with incandescent and fluorescent lights.

Colour Rendering Index: Northern daylight, which can be close to full-spectrum white light and often, is used as the "normal" standard for judging light from other sources. It has a colour rendering index (CRI) close to 100. The colour rendering index, on a scale of 1 to 100, indicates how well a particular light source renders colour as compared to a specific standard source.

Although daylight is often used as the standard against which other light sources are compared, never use direct sunlight to take tooth shade. The distribution of light waves from the sun depends on the time of day and on humidity and pollution. Morning and evening incident light has shortened blue and green waves scattered and only the longer waves penetrate the atmosphere. Therefore daylight at dawn and dusk is rich in yellow and orange but is lacking in blues and greens. Northern daylight around the noon hour on a bright day is considered ideal, because the incident daylight is most balanced within the Visible Light Spectrum.[7]

Metamerism: Another aspect of lighting is the subject of metamerism. Two objects may appear to be identical Colours under a certain kind of light, yet under another kind of light they may appear totally different. This is called metamerism. The problem of metamerism can be avoided by selecting a shade and confirming it under different lighting conditions (e.g., natural daylight and fluorescent light).[20]

Guidelines for Shade Selection[9]

1. Teeth to be matched should be cleaned of all debris and stains. Prophylaxis should be done before shade selection.

2. Brightly coloured lipstick/makeup should be removed (strong red lipstick next to the tooth will fatigue the red receptors while the blue and green receptors remain fresh and fully stimulated. This makes the tooth that looks blue- green) and bright clothing should be draped with grey napkin. The operatory walls should be painted grey.

3. Patient should be viewed at eye level and at arms length, so the most sensitive part of the retina will be used.

4. Shade comparisons should be made under different lighting conditions. Initial shade may be taken under a colour corrected fluorescent light and then confirmed in natural daylight (taking patient to an operatory window).

5. Shade comparisons should be made at the beginning of a patient's visit. Teeth increase in value when they are dry because of desiccation.

6. Shade comparisons should be made quickly (5 seconds), with shade tabs placed just under the lip and adjacent to the teeth to be matched.

7. Look at a gray walls or patient's napkin between each shade evaluation.

CONCLUSION

Patients expect the broken down and missing teeth to be restored with proper form, function, and an aesthetic appearance. To provide an aesthetic restoration to the patient, the dentist must have a full understanding of the science of colour and colour perception. Colour matching forms an important part in producing aesthetics prosthesis. The tooth colour determination and replication is a challenging task for every dentist. Understanding the science of colour, colour perception, colour matching instrument usage, and limitations, and communication between technicians and dentists are essential for successful aesthetics treatments. Accurate colour matching that allows the prosthesis to match the natural teeth positively influences the appearance and aesthetic self-confidence of the patient.

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DENTAL STEM CELLS: A REVIEW

[1] Akhil Yadav B, [2] Swathi P

ABSTRACT

Stem cells can develop into many different types of cells in the body and are the only cells with this ability. Dental stem cells are the stem cells that are present in tissues like pulp, exfoliated primary teeth, periodontal ligament, dental follicles, and dental papilla which can be utilized for many regenerative therapies. The present article sheds light on dental pulp stem cells and their wide application in various fields.

Keywords : Stem cells, dental pulp stem cells, regenerative endodontics.

INTRODUCTION

Three basic categories of cells make-up the human body: germ cells, somatic cells and stem cells. Somatic cells include the bulk of the cells that make-up the human adult and each of these cells in its differentiated state has its own copy, or copies, of the genome; the only exception being cells without nuclei, i.e., red blood cells. Germ cells are cells that give rise to gametes, i.e., eggs and sperm.[1] The canonical definition of a stem cell is a cell with the ability to divide indefinitely in culture and with the potential to give rise to mature specialized cell types. When a stem cell divides, the daughter cells can either enter a path leading to the formation of a differentiated specialized cell or self-renew to remain a stem cell, thereby ensuring that a pool of stem cells is constantly replenished in the adult organ. This mode of cell division characteristic of stem cells is asymmetric and is a necessary physiological mechanism for the maintenance of the cellular composition of tissues and organs in the body.[2]

DISCUSSION

SOURCES OF STEM CELLS

Mammalian stem cells are usually classified according to their tissue of origin. The ovary and testis contain oogonia and spermatogonia, which have been referred to as the stem cells of the gonads. In adult mammals, only the germ cells undergo meiosis to produce male and female gametes, which fuse to form the zygote that retains the ability to make new organism thereby ensuring the continuation of the germ line. In fact, the zygote

[1,2] Conservative Dentistry & Endontic specialists, Dr Akhil's Multispeciality Dental Clinic, Poredom, Kollam

Correspondence : Akhil Yadav B

Email: akhilyadavbabu91@gmail.com

How to cite this article : Yadav AB, P Swathi. Dental Stem Cells: A Review. Impressions. 2024;14(3):Page No. 25-31

Source of support : Nil,

Conflict of Interest : None declared.

is at the top of the hierarchical stem cell tree being the most primitive and producing the first two cells by cleavage. This unique characteristic of germ cells is known as 'developmental totipotency'.[3]

In mammals, the fertilized egg, zygote and the first 2, 4, 8, and 16 blastomeres resulting from cleavage of the early embryo are examples of totipotent cells. Proof that these cells are indeed totipotent arises from the observation that identical twins are produced from splitting of the early embryo.[3] However, the expression 'totipotent stem cell' is perhaps a misnomer because the fertilized egg and the ensuing blastomeres from early cleavage events cannot divide to make more of them. Although these cells have the potential to give rise to the entire organism, they do not have the capability to serenaded, by strict definition therefore, the totipotent cells of the early embryo should not be called stem cells.[4]

EMBRYONIC STEM CELLS

Embryonic stem (ES) cells, however, are derived from the isolated inner cell masses (ICM) of mammalian blastocysts. The continuous in vitro subculture and expansion of an isolated ICM on an embryonic fibroblast feeder layer (human or murine) leads to the development of an embryonic stem cell line. In nature, however, embryonic stem cells are ephemeral and present only in the ICM of blastocysts. The cells of the ICM are destined to differentiate into tissues of the three primordial germ layers (ectoderm, mesoderm and endoderm) and finally form the complete soma of the adult organism.[5]

Embryonic Stem cells can be expanded in vitro very easily and, under optimal culture conditions, divide symmetrically to give two daughter cells. ES cell lines express the telomerase gene, the protein product of which ensures that the telomere ends of the chromosomes are retained at each cell division, preventing the cells from undergoing senescence.[6] These cells also retain a normal karyotype after continuous passage invitro, thus making them truly immortal. The establishment of his lines is a highly efficient procedure, with up to a 60%success rate from spare IVF blastocysts. The quality of the donated embryos appears to be an important determinant of success in deriving his lines. Nevertheless, protocols for his line derivation have been reproduced in many labs and are relatively easy to follow.[7]

Stem cells can also be classified as totipotent, pluripotent and multipotent. Totipotency is the ability to form all cell types of the conceptus, including the entire fetus and placenta. Such cells have unlimited capability; they can basically form the whole organism.[2] Early mammalian embryos are clusters of totipotent cells. Pluripotency is the ability to form several cell types of all three germ layers (ectoderm, mesoderm and endoderm) but not the whole organism. In theory, pluripotent stem cells have the ability to form all the 200 or so cell types in the body. There are four classes of pluripotent stem cells. These are embryonic stem cells, embryonic germ cells, embryonic carcinoma cells and recently the discovery of a fourth class of pluripotent stem cell, the multipotent adult progenitor cell from bone marrow. This, coupled with the deluge of exciting experimental reports and publications on hiss, appears to have overshadowed much of the interest in hEGCs. Human embryonal carcinoma (hEC) cell lines are derived from tumors of germ cell origin and have long served as the human counterpart of murine EC cells for studying human development and differentiation in vitro. hEC cell lines are capable of multilineage differentiation in vitro but, being of tumor origin, are unfortunately mostly an euploid,

which makes them unsuitable for cell-replacement therapeutics. Both hESCand hEC cell lines express similar stage-specific embryonic antigens and tumourrejection antigens on the surfaces of their cells.[4,8]

ADULT STEM CELLS

These stem cells reside in tissues that have already developed, directing their growth and maintenance throughout life.[9] These cells are also multipotent. Adult stem cells typically generate the cell types of the tissue in which they reside. However, some experiments over the last few years have raised the possibility of a phenomenon known as plasticity, in which stem cells from one tissue may be able to generate cell types of completely different tissue. Researchers also found evidence suggesting that adult stem cells from various organs can contribute to the regeneration of other, often dissimilar organs.[10]

Adult stem cells are often relatively slow cycling cells able to respond to specific signal and either generate new stem cells or select a particular differentiation program.[11] When a stem cell undergoes a commitment to differentiate, it often first enters a transient state of rapid proliferation. Upon exhaustion of its proliferative potential, the transiently amplifying cell withdraws from its cycle and executes its terminal differentiation program.

Adult stem cells have unique characteristics:[12]

a) They exist as undifferentiated cells and maintain this phenotype by the environment and/ or the adjacent cell populations until they are exposed to and respond to the appropriate signals.

b) They have an ability to self-replicate for prolonged periods.

c) They maintain their multiple differentiation potential throughout life of the organism.

The name adult stem cell is rather a misleading because infants and children also have stem cells. Thus, the term postnatal stem cell is preferable.

CHARACTERISATION OF ADULT STEM CELLS

Three methods can be used to identify adult stem cells.[13]

1. Labelling the cells in a living tissue with molecular markers and then determining the specialized type they generate.

2. Removing the cells from living animals, labelling them in a cell culture, and transplanting them back into another animal to determine whether cells will repopulate their tissue of origin.

3. By isolating the cells, growing them in cell culture, and manipulating them often by adding growth factors or introducing new genes to determine what differentiated cell types they can become.

Postnatal stem cells have been found in almost all body tissues, including dental tissues. To date, five types of human dental stem cells have been isolated and characterized:

i) Dental pulp stem cells (DPSCs)

ii) Stem cells from human exfoliated deciduous teeth (SHED)

iii) Stem cells from apical papillae (SCAP)

iv) Periodontal ligament stem cells (PDLSCs)

v) Dental follicle progenitor cells

The identification of these dental stem cells provides better understanding of the biology of the pulp and periodontal ligament tissues, and their regenerative potential after tissue damage.

PROGENITOR CELLS

Stem cells generate intermediate cell types before they achieve their fully differentiated state. The intermediate cell is known as a precursor or progenitor cell. It is believed that such cells usually differentiate along a particular cellular development pathway.[13] Generally, undifferentiated cells are considered to be progenitor cells until their multi tissue differentiation and self-renewal properties are demonstrated and they become designated as stem cells.[13]

DENTAL PULP STEM CELLS (DPSCS)

In the dental pulp of adult teeth, there is a population of clonogenic cells with a high proliferative capacity - the DPSCs. These cells were successfully isolated by enzymatic digestion of pulp tissue after separating the crown from the roots for the first time in 2000 by Gronthos et al, based on their striking ability to regenerate dentin-pulp-like complex composed of a mineralized matrix of tubules lined with odontoblasts, and fibrous tissue containing blood vessels in an arrangement similar to the dentin-pulp complex found in normal human teeth.[14] Then, in a later study, the same group demonstrated that these cells had a high proliferative capacity, a self renewal property and a multi-lineage differentiation potential. Dental pulp stem cells are multipotent cells that proliferate extensively (maintained for at least 25 passages), can be safely cryopreserved, possess immunosuppressive properties, and express markers such as CD13, CD29, CD44, CD59, CD73, CD90, CD105, CD146 and STRO-1, but do not express CD14, CD24, CD34, CD45, Cd19 and HLA-DR. The plasticity of DPSCs has been verified through in vitro and in vivo studies.[15] DPSCs have the ability to differentiate into odontoblast-like cells, osteoblasts, adipocytes, neural cells, cardiomyocytes, myocytes and chondrocytes in vitro. DPSCs can form mineralized nodules with a dentine like structure under osteoinductive conditions in vitro and reparative dentine-like tissue on the surface of human dentine in vivo. DPSCs transplanted with the carrier hydroxyapatite/tricalcium phosphate (HA/TCP) produce a dentine-like structure lined with human odontoblast-like cells and surrounded by pulp-like interstitial tissue in vivo. Thus, DPSCs have the capacity to differentiate into osteoblasts in vivo and produce a bone-like tissue.[12,13] Laino et al isolated a selected sub population of DPSCs known as Stromal Bone-producing Dental Pulp Stem Cells (SBP-DPSCs). These were described as multi potential cells that were able to give rise to a variety of cell types and tissues including osteoblasts, adipocytes, myoblasts, endotheliocytes, and melanocytes, as well as neural cell progenitors (neurons and glia), being of neural crest origin. Paakkonen et al demonstrated that DPSCs have a general gene expression pattern similar to that of mature native odontoblasts, and are therefore a valuable humanderivedcell line for in vitro studies of odontoblasts. However, definitive proof of their ability to produce dentin has not yet been obtained.[15]

The EMPs, particularly laminin, and chemo actants, particularly S1P and TGF-b1, were found to be important promoters of DPSC migration. The interplay between the EMPs, blood lipid, serum, and chemoactants suggests that the migration of DPSC is highly regulated. Specific chemoactants and EMPs might mediate the process of pulp-dentin regeneration after tooth injury, and they could be used as part of regenerative endodontic therapy.[8]

STEM CELLS FROM HUMAN EXFOLIATED DECIDUOUS TEETH

Stem cells from human exfoliated deciduous teeth reported the potential to obtain stem cells from human deciduous teeth. As DPSCs, these multipotent cells are derived from dental pulp explants or by digestion of dental pulp tissue and have immunosuppressive properties. The morphology of SHEDs, also termed immature, is similar to that of DPSCs, SCAPs and DFPSCs. SHEDs have a higher proliferation rate than bone marrow mesenchymal stem cells (BMMSCs) and DPSCs and express Oct4, CD13, CD29, CD44, CD73, CD90, CD105, CD146 and CD166, but do not express CD14, and CD34.4-7 Stem cells isolated from the pulp tissue of exfoliated deciduous teeth are capable of differentiating into a variety of cells, such as neural cells, osteoblasts, chondrocytes, adipocytes and myocytes. Stem cells from human exfoliated deciduous teeth are also capable of repairing critical-size parietal defects in immunocompromised mice; however, the bone generated by these cells lacks hematopoietic marrow elements. In addition, neural developmental potential was studied by injecting SHEDs into the dentate gyrus of the hippocampus of immunocompromised mice. These studies showed that SHEDs can survive for more than 10 days inside the mouse brain microenvironment and express neural markers such as neurofilament M (NFM).[14]

The ethical constraints associated with the use of embryonic stem cells, together with the limitations of readily accessible sources of autologous postnatal stem cells with multipotentiality, have made SHED an attractive alternative for dental tissue engineering.[13] The use of SHED for tissue engineering might be more advantageous than that of stem cells from adult human teeth; they were reported to have a higher proliferation rate than stem cells from permanent teeth, and can also be retrieved from tissue that is disposable and readily accessible. Thus, they are ideally suited for young patients at the mixed dentition stage who have suffered pulp necrosis in immature permanent teeth as a consequence of trauma.[15]

STEM CELLS FROM APICAL PAPILLA

A potentially new type of stem cell has been discovered in the apical papilla of human immature permanent teeth. The distinction between the dental pulp and the apical papilla is that the apical papilla represents a precursor tissue for the radicular pulp. SCAPs obtained by explant cultures or enzymatic digestion of apical pulp tissue, are derived from a developing tissue that may represent a population of early stem/progenitor cells. SCAPs may thus be a superior cell source for tissue regeneration.[16] SCAPs express mesenchymal markers, such as CD13, CD24, CD29, CD44, CD73, CD90, CD105, CD106 and CD146 and do not express CD18, CD34, CD45, or CD150. Stem cells from apical papilla also have the capacity to undergo osteo/dentinogenic, neurogenic, and adipogenicity differentiation.[17] In fact, SCAPs display an expression pattern of osteo/dentinogenic markers and growth factor receptors similar to that observed in DPSCs, but these markers are expressed at lower levels in SCAPs than in DPSCs. Despite these findings, the myogenic and chondrogenic differentiation potential of SCAPs has not been determined. The discovery of stem cells in the apical papilla may also explain a clinical phenomenon described in a number of recent clinical case reports showing that apexogenesis can occur in infected immature permanent teeth with peri radicular periodontitis or abscess. It is likely that the SCAP residing in the apical papilla survive

such pulp necrosis because of their proximity to the vasculature of the periapical tissues. Therefore, after endodontic disinfection, and under the influence of the surviving epithelial root sheath of Hertwig, these cells can generate primary odontoblasts that complete root formation.[18]

PERIODONTAL LIGAMENT STEM CELLS (PDLSCS)

Seo et al. (2004) suggested that human PDL contains a population of postnatal multipotent stem cells that can be isolated using explant cultures or enzymatic digestion and expanded in vitro. The presence of MSCs in the periodontal ligament is also supported by the findings of Trubiani et al, who isolated and characterized a population of MSCs from the periodontal ligament which expressed a variety of stromal cell markers, PDLSCs express MSC markers such as CD10, CD13, CD29, CD44, CD59, CD73, CD90 and CD105, and do not express CD14, CD34, CD45, HLA-DR.[19]

Periodontal ligament stem cells have the capacity to differentiate into cells similar to cementoblasts and collagen-forming cells. Formation of calcified nodules is less prominent than that observed with DPSCs and SHEDs. Furthermore, PDLSCs have the ability to differentiate in vitro into adipogenic, osteogenic and chondrogenic cells.

In vivo, PDLSCs have the capacity to differentiate into functional cementoblasts when transplanted subcutaneously on the dorsum of immunocompromised mice, and had the capacity to form collagen fibres embedded in the cementum-like tissue, suggesting the potential to regenerate the cementum/PDL-like tissue in vivo.[18]

DENTAL FOLLICLE PROGENITOR CELLS

The dental follicle is a mesenchymal tissue that surrounds the developing tooth germ. The dental follicle plays a crucial role in tooth development and contains precursors of the periodontium. Precursor cells have typically been isolated from human dental follicles of impacted third molars using explant cultures or enzymatic digestion of dental follicle tissue. Similar to other dental stem cells, these cells form low numbers of adherent clonogenic colonies when released from the tissue by enzymatic digestion and can be maintained in culture for at least 15 passages.[19]

Dental follicle progenitor cells (DFPCs) express CD10, CD13, CD29, CD44, CD53, CD59, CD73, CD90 andCD105, and do not express CD34, CD45, or HLA-DR. DFPCs have the ability to differentiate into osteoblasts/cemented-lasts, chondrocytes and adipocytes when grown in appropriate osteogenic, adipogenicor chondrogenic media. In vitro findings suggest that DPSCs have greater hard tissue-forming potential than DFPCs.[20] This might be explained by the developmental stage of the tooth germs from which these cells are derived. At the crown forming stage, mineralization (dentinogenesis) can be detected in certain areas of the dental papilla, but not in the dental follicle (cement genesis). Immortalized dental follicle cells are able to re-create a new periodontal ligament (PDL) after in vivo implantation; however, hard tissues such as dentine, cementum, or bone have not been identified after transplantation of these cells into immunocompromised mice. More in vivo studies are thus needed to confirm the potential forward tissue regeneration.[21]

CONCLUSION

Postnatal stem cells residing in the dental tissues are extremely promising in terms of regenerating tissue; however, there use in a clinical setting to induce apexogenesis or apexification using stem cells, morphogens and scaffolds is presently unpredictable and its applications in endodontic practice are some way off. The expression of common proteins for DPSC, SHED, SCAP, PDLSC and BMSSC may implicate a common origin and molecular pathway regulating dentine, cementum and bone formation; however, the phenotype repopulating the open root apex will be selected by environmental factors.

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EFFECTS OF ENERGY DRINKS ON TEETH: A REVIEW

[1] Lekh Raj N.Girish, [2] Aarathi Vijayan

ABSTRACT

Energy drinks have gained popularity among consumers, particularly among young adults and athletes seeking increased energy and alertness. However, the excessive consumption of these beverages has been associated with various adverse health effects, including dental problems such as enamel erosion, dentin hypersensitivity, and dental caries. This review aims to explore the current understanding of the effects of energy drinks on dental health, focusing specifically on enamel erosion, dentin hypersensitivity, and dental caries. The review discusses the composition of energy drinks, the mechanisms through which they can lead to dental erosion and caries, the effect on restorative materials, the effect on overall oral health, and the clinical implications of their consumption. Furthermore, potential preventive strategies and recommendations for dental practitioners and consumers are also discussed.

Keywords : energy drink, dental erosion, dentinal hypersensitivity

INTRODUCTION

Energy drinks are non-alcoholic, often lightly carbonated beverages designed to give a burst of energy by the addition of several energy-enhancing ingredients, most notably caffeine.[1] Sports drink consumption has increased dramatically year by year. These drinks are typically formulated to (a) prevent dehydration, (b) supply carbohydrates to augment available energy, and (c) provide electrolytes to replace losses due to perspiration.[2] These beverages, when in contact with teeth, will reduce the pH at the tooth surface to a level below the critical value of 5.5 for demineralization of enamel and eventually, dissolution of the smear layer at the level of cemento-enamel junction whenever exposed to the oral environment by root caries or periodontal disease.

DISCUSSION

Dental erosion is an irreversible loss of hard tissues due to a chemical process such as dissolution or chelation without the involvement of microorganisms.[3]

[1] Intern, Azeezia College of Dental Sciences and Research, Kollam.[2] Professor and Head, Department of Public Health Dentistry, Azeezia College of Dental Science and Research, Kollam. [3] Dental Surgeon, Dr Subramony's Suparna Dental Clinic. Nedumangad, Trivandrum.

Correspondence : Lekh Raj N. Girish.

Email: lekhrajgirish2255@gmail.com

How to cite this article : Girish LRN, Vijayan A. Effects of Energy Drinks on Teeth: A Review. Impressions. 2024;14(3):Page No. 32-36

Source of support : Nil,

Conflict of Interest : None declared.

Dental erosive wear may be caused by internal or external factors. Internal factors include gastroesophageal reflux and eating disorders with vomiting, while intake of acidic foods and drinks are external factors. A high intake of acidic beverages is considered to be the main external cause of erosive tooth wear.[2] Acidic beverages and foods lower the pH level of the oral cavity so consuming those causes the teeth to demineralize and loss of hard structure gradually.[4] Factors such as pH, salivary flow, and buffering capacity play an important function in the formation of erosion lesions. Studies reporting the frequency of the ingestion of soft drinks and other low-pH beverages have shown an increased potential in the formation of dental erosive lesions.

Dentin hypersensitivity, often referred to as tooth sensitivity, is a common dental condition characterized by short, sharp pain in response to various stimuli, such as hot, cold, sweet, or acidic substances, as well as tactile stimulation, like brushing or flossing. This discomfort typically arises from exposed dentin, the inner layer of the tooth, which contains microscopic tubules that lead to nerve endings within the pulp of the tooth.[4]

Enamel erosion and dentinal hypersensitivity:

Research that acidic fruit juices and energy drinks cause tooth erosion has been reported in the early years. Most of these drinks' pH is 2~4 (strong acid), the critical pH of enamel dissolution is pH 5.5, and acid food that is lower than pH 4 is more dangerous and could cause more dental erosion.[5]

Energy drinks are thought to participate in teeth hypersensitivity because of two inherent properties first, the low pH and titratable acidity, and second the fermentable carbohydrates in drinks that can be metabolized to generate organic acids. Research has demonstrated that drinks with a pH of 5.5 or less tend to erode and soften teeth surfaces and eventually remove the protective smear layer on the root.[6]

For analyzing the state of tooth erosion, results of usually used methods such as surface microhardness, SEM, percentage weight loss of teeth structure, plaque pH, effect of temperature, and calcium-chelation are mentioned below:

Surface microhardness: is effective in measuring the change in the surface microstructure as a method for indirectly measuring the degree of demineralization of the initial lesions. Reported dental erosion caused after processing, and on other many studies reported a big connection between pH of drinks and dental erosion.[1]

Scanning electron microscopy(SEM): is shaping the surface structure of the sample image which can be seen by an optical microscope at a much higher resolution by using an electron beam. It is possible to see the fine region having a size smaller than the wavelength of visible light through the electron beam is focused by a magnetic lens. On case energy drinks a view to fine cracks between the crystal surface was slightly rough, because of the erosion.[1]

Weight loss: There is alteration or reduction of tooth structure on exposure of the tooth to different beverages. Red bull showed 21% reduction in weight of the immersed tooth specimens.[4]

Plaque pH: Sport drink contains 7.5% sugar and is usually not recognized as a cariogenic beverage since it does not contain sweet as other sugar-containing beverages. Since sport drink is consumed continuously during exercise, there is prolonged and frequent contact of the drink with the teeth. Subsequently, erosive dental lesions have been reported among athletes and other physically active people. Phosphoric and citric acid are

common ingredients found in either regular, diet or high energy soft drinks. It was demonstrated that diet soft drinks caused less of a decrease in plaque pH when compared to regular soft drinks and high energy drinks following consumption.[5]

Effect of temperature: Increased temperature and exposure periods have also been reported to increase the erosion and/or dissolution of enamel surface structure. Higher temperatures accelerate the chemical reaction rate, which can lead to faster erosive dissolution of teeth. An increased solubility and diffusion coefficient rate of ions (calcium and phosphate) in aqueous solution through the enamel at higher temperatures has been reported.[6]

Chelation: Another factor in the new improved erosion scheme is "chelation". The importance of chelation (calcium-complex formation) is another property that has been and is still overestimated in connection with dental erosion. The reason is that erosion is associated with low-pH products. The anions of citric acid (contained in many juices) or phosphoric acid (contained in cola drinks), which have the highest affinities for calcium ions are the completely dissociated forms citrate3- and $PO_4$3-, and at low pH these anions are present at such low concentrations that this complexing effect is negligible. If an acid has a high buffering capacity, it takes longer to be neutralized by saliva, which leads to a higher risk of softening of the tooth surface. The greater the buffer capacity, as measured, for example, by the amount of acid-neutralizing base needed to increase the pH to 7, the more erosive this substance will be compared to other acidic foods provided that the other parameters are the same.[7]

EFFECT ON RESTORATIVE MATERIAL

Acidic beverage consumption may affect the esthetic and physical properties of restorative materials, such as resin composites, compomers, and giomers. Color stability is one of the most important features of tooth-colored restorative material, while discoloration of the restoration can lead to a major failure and need replacement.

Titanium, composite, fissure sealant

The results of Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) studies on titanium (machined, anodized Titanium), the two types of composites (Estelite SQ composite, Filtek Z250 composite), and the fissure sealant discussed confirmed that energy drinks cause a significant change in the surface roughness and morphology of the various dental materials.

Machined Ti surfaces are more vulnerable to energy drinks than anodized Ti surfaces. Furthermore, it was established that for composite materials with different compositions and different particle arrangements, the impact of energy drinks is altered. Where the surface is characterized by a regular, uniform particle arrangement, energy drinks are much less able to affect the roughness, while for samples where the surface is rich in aggregates, the material erodes much more easily the surface. The surface structure of the fissure sealant discs is characterized by the disordered location of the grains, different particle sizes, and aggregate formation.[8]

Self-adhesive restorative material

These self-adhesive materials contain self-etching and/or self-adhesive monomers that can etch enamel and dentin surfaces or chemically bond to hydroxyapatite. Self-adhesive materials are Alkasite (Cention N), High viscosity glass ionomer, and Glass Carbomer.[4]

The energy drinks have a substantially damaging effect on surface roughness of self-

adhesive materials compared to soft drinks and distilled water; and this effect is increasing with duration of exposure. The erosive potential of beverages is primarily related to the titratable acidity level. Application of coatings on glass ionomer materials surfaces can increase the resistance to abrasion for a short period of time by improving the strength of the material. However, it should be known exactly how important this protection effect is in wear strength.[9]

EFFECT ON OVERALL ORAL HEALTH

Saliva pH and periodontal disease

The oral health status depends on the diet we consume day to day. This decade has shown a global increase in the production and consumption of carbonated and energy drinks. People are unaware of the acidogenic and cariogenic properties of carbonated drinks. A decrease in salivary pH creates an acidic oral environment causing dry mouth, tooth decay, and bad breath.

Saliva has a normal pH of 6.7 ranging between 6.2-7.6. In the oral cavity, the pH is maintained near neutrality (6.7-7.3).

The saliva maintains the pH by two mechanisms which include the elimination of the carbohydrates which could be metabolized by the bacteria thus acid production by the bacteria is removed and acid produced by food, drinks, and microbes is neutralized by the buffering activity of saliva. Thus decrease in the salivary pH provides an acidogenic environment for the growth of aciduric bacteria leading to dental caries which again further lowers the salivary pH leading to a vicious cycle. Salivary pH is a diagnostic biomarker for periodontal diseases. In patients with generalized chronic periodontitis, the pH of saliva was found to be more acidic.[10]

pH became more acidic after consuming carbonated drinks. On consumption of energy drinks even after a reduction in pH after 5 minutes, it increased in pH after 10 to 15 minutes and almost reached the baseline. Thus in this century of craving more soft drinks, it is better to at least consume energy drinks compared to carbonated drinks even though both are harmful to the oral environment. More clinical trials should be conducted with various energy drinks to confirm.[10]

Dental caries

Dental caries is a chronic and multifactorial disease related to several factors, such as sugar intake and dietary habits, salivary flow, susceptibility of the tooth, oral hygiene, and fluoride exposure. Sugars derived from diet are the most important factor in the development of dental caries. Sugar-sweetened drinks (SSDs), such as soft drinks, and energy drinks (excluding bottled water), contain large amounts of refined carbohydrates in the form of sucrose, glucose syrup and high fructose corn syrup.[11]

Therefore, frequent intake of drinks with high sugar content can contribute to a high risk of dental caries. Many studies have shown a strong association between the consumption of soft drinks and dental caries development. Sugars in soft drinks are metabolized by plaque microorganisms (Streptococci mutans, Streptococcus sorbrinus, and Lactobacilli) to produce organic acids, such as lactic acid. Lactic acid then lowers the salivary and plaque pH, causing demineralization of the dental hard tissue and carious lesions. In addition to the sugar content, soft beverages are acidic in nature, contributing to the fall in pH. Although saliva promotes remineralization by the buffering capacity, the development of caries can be increased with frequent consumption of soft drinks, increased exposure time, and poor oral hygiene.[12]

CONCLUSION

To conclude dental erosion, removal of the protective smear layer at the exposed tooth cervix, and the eventual feeling of hypersensitivity seem to have a relationship with energy drinks consumption mainly represented by their low pH and total acidity as well as high total sugar content. The strong relation between the surface microroughness of restorative materials and energy drinks has been ruled out. Information and recommendations to patients at risk should include advice to reduce the consumption of acidic drinks to avoid any additives (mainly smoking, and alcohol) that could cause lower pH values exaggerate the side effects, and maintain good oral hygiene to reduce caries and periodontal diseases. Given the increasing consumption of soft drinks and their significant impact on oral health, healthcare professionals must have a comprehensive understanding of their potential implications. Further studies in this field are necessary to establish a more definitive link.

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Volume - 14., Issue - 3 | SEP-DEC 2024