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DIODE LASER PULPOTOMY ON HUMAN PRIMARY MOLARS A CLINICAL, RADIOLOGICAL AND HISTOLOGICAL STUDY

Thesis submitted to

UTKAL UNIVERSITY

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For the award of the degree of

MASTER OF PHILOSOPHY IN MEDICINE

BY

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Introduction

The incidence of childhood dental caries with widespread geographic distribution has become a worldwide oral health concern and is attributed to the increased intake of carbohydrates and lack of proper oral hygiene practices. The treatment of dental caries in children focuses on preventive intervention with topical application of fluorides and restorations when the lesion is confined to enamel and dentin when untreated due to negligence, ignorance or non-availability of adequate dental care facilities in remote area the carious lesion progresses with the involvement of the pulp dentin complex leading to infection and subsequent extraction resulting premature loss of teeth. This causes an imbalance in the growth of jaw apparatus, arch length discrepancy, masticatory distress, phonation problems, and unpleasant aesthetics. The management of pulpally infected or affected teeth has been tried, to retain the tooth in the arch till its normal exfoliation with different procedures of pulp capping, pulpotomy, pulpectomy, and Lesion Sterilization and Tissue Repair (LSTR).[1]

The pulpotomy procedure has been widely practiced with a positive predictive result in comparison to other procedures particularly when the tooth is vital and is defined as “the amputation of vital pulp from the coronal pulp chamber followed by placement of a medicament over the radicular pulp stumps to stimulate repair, fixation or mummification of the remaining vital radicular pulp”. The rationale is based on the assumption that inflammation and impaired vascularity caused by the bacterial invasion would be confined to the superficial part of the coronal pulp while maintaining the normal vitality of the radicular pulp[2,3]. The medicaments and its use for the pulpotomy procedure have been classified into 3 groups (a) paste which makes the radicular pulp tissue completely fixed sterilized and thus obviating infection and internal resorption. **Preservation-** Preservation is fixation of the tissue which is non- inductive and conserves

virtually all of the radicular pulp and the agents used are Glutaraldehyde and Ferric sulfate. **Regeneration-**Regeneration is aimed at keeping the radicular pulp vital, healthy and reparative it completely enclosed within the odontoblast lined dentin chamber while isolating the tissue from noxious restorative material and thereby reducing the chances of internal resorption and induction of reparative dentin formation. The agents are MTA (Mineral Trioxide aggregate), Biodentine, Calcium hydroxide, BMP (Bone Morphogenic Protein), Enriched collagen solution and Collagen calcium phosphate gel, and the recent is by the application of LASER and Electrosurgery. The ideal properties of pulpotomy agents are ought to be biocompatible without any adverse biochemical, histological and immunological effect on the host tissue and on the other hand to have a bactericidal and healing effect on the radicular pulp, to support the regeneration of dentin pulp complex and not interfere with the physiological process of root resorption.[1,4]

Buckley WK(1904) introduced Formocresol (FC combination of formaldehyde, tricresol, glycerol, and water) as a pulpotomy medicament for primary teeth which has been widely used for decades and considered as “gold standard” due to its bacteriostatic, fixative properties with a success rate of 97%. However, a recent review of the literature and clinical trials suggest formocresol causes potential immunogenic, cytotoxic and mutagenic effects leading to a quest for new biocompatible materials and newer procedures for success of pulpal treatment without any adverse effects[4,5].

The term LASER is an acronym for “Light Amplification by Stimulated Emission of Radiation”. It was first introduced to medical use in 1959 and has been revolutionized its application for the first time in medical procedures of ophthalmic surgery in 1963. Depending on the application of various tissues, the use of laser

application in dentistry can be categorized as follows: Soft tissue application and hard tissue application[6,7].The soft tissue application of laser is wound healing, post herpetic neuralgia, frenectomies, removal of inflamed, hypertrophic tissue, aphthous ulcer, photo-activated dye disinfection, photodynamic therapy for malignancies, aesthetic gingival re-contouring, nerve repair and regeneration, post-surgical pain management, TMJ pain management, and sinusitis[8-19]. The hard tissue applications of laser are photochemical effects, laser fluorescence, cavity preparation, caries and restorative removal etching, and dental hypersensitivity. [20-23]

The most commonly used lasers in dentistry include Holmium Yttrium Aluminium Garnet (Ho: YAG), Neodymium-Yttrium Aluminium Garnet (Nd: YAG), Carbon Dioxide Laser (CO2), Erbium-Yttrium Aluminium Garnet (Er: YAG), Gallium Arsenide (GaAs), Erbium, and Argon lasers. Out of these, diode, Neodymium, Erbium, and CO2 lasers are approved by the Food and Drug Administration (FDA) for use in dentistry. The diode is laser made up of microscopic chips of gallium arsenide or other precious semiconductors emits an infrared light beam that is capable of producing well-localized ablation of soft tissue through conversion of the laser energy to heat that adds the advantage of minimal or no bleeding, faster healing, reduced postoperative infection and minimal use of local anesthetic agent. The bio-stimulative effect of laser produces Adenosine Tri Phosphate (ATP), on mitochondria and create a superficial zone of coagulation with underlying induction and stimulation of dentinogenesis and preservation of pulp vitality. The animal's studies with diode laser pulpotomy revealed the histological changes to be less inflammatory, reduced thermal damage to pulp tissue, accelerated pulpal wound healing, calcific bridge formation and based on clinical and radiological evidence the success of diode laser pulpotomy appears to be promising. [24-30]

Laser in pulpotomy has been clinically tried in pulpally involved human primary teeth with a successful clinical and radiological outcome. However, ideally, all clinical and radiological success outcomes ought to be corroborated by histological study and success. This study is designed to conduct a clinical and radiological evaluation of pulpotomy by diode laser on primary teeth and also includes histological evaluation of LASER pulpotomized teeth which were indicated for serial extraction.

AIMS AND OBJECTIVE

To evaluate the effect of diode laser in pulpotomy of human primary molars in terms of clinical, radiological and histological changes.

1. To study the clinical outcome of pain, swelling, mobility, and sinus of diode laser pulpotomy on human primary molars at a different time interval.
2. To study the various radiographic changes of furcal radiolucency, internal/ external root resorption and pulp canal obliteration of diode laser pulpotomy of human primary molars at a different time interval.
3. To study the histological features of the presence of inflammatory cells infiltrate and the sign of calcific bridge formation of pulp tissue of human primary molar subjected to diode laser pulpotomy.

Material and Methods

The present clinical study entitled "Diode laser pulpotomy on human primary molars: a clinical, radiological and histological study'' was carried out in the Department of Pediatric and Preventive dentistry, S.C.B Dental College and Hospital, Cuttack, Odisha during the period from January 2018 to August 2019 with approval from Institutional Ethics Committee. (Annexure I). The participants of the study were selected from children of both genders in the age group of 5-10 years attending the OPD of Pediatric dentistry department having chief complaint of pain in the primary molar teeth. Detailed medical history was obtained and intraoral examination was carried out and the cases which met the inclusion criteria for pulpotomy procedure were selected for the study. The parents/guardian accompanying the participants were described in detail the purpose of this study its methodology and the related risk and benefits, in the local language or another language they can understand. A consent form prepared in English and Odia was distributed to the parents/guardian(Annexure-II) . Only those cases who gave written consent before the start of treatment were enrolled.

INCLUSION CRITERIA

Children in the age group of 5-10 years from both the sexes who had carious and painful primary molars and met the following clinical and radiographic features were included[55].

(a) Clinical criteria

i. Carious exposed vital primary molars,
ii. Absence of tenderness on percussion
iii. Absence of clinical signs of tooth mobility,
iv. Absence of sinus/fistula,

v. Absence of soft tissue swelling/ cellulitis,

vi. First primary mandibular molars fulfilling the above criteria but indicated for serial extraction for the interceptive orthodontic procedure.

(b) Radiological criteria

i. Absence of furcal or periapical radiolucency

ii. Absence of loss of lamina dura

iii. Absence of widening of the periodontal ligament

iv. Physiological root resorption less than one third

A total number of 60 primary molars (Maxillary- 6, Mandibular- 54) from both the arches of 60 children of both the genders (Male -37, Female-23) were included in the study. Low-level Laser Pulpotomy (LLLP) was performed in all the selected teeth.

ARMAMENTARIUM

For clinical examination and diagnosis

Gloves

Kidney tray

Mouth mirror (GDC, India)

Explorer (GDC, India)

Tweezers (GDC, India)

For radiographic examination

X-ray machine unit (70 kvP, 7 mA,230V, 50 Hz, New Life Radiology, Italy

RVG (ASTRAD IMAGINE)

For clinical procedure

A rubber dam (GDC, India)

Air rotor handpiece (NSK, Germany)

Benzocaine gel UPS 20% ProGel-B (Septodent)

Lignocaine 2% with 1: 80,000adrenaline (2% LIGNOX, Warren, Indoco India)

Disposable syringe

Spoon excavator (GDC, India)

No 2 round bur (Shofu, India)

Normal saline (Haseeb Pharmaceuticals Pvt. Ltd, Nagpur, India)

Zinc oxide eugenol cement (IRM, Dentsply, USA)

Restorative Glass Ionomer cement (type 9, GC Corporation Tokyo, Japan)

Glass Ionomer Luting cement (type1, GC Corporation Tokyo, Japan)

Mixing pad

Stainless steel crown (3M UNITEK, Germany)

Sterile cotton

Agate spatula

Restoration set (GDC India)

Vernier caliper

Straight handpiece (NSK Germany)

Diode Laser

iLase (940 nm±10nm ,3.0W Max CW/5.0 W Peak Power(Pulse Mode, BIOLASE ,Inc, USA)

CLINICAL PROCEDURE

A standardized protocol for pulpotomy procedure were carried out in all the selected teeth. Administration of local anesthesia using 2% lignocaine with 1:

80,000adrenaline (2% LIGNOX, Warren, Indoco) isolation with a rubber dam (GDC, INDIA) and access to the pulp chamber was obtained with a no 2 round bur (SHOFU INC.). The coronal pulp was removed using a sharp sterile spoon excavator (GDC) and bleeding was controlled by the application of cotton pallet shocked with normal saline with pressure for 5 minutes. The procedure was repeated until the bleeding was controlled. Then the pulp was ablated to the level of root canal orifice using the 940-nm diode laser (ILase, Biolase) set at 1 W power with a contact pulse mode for 10 sec through a 400-micrometer optical fiber tip. Adequate eye protection was taken by wearing laser protective eyeglasses by the patient, the operator and the assistant during the application of laser. A thin layer of (approx. 2mm) resin reinforced zinc oxide eugenol cement (IRM, Dentsply) base was placed in the pulp chamber followed by type 9GIC(GC gold Label Type 9 GC Corporation, Tokyo, Japan). After one month clinical and radiological evaluation was carried out and a semi-permanent restoration of Stainless Steel crown (3M UNITEK) was cemented in 50 teeth.

The 10 number of pulpotomized mandibular first molars indicated for serial extraction was extracted (5 teeth each on 7th day and 30th day) subjected to histological examination.

Follow up and evaluation.

The clinical and radiological assessment of all teeth treated were carried out at1, 3,6 and 12 months with the following criteria

Clinical Criteria for evaluation

1. Presence/absence of pain
2. Presence/absence of mobility

3. Presence/absence of intraoral swelling
4. Presence/absence of sinus

Radiological evaluation criteria

1. Presence/absent of radiolucency in the furcal/ Periapical area
2. Presence/absence of internal or external root resorption
3. Presence /absence of pulp canal obliteration

HISTOLOGICAL STUDY

The extracted teeth were immersed immediately in 10% neutral buffered formalin solution and allowed to remain in it for 24 hours to facilitate fixation. The teeth were then decalcified using 10% formic acid. The specimens were immersed in the solution for five days and the demineralization was checked using a scalpel. The decalcified specimens were washed in running water for removal of the formic acid and send for routine histological tissue processing. The specimens were embedded in molten paraffin wax. Serial sections of 5 μm were cut using soft tissue microtome in a buccolingual plane. The tissue sections were mounted on gelatin-coated slides and subjected to Haematoxylin and Eosin staining (H&E staining). The slides were examined and captured using the Lawrence & Mayo trinocular microscope equipped with a camera (5MP), the image was captured at 40X, 100Xand 400X magnification for histological study and calibrated according to the criteria[56] described as follows at the department of Oral Pathology and Microbiology, SCB Dental College and Hospital, Cuttack

Inflammatory cell response

Grade 1. Absent or very few inflammatory cells.

Grade 2. A mild or average number of less than 10 inflammatory cells.

Grade 3. Severe inflammatory lesion appearing as an abscess or dense infiltrate involving one-third or more of the coronal pulp.

Grade 4. Completely necrotic pulp.

Dentine bridge formation

Grade 1. Presence of a dentine bridge directly adjacent to some portion of the medicament interface.

Grade 2. Presence of a dentine bridge distant from the medicament interface.

Grade 3. No evidence of any dentine bridge formation in any sections.

The presence or absence of clinical signs of pain, tenderness, swelling, sinus, and mobility was evaluated at 1, 3, 6 and 12 months for the success of the treatment procedure. The presence or absence of radiological sign of periapical or furcal radiolucency, internal or external root resorption and pulp canal obliteration were evaluated for the success of the treatment. The presence or absent of histological sign of Inflammatory cell infiltrate and sign of calcific bridge formation were evaluated for the success of the treatment

Observation

The study sample comprised of 60 children aged between 5-10 years with a mean age of 7.46±1.26 years from both the sexes (Male -37, Female-23). The Diode laser pulpotomy procedure was carried out in all the 60 primary molars from both maxillary and mandibular arches. The Clinical and Radiographic evaluation was carried out in 50 teeth at the interval of 1, 3, 6, and 12 months. 10 number of treated teeth indicated for serial extraction were extracted after the 7th day (N=5) and 30th day (N=5). The extracted teeth were subjected for histological evaluation for inflammatory response and dentinal bridge formation

TABLE-1:

DISTRIBUTION OF SAMPLE ACCORDING TO AGE AND GENDER

VARIABLE	CATEGORY	SAMPLE	
		No.	%
AGE (In Years)	<7	22	36.7
	>7	38	63.3
GENDER	MALE	37	62
	FEMALE	23	38

Table-1 depicts the distribution of the sample according to age and gender. According to age 22 (36.7%) were below 7 years of age and 38(63.3%) more than 7 years of age, and according to sex 37(62%) were male and 23(38%) female.

TABLE -2:

DISTRIBUTION OF SAMPLE ACCORDING TO ARCH AND TOOTH TYPE

ARCH	TOOTH	SAMPLE	
		No.	%
MAXILLARY (N=6)	1St primary molar	4	6.7
	2nd primary molar	2	3.3
MANDIBULAR (N=54)	1st primary molar	28	46.7
	2nd primary molar	26	43.3

Table-2 depicts the distribution of the sample according to arch and tooth type (Primary 1st or 2nd molar). In the maxillary arch, the first primary molar comprises of 4 (6.7%) teeth and the 2nd primary molar 2(3.3%) teeth. In the mandibular arch, 1st primary molar comprises of 28(46.7%) teeth and 2nd primary molar26 (43.3%) teeth.

TABLE -3:

ASSESSMENT OF CLINICAL FEATURES AT VARIOUS STUDY INTERVALS

CLINICAL FEATURE	1MONTH		3 MONTH		6 MONTH		12 MONTH	
	Present	Absent	Present	Absent	Present	Absent	Present	Absent
	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)
PAIN	-	50(100)	-	50(100)	2(4)	48(98)	3(6)	47(94)
MOBILITY	-	50(100)	-	50 (100)	-	50 (100)	-	50 (100)
SWELLING	-	50 (100)	-	50 (100)	-	50 (100)	-	50 (100)
SINUS	-	50 (100)	-	50(100)	-	50(100)	-	50(100)

Table-3 depicts the clinical feature of pain, mobility, swelling, and sinus at study intervals of 1, 3, 6 and 12 months. As regards to pain it was absent in 1 and 3 months (100%) and at the end of 6 months 2 (4%) teeth presented with of pain and 48 (98%) without pain and at 12 month 3 (6%) teeth presented with pain and 47(94%) without pain. Mobility, swelling, and sinus were not present in any teeth at 1, 3, 6 and 12 months follow up with 100 % success.

TABLE-4:

ASSESSMENT OF RADIOLOGICAL FEATURES AT VARIOUS STUDY INTERVAL

RADIOLOGICAL FEATURE	1 MONTH		3 MONTH		6 MONTH		12 MONTH	
	Present	Absent	Present	Absent	Present	Absent	Present	Absent
	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)	No of tooth (%)
FURCAL RADIOLUCENCY	-	50(100)	-	50(100)	2(4)	48(96)	3(6)	47(94)
INTERNAL/EXTERNAL ROOT RESORPTION	-	50(100)	-	50 (100)	-	50 (100)	1(2)	49(98)
PULP CANAL OBLITERATION	-	50 (100)	-	50 (100)	-	50 (100)	1(2)	49(98)

Table-4 depicts the radiographic assessment at various study intervals of 1, 3, 6 and 12 months. As regards to the periapical radiolucency, it was absent in 1 and 3 months (100%) and at the end of 6 months, 2 (4%) teeth presented with furcal radiolucency and 48 (96%) without furcal radiolucency and at 12 months 3 (6%) teeth presented with furcal radiolucency and 47(94%) without furcal radiolucency. As regards to internal/ external root resorption and pulp canal obliteration, it was absent in 1,3and 6 months (100%) and at the end of 12 months, 1 (2%) tooth was presented with internal/external root resorption and 1 (2%) tooth with pulp canal obliteration.

TABLE 5:

CLINICAL AND RADIOLOGICAL ASSESSMENT AT VARIOUS STUDY INTERVAL

	CLINICAL SUCCESS		RADIOLOGICAL SUCCESS	
FOLLOW UP PERIOD	No. of tooth	%	No, of tooth	%
1 MONTH	50	100	50	100
3 MONTH	50	100	50	100
6 MONTH	48	96	48	96
12 MONTH	47	94	45	90

Table 5 depicts clinical and radiographic success of the study at 1, 3, 6 and 12 months follow up.

The clinical success was considered when none of the clinical evaluation criteria were present i.e. pain, swelling, mobility and sinus. The clinical success at the interval of 1, 3, 6 and 12 month was 100%, 100%, 96% and 94% respectively.

The radiographic success was considered when none of the radiographic criteria were present i.e. periapical radiolucency, internal /external root resorption and pulp canal obliteration.

The radiological success was 100%, 100%, 96% and 90% in 1, 3, 6 and 12 month follow up respectively.

HISTOLOGICAL EVALUATION

TABLE 6:

INFLAMMATORY CELL RESPONSE SCORE AT THE 7TH DAY AND THE 30TH DAY:

DURATION	INFLAMMATORY CELL RESPONSE SCORES				
	GRADE 1	GRADE 2	GRADE 3	GRADE 4	Total
	No.of tooth	No.of tooth	No.of tooth	No.of tooth	
7TH DAY	3	2	-	-	5
30TH DAY	5	-	-	-	5

Grade 1. Absent or very few inflammatory cells.

Grade 2. Mild or average number less than 10 inflammatory cells.

Grade 3. Severe inflammatory lesion appearing as an abscess or dense infiltrate involving one-third or more of the coronal pulp.

Grade 4. Completely necrotic pulp.

Table 6 depicts inflammatory cells' response of pulp tissue to diode laser application after 7th day and 30th day. On the 7th day out of 5 pulpotomized teeth 3 teeth showed very few inflammatory cells and 2 teeth showed mild inflammatory cell, no teeth showed severe inflammatory cell or necrotic pulp. At the 30th day, all the teeth showed no inflammatory cells.

TABLE 7

DENTIN BRIDGE FORMATION SCORES ATTHE 7TH DAY ANDTHE 30TH DAY:

DURATION	DENTIN BRIDGE FORMATION SCORES			
	GRADE 1	GRADE 2	GRADE 3	Total
	No. of tooth	No. of tooth	No. of tooth	No. of tooth
7 DAY	-	-	5	5
30 DAY	-	-	5	5

Grade 1. Presence of a dentine bridge directly adjacent to some portion of the medicament interface.

Grade 2. Presence of a dentine bridge distant from the medicament interface.

Grade 3. No evidence of any dentine bridge formation in any sections.

Table-7depicts dentine bridge formation in response to diode laser application after the 7th day and the 30th day. After 7thday and 30th day no teeth showed any sign of formation of dentin bridge.

Discussion

Modern pediatric endodontic procedure and technique for pulpal treatment of primary teeth has always remained a challenge. The use of formocresol, glutaraldehyde, and other medicaments has been successfully tried with variable results and concern regarding their biocompatibility. A search for alternative methods has already been advocated including the application of LASER (Light Amplification by Stimulated Emission of Radiation), as the LASER beam does not come into contact with the tissue in this process, the cutting process does not mechanically affects or damage the irradiated tissue and has the potential to make the area aseptic[49].

A relatively newer method that has emerged is the use of DIODE Laser a Low-level Laser Therapy (LLLT) energy has been advocated for use in pulpal treatment (Pulpotomy)of primary molars and reported to be able to overcome the histologic deficits thereby accelerating the wound healing of the pulp and the expression of the lectins and collagens and also enhances the formation of calcified nodules in human dental pulp fibroblasts, alkaline phosphatase activity, and the production of collagen and osteocalcin[57]. Evidence suggests it also accelerates the reparative dentin bridge formations, accelerated wound healing, regeneration, relief of pain, and enhancement of local immunity. It also promotes cell proliferation, the formation of granulation tissue and accelerates collagen synthesis by fostering the formation of type I and type III procollagen specific pools of mRNA, increases adenosine triphosphate (ATP) synthesis within the mitochondria and activates the lymphocytes[58-60]. The LLLT can stimulate the odontoblastic cells by activating the cell signalling molecules, which helps in modulating the activity of the transforming growth factor-beta ligands, ultimately leading to mineralization and formation of tertiary dentin due to the presence of Smads, a class of proteins[46,61].

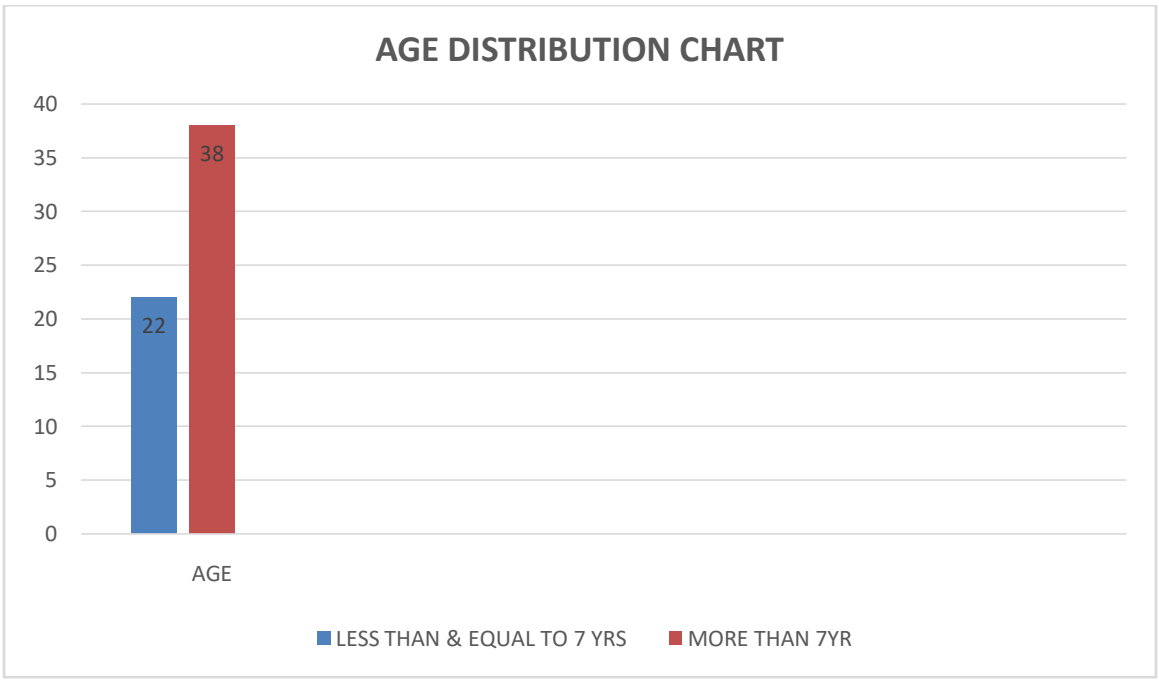
In the present study iLase (940 nm±10nm, 3.0W Max CW/5.0 W Peak Power (Pulse Mode, BIOLASE, Inc, USA) diode laser has been selected since it is proved to be efficient by the researcher for its application in pulp therapy of primary dentition without any adverse effect[26,35,62,63].

The clinical parameters assessed in the present study included pain, mobility swelling, and sinus at different time interval of 1, 3, 6 and 12 months and the presence of pain was seen in only 2 teeth in 6 months and 3 teeth in 12 months and no teeth showed any sign of mobility, swelling and sinus in all the follow-up time interval with a clinical success rate of 98 % and 94% at 6 and 12 months respectively. The radiological parameter assessed in the present study included furcal radiolucency, internal/external root resorption and pulp canal obliteration at different time intervals of 1, 3,6and 12 months. There was a presence of furcal radiolucency only in 2 teeth and 3 teeth at the end of 6 and 12 months with a success rate of 96% and 94% respectively at 6 and 12 months. Regarding internal/external root resorption and pulp canal obliteration, it was present only in one tooth in each with overall success of 94 % at the end of 12 month follow up and in conformity with the earlier report published indicating the fact that the use of diode laser in pulpotomy procedure of primary teeth and considered to be safe and successful[49,51,63].

The comparison of different medicaments for pulpotomy of primary molars when compared with LLLT at different time interval as indicated in the following facts, formocresol pulpotomy showed a clinical and radiological success rates ranging between 70 to 97%[64,65]and when compared with LASER the clinical success and radiological success was 100% and 90% respectively[31] in spite of clinical success rate of formocresol the mutagenic and toxic effects have been reported cytotoxic limiting its use in pulpotomy[66-69]. The clinical and radiological

success of Ferric sulfate pulpotomy from the different studies ranges from 78% - 100% and 43% - 97%[70-73] when compared with laser clinical success of 93% and radiological success of 78% was observed[74]. Electrosurgical pulpotomy showed the clinical success ranged from 87.5% - 100% while radiographic success rate ranged from 84% - 96.8%[75-76]when compared with laser it showed 100% clinical and 80% radiological success[3]. Many research studies on laser pulpotomy show a clinical success of ranged 85.71% – 100% and radiological success of ranged 67% - 94.1 %.)[49,51,63]. MTA pulpotomy show with a high success rate of 80% to 100%[77-79] On the other hand, calcium hydroxide pulpotomy showed significantly worse result and the failure rate ranged from 20- 47%[80-84].

Histological studies of pulpotomized animals teeth with diode laser revealed of least amount of inflammatory cell infiltrate and maximal healing after 7 days follow up[37,39] and pulpotomy with Er: YAG laser showed no inflammation or resorption in any cases after one week follow up but after 60 days follow up a layer of odontoblastic cell formed[35]. In a studied for 30th day and 45th-day post pulpotomy, histological changes showed Laser pulpotomized teeth with lesser inflammatory cell infiltration and more macrophage infiltration, and as regards to calcific bridge formation LASER found to be able to initiate dentin bridge at the interface between the pulp and the material[85,86]. Nd: YAG LASER Pulpotomy on human primary teeth showed after 7th and 60th day follow up less inflammatory cell but no dentine bridge formation[47].Hard tissue barrier formation and continuous odontoblastic layer was observed in a study when pulpotomy was carried out with LASER with calcium hydroxide sealing suggesting successful response with the support that LLLT reduced trauma and inflammation in the pulp tissue, helping the healing process[87].


AGE DISTRIBUTION CHART
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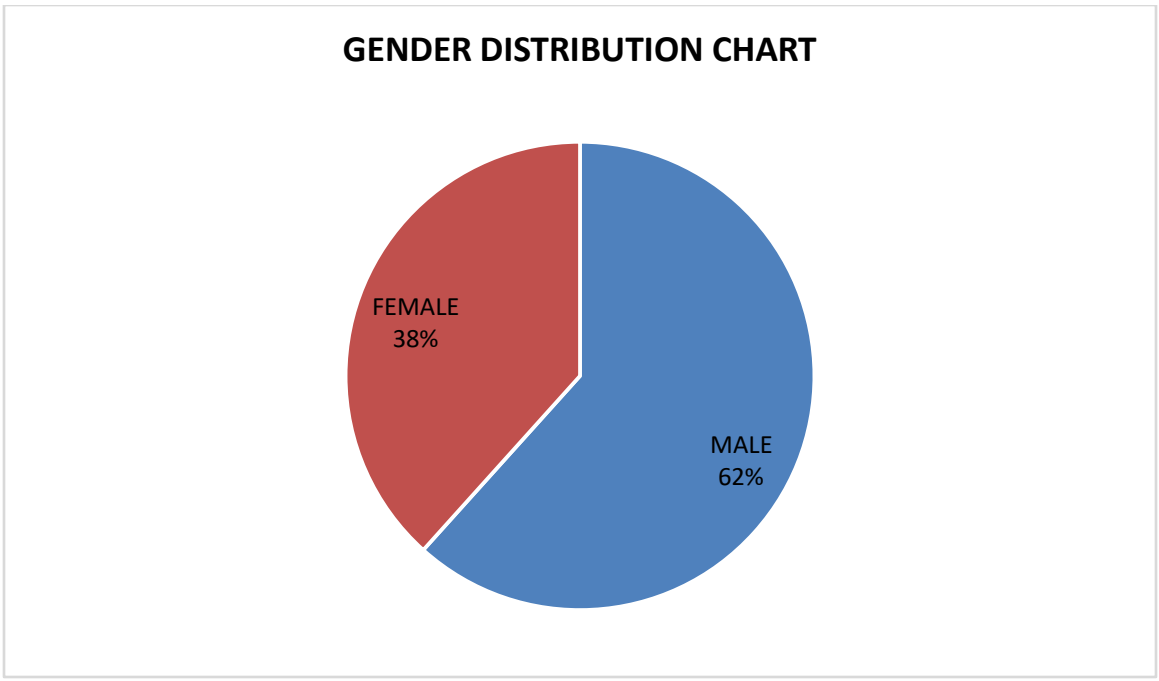
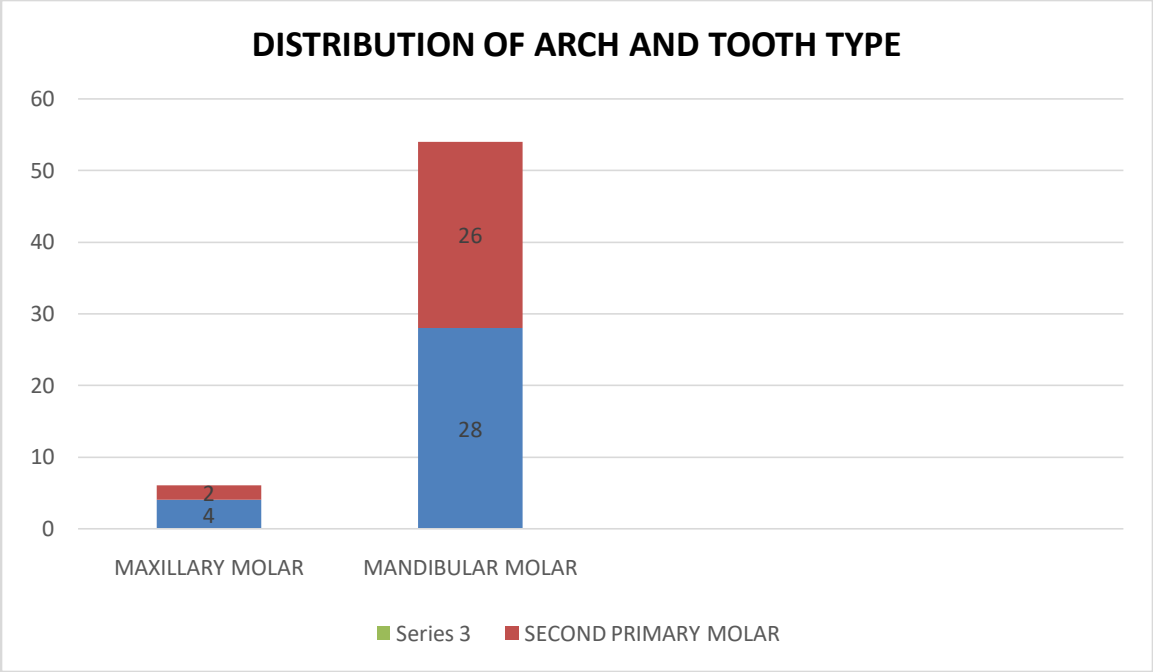
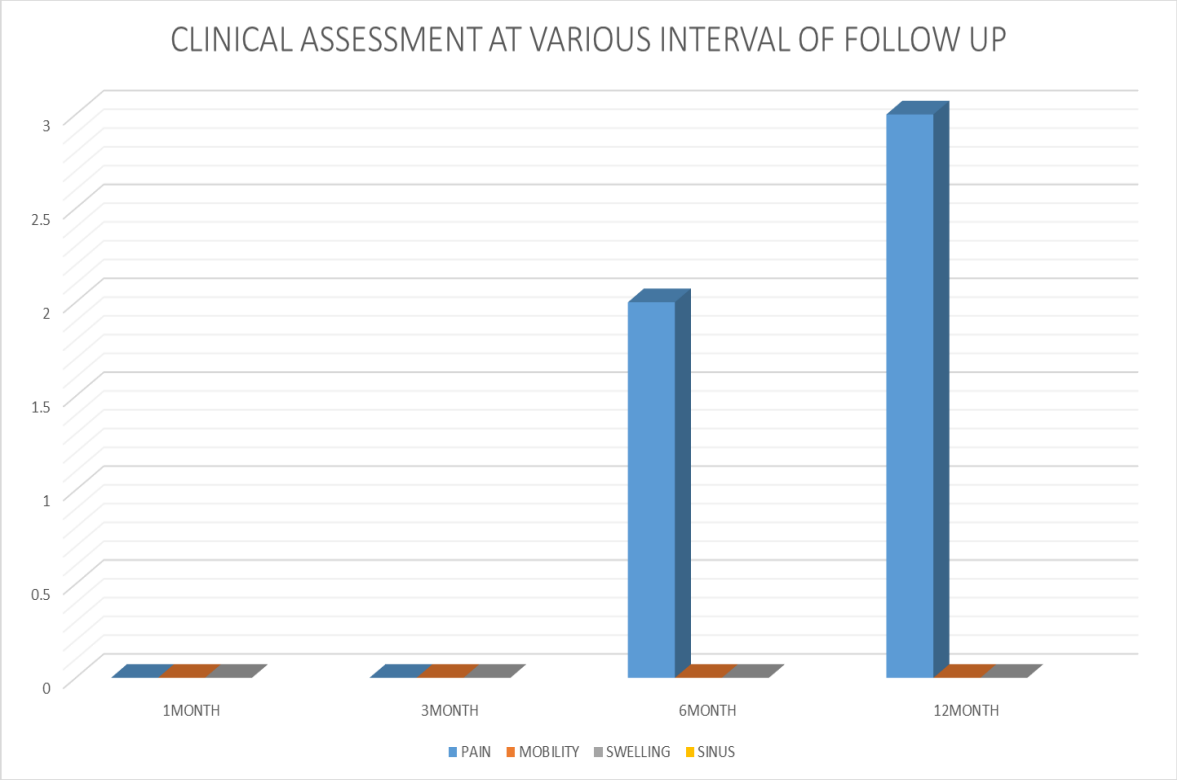
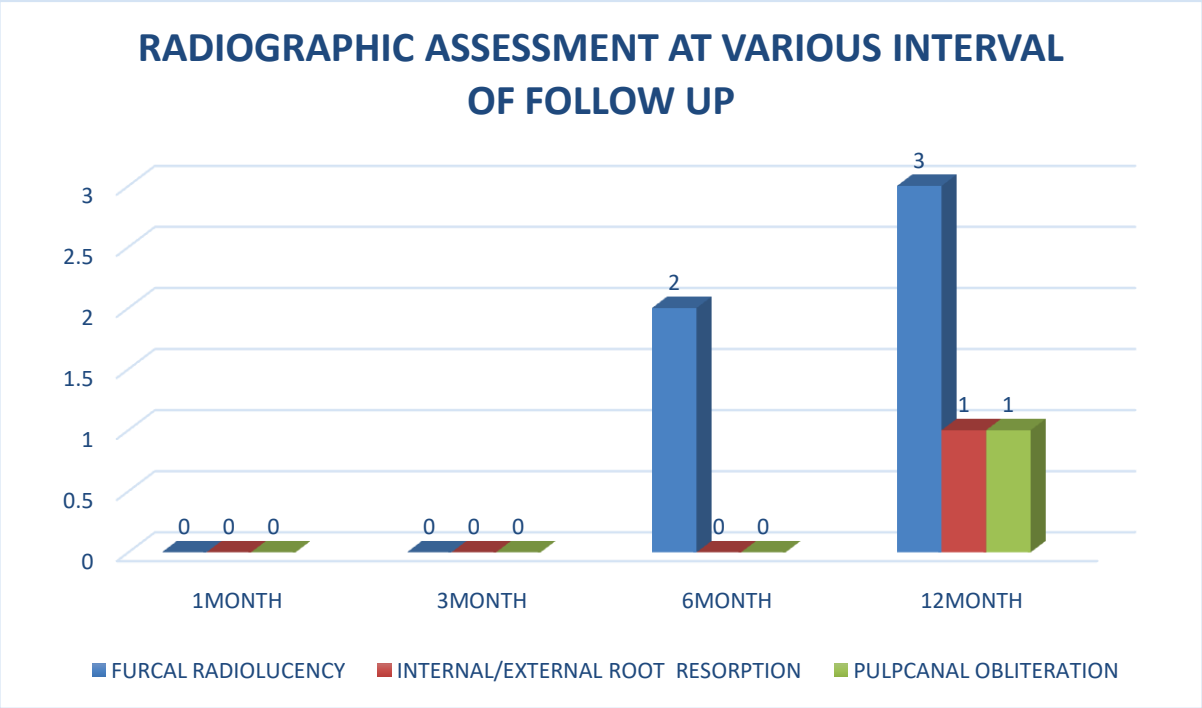
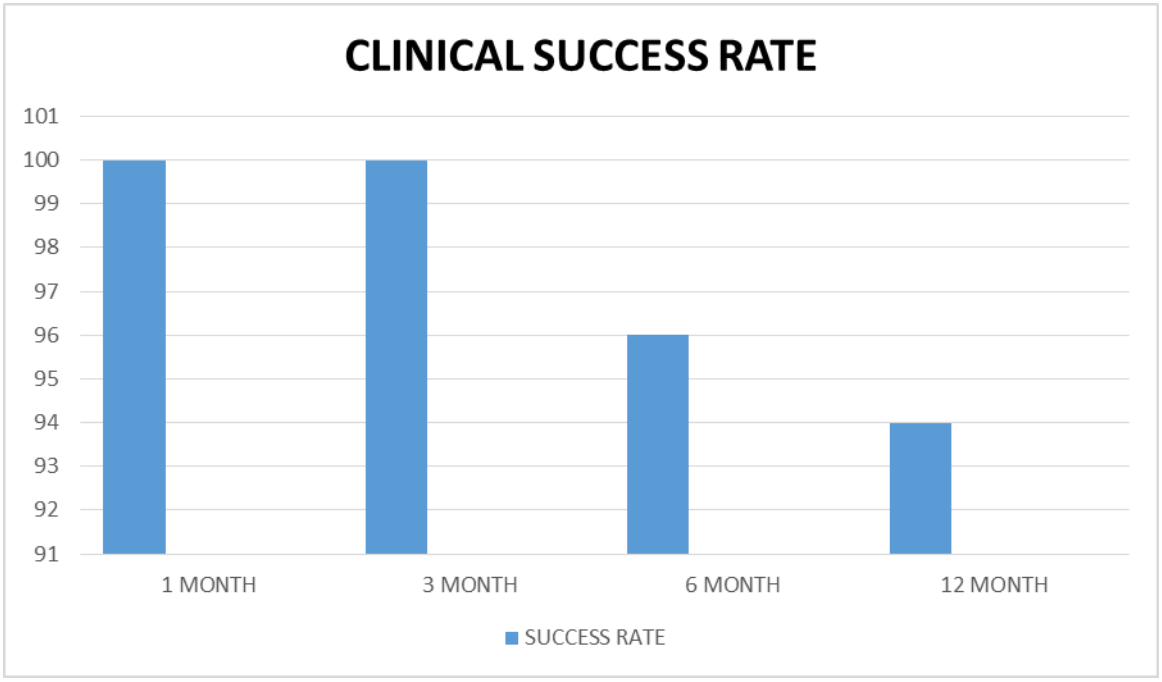
35
30
25
20
15
10
5
0
22
38
AGE
LESS THAN & EQUAL TO 7 YRS
MORE THAN 7YR

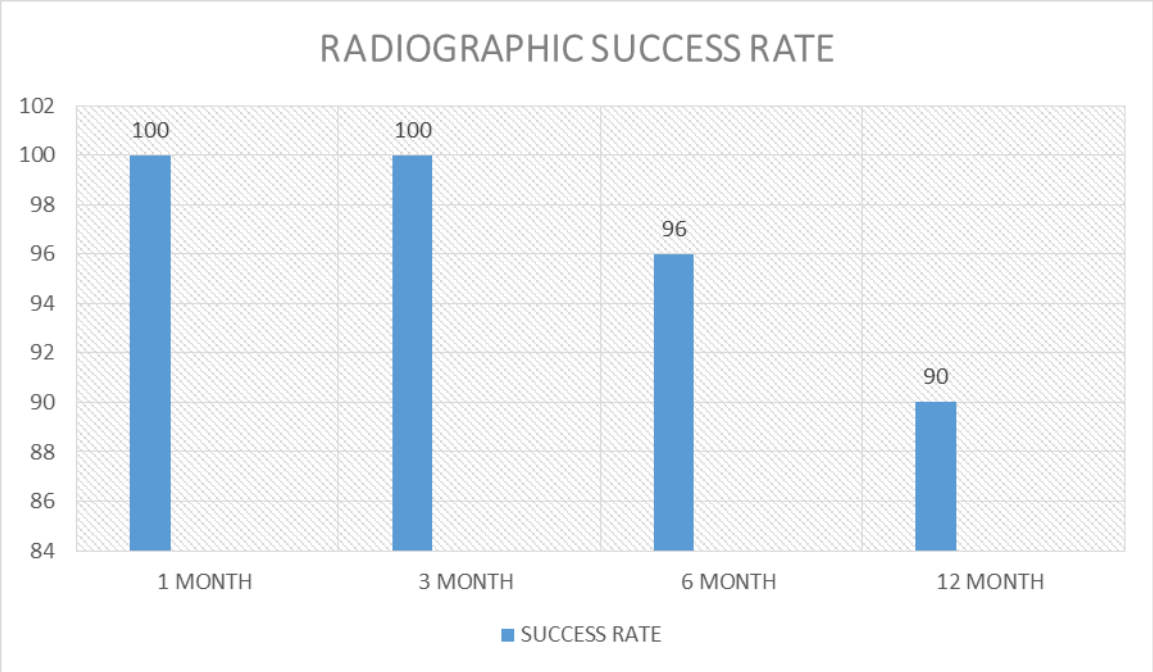

GENDER DISTRIBUTION CHART
FEMALE
38%
MALE
62%


DISTRIBUTION OF ARCH AND TOOTH TYPE
60
50
40
30
20
10
0
26
28
2
4
MAXILLARY MOLAR
MANDIBULAR MOLAR
Series 3
SECOND PRIMARY MOLAR


CLINICAL ASSESSMENT AT VARIOUS INTERVAL OF FOLLOW UP
3
2.5
2
1.5
1
0.5
0
1MONTH
3MONTH
6MONTH
12MONTH
PAIN
MOBILITY
SWELLING
SINUS

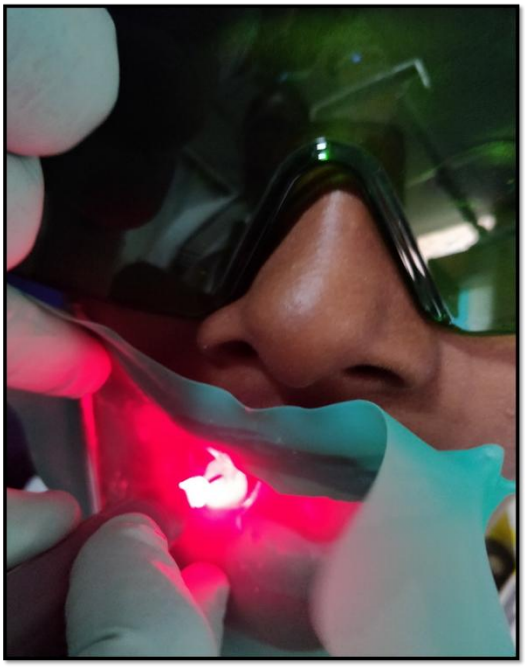

RADIOGRAPHIC ASSESSMENT AT VARIOUS INTERVAL OF FOLLOW UP
3
2.5
2
1.5
1
0.5
0
0 0 0
0 0 0
2
0 0
3
1 1
1MONTH
3MONTH
6MONTH
12MONTH
FURCAL RADIOLUCENCY
INTERNAL/EXTERNAL ROOT RESORPTION
PULPCANAL OBLITERATION


CLINICAL SUCCESS RATE
101
100
99
98
97
96
95
94
93
92
91
1 MONTH
3 MONTH
6 MONTH
12 MONTH
SUCCESS RATE


RADIOGRAPHIC SUCCESS RATE
102
100
98
96
94
92
90
88
86
84
100
100
96
90
1 MONTH
3 MONTH
6 MONTH
12 MONTH
SUCCESS RATE

ARMAMENTARIUM

DIODE LASER



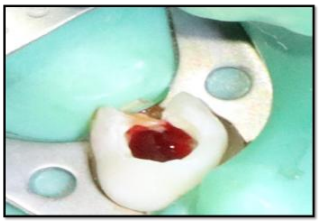
LASER GLASS PROTECTION

CLINICAL PROCEDURE

PRE OPERATIVE XRAY SHOWING CARIOUS 74

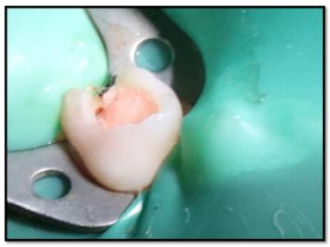
RUBBER DAM PLACED

ACCESS OPENING DONE

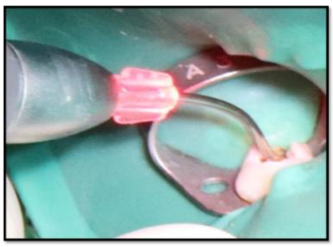


REMOVAL OF CORONAL PULP

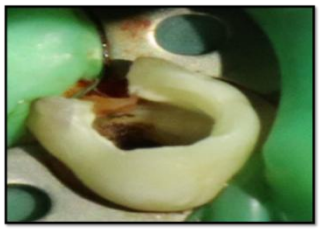
CLINICAL PROCEDURE Contd..



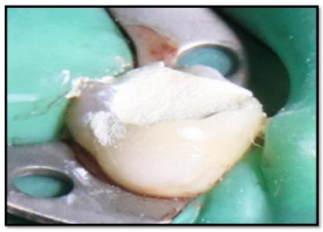
MOIST COTTON PLACED



LASER EXPOSED



POST LASER EXPOSURE



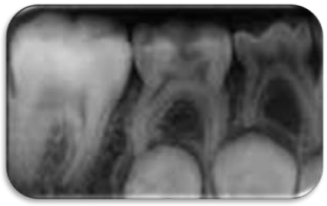
IRM RESTORATION DONE

CLINICAL PROCEDURE contd..

GIC RESTORATION DONE

STAINLESS STEEL CROWN PLACED

RADIOLOGICAL EVALUTION

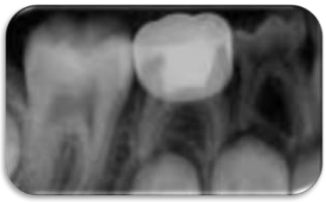


PRE OP

1 MONTH

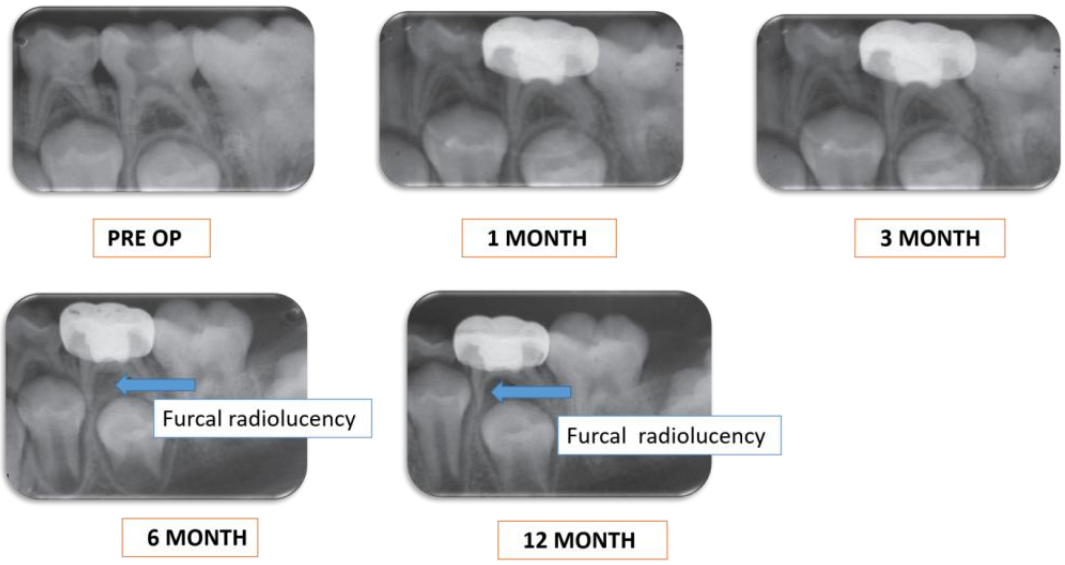
3 MONTH

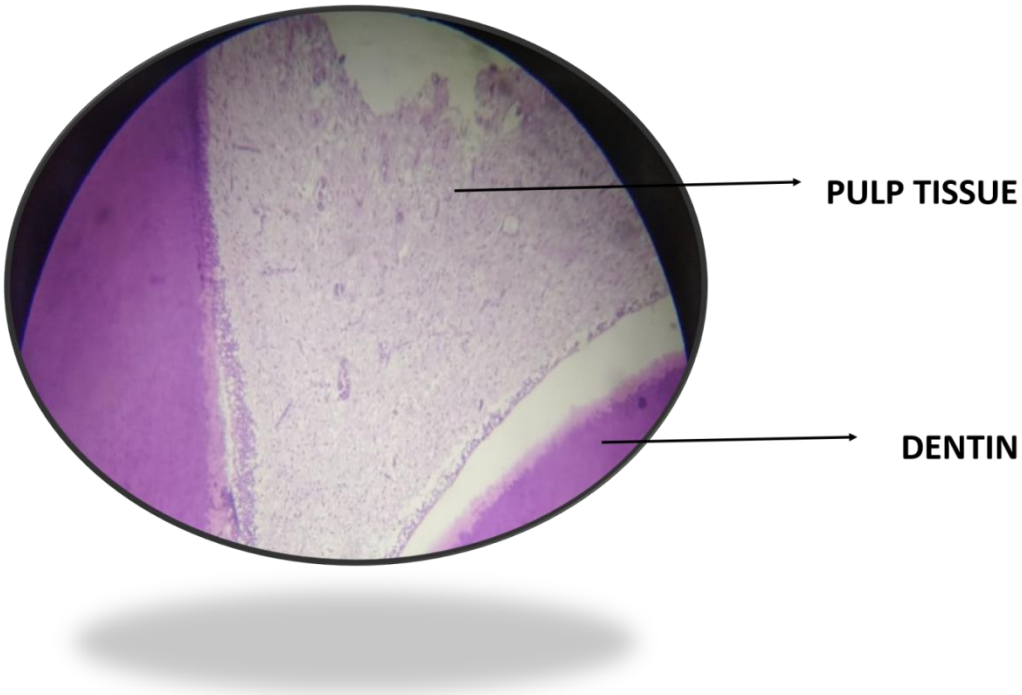
6 MONTH



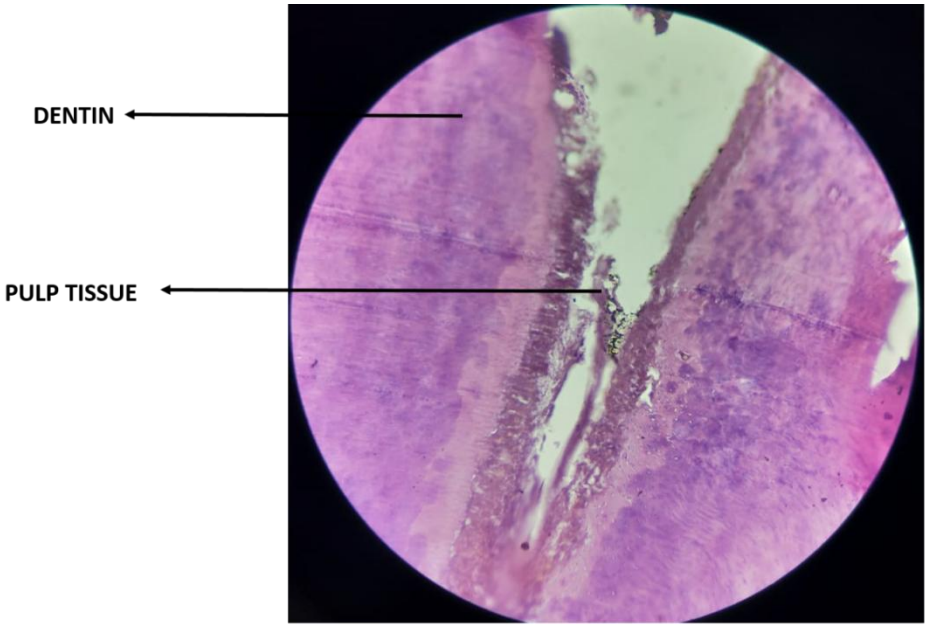
12 MONTH

RADIOLOGICAL EVALUTION





Pulp tissue showing no inflammatory cells



Pulp tissue showing few inflammatory cells

Conclusion

Following conclusion can be drawn from the result of the study

1. The overall clinical success rate of diode laser pulpotomy was 94% at the end of 12 months follow up with absent of swelling, sinus, and mobility
2. The overall radiographic success rate of diode laser pulpotomy was 90% at the end of 12 months follow up with absent of sign of furcal radiolucency, internal/external root resorption and pulp canal obliteration
3. The histological evaluation showed no inflammatory cells respond in diode laser pulpotomy at 7th day and 30th day follow up indicating proper healing of the pulp tissue
4. Calcific bridge formation was not seen due to shorter study duration
5. The diode laser is very effective in pediatric dentistry and often felt comfortable and acceptable by the children and their families with a magical effect.

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