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EDITORIAL

Earth provides enough to satisfy every man's needs, but not every man's greed

Our state is recovering from a major flood, exactly a year after being hit by another one. Last year's floods were described as a once-in-a-century calamity, this one was an ecological disaster waiting to happen. Along with extremely heavy rain, an analysis of the floods shows that the huge number of deaths in the floods could be linked to the rampant destruction of the Western Ghats, the biodiversity hotspot that covers about half of Kerala. Experts warn that if the destruction goes on unchecked, future floods could bring even bigger disasters in India's monsoon gateway. Massive constructions have destroyed the slope of the hills and changed the course of rivers. "Behind every landslide, there is an unscientific change of crops, cutting off the slope of the hill, construction, and quarrying. These findings were based on the well-crafted study made by Madhav Gadgil. Speaking to media, the chairman of Gadgil Committee, Madhav Gadgil said that what happened in Kerala is a man-made calamity.

Environmental issues are big issues now-a-days about which everyone must be aware and give their positive efforts to solve such issues. It is to promote people to change their attitude towards the environment for making a safe future. As a little step towards achieving this, our institution has taken an initiative to plant 1000 saplings in Mukkam municipality. Together we should work towards a Green Campus by planting trees, bio-composting, reducing plastic usage, recycling and conserving water, restricting use of automobiles and going for non -conventional sources of power.

Dr. Manoj Kumar KP
Chief Editor

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PAINLESS JAW SWELLING : PERPLEXING CASE

*Dr. Fawaz Ajmel, **Dr. Ashir K.R., *Dr. Prejith Sampath

Abstract

The mandibular hyper parathyroid brown tumour is considered a rare metabolic disorder, also known as mandibular osteoclastome. This lesion is triggered by the excess of the production of parathyroid hormone (PTH). PTH are directly linked to mechanisms of control of levels of calcium, phosphorus and vitamin D, which confers the lesions the aspect of numerous osteoclastic cells, circumscribed and richly vascularised which causes their reddish-brown coloration. Individuals affected by this disorder show signs and symptoms of weakness, nausea, fatigue, anorexia, excessive thirst, polyuria, constipation and consequently depression. The purpose of this article is to perform a literature review by describing the case of mandibular brown tumour, explaining the conduct performed according to the case by clinical and radiological image studies that guided the case.

Keywords: hyperparathyroidism; bony swelling; radiolucent jaw lesions

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Introduction

Parathyroid hormone, which is produced by the four parathyroid glands located posterior to the thyroid gland, are responsible for the control of phosphorus (P), calcium (Ca) and vitamin D. The level of calcium present in the blood is considered a triggering factor of the disorder by the release and production of this hormone. "The hyperparathyroidism- HPT is a disease in which there may be a complex, of biochemical anatomic and clinical abnormalities."

Brown tumour, has its determinant a metabolic bone disarray caused by the excess production of PTH. Therefore the Brown Tumour has its histopathological complexity described as multiple adenomas, numerous osteoclastic cells, of cystic format, and separated by a highly vascularized tissue which will confer the lesion a dark red or brownish colouration which characterizes its nickname.

It usually affects young people especially females with varying degrees of aggressiveness and risks of recurrence. It can affect the base of the skull, orbits, paranasal sinuses, spinal column as well femur, tibia, humerus, clavicles and scapula. However, it is relatively rare in the maxilla with a

frequency of 4.5–11.8 percent. Radiologically, brown tumour in the jaws presents as a well-defined radiolucent osteolytic lesion that can encircle the roots of teeth, making it hard to differentiate it from other expansive lesions that can present with a similar imaging.

Usually brown tumours do not present with pain unless their dimensions are large enough to compress neighbouring nerve structures. They are often discovered incidentally on routine radiological examinations. In most cases, when the pathway of growth of the tumour is closed and its position is not causing clinical problems, its surgical treatment is not indicated nor necessary.

The most important complications of this neoformation are related to its position and size and the possible effects on nearby structures. It can be a cause of an increased risk of fracture, of spinal cord compression, or of facial disfiguration, compromising normal functions such as mastication, compression, phonation, and social ease of the patient.

The clinical management of a brown tumour aims primarily to reduce the elevated parathyroid hormone levels by pharmacological treatment. Surgical treatment is reserved to nonresponders or to patients with painful symptomatology or alteration of normal function.

Case report

In this paper, we describe a 42-year-old male patient residing at Mukkam who presented with a swelling of the chin region since one year. The swelling was small which gradually increased in size. He also complains of difficulty in chewing. There was no other swelling anywhere else in the body. His medical history revealed arterial hypertension and chronic renal failure for which he is on medication. He has been undergoing dialysis 3 times per week for the last 5 years and is also under anticoagulation therapy. On clinical examination a diffuse swelling on the chin region of size approximately 3 cm x 5 cm, extending from the lower border of the lower lip superiorly to the lower border of the chin inferiorly was seen.

Fig. 1(a)

Fig. 1(b)

Fig 1a, b, c: Extra oral, intraoral and panoramic view

Table 1: Laboratory investigations

Parameter	Observed value (Normal value)
PTH	285.5 pg/ml(10 to 65 pg /ml)
Calcium	9.79 mg/dl(8.5 to 10.2 mg/dl)
Phosphorous	2.33 mg/dl (2.5 – 4.5mg/dl)

On intra oral examination, there was buccal and lingual expansion of the mandible with a smooth surface and no pus discharge. Additionally, there was obliteration of the sulcus with dilated veins on the surface.

On palpation, inspection findings regarding site, size, shape & extent were confirmed. It was a bony hard swelling which was non-tender , non -pulsatile, non-fluctuant and non compressible with no rise in local temperature. Patient was advised to take an orthopantomogram (OPG) and to check his serum PTH, calcium, phosphorus and alkaline phosphatase levels.

Panoramic radiography revealed a solitary, oval-shaped, well-defined, unilocular radiolucency with corticated border in the anterior mandible. It extended mesio-distally from the mesial surface of 44 to the distal surface of root of 34 and superior-inferiorly from 3 mm below the alveolar crest to 5 mm from the lower border of mandible of size 3 cm x 5 cm. The internal structure was completely radiolucent with root resorption and displacement of roots in relation to 42, 41, 32, and 31. There was generalized loss of lamina dura and a ground-glass appearance. The patient's history and physical examination along with the radiological and lab investigations pointed to a diagnosis of

Brown tumour as a result of hyperparathyroidism secondary to chronic renal failure.

Discussion

The Brown tumour is a lesion associated with the hyperparathyroidism and can be divided into primary or secondary.

Etiology/pathophysiology can be due overactivity of the parathyroid glands, can be associated with increased production of parathyroid hormone (PTH), hypertrophy of one or more of the parathyroid glands (usually in the form of an adenoma) and also from: glomerulonephritis, pyelonephritis CRF.

It can be classified in to:

- Primary HPT: Parathyroid adenoma, Parathyroid hyperplasia
- Secondary HPT: PTH is continuously produced in response to chronic level of serum Ca due to chronic renal failure, prolonged dialysis, severe malabsorption
- Tertiary HPT: Prolonged secondary HPT.

It is associated with clinical manifestations like stones, metastatic calcifications in soft tissues, renal calculi, blood vessel calcification, subcutaneous soft tissue calcification, calcification of sclera, dura calcification, calcification of joints.

Oral manifestations include one of the first signs is development of malocclusion because of drifting of teeth giant cell tumors and pseudo- cysts of the jaws are the other possible lesions found. Population with the incidence of tori nearly three times higher in HPT patients.

Radiographically, identified this brown tumour of hyperparathyroidism, due to the presence well defined unilocular or multilocular radiolucency with subperiosteal erosion at the mandibular angle, resorption of the inferior cortex of the mandible, lining of mandibular canal, mental foramen, walls of antrum and nasal cavities. In addition, skull radiographs show patchy regions of demineralization ("salt and pepper" appearance). Reduced radicular lamina dura density and may reflect the localized impact of PTH in the PDL space to evoke cortical bone loss in the area adjacent to the tooth, Generalized demineralization shows an unusual radiolucency Osteitis fibrosa generalisata. It is also called as osteitis fibrosa cystica as they appeared cyst-like on radiographs. Develop cortical resorption and rarefactions, loss of trabeculation presenting as "ground-glass" appearance, Partial or total loss of lamina dura, lytic lesions, and metastatic calcifications. Brown tumors are peripheral or central tumors of bone are seen in the late phase of the disease in 10% of the cases.

Histologically, the Brown tumour of hyperparathyroidism manifests as a mass of soft tissue composed of a giant cells inside the fibro vascular stroma, presenting focus of bleeding and hemosiderin deposition as a friable red mass.

In summary, this case shows that it is possible to avoid surgical of a large brown tumour even though it compromised the physical appearance of the patient and caused dysfunction of the masticatory apparatus. The

surgical resolution of hyperparathyroidism was enough to correct the calcium-phosphate-PTH imbalance and to result in regression of the jaw lesions.

Conclusion

Brown tumour can develop very quickly as happened in this case. Medical treatment, even if appropriate can be insufficient to control the secondary hyperparathyroidism. Therefore, an early diagnosis and a timely parathyroidectomy in a medically resistant case of hyperparathyroidism is the optimal option to control the growth of the bony lesion and to avoid further weakening of the bone structure and consequent increased risk of fractures, compression of contiguous structures, deformities, and functional alteration of other involved areas of the skeleton.

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ESTHETIC REHABILITATION OF A PATIENT WITH BULKY MAXILLARY RIDGE USING GUM FIT DENTURE– A CASE REPORT

*Dr. Roshy George, **Dr. Sheejith M., *Dr. Nicholas Mathew,
*Dr. Abu Nazar, ***Dr. Anaswara Rose, ****Dr. Amrtha Maria

Abstract

Patients with bulky maxillary ridges can have compromised esthetics. The thickness of labial flange of denture can further worsen the situation by increasing the lip fullness. Though alveoloplasty is advocated in such situations, it can result in patient discomfort and denial of treatment. An esthetic and comfortable alternative is flangeless denture or gum fit denture. This case report portrays the treatment of a lady patient with maxillary ridge which was bulky and had severe undercut who was concerned about her esthetics, but not willing to undergo alveoloplasty, treated with gum fit denture.

Keywords: gum fit denture, flangeless denture, severe undercut

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Introduction

Fabrication of complete denture in patient can be a challenging when the intra oral conditions are less than ideal. Some cases require pre-prosthetic surgery, special impression techniques and special denture fabrication techniques. The main objective of pre-prosthetic surgery is to create an environment to achieve good esthetics, retention, support and stability for the denture.[1,2]

The pre-prosthetic surgery is especially important before denture construction when patient has bulky maxillary ridge with severe undercuts. The further delay in healing and the mental trauma associated with alveoloplasty results in the denial of surgical corrections. In these scenarios the prosthodontists are forced to follow alternate methods such as gum fit denture or flangeless denture to meet the patient needs.

Case report

A forty five year old lady came to the department of prosthodontics with the chief complaint of missing maxillary and mandibular teeth since 3 months. On intraoral examination, satisfactorily healed edentulous maxillary and mandibular ridges were observed (Fig 1 & 2). The maxillary ridge was bulky with severe undercuts from 13 to 23 regions. The madibular ridge was Atwood's order III.[3]

Fig 1: The bulky edentulous maxillary ridge

Fig 2: Atwoods order III mandibular ridge with severe undercuts from 13 to 23

Various treatment options were explained to the patient including implant supported prosthesis or alveoloplasty with a conventional complete denture. Since the patient was hesitant to undergo any kind of surgical procedure, a flangeless maxillary denture with conventional mandibular denture was planned.

Primary impressions were made using irreversible hydrocolloid impression material. Special trays were fabricated on the primary cast. Border molding was done using green stick compound. Light body polyvinyl siloxane was the material of choice for the final impression. Once the master cast, denture base and occlusal rims were ready, jaw relation was recorded. The jaw relation was transferred to an articulator and teeth setting was completed. Try in was done in a conventional manner and denture was fabricated subsequently. Once the dentures were ready, the labial flange from 13 to 23 regions was reduced (Fig 3 & 4), so that the flange extends exactly till the undercut starts. This reduces the chance for entrapment of air in between the denture and maxillary ridge, thus not compromising the retention. The removal of flange also helped in reducing the labial fullness which enhanced the esthetics (Fig 5). The dentures were polished and attempted in the patient's mouth for assessment. With the required occlusal corrections being done, the dentures were delivered.

The patient was reviewed following 24 hours, a week and one month for post-insertion visits. The patient was satisfied and had no critical grievances.

Fig 3: Gum fit denture in maxillary arch

Fig 4: Conventional complete denture in mandibular arch

Fig 5: Good esthetics in gum fit denture

Discussion

Residual ridge anatomy varies from patient to patient. Patient with excessive bulky ridges often have a compromised facial esthetics. The thickness of the labial flange further compromises the labial fullness and result in an unesthetic maxillary denture. Preservation of facial esthetics is as crucial as prosthodontic rehabilitation of missing teeth.[4] To confront such situations, an unconventional approach by providing flangeless maxillary complete denture can be followed. "Gum fit dentures", "ridge grip esthetic prosthesis" and "wing dentures" are the various synonyms for flangeless dentures.[5]

Conclusion

Flangeless dentures provide an easy and simple alternative for patients who do not opt for surgical options for the correction of over-contoured ridges. They remain successful in providing satisfactory esthetics and better patient acceptance.

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NANOTECHNOLOGY IN PERIODONTOLOGY

*Dr. Krishnapriya,*Dr. Fathima Hiba, *Dr. Fathimathal Zehra,
**Dr. Harish Kumar VV, ***Dr. Santhosh VC

Abstract

Delivering drug to the gingival epithelium has been the major challenge for the formulation scientists due to the complexity of the anatomy of the route and the contours of the lesion which leads to the drug's poor penetration to the area. However, the recent nanotechnology innovations are increasingly providing a suitable solution for the treatment of many dental disorders including periodontal disease.

Keywords: Nanotechnology, Periodontitis, Management

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Introduction

Periodontal disease is one of the major dental illnesses that affect millions of people around the globe. Being a chronic inflammatory disorder, it is characterized by inflammation and degeneration of the teeth surrounding structures including gums, alveolar bone, periodontal ligament (PDL) and cementum.[1,2] The disease starts with anaerobic gram-negative bacterial invasion around the gingival sulcus [3] leading to the migration of the gingival epithelium along the tooth surface forming periodontal pockets. This when left untreated can lead to deposition of calculus by the microbes and consequently results in the destruction of the tooth neighboring structures and loss of teeth.[4,5] Delivering drug to the gingival epithelium has been the major challenge for the formulation scientists due to the complexity of the anatomy of the route and the contours of the lesion which leads to the drug's poor penetration to the area. There are various proposed local drug delivering devices which include films, fibers, gels and strips etc., but unfortunately, these approaches were only partially successful due to the difficulty in accessing the periodontal pockets.

However, the recent nanotechnology innovations are increasingly providing a suitable solution for the treatment of many dental disorders including periodontal disease. Nanotechnology is the engineering of molecularly precise structures. The term "nanotechnology" was coined by Professor Kerrie E. Drexler, a lecturer and researcher of nanotechnology. The prefix "nano" means 10-9 or one billionth of a unit. The Nano scale is approximately 1000 times smaller than a micro scale, which is approximately 1/80000 the diameter of a human hair. These small scientific scales were first revolutionized by Richard Feynman at his famous speech at the Annual Meeting of the American Physical

Society in 1959 entitled: "There is plenty of room at the Bottom". He proposed that machines and tools that make smaller machine tools could in turn be used to make even smaller machines and tools, right down to molecular levels. In his historical lecture in 1959, he concluded by saying, "This is a development, which I think cannot be avoided".[6]

A dental field of nanotechnology called nanodentistry is very promising and have demonstrated various treatment opportunities in dentistry in areas such as dental re-naturalization, local anesthesia, teeth hyper-sensitivity cure[7], periodontal regeneration,[8] controlled drug delivery[9,10] and overall oral health maintenance,[11] among others. This highly promising field may ensure the attainment of near perfect oral health by way of using nanomaterials, nanorobotics, biotechnology, etc.[12,13]

Nanodentistry will make it possible to induce local anesthesia efficiently in the years to come, through the aid of nanorobots. Colloidal carriers containing active analgesic dental nanorobotic particles in millions and/or antibacterial agents could be directly installed into the patient's gingivae. These nanorobots would be able to make surface contact with the mucosa/crown and eventually get to dentin by moving painlessly through the gingival sulcus to the target site.[7] The future roles of nanotechnology approaches seem to influence almost every aspect of human life, and with its advancement, researchers are acquiring abilities to understand and manipulate materials at the nanoscale.[14]

There are various promising nanotechnology-based approaches in the field of nanodentistry that are being investigated or developed for dental therapy such as nanofibers, nanotubes, nanocapsules, nanopores, quantum dots (QDs), dendrimers, nanoshells, nanofillers, nanorods, nanorings, fullerenes, nano-spheres, nanowires and nanobelts.[15,16] Some of these approaches have demonstrated satisfactory outcomes toward minimizing undesirable side-effects for various active agents while maximizing the therapeutic activity. This review covers various recently investigated nanotechnology-based appro-aches for the treatment of periodontal disease, with emphasis on the keys roles which these approaches play towards achieving effective therapy.

Roles of nanotechnology-based approaches

In nano-diagnostics

Over the years, many strategies have been designed and implemented for the diagnosis of dental illnesses including periodontal disease. However, most of them suffer accessibility problem, hence the need for concerted efforts to improve diagnostic tools and techniques. Nanotechnological innovations provide scientists and researchers with the new hope for progress in this direction through the advent of nanodiagnostics and its rapid transformation. Nanodiagnostics is a phenomenon that involves the use of nanotechnological advancement for clinical and molecular diagnostic purposes. The increased demands for highly sensitive and early disease

detection tools has led to the development of this novel technology, in order to meet the demands of clinical diagnostics.[17] Nanodiagnostics would significantly reduce the waiting time for results after a test is conducted. The technology will help in the use of nanodevices for early disease diagnosis at molecular and cellular level.[17]

Quantum dots (QDs)

QDs are among the most promising nanostructures for diagnostic applications. These are tiny semiconductor nanocrystals that are stable, non-toxic and glow brightly when stimulated by ultraviolet light. Their strong light absorbance property qualifies them to be used as fluorescent labels for biomolecules. Their roles are beyond diagnostic applications, as they have also been found to play the role of photosensitizer and carrier.[12] QDs can attach an antibody to the target cell upon stimulation by UV light, and consequently yield a reactive oxygen species that is capable of destroying the target cells.[12] Some other roles of QDs are their ability to be embedded into dental resins to tune the emission color of the resin. Lead-free and cadmium-free QDs are employed in periodontal therapy to enhance the healing of inflamed periodontal tissues.[18]

Nanoscale cantilevers

Nanoscale cantilevers are tiny beams resembling a row of diving boards or those as in atomic force microscopy, and they are fabricated by using semiconductor lithographic techniques.[19] Nanoscale cantilevers exercise its function through nanomechanical deflections and are used for deoxyribonucleic acid (DNA) hybridization to monitor molecular events. When nanoscale cantilevers are coated with certain receptor molecules, they can bind to specific DNA-substrates; bacterial cells; or viruses, and the overall effect would be the detection of single molecules (DNA or protein); specific pathogenic bacteria or viruses. Nanoscale cantilevers are developed as an integral division of larger diagnostic tools that can provide sensitive and rapid detection of inflammation and cancer-associated molecules, of which periodontal disease could be an important target. Nanoscale cantilevers can scan sample and yield hybridization with the single-stranded DNA when the targeted sequence is determined. This is another important feature of cantilevers that can permit multiple analyses.[17]

Gold nanoparticles

Gold nanoparticles are among the novel diagnostic tools for healthcare investigations. They are developed from thin gold layers or tiny gold spheres and possess good detection sensitivity for various targets.[20] Gold nanoparticles that are coated with silver shells possess strong light-scattering properties with improved detection capacity. These essential diagnostic materials can allow rapid, direct and economically feasible analysis of samples from whole blood. Gold nanoparticles can be functionalized to detect specific targets due to their high surface-to-volume ratios which offer higher selectivity as compared to conventional approach.[21,22] Early diagnosis of periodontal disease is essential in order to initiate suitable therapy

and prevent its progression to advance form of the disease. The unique essential optical features of gold nanoparticles, as described above make them a key role players in the early and rapid diagnosis of periodontal disease.

Nanotubes

Nanotubes such as boron nitride or carbon rods are very small and are used as electrodes with single-stranded DNA probes for detection sensitivity in the attomole range, and in hybridization of the target DNA or protein. They can also be adapted for analytes other than DNA, e.g., by attaching enzyme to detect substrate analyte.[19] Its internal and external surfaces can be chemically functionalized to entrap drugs, and their unique open-ended barrels may make the internal surface accessible and allow incorporation of certain active molecules within the tubes easily.[16] Therefore, the inner volumes of the tubes can be filled with any suitable chemical or biochemical agent for delivery to the targeted location. Examples of nanotubes include fullerene carbon nanotubes, organosilicon polymer nanotubes, peptide nanotubes and template-synthesized nanotubes.[16]

Nanopores

These are tiny (molecular-scale) structures that have great sensitivity and detection capability of the conformation and location of a single molecule that is situated in the pore lumen.[23,24] The nanoholes of nanopores can permit passage of DNA and can also make DNA sequencing even more efficient. The characteristic change in the nanopores conductance enables researchers to be able to electrically elucidate single-molecule kinetic pathways as well as quantify the target easily.[24] Through nanopore technological innovations, it became possible to count and/or distinguish between a variety of unlike molecules in a complex mixture.[17] For instance, the technology can allow the differentiation between hybridized or unhybridized unknown DNA and RNA molecules that differ only by a single nucleotide.[17] This technology could be applied in periodontal disease diagnosis at the molecular level.

In prevention

For a very long time, conventional dentifrices such as gargles, mouthwashes, toothpaste and throat paints have been the most commonly used traditional products for maintaining oral hygiene and oral preventive measures, until recently when nanotechnology provide novel approaches for preventive measures against oral cavity diseases such as periodontal disease and dental caries.[10] Certain agents in nanoscale can be incorporated in these conventional dentifrices to aid in repelling the deposition of bacterial biofilms (plaque and tar) and/or prevent dental caries by remineralization of early carious lesions, and in desensitization of abraded teeth.[25]

Some ceramics like calcium phosphates and nanosized calcium carbonate particles (also called hydroxyapatite) has been reported to be a suitable ingredient for dentifrices that can be effectively used in the process of enamel remineralization. Among these ceramics, hydroxyapatite gain more attention

being it the prototype in bone as well as tooth apatite crystals, and also one of the main constituents of natural bone. Study conducted by Nakashima et al. (2009)[26] showed that there is 48.8% improvement on the remineralization of artificially produced subsurface enamel lesions when the nanosized calcium carbonate particles were incorporated in dentifrices. Furthermore, nanocarbonate apatite has proven to be very efficacious desensitizing dentifrice when compared with the conventional agents.[27]

Mouthwashes containing silver nanoparticles and triclosan-loaded nanoparticles have exhibited plaque control actions which are vital for the prevention of periodontal disease. Silver nanoparticles demonstrated strong antibacterial effects in dental products, because of the antibacterial properties of silver.[28,29] Studies showed that nanoparticles of silver imparted high antibacterial activity on dental resins, which significantly reduces building-up of biofilm as well as lactic acid production by the oral bacteria without interfering with the resins' mechanical and physical properties.[30] In one investigation, carbonate hydroxyl apatite nanoparticles have been found to be highly effective in repairing some tooth defects (micrometer-sized) in vitro, and some of its nanocrystals were incorporated in dentifrices like mouthwash solutions and toothpaste and used as commercial products.[26]

Other preventive nanotechnology-based approach for periodontal disease is fabrication of products for oral health care that are integrated with bioinspired apatite nanoparticles alone or together with proteinaceous substances (like casein phosphopeptides).[31] Casein phosphopeptide demonstrated an important role in biomimetic strategies for overall bacterial biofilm management. Casein phosphopeptide coupled with amorphous calcium phosphate nanocomplexes reduces bacterial adherence on the tooth surface by adsorbing the bacterial macromolecules, as well as binding to the surfaces of bacterial cells and to the components of the intercellular plaque matrix. Similarly, in vitro experiments demonstrated that clustered and non-aggregated hydroxyl apatite nanocrystallite particles can bind on the bacterial surface, and then interact with its adhesins in order to disrupt the attachment of the microbes on the tooth surface.[25]

In treatment

- Bone grafting

Dental bone grafting is a procedure for recovering tooth bone that was lost following severe periodontal disease, and it involves recreation of the lost bone. Bone grafting may also be used to maintain bone structure after tooth extraction. Bone grafting is faced with limitations such as a limited supply of grafting materials, variable resorption, high failure rates and persistent pains.[8] These limitations have evoked massive research for solutions to these limitations. 3D scaffold matrices and nano-engineered particles that promote the growth of new bone have been the main areas of focus,[8,32] and scaffold have been successfully used in various fields of

tissue engineering such as periodontal regeneration and bone formation.

Various alloplastic bone grafts with nanoscale particle sizes are being developed and tested. One of the recent and most promising among them are nano-hydroxyapatite (n-HAP) bone grafts, which is available in crystalline, chitosan-associated and titanium-reinforced forms.[33] When compared with the 'plain' chitosan scaffolds, 'n-HAP' composite bone graft scaffolds demonstrated greater biocompatibility, superior mechanical properties and also appeared to induce better cellular responses.[34] In another development, n-HAP and nanosized crystals of calcium sulphate have been synthesized and evaluated on intrabony defects. Both the nanocrystalline materials demonstrated clinically significant treatment outcomes in terms of bone regeneration and resistance to degradation than their conventional counterparts.[35] Similarly, a nanoceramic composite material with antibacterial effect has been developed, by encapsulation/ entrapment of zinc oxide nanoparticles, nanocalcium phosphate and walled carbon nanotubes in alginate polymer matrix. The nanoceramic composite show promising result for bone grafting, that includes regeneration of bone caused by intrabony defects and enhancement of hydroxyapatite formation in bone defects. In another similar investigation, a precursor of hydroxyapatite called octacalcium phosphate has been synthesized and it has demonstrated a great role in apatite crystal development. The investigation provided evidence that this octacalcium phosphate stimulates bone formation which is even more than that stimulated by synthetic hydroxyapatite in bone defects. Although the precise mechanism of action has not been fully elucidated, but it is likely that the octacalcium phosphate precursor plays a role in bone forming cells stimulation through interaction with the closely encircling tissue.[36]

- In drug delivery

An ideal drug delivery system should be able to transport active compound(s) to the intended site of action safely. In the present context however, ideal drug delivery should be able to make optimum contact with the mucosal surfaces in the periodontium and should prolong the residence time at the targeted site (i.e. in the periodontal pocket), and should also intensify contact with the junctional epithelium so as to enhance the epithelial transport of poorly absorbable drugs. This is a desirable approach in order to improve the regeneration ability of damaged tissues and to effectively treat periodontal disease.[10] Nanotechnological drug delivery approaches are highly promising in achieving these goals. It provides an avenue by which therapeutic molecules could be capsulated/loaded in carriers, such as nanoparticles or scaffolds, to allow targeted, sustained and controlled release to the intended location.[10] Nanoparticulate drug delivery systems are among the most popular fields of current research for periodontal treatment and regeneration. Better penetration of the active moiety into the junctional epithelium (site of action) combined with optimal drug release profiles

are among the important benefits of this approach.

Lipsomes

Their extremely lipid bilayer is very chemically reacting thereby providing a means to conveniently tissue "tags" on covalent basis. Such "tags" can be antibodies, antigens,cell receptors, nucleic acid probes etc. this provides significant versatility in assay formats. With diametres ranging in size from 50-800nm, their aqueous core encapsulates up to millions of molecules of signal generating "markers" that can be detected in various means. The encapsulants mainly includes detectable dyes, optically and flurometrically detectable dyes, enzymes and electroactive compounds.[37]

Niosomes

Non-ionic surfactant vesicles studied as an alternative for liposomes. The vesicles are similar to liposomes in physical properties and are prepared in the same way under variety of conditions from unilamellar and multilamellarstuctures. They have the potential for controlled and targeted drug delivery along with enhanced drug penetration.[37]

Micelle

An aggregate of amphipathic molecules in water with its nonpolar portion on the interior surface and polar portion on the exterior surface of the exposed water. These are known to have anisotropic water distribution within their structure, thus making hydrophobic drug encapsulated into its core. The position of a soluabilized drug in a micelle will depend on its polarity, nonpolar molecules will be soluabilized in the miceller core, and substances with intermediate polaritywill be distributed along the surfactant molecules in the intermediate positions.[37]

C60

These are spherical molecules about 1nm diameter comprising 60 carbon atoms arranged as 20 hexagons and 12 pentagons, thus they find application as nano pharmaceuticals with large drug payload in their cage like structure.[28]

Pinon-Segundo et al produced and characterized triclosan-loaded nanoparticles by the Emulsification – diffusion process, in an attempt to obtain a novel delivery system adequate for the treatment of periodontal disease.[38] The nanoparticles were prepared using poly (D, L-lactidecoglycolide), poly (D,L-lactide) and cellulose acetate phthalate. poly (vinyl alcohol) was used as stabilizer. These triclosan nanoparticles behave as a homogeneous polymer matrix-type delivery system, with the drug (triclosan) molecularly dispersed.[39] Tetracycline incorporated into microspheres is available as Arestin for drug delivery by local means into periodontal pocket.[38]

Nanotechnology in dental implants

Nanotechnology can be used in the surface modifications of dental implants since surfaces properties such as roughness and chemistry play a determinant role in achieving and maintaining their long-term stability in bone tissue.[40] Deficient formation of bone around the biomaterial immediately after the implantation is the most common

reason for failure of dental implant.The coating of nano particles over the dental implants, improves the adhesion and integration of surrounding tissues.[41]

Biologically active drugs such as antibiotics or growth factors can be incorporated in the implants. eg: Nanotite™ Nano-Coated Implant. Recently three nano-structured implant coatings are developed:

- Nanostructured diamond: They have ultrahigh hardness, improved toughness over conventional microcrystalline diamond, low friction, and good adhesion to titanium alloys.[42]
- Nanostructured processing applied to hydroxyapatite coatings: This is used to achieve the desired mechanical characteristics and enhanced surface reactivity and has been found to increase osteoblast adhesion, proliferation, and mineralization.[42]
- Nanostructured metalloceramic coatings: These provide continuous variation from a nanocrystalline metallic bond at the interface to the hard ceramic bond on the surface.[42]

Conclusion

The advancement of nanotechnology in dental science has brought tremendous progress in periodontal disease therapy. The technology offers significant promise in the disease's early diagnosis even at molecular and cellular level, thereby reduces the waiting time for results. It also play an important roles in the prevention of the disease, through using nanoscale agents to repel bacterial biofilms deposition and accumulation on the tooth surface, and by remineralization and desensitization of abraded teeth. Nanodentistry have also make the development of potent restorative nanomaterials possible. Such materials can promote the growth of new bone structure in intrabony defect and can also be used for tooth regeneration and for aesthetics purposes. Moreover, there have been significant progress in periodontal drug delivery systems through the recent nano technological advancement, whereby therapeutic agents could be loaded in carriers that can facilitate targeted, sustained and controlled release of the loaded drug(s) to the intended location. Certainly, nanotechnology based drug carrier systems will play a vital role in future drug delivery systems for not only periodontal disease, but for a lot of other oral cavity diseases. Investigations are underway for more exploitation of the effectiveness and significance of these vital therapeutic drug carrier systems. These advances may simplify periodontal disease treatment and may help bring dental care closer to millions of people around the globe that doesn't have access to high-quality oral healthcare.

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POLYETHER ETHER KETONE – A REVOLUTIONARY MATERIAL IN DENTISTRY

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Abstract

Polyetheretherketone (PEEK) is a semicrystalline biomaterial which can be used in dentistry in many different ways. The review was aimed at summarising the outcome of research conducted for drawing out the dental application of this polymer. The future prospects of PEEK in clinical dentistry are also highlighted. PEEK has been explored on various grounds for its application in clinical dentistry. PEEK is a promising material for a number of removable and fixed prosthesis. PEEK can be used in various areas of dentistry as their mechanical and physical properties are closely similar to bone. Major challenge to overcome is to improve the bioactivity of PEEK dental implants without compromising their mechanical properties. Further modifications and improving the material properties may increase its applications in clinical dentistry.

Key words: Polyetheretherketone, biomaterial, clinical dentistry

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Introduction

Polyether ether ketone(PEEK), a commonly used semi crystalline biomaterial in orthopaedics since many years, is a synthetic tooth coloured polymeric material.[1] The major beneficial property of orthopaedic implant application is its lower Young's modulus being close to human bone.[2] The monomer unit of etheretherketone polymerises via step-growth dialkylation reaction of bis-phenolates to form PEEK. PEEK is commonly synthesised by the reaction between 4, 4'-difluorobenzophenone and disodium salt of hydroquinone in a polar solvent such as diphenyl sulphone at 300°C.

PEEK can be modified either by addition of functionalized monomers (pre-polymerization) or post-polymerization modifications by chemical processes such as sulphonation, amination and nitration.[3] Incorporation of carbon fibres can increase the elastic modulus of PEEK from 4Gpa to 18Gpa.[2] This is comparable to those of cortical bone and dentin exhibiting lesser stress shielding when compared to titanium which has higher modulus when compared to bone resulting in severe stress shielding and failure.[4]

Tensile properties of PEEK are analogous to that of bone, enamel and dentin making it suitable restorative material as far as mechanical properties is considered. Its melting point is around 335°C. In contrast to titanium they have very limited inherent osteoconductive properties.[5] Hence many researches are conducted to improve the

bioactivity of PEEK implants and various methods have been proposed.

1. Coating PEEK with synthetic osteoconductive hydroxyl apatite[6]
2. Increasing its surface roughness and chemical modification[7]
3. Incorporating bioactive particles[8]

Due to its white colour and excellent mechanical properties, PEEK has been proposed for fixed prosthesis[9] and removable prosthesis. Investigations are done on the effect of surface modification of PEEK for bonding with different luting agents[9] and extracted teeth. They are able to deliver higher orthodontic forces and are thus used as aesthetic orthodontic wires.[10]

Applications of PEEK

Dental application of PEEK:

Implant material

RPD material

Crown

CAD-CAM milled FPD

PEEK – implant material

Conclusion of various studies on PEEK as an implant material is as follows:

- Animal studies have suggested that PEEK can survive for up to 3 years while inducing non-remarkable localized inflammation.[11]
- Proteomic studies have found no difference between the bio inertness of PEEK, zirconium and titanium.
- FEA study by Sarot et al. suggests there is no difference between the stress distribution around PEEK and titanium dental implants.
- Studies have shown that there is no significant effect of unmodified PEEK on the proliferation rate of cells in vitro.[12]
- Proteomic studies have indicated that PEEK inhibits mRNA processing that may lead to a decreased cellular proliferation rate on the surface and cytotoxic effects may be produced in the long-term.
- There have been no conclusive evidence of osseoconductive effects of PEEK in vivo hence, in its unmodified form; the long term survival rate of PEEK implants is questionable.

Table 1: Modifications done with PEEK

Sl. No	*Modifications done with PEEK*	*Properties*
1	Unmodified PEEK	➢ Inherently hydrophobic in nature, with a water-contact angle of 80–90° and bio inert. ➢ Increased protein turnover in cells in contact with material.[13]

Sl. No	*Modifications done with PEEK*	*Properties*
2	Carbon-fibre reinforced PEEK (CFR-PEEK) implants	➢ Lesser stress shielding than titanium. ➢ Increased protein turnover in cells in contact with material.[13]
3	Nanoscale coating of PEEK with bioactive apatite	➢ Production of bioactive PEEK nanocomposite. Improve bioactivity and osseoconductive properties. ➢ Improve the interaction with bony tissues and results in better osseointegration of implant materials.
3a	Osteogenic implant coatings	Modify the surface properties of dental implants.
3b	Spin implant coating- coating a thin layer of nanoscale calcium hydroxyapatite on PEEK surface.[8]	
3c	Plasma-gas etching.	➢ Promotion of proliferation and differentiation of human mesenchymal cells seeded on the implant. ➢ Disadvantage is involvement of high temperatures which could damage PEEK structure due to its relatively low melting temperature. ➢ Low bond strength (2.8 MPa)

PEEK- RPD material

- Dentures can be constructed by using PEEK computer-aided design and computer-aided manufacture systems.[14]
- Used to construct removable obturator.
- Tan- nous et al has suggested that denture clasps made of PEEK have lower retentive forces compared to cobalt–chromium (Co–Cr) clasps.
- The superior properties of PEEK, both mechanical and biological, are suggestive of their regular and repeated use in near future.

PEEK – crowns

- Various procedures are done to condition the surface of PEEK in order to facilitate its bonding with resin composite crowns.

- PEEK can be used under resin-composite as a coping material
- Air abrasion with and without silica coating creates a more wettable surface
- Etching with sulphuric acid creates a rough and chemically altered surface which enables it to bond more effectively with hydrophobic resin composites with shear bond strength: 9.0 T 3.4 MPa.
- It has been observed that etching with sulfuric acid for 60–90 scan exhibit shear bond strength to resin composite cements as high as 15.3 T 7.2 MPa after being stored in water for 28 days at 37-38°C.
- No significant differences were observed in the tensile bond strength of PEEK crowns and dentin abutments using air abrasion and sulfuring acid etching techniques.
- Etching with piranha acid and using a bonding agent have been shown to produce tensile bond strength to composite resin as high as 23.4 T 9.9 MPa in aged PEEK specimens.
- Their mechanical properties are similar to those of dentin and enamel and could have an advantage over alloy and ceramic restorations.

PEEK-CAD CAM milled FPD

- Dental prosthesis can be produced chair-side.
- The fracture resistance of the CAD-CAM milled PEEK fixed dentures is much higher than those of lithium disilicate glass-ceramic, alumina, zirconia
- Three-unit PEEK fixed partial denture manufactured VIA CAD-CAM has been suggested to have a higher fracture resistance than pressed granular- or pellet- shaped PEEK dentures.[15]
- They have significantly low elastic moduli and hardness.
- Abrasive resistance of PEEK is competitive with metallic alloys.
- Expected to have a satisfactory survival rate.
- No clinical studies have attempted to compare the abrasion produced by PEEK crowns on teeth to that produced by other materials such as alloys and ceramics. Hence, it is still unknown if PEEK crowns can function efficiently in harmony with dentin and enamel.

Conclusion

PEEK has numerous dental applications as their mechanical and physical properties are mostly identical to that of bone. PEEK dental implants have lower stress shielding compared to that of titanium implants, and is thus widely accepted. The major challenge to overcome is to increase the bioactivity of PEEK dental implants without affecting their mechanical properties. PEEK is also an attractive material for producing CAD-CAM fixed and removable prosthesis owing to its superior mechanical properties compared to materials such as acrylic. Further research and clinical trials are required to explore this material and possible modifications for further dental applications.

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EFFECT OF STORAGE MEDIA ON FRACTURE RESISTANCE OF REATTACHED TOOTH FRAGMENTS USING FLOWABLE COMPOSITE

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Abstract

Aim: To compare the fracture resistance of incisor tooth fragments stored in four storage media: Dry air, milk, coconut water, or normal saline before reattaching them with Flowable composite. Materials and Methods: Twenty freshly extracted maxillary incisors will be divided into four groups. Teeth will be then sectioned, and fragments will be stored in dry air (Group I), milk (Group II), coconut water (Group III), and normal saline (Group IV). The fragments will be reattached using simple reattachment technique and fracture resistance of the samples will be measured using a Universal Testing Machine. Significance: The mode of storage of a fragment before its reattachment significantly affects the prognosis. Thus, there is a need to catalyze public awareness about the manner of preservation of such fragments such as their avulsed counterparts.

Key words: Fracture resistance, fragment reattachment, Filtek Z350 XT, storage medium

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Introduction

Coronal fractures of anterior teeth represents 18–22% of all injuries to dental hard tissues; 96% of them involving the maxillary incisors alone.

Numerous techniques have been put forth to reconstruct such traumatically injured teeth

- resin crowns
- stainless steel crowns
- orthodontic bands
- ceramic crowns and
- composite resin restorations.

All these interventions tend to sacrifice a lot of healthy natural tissue

The treatment of coronal fracture is a considerable challenge for the dentist because they have to fulfill the parameters, like form and dimension, opacity, and translucence of the original tooth to obtain a successful restoration. Although composite resin restoration is indicated in the management of fractured anterior teeth, reattachment is an excellent option when the fragment is available. With the development of adhesive dentistry came the concept of "fragment reattachment". Reattachment offers the advantages of being a highly conservative technique and does not involve any kind of preparation that promotes the preservation of natural tooth structure, good esthetics, and acceptance by the patient who receives the treatment. Compared to conventional techniques, fragment

reattachment offers several advantages the most predominant one being-aesthetics. Fragment reattachment is considered as a minimally invasive biological option for managing such injuries.

Prognosis of the reattached fragment is dictated by

- Firmness of its attachment to the tooth
- Mode of storage immediately following trauma

Storage medium acts as one of the key determinants since hydration aids to maintain the vitality, esthetic appearance, and the bond strength. The hydrophilic characteristic of adhesive systems also means that hydration acts to ensure adequate bond strength.

Hence, the present study was planned to compare the fracture resistance of fractured incisor tooth fragments stored in four storage media namely, dry air, milk, coconut water, or normal saline which were eventually reattached using a newer nanohybrid flowable composite.

Materials and methods

Sixteen freshly extracted permanent maxillary incisors extracted due to therapeutic reasons with intact crown structures were collected. Teeth with defects such as fractures, decalcification, or caries were discarded.

The selected teeth were randomly divided into four groups of 12 each based on the storage medium used.

- Group I: Dry storage
- Group II: Milk as storage medium
- Group III: Coconut water as storage medium
- Group IV: Normal saline as storage medium.

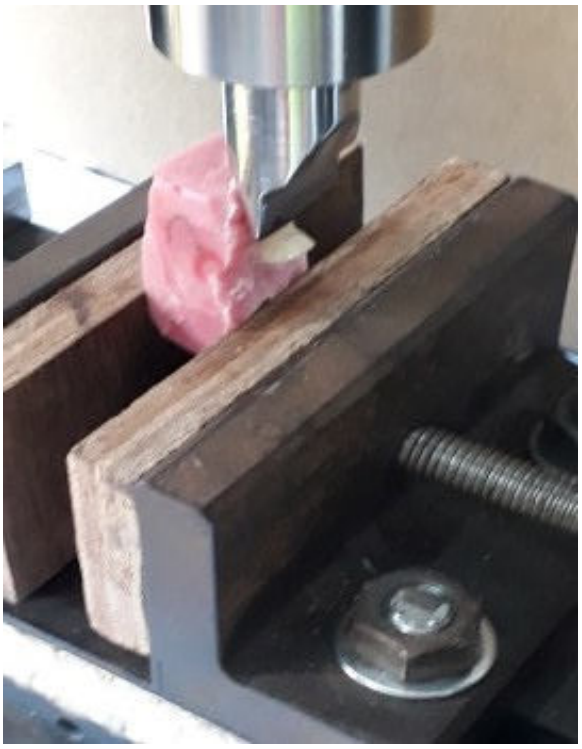
Intentional fracture of freshly extracted sound teeth: The cervicoincisal distance was measured for each of the tooth on the labial surface. One-third of this distance was then calculated and marked on the labial surface from the incisal edge. The tooth was cut on the marked line perpendicular to its long axis with a low-speed diamond disk.

Immediately after fracturing, the fragments were stored in separate marked containers with appropriate storage media (milk, coconut water, and normal saline).

Fragments were reattached after 2 hours by means of simple reattachment technique. About 37% phosphoric acid was applied to the fragment and the tooth for 15 s, rinsed for 10 s followed by air drying for 5 sec. Bonding agent (Te-Econom Bond , Ivoclar Vivadent) was applied in two consecutive coats. Surfaces were dried for 5 s using an air syringe to allow solvent evaporation. The bonding agent was then light cured for 20 s in the fractured fragment and 20 s in the tooth remnant. Nanohybrid flowable composite (Filtek Z350 XT) was applied on the surface of the fragment and tooth remnant. The fragment was then positioned back to the tooth remnant by means of a sticky wax (to carry the fractured fragment). After ascertaining the correct position, light curing

was carried out: 40 s labial half, 40 s lingual half. Each sample was then embedded in a self-cure acrylic resin block such that only the coronal portion of the tooth was exposed. Fracture resistance of the samples were measured using a Universal Testing Machine. The rod of universal testing machine was held perpendicular to the long axis of the tooth at the incisal third of the crown near the bonding line on the labial surface. The load was applied at a crosshead speed of 1 mm/min. The load was increased progressively and the value at which the reattached fragment debonded was recorded in kilograms and converted into Newton (N) using the relationship, 1 kg = 9.81 N. This load represented the fracture resistance of the reattached tooth.

Fig 1(a –i): Materials and methods

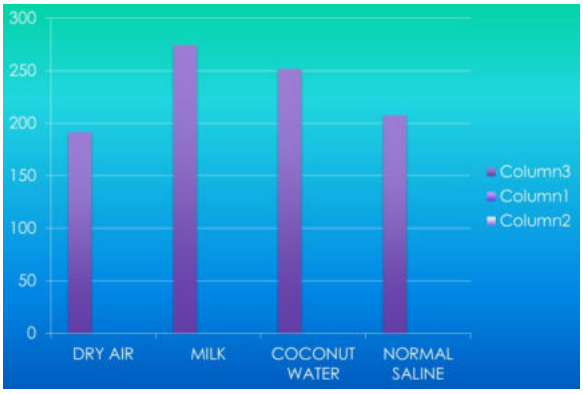


Results

The highest fracture resistance value was demonstrated by Group II(Milk), followed by Group III(coconut water), followed by Group IV(normal saline)and least fracture resistance values were observed in Group I(dry air).

Table 2 : Results

GROUPS	n	MEAN VALUE(N)
Dry air	4	191.3
Milk	4	274.2
Coconut water	4	251.5
Normal saline	4	207.6



Discussion

Maxillary central incisors were selected for the study because of the high incidence and prevalence of trauma in this region.[9,10] Bond strength evaluation of reattached fragment is relevant because most often reattachment failures occur due to repeated trauma.[11] Bond strength can be enhanced by storing the fragment in various storage media.

One of the factors that play a significant role in the success of fragment reattachment is the type of storage media used for the storage of fragment following trauma. If the coronal fragment has been allowed to dry out prior to reattachment, the fragment will desiccate and in vitro tests have shown decreased bond strength of such reattached fragment. Storing the fragment in a moist environment ensured that there is no or minimal collapse of the collagen fibers in the dentin leading to a better bond strength. Moreover, it prevents the drying of the fragment which can be detrimental to the esthetics.[12] Farik et al[8] showed that drying for more than 1 hour prior to bonding of the fragment resulted in declined fracture strength.

- In this study, the fracture resistance value for Group II was recorded as the highest being statistically significant over Group I and Group IV.
- The teeth were cut in a standardized manner using a low-speed diamond disk, as the aim was to evaluate the storage media.
- Dehydration of human dentin has demonstrated a brittle behaviour.

- It can be attributed to the isotonicity of milk with high water content which allowed adequate rewetting of the dentinal tubules.
- Coconut water has higher osmolality than milk.
- The water content of coconut water being greater than milk might have allowed better wetting of the dentin preventing the collapse of the collagen fibers which play a role in resin tag formation.
- The difference between the fracture resistance values between Group II and Group III were not statistically significant.

Considering the Indian scenario for the problem in question, there is a greater probability of coconut water being readily available at the site of trauma such as a typical school playground. Hence, this study has the potential to be the eye opener to the fact that the mode of storage of a fragment before its reattachment significantly affects the prognosis. Thus, there is a need to catalyze public awareness about the manner of preservation of such fragments such as their avulsed counterparts.

Conclusion

Within the limitations of this study, it can be concluded by saying that the hydration of the fragment does improve its fracture resistance significantly. Milk offers the highest fracture resistance values among the tested media. Coconut water can also be considered a viable alternative.

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