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CONTENTS

Office:
ijo journal
St. GREGORIOS DENTAL COLLEGE
Chelad, P.O., Kothamangalam,
Ernakulam Dist.
Kerala Pin - 686 681
Phone: 0485 - 2571429, 2572529
Fax: 2572530
Mail: ijoonlinejournal@gmail.com
www.ijoonline.net

EDITORIAL

“We don’t write because we want to; we write because we have to.”
— Somerset Maugham

The landscape of dental science continues to evolve tremendously. By harnessing the power of technology and fostering interdisciplinary collaborations between dentists, researchers, and healthcare providers, we are rapidly cultivating a culture of innovation and knowledge-sharing.

It is imperative for both faculty and students to be actively engaged in research activities. Among the many duties of dental professionals, the duty to write is paramount. Sharing the insights gained from research is as vital as conducting the research itself. Publications in the scientific realm play a pivotal role by serving as a cornerstone for continuous advancement, pushing the boundaries of understanding, and allowing academicians to establish themselves as experts. This, in turn, enhances their professional reputation and opens doors to collaborations and networking opportunities.

There are deep concerns within the scientific community that contemporary publishing systems fall short of the needs of global science. Today, many institutions and researchers are excluded from accessing articles hidden behind paywalls and from publishing articles in journals with unaffordable fees. The surge in demand is straining the peer review system, and numerous predatory publishers are exploiting this increasing demand. The publication model centered around "high-impact" journals, which are unaffordable for many authors and readers, exacerbates inequalities and limits access to valuable knowledge.

For scientific publishing to fulfill the vision of science as a global public good, it should be freely available and accessible worldwide without barriers to its use.
On behalf of the editorial board, I extend my heartfelt gratitude to the Management and Principal, Prof. Dr. Jain Mathew of St. Gregorios Dental College, whose unwavering support has been instrumental in bringing this journal to fruition. The editorial board also wishes to thank interns Mariya Elizabeth and Alex Mathew, as well as BDS students Liya Merin and Anit Simon, for their invaluable assistance in publishing this journal.

Dr. Tina Elizabeth Jacob
Editor

Publication Types: *Original Research*

ASSESSMENT OF SHEAR BOND STRENGTH AND MICROLEAKAGE IN BULK-FILL COMPOSITE RESTORATIONS FOR CLARK'S CLASS II CAVITIES: A COMPARATIVE IN-VITRO ANALYSIS BETWEEN INJECTION MOULDED AND BULK-FILL TECHNIQUES

Dr. Jerrin Abraham[1], Dr. Dithykumari[2], Dr. Robin Theruvil[3], Dr. Jain Mathew[4], Dr. Saira George[5]
1,2 Post Graduate student, 4,Professor and HOD, 3,5 Professor
: Conservative Dentistry and Endodontics, St. Gregorios Dental College, Chelad.

Resin composite is the most commonly used material for direct placement restorations. In particular, composite is now used more frequently than amalgam for direct posterior restorations. However, resin composite still suffers from some disadvantages, including the use of an adhesive interfacial bond that degrades with time, moisture, and function in the mouth, and certain key mechanical properties (e.g., modulus of elasticity) that are inferior to those of amalgam. As such, there is a concern that the resin composite should be inserted into a preparation with as few voids as possible to enhance interfacial adaptation, and maximizing the composite degree of conversion so as to maximize mechanical properties. The use of preheated composite has been suggested to aid in both of these goals

ABSTRACT

Background:

Aim: To compare the shear bond strength and microleakage, of 3M ESPE Filtek Bulk-fill Composites on Clark's class II cavity configuration placed using Injection moulding technique and Bulk-fill technique.

Methodology:
Class II cavities with Clark's configuration were prepared on the mesial surfaces of selected 90 premolars which were mounted on acrylic blocks. A polyester matrix band was used as a matrix around the tooth. Cavities were etched with 37% phosphoric acid for 20 seconds and rinsed with water and blot dried. Bonding agent was applied to the dentin surface. In Group 1 (Injection moulded technique), flowable composite was injected into the cavity filling approximately 1/3rd. Preheated bulk-fill composite (at 65 degrees Celsius) was injected with pressure using a composite gun into the pool of flowable composite displacing most of the flowable composite. The excess composite was removed and 3-point curing of 20 seconds each was done. In Group 2 (Bulk-fill technique), the composite was placed in a bulk of 4-5 mm and cured for 40 seconds. All specimens were subjected to thermo-cycling for 1500 cycles between 5-55 degrees Celsius. Both Group 1a and Group 2a were subjected to shear bond strength testing using Universal testing machine. Both Group 1b and Group 2b were immersed in 0.5% methylene blue dye for 24 hours, rinsed under running water to remove the dye, and dried at room temperature and evaluated with a stereomicroscope at 20x magnification.

Results:
Based on the result statistical analysis was done, it was concluded that Clark's Class II cavity restored with bulk-fill composite using Injection moulded technique have higher shear bond strength and lower microleakage compared to that of Clark's Class II cavity restored with bulk-fill composite using Bulk-fill technique.

Conclusion:
Hence within the limitation of the study, it can be concluded that preheating Bulk-fill composite and placing it using Injection moulded technique in Clark's Class II cavity has a positive effect on shear bond strength and microleakage.

Keywords: Bulk-fill composites, Preheated composites, Clark's Class II cavity, Injection moulded technique, Bulk-fill technique

INTRODUCTION

The frequency of posterior composite resin restorations is increasing significantly due to the aesthetic appearance and conservative nature of the material and advances in their physio-mechanical properties. One of the most common problems associated with composite resin restorations is poor adaptation and formation of gaps between the restorative material and the tooth structure, resulting in some problems, including microleakage of oral fluids, postoperative sensitivity, and recurrent caries.[1]The clinical success of composite resin restorations dramatically depends on the properties of the material, including polymerization shrinkage, viscosity, packing capacity, and bonding ability.[2]

Incremental filling techniques have been used for the placement of resin composites. [3 5] However, postoperative sensitivity has been frequently observed, mainly due to polymerization shrinkage stress,[5] which causes microleakage, debonding from margins, staining at the margins, development of pulpal pathology, and recurrent caries in addition to postoperative sensitivity. To negate these problems, newer composites, cavity configurations, and placement techniques were introduced.

Different filling techniques and different modifications in composite resins have been developed to minimize polymerization shrinkage and its clinical effects.[6]Recently, bulk-fill composite resins have been designed for placing the composite in bulk in the cavity. Changing the initiator in these composite resins makes it possible to place them in layers measuring >4 mm in thickness, which decreases the time required for placing the material in the cavity.[7] The main concern about the curing process of bulk-fill composite resins is the amount of polymerization shrinkage, polymerization stresses, and the subsequent gap formation.[8]

The configuration of the cavity plays a crucial role in the durability of the restoration. Conventional Class II cavity preparations used for restoring small lesions with amalgam could also be inappropriate for composite resin restorations because of the extensive cavity form, large occlusal area particularly in the areas of occlusal contact, and compromised gingival enamel.[9]

One recent alternative innovation is the use of conventional composites that are preheated in a chairside warming device before polymerization. [9] Polymers can present lower viscosity when they are warmed. This is based on the theory that thermal energy forces the monomers or oligomers to move apart, allowing them to slide by each other more readily, this increases the flow of preheated composite which would improve the adaptation of uncured resin to tooth walls and potentially reduce microleakage.

Injection moulded technique is a modified technique for composite placement introduced by Dr. David Clark, a pioneer in the field of Adhesive Restorative Dentistry. It reduces the potential for voids and fault lines while maintaining the structural integrity of the tooth. This technique involves the use of a redesigned cavity preparation, a translucent matrix system, and the proper combination of preheated packable and flowable composites in order to create strong and aesthetic restorations.

Considering the importance of the marginal adaptation of composite resin restorations, the existing variations in their types and structural differences in these materials and their possible effects on the behaviour of preheated composite resins, this study evaluated the effect of preheating on Shear bond strength and microleakage of bulk-fill composite (3M ESPE Filtek Bulk-fill) placed using Injection moulded technique compared to Bulk-fill composite (3M ESPE Filtek Bulk-fill) placed using Bulk-fill technique on Clark's class II cavity.

MATERIAL AND METHODS

The study protocol was approved by the Ethics Committee at St. Gregorios Dental College. Table 1 presents the characteristics of the materials used in the present study.

This in vitro study was carried out on 60 human premolar teeth extracted for orthodontic reasons. The teeth were sound, with no caries, cracks, or anomalies as evaluated visually and under a stereomicroscope. All the teeth were cleaned with a scaling curette and stored for one week in 0.5% chloramine T solution, followed by storage in distilled water at refrigerator temperature until tested. Class II cavities with Clark's configuration were prepared on the mesial surfaces of selected premolars. Each cavity had a standard buccolingual width of 2 mm, axial depth of 1.5 mm, and occlusogingival height of 3.5 mm. The occlusal, proximal, and gingival margins of the cavity preparation had disappearing/serpentine margins in enamel approximately 3 mm. The cavities were prepared with sharp diamond fissure burs, measuring 1 mm in diameter in a high-speed handpiece under water and air coolant. The burs were replaced by new ones after every five cavity preparation procedures. The prepared cavities were randomly divided into two groups. The teeth are randomly assigned to 2 groups based on Method of composite placement (n=15).

GROUP 1- Injection Moulded Technique

Sub-Group 1a – Shear bond strength
Sub-Group 1b – Microleakage

GROUP 2- Bulk-fill Technique

Sub-Group 2a – Shear bond strength
Sub-Group 2b – Microleakage

A metallic matrix band in a Tofflemire matrix retainer was fixed around the teeth to create a uniform clinical condition.

In group 1, 3M™ Single Bond Universal Adhesive was used in all the cavities according to the manufacturer's instructions before placing composite resins in the cavities. First, cavities were etched with 37% phosphoric

acid for 20 seconds, rinsed with water and blot dried. Then Bonding agent was applied to the dentin surface. Flowable composite was injected into the cavity filling approximately 1/3rd. Preheated bulk-fill composite was injected with pressure into the pool of flowable composite displacing most of the flowable composite. Excess composite was removed and 3-point curing of 20 secs each was done. Specimens were subjected to thermo-cycling for 1500 cycles between 5-55 degrees Celsius, dwelling time of 20 secs and transferring time of 10 secs.

In group 2, Cavities were etched with 37% phosphoric acid for 15 seconds, rinsed with water and blot dried. Bonding agent was applied to the dentin surface and light cured for 20 seconds. The composite was then placed in a bulk of 4 - 5 mm and cured for 40 sec. Specimens were subjected to thermo-cycling for 1500 cycles between 5 - 55 degrees Celsius, dwelling time of 20 secs and transferring time of 10 secs.

To evaluate SHEAR BOND STRENGTH

Universal Testing Machine was used for Shear bond strength measurements. The specimen teeth were positioned in the sample holder of the testing machine at an angulation of 45 degrees and the chisel-shaped loading piston is placed on the tooth restoration interface. Shear loading was applied to the tooth-restoration interface at a crosshead speed of 1 mm/min until debonding occurred. Load at debonding was recorded and bond strength values, in MPa were calculated according to the equation:

Bond strength = F/A

F: load at fracture (N), A: adhesive area (mm2).

For MICROLEAKAGE MEASUREMENT

The degree of microleakage determined through the extent of dye penetration and was scored according to scoring criteria (0 to 3) as followed:

Score 0 = No dye penetration

Score 1 = Dye penetration up to one-third of the cavity wall

Score 2 = Dye penetration more than one-third, but less than two-thirds of the cavity wall

Score 3 = Dye penetration more than two-thirds, or to the full extent of the cavity wall.

Of the samples under an electron microscope, first, the samples were fixed on the aluminium tabs and evaluated under an SEM.

Data was analysed with SPSS 21. Independent T test and MANN-WHITNEY U TEST were used to compare the mean. Statistical significance was set at $P<0.05$.

Table 1: The materials used in the present study.

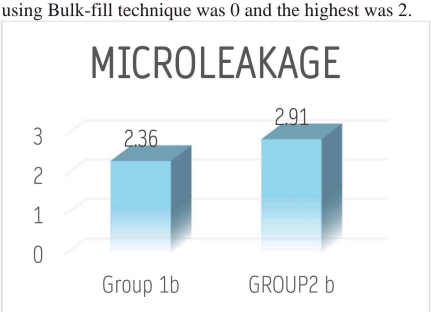
Material	Manufacturer	Composition
Filtek P60 (shade: A2)	3M ESPE, St Paul, USA	Monomer matrix: Bis-GMA, UDMA and Bis-EMA Inorganic fillers: zirconia/silica (61% by vol, 83% by wt) (without silane treatment). The particle size ranges from 0.01µm to 3.5 µm.
3M™ Filtek™ Bulk Fill Flowable Restorative	3M ESPE, St Paul, USA	Monomer matrix: Bis-GMA, UDMA, (6) and Procrylat resins Inorganic fillers: zirconia/silica with a particle size range of 0.01 to 3.5µ and ytterbium trifluoride filler with a range of particle sizes from 0.1 to 5.0µ. The inorganic filler loading is approximately 64.5% by weight (42.5% by volume).
3M™ Single Bond Universal Adhesive	3M ESPE, St Paul, USA	MDP, Vitrebond Copolymer, Phosphate Monomer, Di methacrylate resins, HEMA, Silane, Initiators

Bis-EMA: bisphenol A ethoxylated Di methacrylate; Bis-GMA: bisphenol A glycol Di methacrylate; HEMA: 2-hydroxyethyl methacrylate; MDP: 10methacryloyloxydecyl di-hydrogen phosphate; TEGDMA: Tri ethylene glycol Di methacrylate; UDMA: urethane dimethacrylate

RESULTS

The highest mean shear bond strength value was recorded for Group 1a (4.6238±1.25086), the mean shear bond strength value recorded for Group 2a was (3.5190±0.91140). The highest shear bond strength value measured for the tooth restored with Injection molded

technique was 8.0832 MPa and the lowest value recorded was 3.1152 MPa. The highest shear bond strength value measured for tooth restored with Bulk-fill technique was 4.9820 MPa and the lowest value recorded was 1.8562 MPa. Group 1b showed least microleakage with mean rank (14.83) compared to Group 2b with mean rank (16.17). The lowest microleakage score for tooth restored using Injection molded technique was 0 and the highest was 2. The lowest microleakage score for tooth restored using Bulk-fill technique was 0 and the highest was 2.

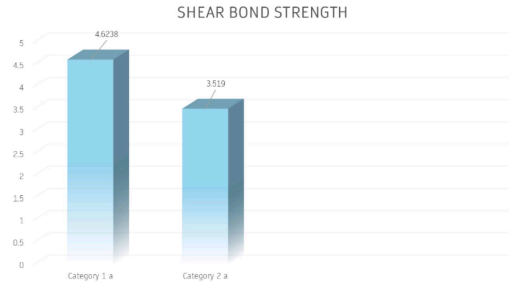


GRAPH 1

DISCUSSION

The use of resin composite restorations has become widespread due to their adequate mechanical behaviour and attractive aesthetic characteristics.[13] These restorations traditionally use a complex restoration technique, which is performed using a so-called "incremental technique".[14, 15]It is used for 2 reasons: (a) the depth of cure of these conventional resin materials is limited, preventing total polymerization in increments that are greater than 2 mm; and (b) an attempt is made to control the effects of material shrinkage when the polymerization reaction occurs.[16, 17,18] Therefore, for deep or extensive preparations, several layers of the conventional resin material must be applied, which is technically challenging, consumes a lot of clinical time, and also involves certain risks, such as entrapment of air bubbles or contamination between layers. In response to these difficulties, a new generation of composite resins was developed called "Bulk-fill" resins. Bulk-fill composite resins were introduced to enable the clinician to use thicker layers of composite filling materials in increments of 4–5 mm.[14] Bulk-fill composites are commonly categorized into high-viscosity (sculptable, full-body) and low-viscosity (flowable, base) materials. Different strategies are combined to achieve application in 4-mm-thick layers. Some low-viscosity Bulk-fills have a filler load comparable to high-viscosity materials, while some high-viscosity materials have mechanical properties similar to low-viscosity Bulk-fills.

This study evaluated three parameters: shear bond strength, microleakage, and fracture resistance of class II restorations restored with Bulk-fill resin composites using injection molded technique and Bulk-fill technique. The Bulk-fill composite used in this study was 3M ESPE Filtek Bulk-fill composite.



GRAPH 2

increased translucency of these resins due to the incorporation of more photoinitiator reagents allowed for deeper photopolymerization and insertion of the material into a thickness of 4–5 mm increments, with uniform polymerization and degree of conversion. [19,20]

Hakan et al. found that shear bond strength of Bulk-fill resin composite was comparable to that achieved via conventional resin-based composites, suggesting Bulk-fill composites as a reliable alternative. Furnes et al. examined the effects of composite type (bulk-fill/conventional) and placement (4-mm bulk/2-mm increments) on internal marginal adaptation of Class I preparations and concluded that the bulk-fill composite would be one that could be placed into a preparation having a high C-factor design and still exhibit very little polymerization shrinkage stress, while maintaining a high degree of cure throughout and consequently minimize internal and external marginal gap formation, compared to conventionally incrementally placed composites.[21] Negating all of these factors are essential to obtain sufficient mechanical properties, thus increasing the longevity of the restorations.

Additionally, Bulk-fill resins contain polymerization modulators that achieve low shrinkage and less stress on the bonded interface. [22]. The insertion of thicker increments contributed to reducing the incorporation of air voids, forming a more homogeneous restorative unit.[19, 20]

The configuration of the cavity played an important role in the durability of the restoration. The traditional box shape of a Class II preparation creates sharp internal line angles, promoted crack initiation, and left dentin susceptible to fracture. Moreover, this shape of preparation made the restoration vulnerable to unfavourable composite shrinkage, as the composite shrank away from the opposing walls of the preparation which created gaps. However, with a redesigned preparation that was flat and shallow, the typical C-factor

problems were eliminated or mitigated.[13] A saucer-shaped preparation with feather edges avoids sharp angles and allows the composite to act in a new way that sat on the tooth instead of in it. With this shallower preparation, the composite was injected in one phase instead of increments, which saved time and more importantly, eliminated the risk of gaps between layers.[12]

CONCLUSION

Within the limits of this in vitro study, it was seen that Clark's Class II cavity restored with Bulk-fill composite using Injection moulded technique has higher shear bond strength when compared to that of Clark's Class II cavity restored with Bulk-fill composite using Bulk-fill technique. Clark's Class II cavity restored with Bulk-fill composite using Injection moulded technique has comparable microleakage to that of Clark's Class II cavity restored with Bulk-fill composite using Bulk-fill technique.

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Conflicts of interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article

Publication Types: Original Research

COMPARATIVE EVALUATION OF CYTOTOXICITY OF 2.5% AND 5.25% CALCIUM HYPOCHLORITE IN COMPARISON WITH 2.5% AND 5.25% SODIUM HYPOCHLORITE: AN INVITRO STUDY

Dr. Pooja Jayan [1], Dr. Sona Anns [2], Dr. Jain Mathew [3], Dr. Robin Theruvil[4], Dr. Saira George [5]
: 1.2 Post Graduate student, 3. Professor and HOD, 4,5 Professor
Conservative Dentistry and Endodontics, St. Gregorios Dental College, Chelad.

Abstract
Background:

The aim of this article is to evaluate the cytotoxicity of 2.5% and 5.25% Calcium hypochlorite in comparison with 2.5% and 5.25% Sodium hypochlorite: An In Vitro Study.

Methodology:
Human peripheral blood cells were used as the test system.Peripheral venous blood was collected from healthy adults, both male and female. NaOCl and $Ca(OCl)_2$ were added after 24 and 48 h of culture initiation.Human lymphocytes were exposed to different concentrations of both solutions.

Results:
$Ca(OCl)_2$ at a concentration of 2.5% was less cytotoxic than 2.5% NaOCl and $Ca(OCl)_2$ at a concentration of 5.25% was less cytotoxic than 5.25% NaOCl.

Conclusion:
Solutions of $Ca(OCl)_2$ showed acceptable outcomes in terms of cell migration, viability, and level of inflammatory response. In contrast, Sodium hypochlorite solution was severely cytotoxic at practically all tested concentrations. These results suggest that Calcium hypochlorite has less cytotoxicity than Sodium hypochlorite and thus qualifies as an irrigant solution for endodontic procedures.

Keywords: Cytotoxicity, human lymphocytes,trypan blue assay , root canal irrigants.

INTRODUCTION

The objectives of root canal treatment include the removal of infected pulp tissue, elimination of bacteria or fungi present in the canal as well as dentinal tubules and prevention of recontamination after treatment. These objectives are achieved by thorough cleaning, shaping, and disinfecting the root canal system as well as sealing it with a 3-dimensional obturation and by placing a coronal seal.[1]

The extraordinary complex root canal system has allowed researchers in the past few decades to extrapolate its complexities through the intervention of new technologies which have revealed the real complex nature of the root canal system which extend far beyond the reach of hand and mechanically driven endodontic instruments. Such root canal intricacies are resistant or inaccessible even to intracanal irrigants and medicaments. Available literature from previous studies have reported that almost 35% of the canal walls remain completely untouched regardless of the method of biomechanical preparation or the various file systems used. Moreover, mechanical instrumentation usually results in an amorphous irregular smear layer composed of inorganic and organic material covering the canal surfaces and plugging the dentinal tubules.[2] Therefore, the mechanical instrumentation needs to be augmented with thorough intracanal irrigation with an effective irrigant to best disinfect such shrouded intricacies.

Irrigation is an unavoidable, essential component of root canal preparation. The purpose of irrigation during root canal preparation includes wetting of the root canal walls, flushing out of debris, destruction of microorganisms, dissolution of organic matter and softening of dentin to remove smear layer. Any further disinfection of the root canal system will only occur with the support of an intracanal dressing.[2]

Till date, Sodium hypochlorite solution is the most employed root canal irrigant since the time Walker introduced it into the field of endodontics in 1936.[3] This is mainly due to its unique capacity to dissolve organic matter[4], neutralize and degrade fatty acids and amino acids as well as disrupt the biofilm.[3] The effectiveness of organic tissue dissolution by NaOCl is well known.[4-10] Although it is beneficial during root canal treatment, it is a hazard for normal tissue if it comes in contact with it. In addition, NaOCl is chemically unstable and external agents such as temperature, light and storage conditions can influence the availability of

chlorine ions and interfere with its effectiveness.[4,10] Therefore, alternative auxiliary chemical solutions should be investigated.

One such promising endodontic irrigant is found to be $Ca(OCl)_2$. It has shown comparable results with NaOCl in terms of tissue dissolution and antimicrobial activity. It has higher chlorine content than NaOCl at the same concentration.[11] In endodontics, the main outcome of the treatment is the periapical and apical tissue repair. The chemical solutions used during therapy can accelerate or retard the healing process. In this regard, $Ca(OCl)_2$ showed more satisfactory results than NaOCl.[12] However, there is a lack of consistent information regarding the properties of $Ca(OCl)_2$ with reference to toxicity in comparison to NaOCl which is cytotoxic in high concentrations.[13]

Cytotoxicity is one among the foremost important indicators for biological evaluation of in vitro studies. In vitro, chemicals have different cytotoxicity mechanisms like destruction of cell membranes, prevention of protein synthesis, irreversible binding to receptors etc. To determine the cell death caused by these damages, there is a need for reliable and reproducible short-term cytotoxicity assays.

Considering that there is a high chance for the extrusion of irrigants beyond the apical constriction, resulting in direct contact with the periapical tissue[16].it is important to determine the cytotoxicity assays which have gained widespread acceptance as a crucial and useful indicator for carcinogenicity.

Thus, the aim of the present study is to Evaluate the Cytotoxicity 2.5% and 5.25% Calcium Hypochlorite in comparison with 2.5% and 5.25% Sodium Hypochlorite, In Vitro.

MATERIAL AND METHODS

Calcium hypochlorite powder was made into a solution for use, by dissolving in distilled water to reach the two target concentrations of 2.5% and 5.25%.

Figure 1 a: Calcium Hypochlorite Powder

Figure 1 b: Calcium Hypochlorite solution in different concentrations

Figure 2: Different Concentrations of Sodium Hypochlorite

PREPARATION OF THE SOLUTIONS:

• The Solutions were prepared immediately before the experiments, as described by Blattes et al.[47]
• A 12% NaOCl solution was diluted using sterilized and distilled water to obtain the two target concentrations of 2.5% and 5.25%.
• Ca(OCl)2 powder with 65% purity was dissolved in distilled and sterilized water to obtain the two target concentrations of 2.5% and 5.25%.
• After total dissolution, the solutions were filtered twice with Millipore filtration to remove debris and stored in blinded, randomly numbered bottles.
• Human peripheral blood cells were used as the test system. Peripheral venous blood was collected from healthy volunteers. Informed consent was obtained from the donors at the time of donation for the use of their blood sample in this study.

The Groups were assigned as follows:

GROUP 1 (G1) : 2.5% Sodium hypochlorite solution and culture media

GROUP 2 (G2) : 5.25% Sodium hypochlorite solution and culture media.

GROUP 3 (G3) : 2.5% Calcium hypochlorite solution and culture media.

GROUP 4 (G4) : 5.25% Calcium hypochlorite solution and culture media.

GROUP 5 (G5) : Control group with culture media only.

Figure 3: Test Solutions in Culture Medium

Cell culture media and maintenance

The peripheral lymphocytes were cultured in Roswell Park Memorial Institute medium (RPMI-Himedia), supplemented with 10% heat inactivated Foetal Bovine Serum (FBS) and a 1% antibiotic cocktail containing Penicillin (100U/ml), Streptomycin (100µg/ml), and Amphotericin B (2.5µg/ml). The cell containing TC flasks (25cm2) were incubated at 37OC at 5% CO2 environment with humidity, in a cell culture incubator (Galaxy® 170 Eppendorf, Germany).

Trypan Blue Exclusion Assay

Principle:

The dye exclusion test was used to determine the number of viable cells present in a cell suspension. It is based on the principle that cells that are living possess intact cell membranes that exclude certain dyes, such as trypan blue, eosin, or propidium, whereas dead cells do not. In this test, a cell suspension was mixed with the dye and then visually examined to determine whether the cells took up or excluded the dye. In the protocol presented here, a viable cell would have a brighter appearance whereas a nonviable cell would have a dark blue appearance.

Assay Procedure:

1. An aliquot of cell suspension was tested for viability for 5 min at 100 Ã~ g, was centrifuged and the supernatant was discarded. The size of the aliquot depended on the approximate number of cells present. The aliquot contained an adequate number of cells to count in a hemocytometer when suspended in 1 ml PBS. It was diluted again by mixing with 0.4% trypan blue.
2. The cell pellet was resuspended in 1 ml PBS or serum-free complete medium. Since Serum proteins stained with trypan blue can produce misleading results, the determinations were made in a serum-free solution.
3. 1 part of 0.4% trypan blue and 1 part cell suspension (dilution of cells) was mixed. The mixture was allowed to incubate ~3 min at room temperature. The cells were counted within 3 to 5 min of mixing with trypan blue, as longer incubation periods would lead to cell death and reduced viability counts. Mixing was performed in the well of a microtiter plate or a small plastic test tube using 10 to 20 µl each of cell suspension and trypan blue.

4. A drop of the trypan blue/cell mixture was added to the hemocytometer. The hemocytometer was placed on the stage of a binocular microscope and focussed on the cells.

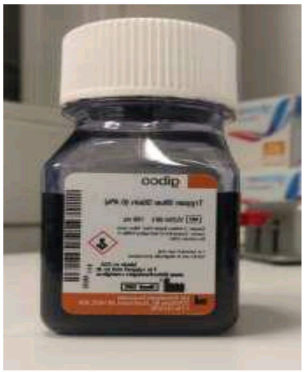


Figure 4: Trypan Blue

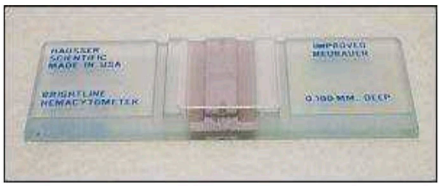


Figure 5: Hemocytometer

OUTCOME MEASUREMENT

The unstained (viable) and stained (nonviable) cells were counted separately in the hemocytometer. To obtain the total number of viable cells per ml of aliquot, the total number of viable cells were multiplied by 2 (the dilution factor for trypan blue). To obtain the total number of cells per ml of aliquot, the total number of viable and nonviable cells were added and then multiplied by 2.

The percentage of viable cells were calculated as follows:

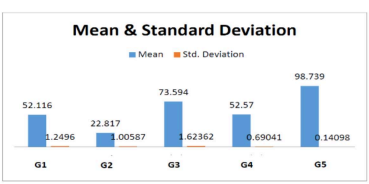
$$\text{Viable cells (\%)} = \frac{\text{Total number of viable cells per ml of aliquot}}{\text{Total number of cells per ml of aliquot}} \times 100$$

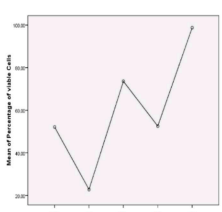
The data recorded on the computer was collected, tabulated, and statistically analyzed.
One way ANOVA test was done for the analysis of differences between the groups and
then the post hoc analysis was done to find out the significant difference between any
of the two given groups. Statistical analyses were performed using SPSS software
(IBM). In all the analysis, significance level was taken to be 0.05 (i.e., if the p-value is
less than 0.05, the null hypothesis would be rejected or it can be concluded that the null
hypothesis is statistically significant).

Table1: Mean and Standard deviation Of Percentage of Viable Cells

PERCENTAGE OF VIABLE CELLS										
					95% Confidence Interval for Mean					
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	df	Mean Square	F	Sig.
G1	10	52.116	1.24960	0.39516	51.2221	53.0099				
G2	10	22.817	1.00587	0.31808	22.0974	23.5366				
G3	10	73.594	1.62362	0.51343	72.4325	74.7555	4	7963.599	6978.00	0.00
G4	10	52.570	0.69041	0.21833	52.0761	53.0639				
G5	10	98.739	0.14098	0.04458	98.6381	98.8399				
Total	50	59.967	25.5174	3.60871	52.7152	67.2192				

Diagrammatic Representation of Percentage of Viable Cells





ONE WAY ANOVA

One way ANOVA showed significant value 0.000 (p=0.000) which is below 0.05 (ie α = 0.05). Therefore, there is a statistically significant difference between Groups determined by F and p = 0.00.

KRUSKAL-WALLIS TEST

The Kruskal Wallis test was done to find out the significant difference between the
given groups.

Table 2: Kruskal-Wallis Test

	Percentage of Viable Cells
Chi-Square	44.824
df	4
P value	**0.00**
a. Kruskal Wallis Test	
b. Grouping Variable: Group 2	

Table 3: Test Statistics

	Ranks		
	Groups	N	Mean Rank
Percentage of viable Cells	G1	10	19.4
	G2	10	5.5
	G3	10	35.5
	G4	10	21.6
	G5	10	45.5
	Total	50	

POST HOC TESTS

The Tukey HSD post hoc analysis was done to find out the significant difference between any two given groups.

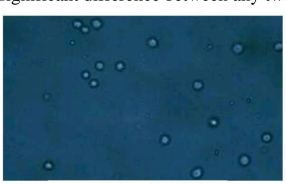


Fig 6: Control

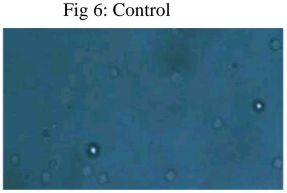


Fig 7: Sodium hypochlorite 2.5%

Table: 4

PERCENTAGE OF VIABLE CELLS						
Tukey HSD						
					95% Confidence Interval	
(I) GROUPS	(J) GROUPS	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
G1	G2	29.29900*	0.47774	0.00	27.9415	30.6565
	G3	-21.47800*	0.47774	0.00	-22.8355	-20.1205
	G4	-0.454	0.47774	0.01	-1.8115	0.9035
	G5	-46.62300*	0.47774	0.00	-47.9805	-45.2655
G2	G1	-29.29900*	0.47774	0.00	-30.6565	-27.9415
	G3	-50.77700*	0.47774	0.00	-52.1345	-49.4195
	G4	-29.75300*	0.47774	0.00	-31.1105	-28.3955
	G5	-75.92200*	0.47774	0.00	-77.2795	-74.5645
G3	G1	21.47800*	0.47774	0.00	20.1205	22.8355
	G2	50.77700*	0.47774	0.00	49.4195	52.1345
	G4	21.02400*	0.47774	0.00	19.6665	22.3815
	G5	-25.14500*	0.47774	0.00	-26.5025	-23.7875
G4	G1	0.454	0.47774	0.01	-0.9035	1.8115
	G2	29.75300*	0.47774	0.00	28.3955	31.1105
	G3	-21.02400*	0.47774	0.00	-22.3815	-19.6665
	G5	-46.16900*	0.47774	0.00	-47.5265	-44.8115
G5	G1	46.62300*	0.47774	0.00	45.2655	47.9805
	G2	75.92200*	0.47774	0.00	74.5645	77.2795
	G3	25.14500*	0.47774	0.00	23.7875	26.5025
	G4	46.16900*	0.47774	0.00	44.8115	47.5265

*. The mean difference is significant at the 0.05 level.

RESULTS

The trypan blue assay is used for evaluating cytotoxicity, along with cell viability, which is indicated by dye exclusion. The highest percentage of viable cells mean value was recorded for Group 5 (98.739±0.14098). In the test groups, Group 3 showed the highest percentage of viable cells (73.594±1.62362), while the lowest percentage of viable cells was for Group 2 (22.817±1.00587) indicating maximum cytotoxic effects.

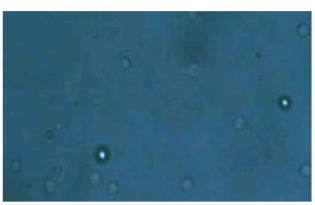


Fig 8: Calcium hypochlorite 2.5%

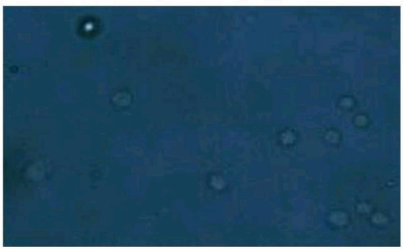


Fig 9: Sodium hypochlorite 5.25%

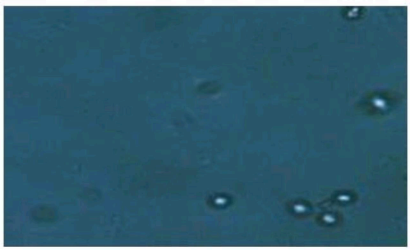


Fig 10: Calcium hypochlorite 5.25%

The Mean and Standard Deviation value for measuring percentage of Cytotoxicity (Percentage of Viable Cells) of all Groups was tabulated in Table 1. Group 5 which was the Control Group showed 98% of viable cells followed by Group 3 with 72% viable cells and Group 2 with 22% , showing the least percentage of viable cells. This was represented in Graph 1 and was correspondingly shown as Diagrammatic Representation. Kruskal-Wallis Test for percentage of viable cells (Table 2) showed that besides the Control Group , Group 3 gave the highest value of viable cells indicating that Group 3 showed the least Cytotoxicity. This is further evident when we study Figures 7, 8, 9 and 10 with 6 being the Control Group.
Table 3 shows the Test Statistics with CHI Square of 44.824 , df of 4 and P value of 0.00.
The Tukey HSD post hoc analysis was done to find out the significant difference between the given Groups. On comparison of the p value given in the Table 4 ($\alpha = 0.05$), if $p < \alpha$, there is statistical difference between the Groups. There is statistically significant difference of Percentage of Viable cells between Group 1 and Group 4 since p= 0.01 which is less than 0.05 i.e.α.

DISCUSSION

One of the greatest challenges in endodontic therapy is the procedure of rendering a complex root canal system and its ramifications completely clean of organic and inorganic debris, thereby creating a healthy environment for the tooth to achieve maximal healing. The elimination of microorganisms from the root canal is an important step in the success of endodontic therapy.[62]

The colonisation of dentinal walls with biofilm, along with the anatomical complexity of the root canal and the possibility of invasion of dentinal tubules, can compromise the success of endodontic therapy.[63]

Chemo-mechanical preparation plays an important role in the success of endodontic treatment.[64] An ideal endodontic irrigant must present some important characteristics, including antimicrobial activity and tissue-dissolving capacity. Irrigation solutions can cause complications, like tissue damage, allergies, and variable degrees of discomfort to patients which depends on the type and volume of the irrigant used on periradicular tissues.[65] Additionally, it should induce mild or no inflammatory response in the periapical tissues with a minimal toxic effect.[66] Therefore, biocompatibility issue is as important as the antibacterial or tissue-dissolving property for an intracanal irrigation solution.[67]

Since 1920, NaOCl is one of the most used endodontic irrigants. It is known for its antibacterial activity and for its capacity of dissolving organic tissue in root canal.[68] Sodium hypochlorite exhibits a dynamic balance as shown by the following reaction.[69]

$$NaOCl + H2O \; NaOH + HOCl \; Na+ + OH- + H+ + OCl-$$

Interpreting these chemical reactions, sodium hypochlorite acts as a solvent for organic and fat degrading fatty acids, transforming them into fatty acid salts (soap) and glycerol (alcohol) that reduces the surface tension of the remaining solution. [69] NaOCl ionizes to liberate hypochlorous acid (HOCl) and hydroxyl ions in an aqueous environment. HOCl disrupts the microbial metabolism by oxidation of sulfhydryl groups within bacterial enzyme systems.[70] Saponification, amino acid neutralization, and chloramination reactions contribute to tissue dissolution with participation from hydroxyl ions in the first two reactions and HOCl in the third. The state of HOCl is dependent on the pH of the solution. At pH >8.5, hypochlorite ions (OCl-) predominate, whereas at pH <6.5 the HOCl molecule is dominant. At pH values between 6.5 and 8.5, they are in a state of equilibrium. HOCl and OCl- contribute to the available chlorine

content of the solution although the HOCl molecule is more active. When hydroxyl ion levels decrease as a result of the saponification and amino acid neutralization reactions, the pH also decreases, thereby favouring the formation of HOCl molecules. The chloramination reaction is then initiated, which is the most important step for tissue dissolution because it results in degradation and hydrolysis of amino acids. The amino acid chloramination reaction forming chloramines interfere with cellular metabolism.
Oxidation promotes irreversible bacterial enzymatic inhibition replacing hydrogen with chlorine. This enzyme inactivation can be observed in the reaction of chlorine with amino groups (NH2-) and an irreversible oxidation of sulphydryl groups (SH) of bacterial enzymes (cystein).[71] Strong basic pH and high percentage of free chlorine in solution are the two peculiar actions related to the antibacterial and solvent actions of NaOCl.[71] It has limited activity on the inorganic components of the smear layer, and this required the use of chelating agents. [72] The high pH of sodium hypochlorite interferes in the cytoplasmic membrane integrity with an irreversible enzymatic inhibition, biosynthetic alterations in cellular metabolism and phospholipid degradation observed in lipidic peroxidation.[70]

Although higher concentrations of NaOCl significantly improve its antimicrobial and tissue-dissolving effects, it can become more cytotoxic and induce inflammatory response when in contact with periapical tissues.[73] It also has a pronounced negative effect on the survival and differentiation of stem cells of the apical papilla, factors which may hinder periapical repair and pulpal regeneration.[74]

Most complications of sodium hypochlorite appear to be the results of its accidental,injection beyond the root apex which may cause violent tissue reactions characterized by pain, swelling, haemorrhage, and in some cases the development of secondary infection and paraesthesia. [75] A great deal of care should therefore be exercised when using sodium hypochlorite during endodontic irrigation. Ehrich et al. [76] suggested that a clinician should check, both clinically and radiographically for immature apices, root resorption, apical perforations or any other conditions that may result in larger than normal volumes of irrigant being extruded from the root-canal system into the surrounding tissue. Irrigation should be performed slowly with gentle movement of the needle to ensure that it is not binding in the canal. [77] In an in vitro study by Brown et al. [78], the use of a reservoir of irrigation fluid in the coronal access cavity and carried into the root canal during filing resulted in significantly less apical extrusion of irrigation solution than with deep delivery with an irrigation needle.

Another important limitation to the use of NaOCl is its chemical instability. External agents like temperature, light, and storage conditions influence the availability of chlorine ions, which successively affect the maintenance and preservation of its properties and influence the outcome of endodontic treatment. [79] Currently, there is no root canal irrigant considered ideal, and alternative solutions continue to be studied.

Calcium hypochlorite ($Ca(OCl)_2$) is a halogenated compound, used for industry sterilization, bleaching, and water purification. In contrast with NaOCl, $Ca(OCl)_2$ is relatively stable with an available chlorine ion percentage higher than NaOCl(up to 65% available chlorine).[80] $Ca(OCl)_2$ has the ability to promote soft-tissue dissolution and presents similar antibacterial properties when compared with NaOCl on Enterococcus faecalis colony-forming units in infected bovine teeth. [74]

$Ca(OCl)_2$ in a freshly prepared aqueous solution, the following reaction occurs:

$Ca(OCl)_2 + 2\ H2O\ 2\ HOCl + Ca(OH)_2$

The presence of the Ca2+ leads to the production of twice as many hydroxyl ions than in a NaOCl solution. In a $Ca(OCl)_2$ solution, these would take longer to be exhausted in the saponification and amino acid neutralization reactions before the pH could decrease and favour the formation of hypochlorous acid, which is the more reactive species formed during the ionization reaction.

The preparation of a $Ca(OCl)_2$ solution could also be more accurate than that of NaOCl, because $Ca(OCl)_2$ powder are often weighed and incorporated into water prior to use. On the other hand, a NaOCl solution is prepared by diluting a more concentrated and therefore unstable solution, thus making it difficult to obtain an accurate concentration of NaOCl. [81]

The aim of this study was to assess the cytotoxicity of NaOCl and $Ca(OCl)_2$ on human peripheral blood cells. This kind of study is important because the root canal irrigant may reach the periapical tissues [16] and influence the prognosis of endodontic therapy, mainly in teeth with destroyed apical constriction because of root canal instrumentation or root resorption. This becomes more critical when regenerative endodontic protocols are used in immature teeth, since root canal irrigant contacts the periapical tissues, which are essential for regeneration. [82] The null hypothesis was rejected because there have been differences between solutions.

Blattes et al. [47] compared the cytotoxicity of $Ca(OCl)_2$ and NaOCl both in vitro over 3T3 fibroblasts and in vivo through the inflammatory response in both n rats. $Ca(OCl)_2$ showed favourable results for in vitro cell viability and induced a minimal inflammatory response. Swelling was observed immediately after injections of 2.5% NaOCl in some sites, which occurred transiently. $Ca(OCl)_2$ induced only a low-level inflammatory response.

The trypan blue is taken into account as an appropriate assay to evaluate cytotoxicity of dental materials. Trypan blue is a dye that is readily absorbed by dead cells owing to the loss of plasmatic cell membrane selectivity. In contrast, live cells remain unstained. [84] Certainly, such data will contribute for a better understanding of the behaviour of these compounds on the cellular system. Many authors assert that the NaOCl cytotoxicity is directly proportional to its concentrations. [85] With trypan blue staining, this outcome was confirmed for NaOCl and Ca(OCl)2. An increase in cytotoxicity was observed as the concentration increased. [86] In the present study, the solution of 2.5% Ca(OCl)2 seemed to show a better cell viability than NaOCl at the same concentration. Ca(OCl)2 produced some evidence of cytotoxicity only at the highest tested concentrations and the same was observed by others. [87]

In contrast, NaOCl was severely cytotoxic at practically all tested concentrations in this study, confirming a recent report conducted by Missotten et al., [88] in which no surviving ocular cells were observed after treatment of 3 min with 0.5% NaOCl in vitro. These findings confirmed that the cell membrane was the main target for the toxic agent and that the damage occurred rapidly. Cell number was significantly reduced, and a considerable number of cells appear darker, indicating enhanced cell death on increasing concentrations of both the solutions. Cell viability was significantly reduced by the application of calcium hypochlorite and sodium hypochlorite in a dose dependent manner, indicating cytotoxicity of these chemicals. The maximum reduction in viability was observed with Sodium Hypochlorite 5.25 % followed by Sodium Hypochlorite 2.5 %. The lowest cytotoxicity was observed for Calcium Hypochlorite 2.5 %.

From this study, we can suggest that Calcium hypochlorite can be considered as an alternative endodontic irrigant. However, It is important to note that cell culture models have limitations because of the non-physiological conditions in which cells are maintained: only one cell type without cell-cell interaction, no elimination of toxic substances, lack of biotransformation capacity and defense mechanisms. [90] For these reasons, a direct extrapolation of results from cytotoxicity tests to the periapical tissue is not possible. [91] Further in vivo researches evaluating the biocompatibility of Calcium hypochlorite solutions is necessary to verify its use in endodontic therapy

CONCLUSION

From the study the following conclusions can be drawn :

1. 5.25% $Ca(OCl)_2$ was found to be less cytotoxic than 5.25% NaOCl.
2. 2.5% $Ca(OCl)_2$ was found to be less cytotoxic than 2.5% NaOCl.
3. 5.25% $Ca(OCl)_2$ was found to be more cytotoxic than 2.5% $Ca(OCl)_2$.
4. 5.25% NaOCl was found to be more cytotoxic than 2.5% NaOCl.

Therefore, based on the observations in this study, we see that Calcium hypochlorite is
a relatively safer root canal irrigant than Sodium hypochlorite specifically in terms of
cytotoxicity and can be considered as a possible alternative to Sodium
hypochlorite.

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ROLE OF PROSTHODONTICS IN FORENSIC DENTISTRY

Dr. Rebekah M James
: Intern, St. Gregorios Dental College, Chelad.

ABSTRACT

Forensic odontology has recently become an integral part of forensic science. Dental identification holds an important role in the identification of remains after postmortem changes, traumatic tissue injury or lack of a fingerprint record. Forensic identification based on assessment of prosthodontic appliances and or prosthesis by methods such as of labelling of dentures and other prosthetic appliances could provide vital clues for victim identification. Other sources such as salivary sample collection from the prosthesis can provide a rich source of DNA collection. How a prosthodontist can play a crucial role in forensic medicine by application of various modes that can aid in identification of a deceased individual is illustrated in this review article.

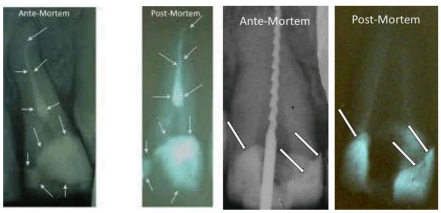
Keywords: Forensic Odontology, Denture labelling, DNA matching, Rugoscopy, Forensic

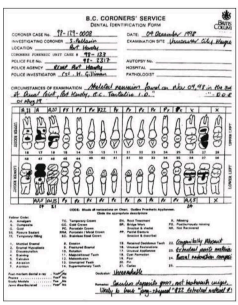
INTRODUCTION

Forensic dentistry engages the processing, reviewing, evaluation and presentation of dental evidence with the intention of contributing scientific and objective data as evidence in legal processes. Experienced professionals require a detective's qualities that require knowledge encompassing several disciplines, since the dental records obtained can identify an individual or provide the information needed by the authorities to establish neglect, fraud and/or abuse. Dental structures are the hardest and the most resilient tissues of the human body. Teeth on exposure to postmortem influences survive longer than other body tissues as the materials used to restore damaged teeth are extremely resistant to physical, chemical, and biological destruction. Role of a Prosthodontist in forensic dentistry comes into play in cases where the victim has lost natural dentition and has been wearing prosthesis.

Identification with the help of dentistry, can have three different applications:

a. Comparative identification that helps in comparing the postmortem dental records with the antemortem records of an individual.
b. To ascertain the search of an individual when the antemortem records are not available and there are no possible data referred to the identity of the subject.
c. Identification of victims following mass disasters or catastrophes.





HISTORY

One of the earliest known examples of forensic dentistry involved Agrippina, the mother of Roman emperor Nero. In 49 B.C., Agrippina ordered the death of her rival Lollia Paulina, who was in competition with her to be the wife of Emperor Claudius. Agrippina demanded to see Lollia Paulina's head as proof of her death, but she wasn't sure that her rival was dead until she noticed Lollia Paulina's distinctive discolored front teeth1. History dates to 1775, during the US Revolutionary War when Paul Revere, a young dentist, identified war casualties by assessment of their crown and bridgework. Later in 1885, the burnt body of Countess of Salisbury was identified with the help of a gold denture. After the Second World War, out of 819 soldiers only 9 could be identified with the help of denture as labelling of the dentures and preservation of antemortem records were not much in practice at that time[2]. In 1849, Dr. Parkman a professor at the Harvard University body was burned out completely. The body of the late professor was identified by charred fragment of a tooth fused to gold by Dr. N

C Keep, who had previously made a removable denture for the victim. In 1968, a badly mutilated body found on the railway line near Sydney was identified by a maxillary acrylic denture bearing a name inscribed on it[3]. In 1977, Hitler and his wife's bodies were identified using dental records with the help of radiographs and prostheses4. Many more such as M. Raja Jayachandra Rathore of Canouj who died on the battlefield in 1191 was also identified by his artificial anterior teeth. This was probably the first case of identification using dentition in India. On September 11, 2001, thousands of people lost their lives in the world trade center disaster in New York, U.S.A. Deoxyribo Nucleic Acid (DNA) extracts from toothbrushes of the victims were used in identification of some of the victims.

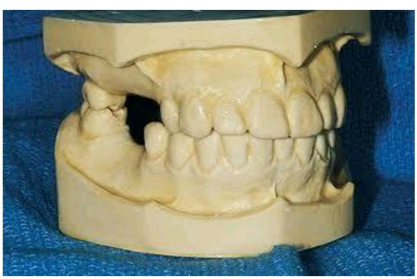
DISCUSSION

Legal identification of an individual's identity is based on numerous parameters centered around the appearance and personal features like identity cards, accessories, clothes etc.). However, it is not necessary that this may always be available or applicable necessitating the use of other sources of identification. In general, certain characteristics such as age, gender, race, ethnicity and/or blood samples are used. Dental examinations are second only to fingerprints and play a fundamental role in medico-legal investigations including mass disasters. A prosthodontist can play a pivotal role in forensic identification by employing various methods and techniques available in literature. Various processes and systems are employed for identification and a prosthodontist can become a part of this team and render these services in a better way.

The Prosthodontist can contribute to forensic science in the following ways[5].

COMPARATIVE DENTAL IDENTIFICATION

This procedure of dental identification of a victim involves the matching or comparison of postmortem dental remains with antemortem dental records. However, antemortem data needs to be available for this methodology to be successful by keeping a record of the dental notes, radiographs, study models and clinical photographs by the dental professionals[6].



PROSTHESIS LABELLING

Denture labelling has been well documented as a useful technique in the identification of the victims of fatal disasters as well as for the patients who suffer from mental disorders or psychiatric problems such as traumatic or senile loss of memory like dementia and Alzheimer's[8]. The Australian Dental Association recommends labelling on all the dentures for residents as a health care norm. Denture marking is also regulated by law in Sweden, Iceland, and a few cities of the United States of America. Although no legal orders have been approved pertaining to this matter, it is still an ethical and social obligation on the part of the dental surgeon to do so. In incinerated bodies of the victims, it is noted that the mandibular lingual posterior and the maxillary palatal posterior portions of the dentures are generally spared. Hence, these sites become the choice of areas for the labelling. Alloys such as cobalt chromium resist melting even in some cases of incinerated victims. Hence, the complete denture marking should not only be restricted to acrylic complete or partial dentures only but also be executed on to the ones made from these alloys[7].

Various other appliances in dentistry such as the ones used in orthodontics, maxillofacial prosthesis etc. should also be marked for identification.

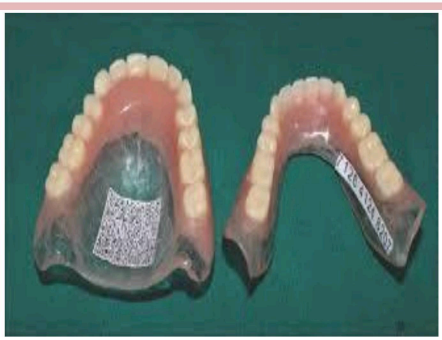
Requirements for ideal markings[9]:

The strength of the prosthesis must not be compromised. It must be easy and cheap or inexpensive to apply. The identification system must be efficient. The marking must be visible and durable. The identification should withstand fire and humidity. The identification mark should be aesthetically acceptable. The identification should remain inert.

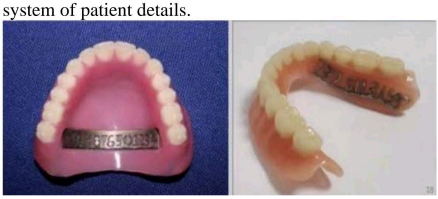
Denture labelling can be performed by two techniques:

1. Surface modification technique: It involves writing, scribing on the polished or tissue surface of the denture post fabrication with a waterproof marker or embossing initials of the patient on the master cast. However, these methods are not permanent and may lead to food and debris accumulation making the surface prone to oral infections.
2. Inclusion technique: This technique involves the placement of metallic, non-metallic labels or microchips during the denture processing stage. Patient's name or identification number is incorporated in the denture permanently. This technique might be time consuming and requires skill.

Paper strips: Incorporation of paper strips is an economical technique wherein a scribed paper strip is inserted between the slopes of the alveolar ridge and the center of the palate. The paper strip is covered with the acrylic resin before the final closure for acrylization of the denture is done[10].



ID Band: Stainless steel bands or fire-resistant materials like titanium foil, matrix bands containing the information of the denture wearer can be used to mark the dentures. The most used are titanium foil and HO matrix band which usually contains an identifiable coding system of patient details.



Laser etch: Laser etching is a technique wherein copper vapor laser can be used to etch the metal surface of the prosthesis. This method is expensive and needs special training.

Denture micro labelling system: Micro labelling procedure contains transparency film with name and other information of the patient incorporated onto the dentures. Chemical treatment with 100% cyanoacrylic acid is done prior to the incorporation of the label into the denture. A thin layer of autopolymerising clear acrylic resin can then be coated.

T- Bar: A T shaped clear PMMA resin bar is constructed by trimming the base plate wax and is then acrylized with clear or pink PMMA. A printed identification is fixed against the flat surface of the bar. It is then highly polished to produce a clear window displaying the necessary information of the denture wearer.

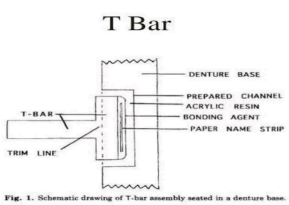
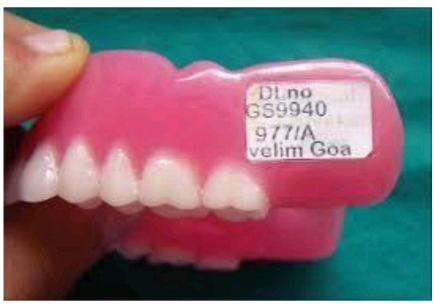
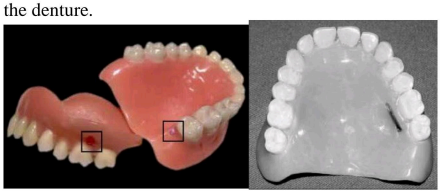


Fig. 1. Schematic drawing of T-bar assembly seated in a denture base.

Lenticular card: Lenticular printing is a multistep process which includes creating a lenticular image from minimum two existing images and combining it with a lenticular lens. Images are produced with an illusion of depth, morphology or the ability to move or change as the image is viewed from different angles. Each image is sliced into strips, which are then interlaced the other images. These are then printed on the back side of a synthetic paper and laminated on the lens. One of the disadvantages of this method is that it may not withstand fire and the information once written cannot be altered again[11].



RFID Tags: Radio Frequency Identification (RFID) is a cosmetic labeling method of identification with the help of using radio waves. The tag consists of a microchip that stores patient's information. The reader reads the information contained in the tag. The tag is programmed by connecting to the computer and then the programmed tag is incorporated into the channel on the posterior buccal surface of the denture. Clear acrylic resin is then placed over the tag to recontour the denture. This is an expensive technique, and the tag is not fireproof. It permits rapid and reliable identification of size 8.5 X 2.2 mm. So, large amount of patient details can be stored into the denture.



DNA IDENTIFICATION

DNA patterns for each individual are unique. The resistant nature of dental tissues to external trauma like incineration, immersion, mutilation and decomposition, teeth represent a rich source of DNA material. This DNA biological material can provide the necessary link to prove identity of a victim when traditional dental identification methods fail. This identification method should always be used as a supplementary method.

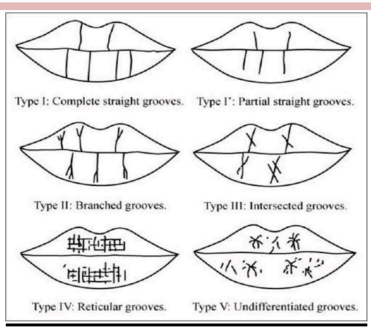
RUGOSCOPY

Rugoscopy is the study of palatal rugae. The rugae are irregular, asymmetrical ridges of mucous membrane extending laterally from the incisive papillae located in the anterior part of the mid palatine raphe. The arrangement of these rugae is considered unique to an individual and can be used as a trusted method in postmortem cases. The rugae is anatomically surrounded by cheeks, lips, tongue, buccal pad of fat, teeth and alveolar bone that keeps them well protected from trauma and high temperatures. Length of palate increase with age but remains in same position throughout life. It is formed in 12 -14 week of prenatal life and remain stable until degeneration of oral mucosa after death. It is specifically useful in edentulous cases and in certain conditions where their other methods for identifications are less reliable as in burnt cases or where bodies have undergone severe decomposition. Rugae pattern may also be unique to racial groups therefore facilitating population identification. To study the rugae pattern, first the impression of maxillary arch needs to be taken which is the poured with dental stone. A prosthodontist by the identifying of the rugal pattern may help to find out upper denture wearer and some judgments are usually made by using ante-mortem impressions made for study models or prosthodontic consideration.

CHEILOSCOPY

It is the study of lip prints, i.e. The elevation and depression which form the characteristics features of lip. Edmond Locard (1932) is the first person who suggested use of lip prints in crime identification. Figuralineariumrubrorum is the new name suggested by Suzuki and Tsuchihasi for lip prints. Lip prints can be obtained by direct and indirect methods. In, 1932 a French Criminologist, Edmond

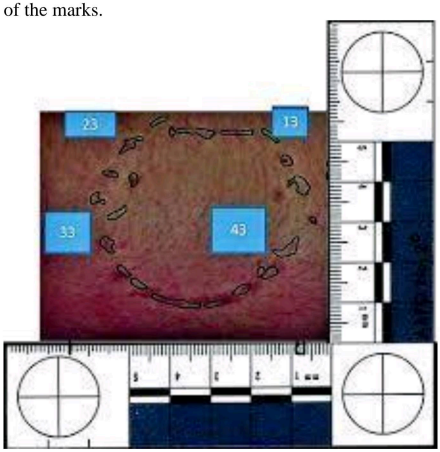
Locard first utilized lip prints in the identification of victim.[13]



BITEMARK ANALYSIS

The dentition will be different for each person. The missing or prominent tooth in dental arch help easy identification of bite mark there by the culprit. The maxillary and mandibular teeth are found to be the main factor in causing bite mark. Each bite mark will differ according to the texture of skin. Most found bite mark is contusion. Bite mark will reduce size within 10-20 min so the initial documentation should be done at initial stage by forensic dentist. The most common type of bite marks is contusions[12].

Bite marks may be both two- or three-dimensional evidence. Prosthodontists who are usually well versed in the properties of different impression materials and hence can easily help in the construction of an accurate replica of the marks.

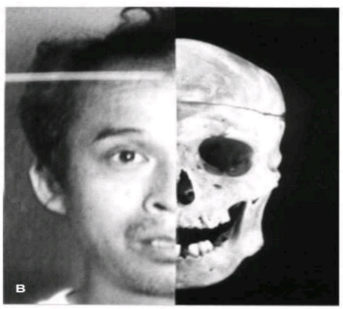


SEX DETERMINATION BY USING PULPAL TISSUE:

It is based on the presence or absence of X-chromosome[14].

PHOTOGRAPHIC SUPERIMPOSITION

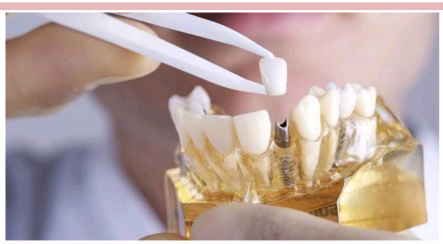
This technique of superimposition and x-ray tomography can be very effective in identifying between a complete denture and a skull. Since the morphological characteristics of the denture base, including the arrangement of the artificial teeth must be compared with those of the surfaces of the jaw bones, it become difficult since the morphological characteristics of the denture base, including the arrangement of the artificial teeth, have to be compared with those of the surfaces of the jaw bones[17].



DENTAL IMPLANT IDENTIFICATION

Dental implants can play an important role in identification. DNA identification, fingerprint and dental comparison are primary scientific identifiers. However, in some situations where a victim has been incinerated, there may be loss of fingerprint detail and denaturing of DNA. The physical properties of titanium like high corrosion resistance, high structural strength, and high melting point, suggest the retention of implants following most physical assaults. Berketa et al placed Implants in sheep mandibles and then cremated entire sheep heads in a commercial cremator.

The information regarding batch number was laser etched within the chamber of the Straumann TM implants. Following retrieval of the implants, the batch number within the implant was still visible, which could significantly add importance to the identification of a victim. The result indicated that there was an intact identifiable batch number on removal of the abutment. Hence, it was suggested if the companies constructing implants place individual serial numbers rather than batch numbers on these implants then this can become a potential new approach for the identification of the deceased[15].



STUDIES FOR AGE ESTIMATION AND SEX DETERMINATION

1.Mandibular Canine Index as a Sex Determinant.

Canines seem to be unaffected by extreme catastrophic events like air crashes or hurricanes. The method comprises of evaluating dental casts in the age group of 1420 years. Boaz, et al revealed that the mean values of the buccolingual and mesiodistal dimensions of the mandibular left canine were greater in females than in males and the mean values of the mesiodistal dimensions of the mandibular right canine in females were greater than that in males in the given sample[16].

2.Cementum Annulations for Age Estimation.

The tooth cementum annulations may be used more reliably for age estimation. The predicted age of the individual is thus obtained as:

Number of incremental lines (n) = X/Y, where X is the total width of cementum from dentinocemental junction to cementum surface and Y is the width of cementum between the two incremental lines. By adding average age of eruption in

years for each tooth as presented in Gray's Anatomy, the counted number of incremental lines, the chronological age of the individual was obtained.

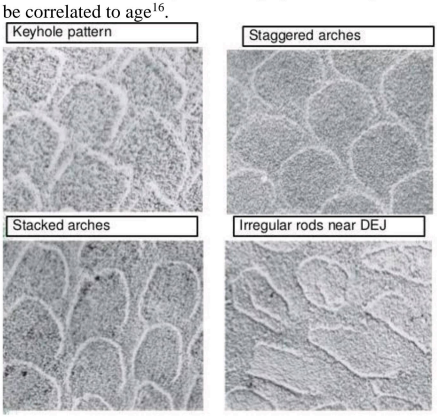
E = n + t, where estimated age = number of incremental lines (n) + eruption age of tooth (t).

3.Enamel Rod End Patterns.

Enamel rod end patterns are unique to an individual tooth of the same individual and in different individuals. Enamel rods are laid down by the ameloblasts in an undulating and intertwining path. This is manifested on the outer surface of enamel as patterns of the ends of a series of adjacent enamel rods. These patterns on the enamel surface are called tooth prints. The term 'ameloglyphics' ('amelo' meaning 'enamel'; 'glyphics' meaning 'carvings')—has been used for the study of enamel rod patterns on tooth surface. These enamel rod end patterns can be duplicated by various methods like acetate peel technique, rubber base impression, etc. The age related changes in the dentition can be divided into three categories: formative, degenerative and histological. Formative changes can be good predictors till the age of 12. They include the completion of the crown, eruption of the crown into oral cavity and

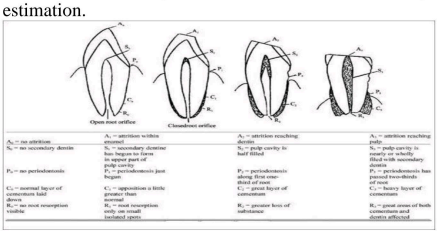
completion of the root. Degenerative changes include attrition, periodontosis, secondary dentin and cementum apposition (both seen microscopically), root resorption and transparency of the root seen in ground sections. Amino acid racemization studies are also used to determine age.

Aspartic acid is most used based on its presence in human dentin. Aspartic acid exhibits optical phenomena by existing in the dextro (D) or laevo (L) forms. Laspartic acid is found in human dentin and with time converts into the D-aspartic acid. It has a slow metabolic turnover and, therefore, is slow to decompose. Thus, assessment of the D/L ratios in dentin, by chromatographic techniques, can be correlated to age[16].



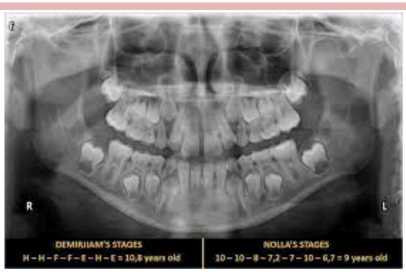
4.Dentin Translucency.

Dentinal translucency is considered best for dental age estimation.



5.Panoramic Radiography.

Dental examination and comparison between antemortem and postmortem dental records and radiographs produce results with a high degree of reliability and relative simplicity. Panoramic radiographs are also helpful to determine the age of the individual by assessing the stage of eruption. The size of dental pulp cavity is reduced because of secondary dentin deposit.



6.Third Molar for Age Estimation.

The eruption stages were evaluated using the classification of stages by Olze, et al as:

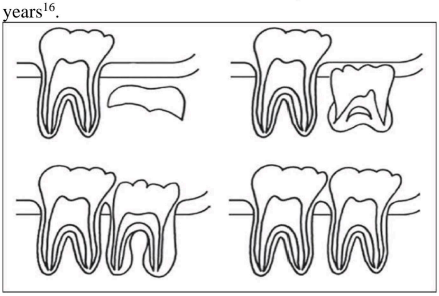
Stage A: Occlusal plane covered with alveolar bone.

Stage B: Alveolar eruption; complete resorption of alveolar bone over occlusal plane.

Stage C: Gingival emergence; penetration of gingiva by at least one dental cusp.

Stage D: Complete emergence in occlusal plane.

Each individual age was calculated as date of exposure minus date of birth and recorded as years and 1/10 of years[16].



CONCLUSION

Application of forensic dentistry for the identification of a victim is not anymore, a recent concept. The oral cavity is a rich and noninvasive source of DNA and can be used for the identifications for providing information needed in legal processes. However, there is a need to motivate dental practitioners to maintain dental records and apply distinctive markers in prosthesis and also maintain a database which can be made available on request. More studies should also be performed to better understand the population-based characteristics in high-risk areas to explore this interesting field of Forensic Sciences.

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Publication Types: Review article

OSSEODENSIFICATION: ENHANCING PRIMARY STABILITY OF A DENTAL IMPLANT- A NEWER APPROACH

Dr. Arya Aravind[1], Dr. Jasmin Cyril[2], Dr, Jinson James[3], Dr. Reshma Raju[4]
1,2,3. Post Graduate Student, 4. Senior lecturer, Dept. Of Prosthodontics and Crown and Bridge, St. Gregorios Dental College, Chelad

ABSTRACT

Dental implants have attained great usage in the field of oral rehabilitation. In the case of implants, it is essential to have sufficient bone bulk and density in order to achieve good bone-to-implant contact and primary stability. These factors are crucial for osseointegration. Surgical procedures also affect the implant's primary stability. A new osteotomy procedure called osseodensification, which was recently introduced, increases the primary stability.

Keywords: dental implants, osseodensification, osteotomy, implant primary stability

INTRODUCTION:

Dental implants have revolutionized the field of oral rehabilitation, boasting a success rate of over 90% over 10 years. These endo-osseous implants can successfully replace missing teeth in the oral cavity. It has gained popularity in the modern dentistry both in the case of aesthetic concern as well as the retention and superior quality.

The success of an implant is determined by different factors. Albrektsson et al., in 1981, enlisted certain factors, which include:

1. Implant material
2. Implant design
3. Implant finish
4. Status of the bone
5. Surgical technique
6, Implant loading conditions.[1]

Factors that influence the implant success:[2]

1. Implant-related factors – such as biocompatibility, surface topography, composition, shape, design, dimensions etc.
2. Host-related factors – like bone quality, density, volume.
3. Surgical factors – Achieving primary stability, preventing infection, minimizing mechanical and thermal trauma.
4. Biomechanical factors – Loading conditions.
5. Systemic factors – Systemic diseases, medications, parafunctional habits.

Primary stability in dental implants is an essential factor for achieving successful osseointegration. Osseointegration is defined as a direct structural and functional connection between living bone and an implant surface[3]. It is considered the prerequisite for implant loading and long-term clinical success. Two factors that affect this osseointegration are direct bone-to-implant interfaces and bone quantity and quality.

The key factors that enhance the implant primary stability are bone density, surgical protocol and implant thread type and geometry. Primary stability is mainly provided by the mechanical friction between the external surface of the implant and the walls of the implant osteotomy sites. Also, the insertion torque peak is directly proportional to the implant primary stability and bone density. Initial bone-to-implant contact percentage (%BIC) increases with high insertion torque.

Many techniques have been tried in the past to increase the implant primary stability. A few among them included bi-cortical fixation, under preparation for the implant bed, stepped osteotomy of the implant bed, and the use of osteotomes and condensers[2]. The undersized preparation drilling technique has been shown to improve the early fixation of oral implants in both clinical and histologic studies. Osteotome techniques and undersized drilling have been shown to create a layer of compacted bone at the implant interface, which increases primary stability of low-density cancellous bone. However, these techniques also present limitations during surgery.

The repeated impacting of a mallet is required to advance the Summers osteotome, which is a traumatic technique that may be difficult for the surgeon to control and, in some cases, can result in unintentional displacement, fracture, or patient side effects such as vertigo[18]. Expander drills offer an atraumatic technique but maybe cumbersome or difficult for the surgeon to use because the threading pattern creates direct coupling between feed rate and expansion rate, which limits the surgeon's control[2].

Recently, a new technique to increase the density of the osteotomy site has been introduced, known as osseodensification, developed by Huwais in 2015[5]. These techniques make use of specially designed burs to increase bone density by expansion during osteotomy[2].

Osseodensification:
Osseodensification (OD) is a new method of biomechanical bone preparation performed for dental implant placement. This procedure is characterized by low plastic deformation of bone that is created by rolling and sliding contact using a densifying bur that is fluted such that it densifies the bone with minimal heat elevation. It is a bone non-extraction technique developed by Huwais 2013[7] and performed by using a specially designed burs (Densah burs) (Figure 1) that helps to densify the bone while preparing an osteotomy site[8].

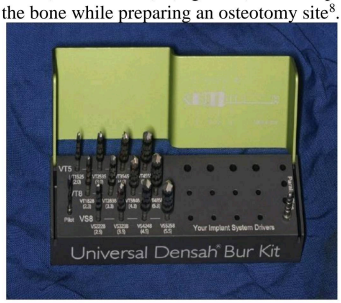

Figure 1: Versah kit with densification drills

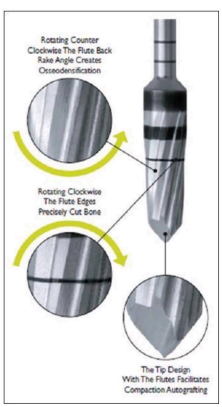

Figure 2: Role of densification Drills

Densifying burs (Densah burs): These burs have many lands with a large negative rake angle. These negative rake angles acts as non-cutting ends and which increases the density of bone in the osteotomy site, as they expand the osteotomy sites. These densifying burs basically have four or more lands or flute that smoothly compact the bone in the osteotomy site. It is a novel surgical device design to have a cutting chisel edge and a large shank. These burs are used with a standard surgical engine, and can densify bone by rotating in a non-cutting direction (counter clockwise) or drilling by rotating in the cutting direction (clock wise).[5] (Figure-2)

Mechanism of action of densifying burs:
Densifying burs produced controlled bone plastic deformation, which allows the expansion of a cylindrical osteotomy without excavating any bone tissue. The osseous densification preparation technique preserves bone bulk in two ways: compaction of cancellous bone due to viscoelastic and plastic deformation, and compaction autografting of bone particles along the length and at the apex of the osteotomy. Mainly implant stability depends on the direct contact between the implant surface and the surrounding bone. In low-density bone, drilling procedures that remove bone inevitably led to low insertion torques and that causing reductions in bone mineral density. In these cases, early loading of the implant will cause micromotion and cause failed bone healing response. Cancellous bone stiffness and strength are proportional to bone mineral density. With reduced bone mineral density there is a higher risk that the remaining bone will reach or exceed the bone's micro damage threshold. If micro damage does occur, the bone remodelling unit may require 3 or more months to repair the damaged bone area[17]. On the other hand, bone compaction techniques have been shown to increase insertion torque and bone density and therefore reduce micromotion[19]. Bone compaction technique showing an inverse correlation between insertion torque and micromotion.

Osseodensification procedure:
Densifying burs progressively increases in diameter throughout the surgical procedure. These burs are used with a standard surgical engine. To preserve and condense the bone, burs are used in the densifying mode. The burs work in a counterclockwise direction at 800 - 1500 rpm. Cutting mode of the bur is used for precisely cutting the bone and working in a clockwise direction at 800 - 1500 rpm (Figure-3). Recommended drill speed is 800 - 1500 rpm with torque range from 5 - 50 Ncm for both modes. These procedures should be done under constant water irrigation.

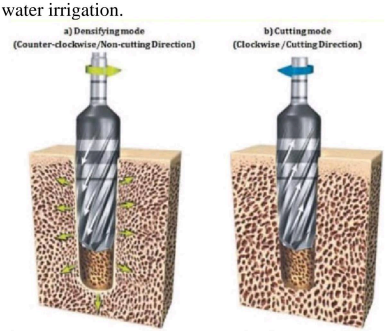

Figure -3: densifying and cutting mode

Indications:[5]
In cases with less than 3 mm of ridge width- It facilitates lateral ridge expansion.
In maxillary sinus autografting- It facilitates vertical ridge expansion.

Osseodensification and the bone density:
Osseointegration is the process of bone formation in the implant surface which provides implant secondary stability between the bone and implant surface. Maxillary posterior region like low bone density region insufficient bone is available for the implant placement. This will affect the primary stability of the implant by reducing the %BIC and %BV. In such cases osseodensification procedures will be more helpful. Osseodensification will increase the bone density eventually leads to the stability of the implant.

Osseodensification and effect in primary stability:
Osseointegration is related to primary stability. The implant primary stability is a crucial factor to achieve implant osseointegration. Primary stability is critical in cases of immediate loading. Implant micromotion leads to implant failure mainly by increasing peri-implant bone resorption. Trisi et al. in their in-vivo study found a statistically significant correlation between peri-implant bone density, insertion torque, and micromotion[9]. A significant increase in insertion torque and a concomitant reduction in micromotion was noted with an increase in bone density values. Berardini et al.[10] and Li et al[11]. in a review reported no significant difference in crestal bone resorption and failure rate between implants inserted with either high- or low-insertion torque values. They also demonstrated the ability of OD drills to increasing the % of BV and % of BIC for dental implants inserted into poor density bone compared to conventional osteotomies, which may help in enhancing osseointegration.

Advantages of osseodensification over the conventional osteotomy:
Biomechanical capabilities of an implant are related to various factors, which include implant geometry, surface modifications and osteotomy techniques. Standard drills used in implant site osteotomy facilitate implant placement mainly by excavating the bone. They lack design capability to create a precise circumferential osteotomy. So the conventional osteotomy technique lead to the formation of elongated and elliptical osteotomy sites due to the imprecise cutting of the drills. This reduces the insertion torque during implant placement, leading to poor primary stability. This potentially contributes to the non-integration of implant. Most common problem is that osteotomies prepared in deficient bone may produce either buccal or lingual dehiscence, which results in a reduction of primary stability of the implants. In such condition additional bone grafting is needed, which further increases the total cost of treatment and increases healing time.
Undersizing the implant site and using osteotomes for bone condensation are some of the surgical methods commonly advised to increase primary stability in implants and also to increase % of BIC in poor density bone. In the posterior maxillary region alternative to implant drilling procedures, osteotome technique was done to compact the bone with the mechanical action of cylindrical instruments along the osteotomy walls. This procedure also has drawbacks; it creates trabecular fractures with debris, which caused an obstruction to the process of osseointegration.
Osseodensification osteotomy diameters are found to be smaller than conventional osteotomies. This increases the percentage bone availability at the implant site by about three times. Studies reported the presence of autogenous bone fragments in the osseodensified osteotomy sites when compared with the conventional osteotomy sites. These findings are most relevant in case of low bone density areas. These fragments promote new bone formation around the implants. This increases the bone density and primary stability of the implant.

CONCLUSION:
Osseodensification is a specialized osteotomy technique which helps preserves the bone during osteotomy procedure. Specialized densifying burs are used for the procedure rather than conventional drills for osteotomy preparation and autograft bone in plastic deformation phase. The osseodensification osteotomy technique increases the implant primary stability, bone mineral density, and the percentage of bone formation at the implant surface. It also increases the insertion and removal torques of the implants compared to standard drilling and extraction drilling which eventually lead to the increased primary stability. The bone mineral density of the osteotomy sites along the periphery and at the apex of the osteotomies was increased by both compaction as well as autografting. This technique results in an expanded osteotomy with preserved and dense compacted bone tissue. These will maintain ridge integrity and allow implant placement with superior stability.

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Publication Types: Review article

OCCLUSAL SPLINT THERAPY: AN OVERVIEW

Dr. Ann George[1], Dr. Harishankaran U[2], Dr. George Francis[3], Dr. Arun K Joy[4]
1,2. Post Graduate Student, 3. Professor and HOD, 4. Reader, Dept. of Prosthodontics and Crown and Bridge, St. Gregorios Dental College, Chelad, Kothamangalam

ABSTRACT

Background: Occlusal splint therapy has been used for many years for the diagnosis and treatment of various disorders of the masticatory system. It is recommended in oral parafunction, unstable occlusion, stress related pain symptoms, occlusal interferences, and in extensive restorative treatment.

Summary: Occlusal splint therapy has been used routinely for diagnosis and treatment of various masticatory system disorders. Treatment with these appliances is non-invasive, reversible, and provides proper treatment. Literature provides an understanding of treatment protocol for the use of splints for temporomandibular disorders. The selection of particular splint design appropriate for patient's disorder will be facilitated by a better understanding of its physiologic and therapeutic effects.

Conclusion: The goal of this article is to familiarize readers of the various types, their rational, functions and proper case selection for the occlusal splint therapy. Also, it will familiarize the reader with basic splint designs and explain how to use these effectively.

Key Words: bite splint, occlusal splint, occlusal device, occlusal appliance, temporomandibular dysfunction.

INTRODUCTION:

Occlusion splint therapy is often a challenge for both the dentist and the patient. Occlusion related disorders are often difficult to diagnose, as the symptoms presented by the patients may be variable. Once the cause of occlusal-related disorders is identified, this reversible, non-invasive therapy provides both diagnostic information and relief with the other problems

Occlusal device: Any removable artificial occlusal surface affecting the relationship of the mandible to the maxillae used for diagnosis or therapy; uses of this device may include, but are not limited to, occlusal stabilization for the treatment of temporomandibular disorders, diagnostic overlay prior to extensive intervention, radiation therapy, occlusal positioning, and prevention of wear of the dentition or damage to brittle restorative materials such as dental porcelain [1](GPT 9).

Occlusal splint therapy may be defined as "the art and science of establishing neuromuscular harmony in the masticatory system by creating a mechanical disadvantage for parafunctional forces with removable appliances".

Occlusal splint therapy has been used routinely for diagnosis and treatment of various masticatory system disorders. Treatment with these appliances is non-invasive, reversible, and provides proper treatment.

Indications

- Growth modifications during mixed dentition
- Limited (tipping) tooth movements desired (arch expansion, individual tooth malposition)
- Retention following orthodontic treatment
- Adjunct to fixed orthodontic appliances
- Interfere with (or prevent the development of) abnormal orofacial habits
- TMJ disorders
- Fractures of the mandible

Contraindications

- Severe skeletal discrepancy
- Severe rotation-bodily movement needed
- Vertical discrepancy
- Severe crowding
- Very dense bone.

Principle

Most occlusal splints have one primary function: To alter an occlusion, so that they do not interfere with complete seating of the condyles in centric relation (CR).

Made of hard acrylic. Fits over the occlusal and incisal surfaces of teeth in one arch, creating precise occlusal contact with the teeth of opposing arch

Commonly referred to as a night guard, bite guard, interocclusal appliances, intraoral orthotic

Theories of Splint Action

- Restored vertical dimension theory
- TMJ reposition theory
- Occlusal disengagement theory
- Cognitive awareness theory
- Maxillomandibular aliment theory.

Occlusal Splints can stabilize weak teeth, uniformly distribute occlusal forces, reduce wear of teeth, and

stabilization of unopposed teeth but occlusal splint does not unload the condyles.

Types:

According to Okeson [3]

1. Orthopaedic repositioning appliances/anterior repositioning appliances
2. Stabilization appliance which reduces muscle activity/ muscle relaxation appliance.

Other types

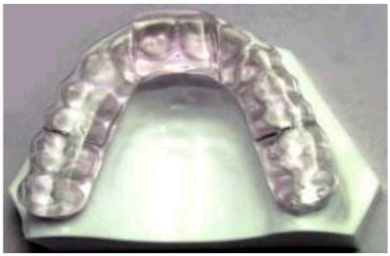
3. Soft/resilient appliance
4. Anterior bite plane
5. Pivoting appliance

According to Dawson:[4]

1. Muscle deprogrammer or permissive splints
2. Directive splints or non-permissive splints
3. Pseudo permissive splints, for example, soft splints.

Types of occlusal splints

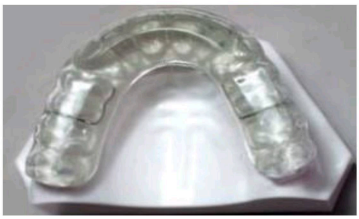
Permissive splints



The primary function is to unlock the occlusion and to remove the deviating tooth inclines from contact areas. [5] These eliminate noxious occlusal contacts and promote harmonious masticatory muscle function. These splints have flat occlusal surfaces.

The condyles are allowed to return to their correct seated position in CR Muscle deprogrammers.

Directive splints/non-permissive splint



Directive splints guide the mandibular condyles away from the fully seated joint position when a painful joint problem is present.

The sole purpose of these is to position or align the condyle-disk assemblies.

Anterior repositioning directive splints are useful in two scenarios of joint management:

Severe trauma with retrodiscal edema and chronic, painful disc displacement disorders.

CR splint/superior repositioning splint (SRS)

A CR splint is a full arch hard acrylic appliance.

The SRS is an interocclusal appliance that provides an occlusal relationship in the masticatory system that is considered optimal. The teeth are contacting simultaneously and Musculo skeletally; the condyles will be in their most stable position. The SRS is a full coverage splint, and it incorporates a full occlusal scheme with incisal guidance.

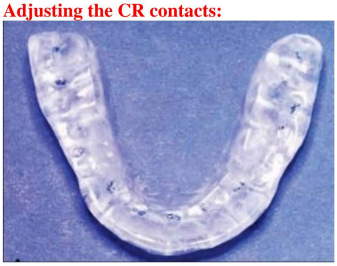
Indications

Muscle hyperactivity

Myospasms or myositis

Parafunctional activity associated with increased level of emotional stress

Adjusting the CR contacts:



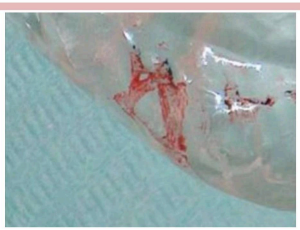
- Mark with pencil the deepest area of each mandibular buccal cusp tip and incisal edge
- The acrylic surrounding the pencil marks is removed so that the flat occlusal surface allows freedom in eccentric movements
- Anterior and posterior contacts should be carefully refined so that they will occur on flat surfaces and occlusal forces are equalized.

Adjusting the eccentric guidance

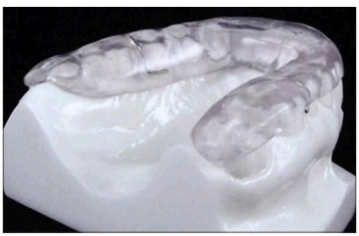
The acrylic prominences labial to the mandibular canines is smoothed.

They should exhibit about a 30-45° angulation to the occlusal plane and allow the canines to pass over in a smooth and continuous manner during protrusive and laterotrusive excursions.

Mandibular canines should move freely and smoothly over the occlusal surface of the appliance.



Anterior Repositioning Splints



It encourages the mandible to assume a more anterior position to the centric occlusion to provide more favorable condyle relationship in the fossa.
The purpose of anterior repositioning therapy is fulfilled when the retrodiskal tissues have healed sufficiently to regain a backward pull on the disk.[7]

Indications

1. To treat disc derangement disorders. Patients with joint sounds (e.g., a single or reciprocal click) can sometimes be helped by it
2. Intermittent or chronic locking of the joint (e.g. Retrodiscitis)
3. Some inflammatory disorders are symptomatically treated as the slight anterior position is more comfortable position for mandible.

Locating the correct anterior position
The key to successful anterior repositioning appliance fabrication is finding the most suitable position for eliminating the patient's symptoms.
The anterior stop is used to locate it.
The patient is instructed to protrude slightly and to open and close in this position. The joint is revaluated for symptoms and the anterior position that spots the clicking, is located and marked with red marking paper.

Anterior deprogrammers

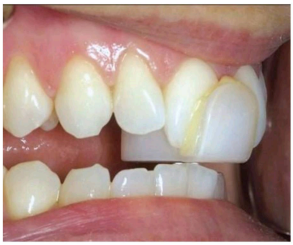
It is a hard acrylic appliance worn over the maxillary teeth providing contact only with the mandibular anterior teeth.
It is primarily intended to disengage the posterior teeth.
By disengaging, it eliminates the influence on the function of the masticatory system.

Indications

Muscle disorders related to orthopedic instability or an acute change in the occlusal condition

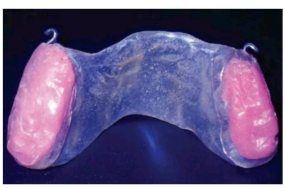
Disadvantages

If the appliance is worn continuously for several weeks or months, there is a great likelihood that the unopposed mandibular posterior teeth will supraerupt and the result will be an anterior open-bite.



Posterior bite plane

It is fabricated for the mandibular teeth. It consists of areas of hard acrylic located over the posterior teeth and connected by a cast metal lingual bar. The treatment goal is to achieve major alterations in vertical dimension and repositioning of mandible



Indications

Severe loss of vertical dimension or when there is a need to make major changes in the anterior repositioning of the mandible. Some therapists have suggested that this appliance be used by athletes to improve athletic performance. However, scientific evidence does not support this theory

Disadvantages

Potential supraerutpion of the unopposed teeth and/or intrusion of the occluded teeth.
Constant and long-term use should be discouraged

Pivoting appliance

The pivoting appliance is a hard acrylic device that covers one arch and provides a single posterior contact in each quadrant.
This contact is usually established as far posteriorly as possible.
When superior force is applied under the chin, the tendency is to push the anterior teeth close together and pivot the condyles downward around the posterior pivoting point.

Soft or resilient appliance

Description and treatment goals

The soft appliance is a device fabricated from resilient material that is usually adapted to the maxillary teeth. Treatment goals are to achieve even and simultaneous contact with the opposing teeth.

Indications

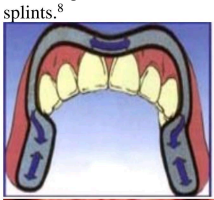
1. Protective device for persons who are likely to receive trauma to their dental arches
2. Protective athletic splints decrease the likelihood of damage to the oral structures when trauma is received
3. Clenching and bruxism.

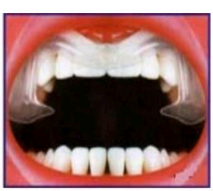
Before any permanent therapy is begun, one needs to be aware that there are six general features common to all devices that may be responsible for decreasing muscle activity and symptoms

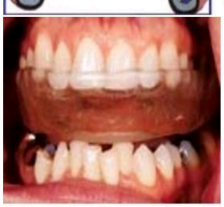
1. Alteration of the occlusal condition
2. Alteration of the condylar position
3. Increase in the vertical dimension
4. Cognitive awareness
5. Placebo effect: 40% of the patients suffering from certain TMDs respond favorably to such treatment [6]. Increased peripheral input to the CNS: Any change at the peripheral input level seems to have an inhibitory effect on this CNS activity.

Hydrostatic occlusal splint (aqualizer)

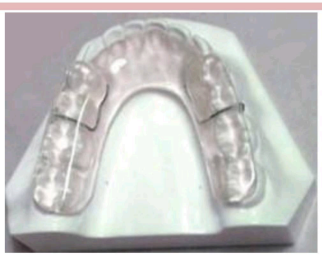
Hydrostatic splints are dental splint cushioned with fluid to redistribute occlusal force. These splints are based on a new application of a basic physical law of nature called Pascal's Law, which states that an enclosed fluid will apply equalized fluid pressure regardless of where pressure is applied to the fluid. In other words, biting down on the hydrostatic appliance causes the fluid to evenly distribute bite forces across the bite, reducing TMJ pressure and pain and ensuring relief. Aqualizer™ is the example of hydrostatic dental splints.[8]







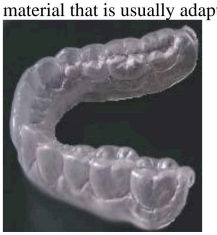
If 4 mm increase in vertical height is not effective in reducing muscle hyperactivity, the height may be increased 12-15 mm



If the patient demonstrates parafunctional movement in lateral and protrusive directions, a splint for the mandibular teeth will be effective (no anterior teeth coverage)

Soft Rubber Splint

The soft appliance is a device fabricated of resilient material that is usually adapted to the maxillary teeth.



Soft occlusal splint (made of PVC sheet).

Soft appliances function by separating the teeth. These appliances have been recommended for the patients who exhibit high levels of clinching and bruxism. But these appliances can exacerbate the bruxism probably due to inability to achieve balanced contact with them (usually posterior teeth contact first).[9]

DURATION OF USAGE

Most patients use their splints only during sleep to protect them from the effects of involuntary parafunctional motor activities like bruxing, clenching, tongue pressure, etc. Those who cannot control such habits when awake may need to use the splint during the daytime hours. There are no fixed rules for the length of time that a conservative splint (a splint that doesn't change the jaw relations except for a minimal increase of vertical) should be used. Some patients can discard them after a few months; others may need to continue them for decades. Generally wearing must not exceed a few months because with his parafunctional habits, the patient gets used to occlusal splint and a negative dependence can be created. If the patient is aware that their TMD are correlated with stressful situation such as examination or sporting events, episodic daytime wearing is advisable during these periods. In patient with frequent parafunctional habits which abrade their teeth or put in danger their prosthetic reconstructions or implants, permanent nocturnal wearing of the occlusal splint is recommended.

Splints that do not cover all teeth with balanced contacts with opposing teeth should not be used for longer period than 4-6 weeks. During that period, they should be

continuously worn for 24hrs a day and removed only when brushing the teeth. Irreversible changes may occur in the occlusion if they are used for periods longer than 6 weeks. Anterior bite splints are worn continuously but for a very limited time, wearing it for more than 2 weeks may be hazardous in case intracapsular pathology because of compression risk. It is proposed for emergency treatments, or very short duration and musculoarticular symptoms of an acute form.

Hard splints cannot be used in the children for more than short periods because they may not fit after a relatively short time and therefore interfere with the normal growth pattern.

The effective monitoring of the patients by the practitioner at 2,4,8 and possibly sometimes 12 weeks is essential to accompany rehabilitation and to evaluate the effect of treatment. Dylina TJ[10] has suggested a protocol, which include adjustments at 24hrs, 3 days, 7 days, 14 days, 21 days and 1 month. When no movement on the splint is seen at adjustment appointments and symptoms are improving, then interval between adjustments can be extended.

Regular supervision is important and a splint should never be delivered without securing that the patient can and will come back for regular check-ups. The dentist also has to ensure that he or she is able to see the patient any working day during the first week after delivery.

Acute pain can be caused by inflammation in intracapsular TMJ tissues. They may swell or shrink during different stages of the disease period. Repeated adjustments may have to be made for quite long periods.

The worsening symptoms require immediate revaluation in order to provide explanations, corrections or necessary adjustment but also revaluation of the diagnosis.

CONCLUSION

It is imperative that clinicians have a strong working understanding of masticatory system dynamics.

Differential diagnosis through the screening of muscles, joints, and dental occlusion will clarify the presence of signs and symptoms of dysfunction. Various types of splints are used to treat different conditions.

A proper examination and differential diagnosis is necessary to lead to a decision regarding the appropriate role of splint therapy for the particular condition

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Publication Types: Review article

DIGITAL ANTERIOR ESTHETIC RESTORATIONS - THE INEVITABLE SOLUTION

Dr. Raisa Mariam Jacob[1], Dr. Ann George[2], Dr. George Francis[3], Dr. Paul Kariyatty[4]
1,2. Post Graduate Student, 3. Professor and HOD, 4. Reader
:Dept. of Prosthodontics and Crown and Bridge, St. Gregorios Dental College, Chelad, Kothamangalam

ABSTRACT

CAD design software have become increasingly sophisticated, allowing for more detailed restoration design control. With the advent of CAD, we rely less on the "hands and eyes" of any one individual technician. Digital scanner capture for crown and bridge restorations offers significant advantages over conventional techniques, especially when prescribing digitally manufactured restorations. Although there are many appropriate material options available in the marketplace, a clinician can successfully transit to a digital material based practice using a combination of Zirconia and Lithium Disilicate. Considering the patient's aesthetic requirement and overall force factors will then assist in deciding which of these digital products is to be prescribed.

Key Words: Lithium Disilicate, Zirconia, Intraoral scanning, CAD/CAM

INTRODUCTION:

Computer-aided design and computer aided manufacturing (CAD/CAM) dentistry has evolved dramatically in the past 30 years. Most recently, numerous CAD/CAM systems with broad capabilities that range from implant restoration design and fabrication to orthodontic appliance planning and manufacture have become widely available for clinicians and dental laboratories. In addition, demand for aesthetic materials have increased in restorative dentistry, with concurrent advances in materials science that provide new monolithic materials that synergize with CAD/CAM technology[1].

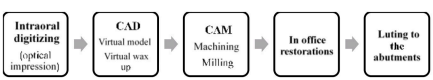
Crown and bridge restorations are one of the main treatment methods used by general practitioners to achieve life like restoration of form and function. Mechanical durability and precision fit are mandatory requirements for crowns and bridges. Two materials, Lithium Disilicate (LD) and Monolithic Zirconia (Zr), have become popular, and both are fabricated with CAD/CAM systems[1]. As clinicians become more comfortable prescribing these products, additional digital materials can be added.

Why Intraoral Digital Scanning?

Any digital workflow for crown and bridge starts with an intraoral scan.

It has been established that current generation intraoral scanners are appropriately accurate for digital capture in conventional crown and bridge. If a clinician is making a traditional rubber base wet (analog) impression and prescribing a zirconia (digital) crown, the laboratory is using a digital process to manufacture that restoration[2]. That means that they are digitizing the impression, or more likely scanning a stone model of the case in order to work in a CAD platform, and ultimately will manufacture (mill) the final product. The same can be true for Lithium Disilicate restorations if a CAD workflow is employed by the laboratory.

Unfortunately, in this scenario, many of the inherent potential inaccuracies associated with an analog workflow are being realized (impression material handling, length of time from impression to pour, shipping and handling issues, water powder ratios of stone, model preparation, etc.). If the 'impression' were captured digitally with an intraoral scanner, then the case is scanned into the CAD platform directly – without the potential problems associated with the analog workflow. Hence, if a clinician is manufacturing their restorations digitally, it would be wise to consider a transition to intraoral digital scanning[3-4].



Digital restorations – the workhorses

Porcelain has been used in dentistry for 100 years. Aesthetics is it's major advantage, but brittleness for load bearing restorations is it's weakest point. The conventional powder buildup firing process was innovative but is still technically sensitive. Therefore, porcelain fused to metal restorations has been the first choice to meet both restoration aesthetics and durability requirements[1].

There are two methods proposed for shifting to all-ceramic restorations. The first method is to apply reinforced glassy materials to single crowns. CAD/CAM is efficiently applied to fabricate a single crown of reinforced glassy materials. The second method is to fuse porcelain to high strength ceramics instead of

alloys. Dense sintered zirconia polycrystalline material appears to be promising for the application to the framework of bridges and even the superstructure of implants.

Various digital options for fixed anterior aesthetic restorations include[3]: -

- Lithium Disilicate with Vestibular Veneering, Selective Stain and Glaze
- Optionally Translucent Porcelain Fused Zirconia with Vestibular Veneering, Selective Stain and Glaze
- Optionally Monolithic Lithium Disilicate, Selective Stain and Glaze
- Optionally Monolithic Translucent Zirconia Highly polished, Selective Stain and Glaze

Zirconia restorations:

Zirconia is available for fabricating frameworks of bridge restorations instead of metal bonded restorations because of its higher fracture toughness. There are two types of zirconia blocks currently available for distinct CAD/CAM applications. The first application is the use of fully sintered dense blocks for direct machining using a dental CAD/CAM system with a grinding machine. The second application is the use of partially sintered blocks and green blocks for CAD/CAM fabrication followed by post-sintering to obtain a final product with sufficient strength. The former application has a superior fit because no shrinkage is involved in the process[3].

Manufacture:-

Commercial laboratory produced zirconia restorations are typically designed using CAD and manufactured by dry milling discs of raw zirconia[5]. The raw zirconia is then infiltrated with color and heat sintered. The resulting restoration can be completed with stain and glaze or can be veneered with feldspathic ceramic – porcelain fused to zirconia (PFZ). This layering process is often necessary in aesthetic areas to impart character to the restoration.

As with traditional PFM, chipping of the veneering ceramic can occur. Careful framework design principles are required to minimize feldspathic veneering ceramic from chipping. Furthermore, with PFZ care must also be taken to properly manage the thickness of the framework and veneering layers, and to properly control the thermal residual stresses generated when heating and cooling a restoration. It is noteworthy that when properly processed, PFZ restorations have similar survival rate of traditional PFM[5].

Advantages:-

The advantages of zirconia as a restorative material are primarily realized when used in the monolithic form. Monolithic Zirconia restorations can be stained, glazed, and/or highly polished. When highly polished, zirconia provides an extremely strong and non-abrasive restorative solution – much stronger and less abrasive as compared to PFM. Recently, zirconia products with increased translucency and pre-shaded gradients have been introduced to the marketplace[6].

The result is an aesthetic tooth coloured restoration with the following characteristics:

Aesthetic tooth coloured with no unsightly framework

- Moderately Translucent - differing translucencies available
- Strong Traditional Zirconia–Over 1200 MPa (Higher Translucency products are closer to 750 MPa)
- Toughness 4 to 5 MPa
- Non-abrasive Similar characteristics to Enamel (must be highly polished)

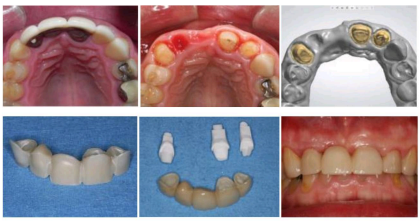


Figure 1: Restoring an existing loose fixed dental prosthesis in the aesthetic zone using a digitized porcelain fused to zirconia bridge

Lithium disilicate restorations:

Commercial laboratory produced Lithium disilicate restorations can be designed using CAD or by employing a traditional wax-added technique. Those designed in CAD are typically wet milled in a 'blue block' form then crystallized. CAD designed restorations may also be printed in wax. Wax patterns (analog or digital) are typically invested and hot pressed. Feldspathic ceramic can be fused to Lithium Disilicate to impart character to the restoration but as with PFZ, many variables must be properly controlled to avoid chipping of the veneering ceramic. Lithium Disilicate restorations are typically stained and glazed, and/or highly polished[3]. Advantages:-

The result is a highly aesthetic tooth coloured restoration with the following characteristics:

- Highly aesthetic tooth coloured with no unsightly framework
- Highly Translucent - 13 Differing translucencies available
- Moderate strength when bonded - 360MPa, CAD - 450 MPa pressed
- Moderately Tough 2.8 MPa
- Low-abrasive similar characteristics to enamel (must be highly polished)

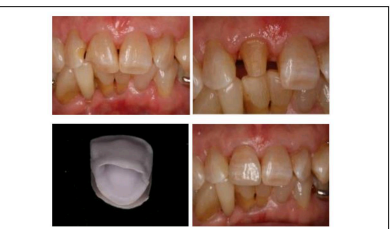


Figure 2: Restoring an endodontically treated tooth with porcelain fused to low translucency lithium disilicate crown

CONCLUSION

The application of CAD/CAM technology in dentistry provides an innovative, state-of-the-art dental service to patients and is also beneficial for general practitioners. Conventional laboratory technology and dental technician skills remain important because dental restorations and prostheses are not just industrial products but medical devices that need to function in the body. Therefore, we must combine new technology and conventional technology to meet patient's demand. Digital scanner capture for crown and bridge restorations offers significant advantages over impression-based capture. It is important, however, that the material properties and indications must be well understood and prescribed with a high degree of specificity.

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Publication Types: Case Report

SOLITARY BONE CYST OF MANDIBLE: A CASE REPORT

Dr. Bright E.C[1], Dr. Sanjith P Salim[2], Dr. Alka Mariam Mathew[3], Dr. Mahalekshmi A Nair[4],
1,2. Reader, 3. Senior Lecturer, 4. Intern
: Department of Oral Surgery, St. Gregorios Dental College, Chelad, Kothamangalam, Ernakulam Dist. Kerala.

ABSTRACT

A Solitary Bone Cyst (SBC) is a type of non-neoplastic bone abnormality. When found in the mandible, it appears as an intra- osseous cavity lacking an epithelial lining, thus categorized as a pseudo cyst. Despite ongoing research, its exact cause and development remain uncertain. Clinically, it typically presents as an asymptomatic lesion with scalloped borders. While often empty, it may contain blood, serous, or serosanguinous fluid and can be visible on routine X-ray examinations. Usually, these cysts are incidentally discovered during routine radiological assessments, most commonly in the premolar to molar regions of the mandible and in the anterior region of the maxilla.

This article describes a well-documented case of a solitary bone cyst affecting the mandibular body, adjacent to the roots of the 1st, 2nd, and 3rd left mandibular molars, in a 17-year-old male patient with no history of prior trauma. The cyst was diagnosed during a routine orthodontic radiographic examination. Simple curettage of the bone cavity resulted in the resolution of the lesion with progressive bone formation. Upon review two years post-treatment, no recurrence was observed.

Keywords: Bone cysts, Solitary bone cyst, Pseudo-cyst, Mandible, Idiopathic bone cyst, progressive bone cavity.

INTRODUCTION:

Solitary Bone Cyst or SBC is a type of benign lesion which can affect any of the skeleton in our body, of which most of the lesion affect long bones like humerus and femur close to the epiphyseal plate [1]. It was first described in 1929 in mandible by Lucas and Blum but, it was not until 1949 that Rushton established the diagnostic criteria of this condition [2]. The lesion is mainly diagnosed most frequently during the second decade of their life. Some reports suggest that it has a male predilection while others report equal distribution between males and females [3]. Solitary Bone Cyst has got variety of names as of now: Haemorrhagic bone cyst, extravasation cyst, progressive bone cavity, simple bone cyst and unicameral bone cyst but the term “traumatic bone cyst” is widely used nowadays [4].

The most commonly located site of Solitary Bone Cysts is the mandibular body between the canine and the third molar followed by the mandibular symphysis [5,6]. Clinically, the lesion is usually asymptomatic in the majority of cases reported and is often discovered accidently on routine radiological examination [7], as an unilocular radiolucent area with a ‘scalloping effect’ and either lacking contents or containing liquid or connective tissue. The borders of these lesions appears as very well defined to corticated/punched out radiolucency [7]. Pain is the presenting symptom in almost 30% of the patients. Other symptoms of SBC of mandible includes tooth sensitivity, paraesthesia, fistulas [8], delayed eruption of permanent teeth [9], displacement of the inferior dental canal [10] and pathologic fracture of the mandible and sometimes cortical plate expansion of the mandible is also noted, hence it results in both intraoral and extraoral swelling in some patients. It sometimes causes facial deformity.

The definite diagnosis of a traumatic cyst is usually gained during surgery. Since material for histopathological examination may be non-existent, it is very often difficult to obtain a definite diagnosis from histopathological studies in this type of cysts [11]. Biopsy material usually consists of fragments of viable bone and friable loose connective tissue & without an epithelial lining. Osteoclast-like giant cells have also been seen in some cases [12].

Surgical exploration is the preferred treatment to rule out more concerning mandibular lesions. Typically, surgeons often find an empty cavity or occasionally fibrous tissue during the procedure, which is then collected for histopathological studies. The bleeding in the cavity forms a blood clot that eventually gets replaced by bone [6,7]. Scraping the bony cavity to induce bleeding is the most widely accepted treatment method currently. Other treatment options include packing the curetted cavity with autologous blood, autologous bone, and hydroxyapatite. Generally, surgical exploration followed by curettage results in healing in the majority of cases, with recurrence being extremely rare[13].

CASE REPORT:

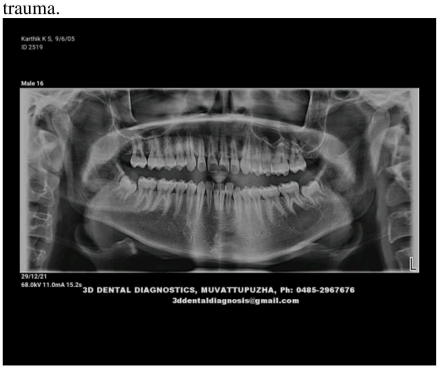
A 17-year-old male patient visited the clinic seeking correction for irregularly positioned teeth, primarily due to aesthetic concerns. The patient's general health was found to be satisfactory, with no significant medical or familial history. Upon

extraoral examination, no abnormalities were detected. Intraoral examination revealed impacted teeth 38 and 48. Clinically, no decay or restorations were observed. Orthodontic evaluation indicated an Angle's Class I malocclusion with proclination of the maxillary and mandibular anterior teeth, along with crowding in the mandibular anterior region.

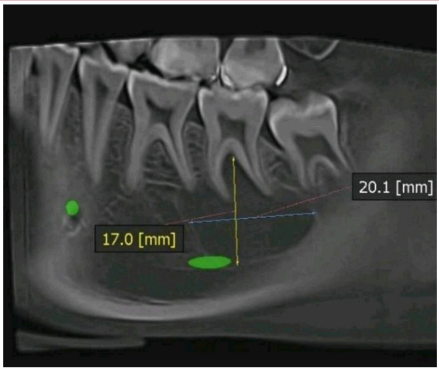
The patient was then recommended to undergo an Orthopantomogram

(OPG) and Cephalometric radiographs. Upon examination of the OPG, a clearly defined unilocular radiolucent lesion was observed, with an irregular border extending from the distal root of tooth 36 to the mesial root of tooth 38. There were no signs of associated root resorption or pathological displacement of the tooth.

The patient was entirely asymptomatic. A physical examination intraorally did not show any swelling, tooth mobility, periodontal pockets, changes in the nearby mucosa, fistulas, or any abnormal secretions. Palpable lymph nodes were noted on the affected side. Teeth 36 and 38 exhibited negative responses to pulp vitality tests. Furthermore, there was no reported history of trauma.



A cone beam computed tomography (CBCT) scan was requested, revealing a clearly defined radiolucency measuring 20.1 x 17.0 mm in the posterior region of the mandible. There was no evidence of perforation of the buccal or lingual cortical layers, and no resorption or displacement of the roots of adjacent teeth was observed.



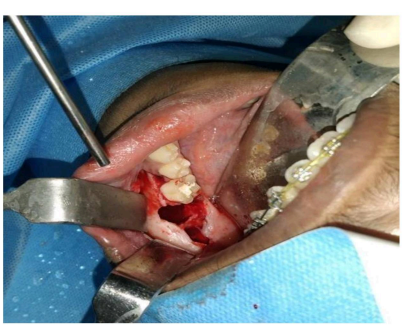
Considering our radiological and clinical findings, the potential differential diagnosis for the individual lesion included Odontogenic Keratocyst, Unicystic Ameloblastoma, and Radicular cyst.

Endodontic treatment for 36 and surgical extraction of teeth 37 and 38 were scheduled. The parents were briefed about the required procedures, and their informed consent was obtained.

The patient was then prepared for surgery and placed under general anesthesia with nasotracheal intubation (NTI).

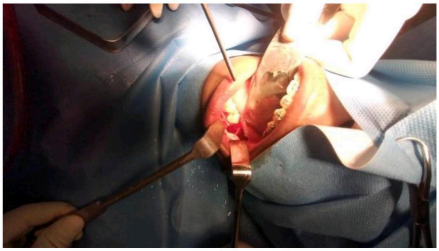
The surgical extraction of tooth 38 was performed first, followed by tooth 37, after administering buccal and lingual infiltration anesthesia. A quadrangular flap was raised by making a releasing incision distal to tooth 35, followed by crevicular incisions and another releasing incision distal to tooth 38. The surgical site was then thoroughly irrigated with saline.

On exposure, an empty cavity with scarce amounts of tissue extending distal root of 36 to mesial root of 38 was seen with some trabeculae extending from the margins into the defect. The cavity was thoroughly curetted to obtain few friable connective tissue specimen and bleeding was induced into the lesion.



The flap was sutured back in place using 3-0 vicryl sutures, and the patient was scheduled for a

follow-up appointment after one week. A specimen of connective tissue was sent for histopathological examination. The biopsy report confirmed the diagnosis of a solitary bone cyst (Pseudocyst). The patient's postoperative recovery was uneventful without any complications.



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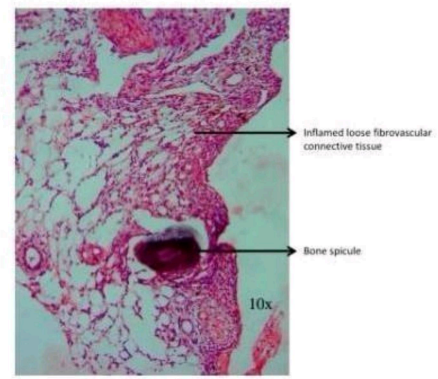
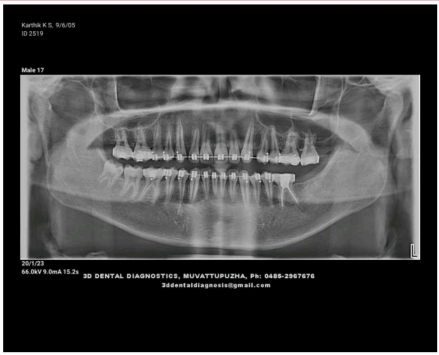
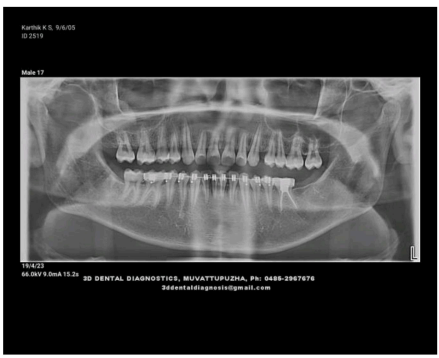


Solitary bone cyst (1183/22)

Histopathological examination revealed, loose fibro-vascular connective tissue showing mild chronic inflammatory cell infiltrate, capillary vessels, extravasated RBCs, adipose tissue and spicules of vital bone. No evidence of cyst lining epithelium, hence, suggestive of SIMPLE BONE CYST/ SOLITARY BONE CYST.

This patient was followed for 2 years, and is asymptomatic with no positive findings of pain, swelling, and paraesthesia.





Follow-up panoramic radiograph on January 20, 2024 indicated formation of bone and resolution of the lesion, without any evidences of recurrence or enlargements.

DISCUSSION:

Solitary bone cyst of the jaws is very uncommon, representing approximately 1% of all jaw cysts.

The pathogenesis of the SBC is not yet completely understood; several theories have been suggested about it. Trauma is one of the etiological factor, However, the incidence of a positive trauma history has been rather variable in the reported set of cases from 17% to 70%. [14] Thoma [15] suggested that trauma initiates a sub-periosteal hematoma that causes a compromised blood supply to the area, leading to osteoclastic bone resorption. In this present case, no history of trauma was elicited.

SBC is related to some medical conditions in some articles. Pogrel reported a case of solitary bone cyst, possibly related to impacted third molar extraction [16].

Solitary bone cysts are mostly detected accidentally because they are mostly asymptomatic. [15] Cases were reported earlier where the lesion was asymptomatic and was detected during routine radiological examinations. In most of the cases, intraorally, the soft tissues

were not affected and there was no increased mobility of the teeth or changes in their colour. The presence of symptoms is quiet variable. Most patients are asymptomatic, while some may develop symptoms such as altered sensations, numbness, swelling, and pain. [15] There will also be cortical plate expansion. In the present case report, the patient had no such associated symptoms.

SBCs are typically located in the mandibular body, above the inferior alveolar canal [19]. Mainly, they seem to appear in the posterior region, and they might extend from the canine to the third molar region [20]. Ascending mandibular ramus and chin symphysis are other likely but less common sites where SBCs may develop. SBCs are hardly ever found in the maxilla, and if they do, unlike their mandibular counterparts, they are more typically seen in the anterior region [21]. Nevertheless, it is possible that visualizing maxillary lesions radiographically could be more challenging because of the existence of the maxillary sinus.

In spite of multiple treatments suggested in scientific literature to treat solitary bone cysts, [17] in our specific case, the lesion's biopsy revealed presence of only connective tissue specimens and it was decided to perform curettage of cavity walls and bone regeneration induction.

The bone cavity may either be empty or have a thin connective tissue layer with small amount of liquid content supporting Howe's [7] theory which stated that the content of the cavity depends on the time that the cyst has existed. In the early stages, the lesion usually contains blood or serosanguineous fluid that decreases as the lesion ages and eventually becomes empty. Due to the limited amount of specimen available for histological examination, it is often quite challenging to reach a definitive histological diagnosis [10] In fact, the diagnosis of SBC can only be confirmed through surgical exploration of the bone cavity. In the present case, negative aspiration of the cystic lesion and the absence of bony expansion and pain, ruled out the possibility of a vascular tumour and aneurysmal bone cyst, respectively.

The treatment for SBC involves surgical exploration. The procedure includes the draining of the cystic contents followed by curettage of the cavity to promote bleeding within it. [11] The wound is then closed with sutures. This process is followed by the formation and organization of a blood clot, leading to healing through the formation of new bone. [12] Cases have been reported where SBC heal on its own without any intervention. [14]. This might explain why they are rarely seen in older individuals and are mostly found in younger age groups [23]. Recurrences after surgical treatment are uncommon. A histopathological diagnosis will confirm the existence of a SBC using tissue samples obtained from the bone cavity. [5] Examination of histological slides typically reveals fragments of fibrovascular connective tissue, cholesterol clefts, and foreign body giant cells.

Resolution typically takes around 6 months or longer, depending on the size of the lesion. The prognosis is generally favorable, with recurrence being rare. Precious and McFadden [18] reported a case of a traumatic bone cyst that did not respond to surgical curettage. Upon recurrence, a significant increase in size with a multilocular appearance was observed on the radiograph. Osseous regeneration and resolution of the lesion were achieved by injecting autologous blood into the bony cavity [18].

Alternative treatments, such as filling the cavity with bovine lyophilized bone or introducing autologous blood with bone from the patient or hydroxyapatite, might be considered in cases where conventional management is not successful [22]. However, the use of radiopaque materials in the cavity could complicate the diagnosis of potential lesion recurrence.

CONCLUSION:

Maxillofacial SBCs are uncommon lesions that often respond well to treatment with surgical curettage. Recurrence can occur due to incomplete removal of the lesion. These solitary bone cysts are typically asymptomatic, with occasional findings, and their aetiology remains largely unknown, often discerned based on individual patient characteristics. The prevailing theory suggests a traumatic origin for these lesions. However, when trauma is ruled out as an etiological factor, the most accepted theory involves alterations in calcium metabolism associated with the patient's overall condition. The cavity in these cysts is usually observed to be empty and lacking an epithelial lining. Careful curettage of the lesion promotes gradual bone regeneration, offering a favorable prognosis with a very low relapse rate. In many cases, it is difficult to establish a diagnosis through histopathological examination due to limited sample availability, especially in empty solitary bone cysts or cysts with minimal fibrous connective tissue adhered to the cavity walls. Additionally, the results may not provide significant characteristics for distinguishing other pathological lesions or for accurately diagnosing solitary bone cysts.

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Publication Types: Case Report

MANAGEMENT OF PEDIATRIC IMPACTED MESIODENS : COMPARISON OF CASE REPORTS

Dr Bright E.C[1], Dr Sanjith P Salim[2], Dr Alka Mariam Mathew[3], Dr Ann Mary Jose[4]
1,2. Reader, 3.Senior Lecturer, 4. Intern
:Department of Oral Surgery, St. Gregorios Dental College, Chelad, Kothamangalam, Ernakulam Dist. Kerala.

ABSTRACT

Mesiodens is the most common type of supernumerary tooth situated between two maxillary central incisors which may be erupted or impacted. Various complications may arise due to the presence of a mesiodens such as impaction / delayed eruption of permanent successor, resorption of permanent teeth and crowding in the maxillary anterior region. The timing of surgical intervention in the mesiodens removal is controversial. However, the child's cooperation to the dental treatment is one of the major challenges to be faced by the dentist during the surgical procedure. The present paper describes the comparison between management of mesiodens in two 8 years old children who reacted to the treatment in different ways.

OBJECTIVE :
Management of impacted supernumerary teeth in children based on their cooperation to the surgical procedure.

CASE REPORTS:
The article involves case reports of two 8 year old children with impacted supernumerary teeth which hindered the eruption of maxillary central incisors. Surgical removal of supernumerary was carried out under local anaesthesia in one patient whereas general anaesthesia was required in another patient due to lack of cooperation.

CONCLUSION :
The level of cooperation exhibited by the patient has a greater influence in the treatment pattern.

KEYWORDS :
mesiodens, impacted, general anaesthesia

INTRODUCTION

A supernumerary tooth is defined as an excess in the number of teeth when compared to the normal dental set1,3 and can occur in almost any region of the
dental arch, but with a particularly strong predilection of about 90% towards the premaxilla area.1 Several theories have been postulated regarding the causes of
supernumerary teeth, including atavism, dichotomy of the tooth bud,3 and
hyperactivity of the dental lamina. However, the exact cause is still unknown.2 Systemic disorders such as cleidocranial dysplasia, cleft palate, and Gardner syndrome can induce the development of this supernumerary tooth.3,8,11 The
prevalence of the supernumerary teeth ranges from 0.10% to 3.6% in the permanent dentition and 0.02% to 1.9% in the primary dentition.3,5 They may occur as single or multiple, unilateral or bilateral, 8 erupted or impacted and in one or both jaws. 3,5
The most common supernumerary tooth is the mesiodens which is located between the two central incisors.8 Four different morphological types of supernumerary
teeth have been described namely conical, tuberculate, supplemental, odontome. 3,8 Males have more gender prediliction for having supernumerary teeth than females. 1,4,,8,11 Most of the mesiodens (55.2%) were found to be in vertical position
(55.2%), followed by inverted position (37.6%) and horizontal position (7%).3 Complications associated with the presence of the mesiodens include the presence of midline diastema > 2 mm, delayed tooth eruption, ectopic eruptions, tooth
rotation, loss of tooth vitality, root resorption of any nearby permanent tooth,
malalignment of teeth.1,3,4,7,8,9,11 The optimal time for surgical intervention is debatable. Major therapeutic considerations include age of the child, development of adjacent structures and location of the supernumerary in the premaxilla.11 Here
the case reports of two children under 13 years of age who underwent the surgical removal of impacted mesiodens is discussed.

CASE REPORTS

Case report 1

A seven years old female patient reported to the Department of Oral Medicine and Radiology, St. Gregorios Dental College complaining of forwardly placed lower jaw and irregularly placed teeth. Patient was aesthetically concerned due to this defect. In general health history patient reported a history of pneumonia at the age of two years. Medical and familial history were noncontributory. Extra oral examination of the patient showed a concave facial profile with retruded maxilla and a forwardly placed mandible. On intra oral examination, the child was found to

be in the mixed dentition period with following teeth present in the oral cavity -16, 55, 54, 53, 52, 51, 21, 62, 63, 64, 65, 66, 26, 36, 75, 74, 73, 32, 31, 41,
42, 83, 84, 85, 46. A dental caries was found on 85. Orthodontic evaluation revealed Angles class I molar relation on right side and class III molar relation on left side with a prognathic mandible. Crossbite was found in relation to 52,51,21,62 and 32,31,41,42 and the patient was referred to Department of Orthodontics for the correction of malocclusion.
Patient was advised to take an orthopantomogram. The restoration of dental caries in relation to 85 was done on the same day at the Department of Pedodontics.
OPG showed radiopaque tooth like structures in the apical region of 51 suggesting the presence of supernumerary teeth. The exact location or the accurate number of supernumerary teeth were unable to be confirmed in the OPG.
On evaluating the OPG, lateral ceph and hand wrist radiographs patient was diagnosed with skeletally deficient maxilla resulting in class III condition. The treatment plan was to correct the maxillary deficiency first followed by the dental correction. It was decided to observe the supernumerary teeth and its removal was postponed until some skeletal correction was achieved.
In the initial treatment phase, maxillary splint with face mask was given to the patient for the skeletal correction. Due to the restriction in maxillary protrusion

caused by 51 it was decided to extract 51 and the facemask therapy was withheld until the extraction socket was healed.
A CBCT was obtained after the healing of the socket. CBCT images showed impacted 11. The crown was placed labially in the alveolar process. The root formation appeared not to be complete. Two supernumerary teeth/ odontomes were noted which were placed palatal to the crown of 11. The supernumerary 1 was located palatally close to the palatal cortical bone with respect to 11 region and was placed inverted with crown facing palate. The crown appeared conical in shape. A single tapering root was identified which extends downwards. It measured about 10.9mm X 3.9 mm. Supernumerary 2 was located on the palatal surface of the crown of 11. It measured about 5.8mm X 4.7mm. It was also located 5.2mm away from the cresta bone. The CBCT report revealed the presence of two supernumerary teeth/ odontomes on the palatal aspect of 11. (Fig 1)
The facemask + maxillary splint therapy was continued for 1 year until the desired maxillary protrusion was achieved. Later on, it was decided to remove the supernumerary teeth to bring the impacted maxillary right central incisor to the occlusion. The patient was referred to the Department of Oral and Maxillofacial Surgery for the same. The parents were informed about the need for surgery and informed consent was obtained from them.

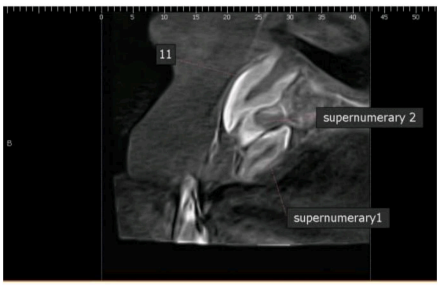

Fig 1: CBCT showing two supernumerary teeth

The surgical extraction of supernumerary teeth was done under infra orbital nerve block, greater palatine and nasopalatine nerve blocks. A triangular flap was reflected by making a releasing incision distal to 21 followed by crevicular incisions. The supernumerary 1 was removed first followed by the supernumerary 2 through a palatal approach. (Fig 2) The retained 52 was also extracted on the same day and the surgical site was thoroughly irrigated with saline. The crown tips of permanent right central and lateral incisors became visible after removal of the supernumerary teeth. (Fig 3)

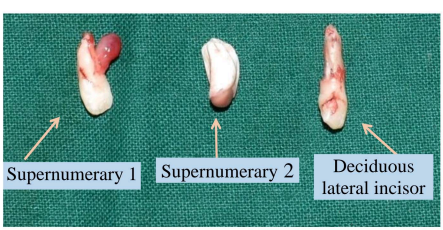

Fig 2: Extracted supernumerary teeth and deciduous lateral incisor

While starting with the procedure, the child was little apprehensive, but after explaining the procedure to her, she became more relaxed and cooperative. The child was allowed to stop the treatment at any time by raising her hand, whenever she feels uncomfortable. (Fig 3)

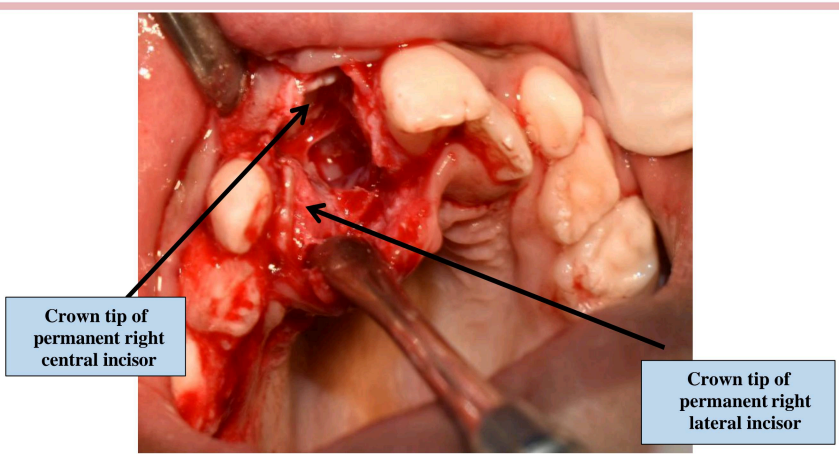

Fig 2: *Surgical site*

Vicryl 3/0 sutures were placed and post operatively the patient was given antibiotics, analgesics and anti-inflammatory drugs for a period of 5 days, 4 days and 3 days respectively. (Fig 4)

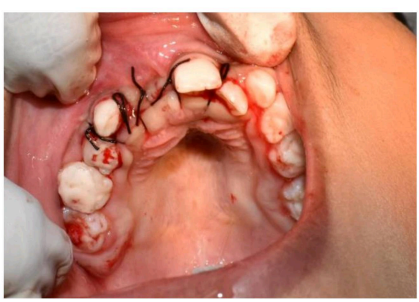

Fig 4: Surgical site after closure

The patient reported after 2 weeks and satisfactory healing was obtained. The sutures were removed. The maxillary splint with facemask therapy was restarted after 1 month.

Case report 2

An 8 years old female patient presented to the outpatient department of a private hospital complaining of retained milk teeth in upper front tooth region. The parents were concerned about the delay in the exfoliation of deciduous teeth. Medical and family histories had no relevant findings. On intra oral examination, the patient was in mixed dentition stage with all the deciduous teeth present in the oral cavity along with all four permanent molars. OPG showed signs of the presence of a mesiodens between the unerupted central incisors. To confirm the diagnosis and for the further localization of the supernumerary tooth, a CBCT was advised.

CBCT showed a supernumerary tooth impacted on the palatal aspect of unerupted right and left central incisors which was hindering the eruption of the permanent incisors into the oral cavity. (Fig 5) It was decided to wait for 6 months to see whether normal eruption of permanent incisors would occur.

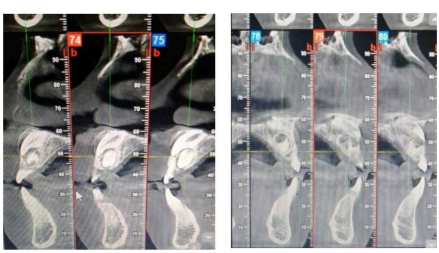

Fig 5: CBCT images of impacted mesiodens (a) Right (b)Left

The deciduous central incisors were not showing any preshedding mobility and hence it was decided to extract them. The deciduous maxillary right and left central incisors were extracted under local anaesthesia. Since no signs of eruption of permanent incisors were found past 6 months, the patient was advised to undergo surgical removal of the impacted

supernumerary tooth.

After evaluating the exams, surgical removal of impacted mesiodens was planned. At first, the surgical removal was attempted under local infiltration. Because of the extremely uncooperative behaviour of the child, the procedure could not be carried out. The child was defiant and unwilling to cooperate to the treatment. Hence, after consulting with the parents, it was decided to carry out the procedure under general anaesthesia.

Pre anaesthetic evaluation was carried out and clearance for general anaesthesia was obtained. Oroendotracheal intubation was performed. Patient was given buccal and palatal infiltration with 2% lignocaine in 1:200000 adrenaline. Impacted mesiodens was removed via palatal approach and the surgical site was irrigated, cleaned and closed using vicryl 3/0 absorbable sutures. (Fig 6)

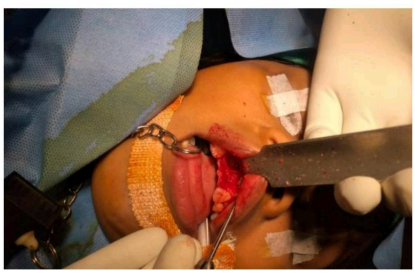

Fig 6 : Surgical site

Post operatively the patient was kept in ICU under observation for 6 hours and was uneventfully discharged on the next day. Post operative antibiotics and analgesics were given to the patient. Periodic follow up were done at 1 week, 3 weeks and 6 months interval which were uneventful.

DISCUSSION

Supernumerary teeth, which occur predominantly in the maxillary midline, are termed as mesiodens.[11] Various theories have been proposed on development of supernumerary teeth. The more accepted theory is the hyperactivity of dental lamina, where dental lamina is induced to develop an extra tooth bud, resulting in supernumerary tooth.[6] The presence of mesiodens is often detected during routine clinical or radiographic examination.1 The diagnosis of mesiodens can be done with the help of an intra oral periapical radiograph and an orthopantomograph.[3] A CBCT can be used for exact localization of the supernumerary teeth. Accurate localization is important to prevent damage to the permanent tooth bud[7] and blood supply during surgical removal.[11] Extraction of mesiodens in early mixed dentition allows spontaneous alignment of adjacent teeth; however symptomless cases could be left untreated with regular follow up. [4] Opposing views exist as to when supernumerary teeth have been treated.[1,8,11] Some recommend early removal of supernumerary teeth especially those which are inverted or unlikely to erupt.[11]Others feel that mesiodens that appear likely to erupt into a more favorable position can be monitored and removed at a later date.[11] Also, if the mesiodens is close to the adjacent permanent tooth, early surgical intervention may injure the permanent tooth bud and affect the further development of roots.[1] Surgical intervention of mesiodens in children require cooperation of child in the surgery. In the first case report, the child was apprehensive but still cooperative, while in the second case, the child had an extremely defiant and uncooperative behaviour. The possible reasons for uncooperative behaviour of children in dental treatment could be younger age, parental fear, previous unpleasant dental experiences and behavioural disorders. Various behaviour rating systems have been introduced to rate the child's behaviour in the dental clinic. Frankel's behaviour rating scale is a popular one among them. (Table 1)

Table 1 : Frankel's behaviour rating scale

1	- -	Definitely negative. Refusal of treatment, forceful crying, fearfulness, or any other overt evidence of extreme negativism
2	-	Negative. Reluctance to accept treatment, uncooperative, some evidence of negative attitude but not pronounced
3	+	Positive. Acceptance of treatment, cautious behavior at times, willingness to comply with the dentist, at times with reservation, but patient follows the dentist's directions cooperatively
4	+ +	Definitely positive. Good rapport with the dentist, interest in the dental procedures, laughter and enjoyment

Since children exhibit a broad range of physical, intellectual, emotional and social development, it is important that dentists have a wide range of behaviour guidance techniques to meet the needs of individual child and be tolerant and flexible in their implementation.[12] The behaviour guidance techniques found in literature can be divided in to: pharmacological and non - pharmacological. Among the non-pharmacological techniques, one can cite the following: Tell - show - do technique introduced by Addleson[10] in which every step in dental treatment is told, shown and then done to the child; positive reinforcement technique which consist of rewarding the child when desired behaviour is achieved; modelling technique in which the child learns by observing; voice control and distraction, whose goal is to change the child's focus and attention

on an unpleasant moment or procedure.[10]
The pharmacological means of behaviour guidance mainly include conscious sedation and general anaesthesia. General anesthesia is usually indicated for patients who cannot cooperate due to a lack of psychological or emotional maturity and/or mental, physical, or medical disability; for whom local anesthesia is ineffective because of acute infection, anatomic variations, or allergy; who are extremely uncooperative, fearful, or anxious.[12] Treatment carried out in general anaesthesia is more effective and long lasting as patient cooperation is not required in the treatment. The common post operative complications following GA include sore throat, nausea, vomiting, sleeping irregularities and mild to moderate pain.[13] However, dental treatment under GA enhance the risk involved in the treatment as procedures like intubation and laryngoscopy are involved in it.

CONCLUSION

Mesiodens is the most common type of supernumerary tooth which is found between the central incisors. The timing for surgical removal of mesiodens is debatable. The removal of mesiodens in mixed dentition stage is advocated if it is interfering with the eruption of permanent teeth and development of occlusion. The attitude of child to the dental treatment is a question in carrying out the surgical procedure. The level of child's cooperation influences the ease in providing treatment as well as alter the complication involved in the surgical procedure. Hence it is important to develop a good rapport between the child, dentist and the parent to facilitate better delivery of dental treatment to the child patient.

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Publication Types: Review article

A CASE REPORT ON MAXILLARY SINGLE COMPLETE DENTURE WITH METAL MESH REINFORCEMENT

Dr Aiswarya Ullattil[1], Dr George Francis[2], Dr Mathew M Alani[3], Dr Arun K Joy[4], Dr Tintu Paul[5], Dr Gopika P Dinesh[6]
1.Post Graduate student, 2.Professor and HOD, 3.Professor, 4.Reader, 5,6,Post Graduate students :Department of Prosthodontics, St. Gregorios dental college, Chelad, Kothamangalam, Ernakulam.

ABSTRACT

Single complete dentures pose a great challenge to clinician. Chances of denture fracture are more when natural teeth are present in opposing arch. Heat cure acrylic resin cannot resist the heavy occlusal loads alone and it leads to denture fracture. This problem can be solved by use of innovative materials and appropriate techniques. Metal mesh reinforcement in denture provides satisfactory and economic solution for such cases. This case report presents a case of fabrication of maxillary single complete denture with metal mesh opposing natural dentition in lower arch.[1]

Key Words: Single denture, Metal mesh, Denture fracture.

INTRODUCTION:

Natural teeth, fixed restorations, a removable partial denture, or an existing complete denture are all possible oppositions to single complete dentures.[2] The most common clinical situation involving a single complete denture is that of an upper complete denture and lower natural teeth.[3] Heat cured denture base resins are the dominant material used for the fabrication of denture bases as they possess acceptable physical, biological and aesthetic characteristics at moderate cost. However, denture base resins fail in some instances for example, fracture of single complete denture under excess masticatory forces.[4]

Koper asserts that any or all of the following can cause occlusal problems and denture base fractures in a single complete denture:

(1) The position of the mandibular teeth, which may not be properly aligned for the bilateral balance required for stability
(2) The flexure of the denture base
(3) Occlusal stress on the maxillary denture and the underlying edentulous tissue from teeth and musculature accustomed to opposing natural teeth.

In fracture prone areas, reinforcement can be done by adding solid metal forms and various types of fibres. Metals in the form of wires, plates, nets or fillers can be used. Metal mesh provide greater strength, greater resistance to fatigue and greater resistance to breakage. Hence it could be a good treatment option in cases of single complete dentures opposing natural dentition. A few disadvantages include poor adhesion to denture base, unesthetic appearance and prone to corrosion.

CASE REPORT

A 69 years old female patient named Rajamma Sadhashivan OP NO: 250912 reported to the Department of Prosthodontics of St Gregorios Dental College, Chelad, with chief complaint of loss of all her teeth in upper arch and wanted them to be replaced by a prosthesis to restore esthetics and speech. Past dental history revealed that patient lost his teeth in upper arch 1 month back due to caries and periodontal disease. A thorough intraoral examination was done. The maxillary arch was completely edentulous supported by a well-formed ridge.

Mandibular teeth were periodontally stable without any mobility.

CLINICAL DIAGNOSIS

PERSONAL HISTORY

The patient is completely blind and reveals a family history where in her sisters are also blind due to nerve degeneration. Patient is diabetic and hyperlipidemic and is under medication for the same.

EXTRA ORAL EXAMINATION

The extraoral findings included face which was ovoid and symmetric with normal forehead and normal-set ears, impaired vision and straight profile.

INTRA ORAL EXAMINATION

Intraorally, the patient exhibited well-shaped arches with well-formed ridge. Mandibular teeth were periodontally stable without any mobility. During intraoral clinical examination generalized attrition of the teeth in the mandibular arch was appreciated

DIAGNOSIS

Based on history and clinical evaluation a provisional diagnosis of Completely edentulous maxillary arch and Kennedy's class 3 mandibular arch was given.

TREATMENT PLAN

Patient was explained about different treatment options

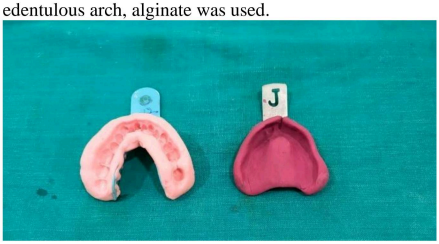
1. Implant supported overdenture in maxilla and individual implant in mandible
2. Cast metal maxillary denture and mandibular removable partial denture
3. Metal mesh reinforced maxillary denture and mandibular removable partial denture.

Due to financial reasons, Patient was not willing to go for implants and cast metal maxillary denture and was also

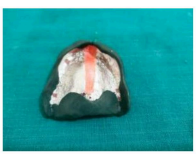
not willing for any treatment in the mandibular arch. Metal mesh reinforced maxillary denture was selected by patient. It was an economic option with the benefit of increasing strength and fracture resistance of denture.

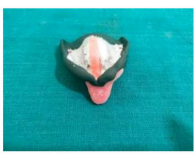
PROSTHETIC TREATMENT APPROACH

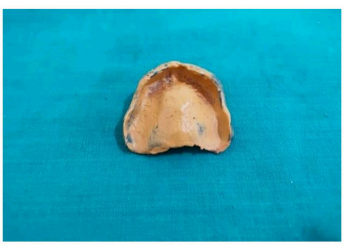
Primary impression of maxillary arch was made with impression compound. For mandibular partially edentulous arch, alginate was used.



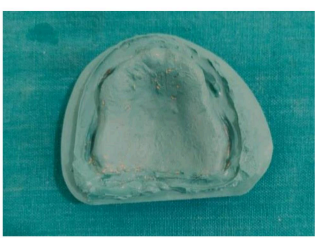
Maxillary special tray was fabricated using auto polymerizing acrylic resin. Border moulding with green stick compound (DPI Pinnacle) and final impression with zinc oxide eugenol (DPI Impression paste) was made.



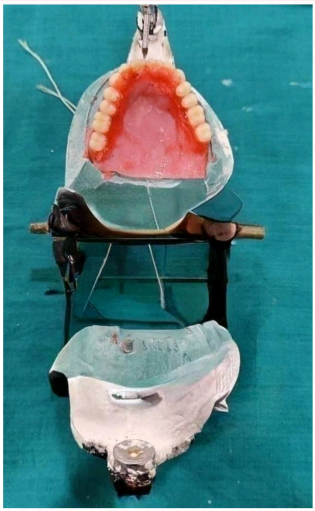




Master cast was poured using dental stone.



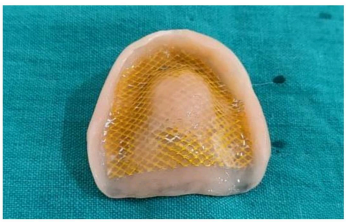
Maxillary and mandibular base plate and occlusal rims were made on respective master casts. Orientation relation was recorded and transferred to articulator.

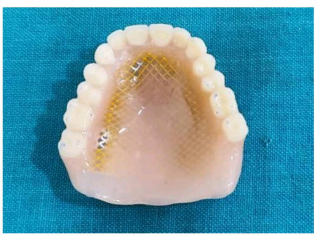


Teeth arrangement was done in class 1 relation. Try-in was done in patient's mouth to verify fit, function and esthetics of trial denture. Patient's approval of trial denture was taken.

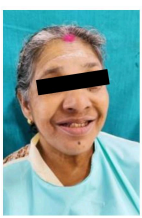
The maxillary temporary denture base with the teeth arrangement was then invested and dewaxed using the regular procedure.
Prior to packing, a metal mesh was incorporated in the maxillary mold and denture was packed using heat cured denture base material (Trevalon, Dentsply) and cured in the regular way.

After bench cooling, the denture was removed, finished and polished.

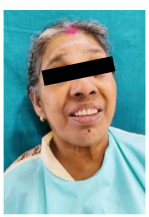




Insertion was done and post insertion instructions were given to the patient. Patient was later recalled for follow up and review.



PRE-OPERATIVE VIEW



POST-OPERATIVE VIEW

REVIEW AND RECALL

Patient was followed up after one week and reviewed for any discomfort or difficulties. Function and esthetics of denture were well accepted by the patient.

DISCUSSION

Denture fracture results from two different types of forces, namely impact and flexural fatigue. Impact fracture occurs due to sudden blow to the denture or accidental dropping of denture from hands ormouth[5]. Flexural fatigue occurs due to repeated stress of lower dimension constantly, which results in micro cracks formation in denture base. Conventional denture base material Poly methyl methacrylate (PMMA) shows poor mechanical properties when put in an environment of heavy occlusal loading and tends to fracture.[6] Repeated denture fracture is a problem for both patient and clinician.

Metal strengthener has a beneficial effect on the fracture resistance of the polymethyl methacrylate.[7] Metal base and metal mesh reinforcement increases the strength of denture and reduces the micro crack propagation. Metal mesh is commercially available in both stainless steel and gold plated metal. They have a thickness of 0.4mm and their mesh design helps to produce a good resin bond.

Metal mesh does not increase the denture weight and decreases the chances of fracture.[8]Metal mesh is also economic to patient. Using metal mesh has few disadvantages. It looks unaesthetic if it appears on labial portion of denture when patient smiles. It is prone to corrosion and has poor adhesion to acrylic denture base. In some cases patient may be allergic to metal contact. Advancement in materials and techniques is required to completely fulfill the requirements of patient and clinician. Implant supported overdentures are newer treatment approach for single dentures.17 Due to financial reasons, not all patients can afford implant treatment. Metal mesh reinforcement is an economic and promising solution for such cases.[9]

CONCLUSION

Metal mesh reinforcement for conventional complete dentures can provide many advantages over commonly used acrylic dentures. They are more retentive, stronger and comfortable to the patient. They even reduce the number of post insertion visits of the patient and patient satisfaction is better with its use. But it should be used cautiously as metal allergy to some patients might cause a big concern[10]

It is a challenge for prosthodontists to provide successful treatment for patients presenting one completely edentulous arch opposing natural teeth in other arch. Such condition places more amount of force on single denture. This is a viable treatment option for all patients who suffer from repeated denture fractures due to heavy occlusal loading.[11]

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