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Clinical and radiographic evaluation of pulpectomized primary molar teeth obturated with zinc oxide eugenol and endoflas by different obturation techniques: An in vivo study

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Abstract

Aims: The purpose of the study was to assess and compare the success of Endoflas and ZOE as obturating material clinically and radiographically by employing 3 different obturation techniques using Endodontic Pressure syringe, Pastinject system, NaviTip syringe.

Methods and Material: Ninety (90) Primary Mandibular Second Molar teeth were selected from children of both sexes within the age range of 4 to 8 yrs. After pulpectomy produres teeth were obturated by employing 3 different obturation techniques like Endodontic Pressure syringe, Pastinject system and NaviTip syringe with Endoflas (N-45) and ZOE (N-45) as obturating materials. Outcomes were evaluated both clinically and radiographically.

Statistical analysis : To prevent bias clinical and radiographic evaluation were assessed by another investigator and all the results were then subjected to biostatistical analysis by Microsoft excel worksheet (2007) and statistical analysis was done using Statistical

Package for Social Sciences, version 20.0 (SPSS, Chicago, IL, USA).

Results: A significant difference in length of obturation was found among 3 obturation techniques within the Endoflas group with maximum optimal fillings in Pastinject with Endoflas group. Within Endoflas group, maximum voids were seen in 28(93.33%) cases with Endodontic Pressure syringe and NaviTips each compared to 23(76.7%) cases in Pastinject group in apical third of mesial and distal canals. Maximum voids were seen in 28(93.33%) cases in Endodontic Pressure syringe compared to 22(73.33%) cases in NaviTip group and 11(36.67%) cases in Pastinject group in middle third of mesial and distal canals with Endoflas as obturating material.

Conclusion: Pastinject was found to be a better obturating technique regardless of the obturating materials used.

Keywords: Endodontic Pressure Syringe, Pastinject**,** Navitip

Introduction

Dental caries is considered to be a disease of modern civilization and despite of great achievements in oral health of populations it is still a major oral health problem in most industrialized countries, affecting 60-90% of school children leading to early loss of primary teeth. [1]The most common cause of premature loss of primary teeth is dental caries leading to involvement of pulp and periradicular tissue causing pain and infection.Premature loss of primary teeth may result in space loss leading to crowding, ectopic eruption of permanent teeth, speech defects, development of deleterious oral habits and masticatory problems thus affecting normal growth and development of orofacial region. Following premature loss of primary teeth maintaining the integrity of the primary dentition until its normal exfoliation is a major goal of Paediatricdentistry which is aimed at restoring the normal occlusal function, esthetics, and normal facio-maxillary growth. [2,3] The infected non vital primary teeth with or without periapical pathology can be successfully treated by pulpectomy procedures. [4]Different techniques and materials have been advocated for obturation of pulpectomized root canals of the primary teeth.An ideal obturating technique should ensure complete filling of the canal without overfill and with minimal or no voids. [5,6]Traditionally Lentulo spiral mounted on a slow-speed handpiece has been used successfully, which is found to be superior in filling both straight and curved narrow canals of primary teeth. [7]Recently new pressure techniques are introduced using NaviTip syringe and Jiffy™ tube for obturation in primary root canals. [8]New specifically designed paste carrierdevice, Pastinject (Micro Mega, Besancon, France) was introduced recently that differs from Lentulo spiral by its design. It works similarly to the lentulo spiral, provides good placement of the obturating material, while eliminating voids and providing a high density of the obturating materials into the root canals. [9] Considering above facts the present study was designed to assess and compare the success of Endoflas and ZOE as obturating material clinically and radiographically by employing 3 different obturation techniques using Endodontic Pressure syringe, Pastinject system, NaviTip syringe.

Materials And Methods

The study was undertaken in the Post Graduate Department of Pedodontics and Preventive Dentistry, S C B Dental College and Hospital, Cuttack, Odisha from January 2016 to November 2017 with a prior approval from the Institutional ethical committee of S C B Medical College and Hospital. Ninety (90) Primary

Mandibular Second Molar teeth were selected from children of both sex within the age range of 4 to 8 yrs.

Inclusion criteria

1. History of spontaneous pain and tenderness on percussion
2. Signs of chronic irreversible pulpitis and pulpal necrosis
3. Presence of gingival abscess or sinus tract
4. Tooth that has been planned for pulpotomy and excessive haemorrhage is encountered following amputation of coronal pulp
5. Presence of inter-radicular or periapical radiolucency
6. Tooth having adequate bone support with at least two third intact root length

Exclusion criteria

Grossly decayed unrestorable tooth, teeth with pathological lesion extending to the succedaneous tooth germ or any evidence of internal or external pathological root resorption were exempted from study.

Clinical Procedure

All pulpectomy procedures followed same standardized protocol and done by a single operator. After anaesthetizing and proper isolation access opening, roof of the pulp chamber was removed with a no. 330 tungsten-carbide bur in high speed hand piece. The root canal preparation was aided with copious irrigation with 3%NaOCl (Parcan, Septodont Healthcare India Pvt.Ltd.,India)and normal saline. After biomechanical preparation all the root canals were irrigated with normal saline. Then the root canals were dried out with appropriately sized sterile absorbent paper points and subjected to obturation [**Fig-1,2**] using any one of the six techniques as followed,

Group I: Endodontic pressure syringe (A 25 gauge pressure syringe ,Pulpdent, Watertown, Mass, USA) with ZOE (2 scoops of powder to 2 drops of liquid)as obturating material.

Group-II: Pastinject (MicroMega SA, Besancon cedex, France, 1000 rpm) was selected two size smaller than the final size file used for root canal preparation with ZOE (1 scoops of powder to 2 drops) as obturating material.

Group III: NaviTip(Ultradentproducts Inc; South Jordan, Utah, USA) with 29- gauge, 21 mm length canula was used with 3 ml luer lock disposable syringe (BD Precision Glide™, Singapore) with ZOE (1 scoops of powder to 3 drops of liquid)as obturating material.

Group IV: Endodontic pressure syringe (Similar to group I) with Endoflas(2 scoops of powder to 2 drops of liquid) as obturating material.

Group V: Pastinject (Similar to group II) with Endoflas(1 scoops of powder to 2 drops of liquid)as obturating material.

Group VI: NaviTip (Similar to group III) with Endoflas(1 scoops of powder to 3 drops of liquid) as obturating material.

After obturating the canals, the access cavities were restored with quick setting Zinc oxide and Eugenol cement. Immediate post-operative radiographs were obtained following obturation.All the pulpectomized teeth were restored with semi-permanent restoration (stainless steel crown) in follow up visits.

All the samples were subjected to clinical evaluation pre-operatively and post-operative 3, 6 and 9 months follow up by criterias like :**(1**) Presence or absence of spontaneous pain (**2)** Presence or absence of tender on percussion (**3)** Presence or absence of gingival swelling (**4**) Presence or absence of draining sinus/fistula (**Score 0:** symptoms absent and **Score 1:** symptoms present).Radiological assessment was done by reduction or absence of pre-existing pathological furcal radiolucency (**Score 0:** decreased size of furcal

radiolucency, **Score 1:**no change or same size furcal radiolucency, **Score 2:** increased size of furcal radiolucency).Similarly endodontic success assessed by quality of obturation and completeness of fill based on the following criteria given by Coll and Sadrian (1996). [10] **Score 1** (Underfilling)**:**All canals filled more than 2 mm short of root apex,**Score 2** (Optimal filling)**:** One or more canals having obturating material ending at the radiographic apex or upto 2 mm short of apex,**Score 3** (Over filling): Any canal showing obturating material beyond the radiographic apex. Completeness of fill in each third (apical, middle, and coronal) of the canal scored as Score 0: voids absent and Score 1**:** voids present.

All the radiographic assessment was recorded for each group and compared at 3,6 and 9 months follow up visits. [**Fig- 3-8**]

To prevent bias clinical and radiographic evaluation were assessed by another investigator and all the results were then subjected to biostatistical analysis by Microsoft excel worksheet (2007) and statistical analysis was done using Statistical Package for Social Sciences, version 20.0 (SPSS, Chicago, IL, USA).

Observations

A total of 90 children (M=47, F=43) with a mean age of 6.40 ± 1.19 years participated in the present study in which pulpectomies were carried out in the mandibular primary second molars. [**Table 1**] As regards to Spontaneous Pain and Tenderness on percussion, Gingival Swelling and draining sinus or fistula, following pulpectomy no sample in any group presented with any spontaneous pain and tenderness on percussion post-operatively in 3, 6 and 9 months follow up visits [**Table 2].** Furcal radiolucency was compared among all the techniques for each of the material at each follow up visit. None of the cases presented increase in the size of furcal radiolucency, so not presented in the table. [**Table 3]**

Length of obturation was compared among all the techniques for each of the material at each follow up visit. Within ZOE group significant difference was compared among 3 obturation techniques and found to be non-significant. (χ^2= 3.1p = 0.54) A significant difference was found among 3 obturation techniques within the Endoflas group with maximum optimal fillings in group V. **(χ^2= 15.60p = 0.003)** [**Table 4]**

Completeness of filling was compared among all the techniques in terms of presence or absence of voids in each third of mesial and distal root canals (apical, middle and coronal).Within Endoflas group, maximum voids were seen in 28(93.33%) cases in group IV and VI each compared to 23(76.7%) cases in group V in apical third of mesial and distal canals.Maximum voids were seen in 28(93.33%) cases in group IV compared to 22(73.33%) cases in group VI and 11(36.67%) cases in group V in middle third of mesial and distal canals.

Maximum voids were seen in 15(50%) cases in group IV compared to 4(13.33%) cases in group V and 9(30.0%) cases in group VI in coronal third of mesial and distal canals. **[Table 5]**

Discussion

Pulpectomy is an endodontic procedure to salvage the primary teeth when pulp becomes irreversibly infected or necrotic due to caries, trauma or other causes. The rationale of this treatment is near total elimination of microorganism from the root canal and prevention of subsequent reinfection.

Since 1930's Zinc oxide Eugenol is one of the most widely used materials for root canal filling of primary teeth. Despite having certain disadvantages like slow resorption, irritation to the periapical tissues, necrosis of bone and cementum and altering the path of eruption of

succedaneous tooth, high success rates have been reported after obturating with Zinc Oxide Eugenol cement in previous studies. [11,12]

In the present study, ZOE paste (Endomet® Plain, Septodont Healthcare India Pvt Ltd, Maharastra, India) was used as one of the obturating material because of its easy availability and cost-effectiveness as compared to any other filling material used. Endoflas (Sanlor Laboratories, Miami, FL, USA) being another successful material available was also included in the present study.

Along with the composition and mixing of obturating materials the various technique of obturating the primary root canals play a major role in the success of the pulpectomy procedure.Various techniques for the obturation of primary teeth have been tried clinically to achieve these goals namely; Endodontic pressure syringe, Mechanical syringe, Tuberculin syringe, Jiffy tube, Incremental filling technique, Endodontic plugger, NaviTipand Lentulo spiral technique.

The Lentulo spiral is the most traditional and commonly used rotary instrument to carry obturating material into the primary root canals with the help of micro motor handpiece. [13]The Pastinject (MicroMega SA, Besancon cedex, France) is a newly and specifically designed paste carrier device that works similarly to the Lentulo spiral. Pastinject was proved to be a good alternative for transportation of the obturating materials, while eliminating voids and providing a high density of the obturation. [14]

On the other hand, Endodontic pressure syringe is one of the novel traditional technique of delivering the desired material into the root canal that consists of a syringe barrel, threaded plugger, wrench and threaded needle. Recently, a thin and flexible metal tip was introduced viz., NaviTip (Ultradent products Inc; South Jordan, Utah, USA) to deliver root canal sealer and available in different lengths with reported success rate in previous studies. [15]

A need has always persisted to evaluate the optimum technique of obturation of primary teeth, so as to obtain a compact and dense filling of the root canal. Hence, the purpose of this study was to compare the efficiency of Endodontic pressure syringe with NaviTip and Pastinject as obturation techniques using ZOE or Endoflas as obturating material in primary teeth.

In the present study, all the pulpectomized teeth were evaluated clinically for spontaneous pain, tenderness on percussion, gingival swelling and draining sinus or fistula preoperatively and post-operatively at 3, 6 and 9 months follow up. At the end of the study no clinical failure was observed in any of the study samples indicating that Zinc oxide Eugenol and Endoflas can have its clinical application for obturation of primary root canals using any of the obturating techniques described. The reason for complete clinical success in the present study may be attributed to thorough biomechanical preparation and copious irrigation of root canals at multiple visits.

Radiographic assessment of furcal radiolucency showed no significant difference between both the obturation materials but maximum cases with reduction in the size of furcal radiolucency was found within Endoflas group at the end of 9 months follow up. This finding was similar to the findings of the study by Rewal et al who found 100% decrease in the size of interradicular radiolucency in Endoflas at the end of 9 months compared to 45% decrease with Zinc oxide eugenol. [16]This finding may be attributed to the broad spectrum antibacterial efficacy of Endoflas because of its iodoform content.

In the present study when length of obturation was compared among 3 obturating techniques, significant difference was found with Endoflas only **(p = 0.003).** Pastinject system gave maximum optimal fillings with both the obturating materials. This finding is in accordance with the study by Gandhi et al and Grover R et al., where Pastinject exhibited the highest number of optimally filled canals. [17]Success of this technique can also be attributed to the fact that Pastinject is a specially designed paste carrier with flattened blades, which improves material placement into root canal, causing a lower occurrence of underfilled and overfilled canals regardless of the obturating materials used.

In the present study, all the techniques used to obturate the root canals led to voids in the filling material, a finding consistent with earlier reports. This observation was perhaps due to radiographs taken in two directions only in RVG, so it was not possible to find exact measurement and location of all the voids present and this could be a drawback of this study.

Completeness of filling (voids) in different canals after obturation and subsequent radiological examination revealed maximum voids with Endoflas using Endodontic pressure syringe and NaviTip at each third of root canals compared to ZOE. However, significant difference was found only at middle third of root canals between both the obturating materials. [18] **(p = 0.002, p = 0.01)** The possible reason for maximum voids with Endoflas in present study was attributable to the thicker consistency of the Endoflas which is difficult to flow within thin canula of the Endodontic pressure syringe and NaviTip compared to ZOE paste which is smooth and easily passed inside the canula. Difficulties in placing the rubber stop correctly and removing the needle (because of the need to refill the hub of the syringe several times during the procedure) may lead the clinician to remove and reinsert the syringe repeatedly, which, in turn, may displace the paste, create voids, and thus decrease filling quality. Some studies, however, found fewer voids after pressure syringe filling. [19,20]The discrepancies between our results and those of other studies probably reflect differences in the type of teeth, sample size, tip thickness, technique used to quantify voids, and operator experience.

On the other hand, Pastinject presented least voids in each third of the root canals but a significant difference was found only in middle and coronal third of the root canals with Endoflas only. This finding is in accordance with study by Grover et al,Oztan et al and Gandhi et al in which minimum number of voids was observed in canals filled with Pastinject technique.Fewer voids in Pastinject system is attributed to its flatter blades which favors a better intracanal placement of obturating materials minimizing the entrapment of voids.

Conclusion

Based upon the radiographic assessment, it was observed that both Endodontic pressure syringe and Pastinject gave maximum number of optimal obturations. We found that pressure syringe gave a compact filling but it was time consuming. On the other hand, Pastinject was easy to use. Considering above facts, in the present study Pastinject system along with Endoflas or ZOE obturating material was found to have maximum optimal fillings with comparable voids at each third of root canals suggesting Pastinject to be a better obturating technique regardless of the obturating materials used. Further clinical trials with larger sample size and evaluation in 3-D (CBCT) are needed to validate the results of present study.

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Legend Tables

Table 1: Demographic distribution of study groups according to age and gender

Material	Technique	Male (N=47) n (%)	Female (N=43) n (%)	Age (in years) (Mean ± S.D)	Overall Age (in years) (Mean ± S.D.)
ZnOE (N=45)	EPS	8(17.03)	7(16.27)	6.87±1.06	6.40±1.37
	PI	9(19.14)	6(13.95)	5.93±1.48	
	NT	8(17.03)	7(16.28)	6.40±1.45	
Endoflas (N=45)	EPS	10(21.27)	5(11.63)	6.47±1.87	6.40±1.01
	PI	5(10.64)	10(23.26)	6.33±1.04	
	NT	7(14.89)	8(18.61)	6.40±0.82	
EPS – Endodontic Pressure Syringe PI - Pastinject NT –NaviTip S.D = Standard Deviation					

Table 2: Distribution of clinical evaluation scores among three obturation techniques using two different obturating materials at various study visits.

Variable	Material	Follow-up	Score	EPS	PI	NT	χ^2	*p*
Pain and Tenderness on percussion	ZnOE	Baseline	0	-	-	-	NA	NA
			1	15(100)	15(100)	15(100)		
		3, 6, 9 month	0	15(100)	15(100)	15(100)		
			1	-	-	-		
	Endoflas	Baseline	0	-	-	-		
			1	15(100)	15(100)	15(100)		
		3, 6, 9 month	0	15(100)	15(100)	15(100)		
			1	-	-	-		
Swelling	ZnOE	Baseline	0	11(73.3)	13(86.7)	10(66.7)	1.68	0.43
			1	4(26.7)	2(13.3)	5(33.3)		
		3, 6, 9 month	0	15(100)	15(100)	15(100)	NA	NA
			1	-	-	-		
	Endoflas	Baseline	0	10(66.7)	8(53.3)	11(73.3)	1.35	0.50
			1	5(33.3)	7(46.7)	4(26.7)		
		3, 6, 9 month	0	15(100)	15(100)	15(100)	NA	NA
			1	-	-	-		
Sinus/ Fistula	ZnOE	Baseline	0	12(80)	11(73.3)	14(93.3)	2.12	0.34
			1	3(20)	4(26.7)	1(6.7)		
		3, 6, 9 month	0	15(100)	15(100)	15(100)	NA	NA
			1	-	-	-		
	Endoflas	Baseline	0	13(86.7)	10(66.7)	12(80)	1.8	0.40
			1	2(13.3)	5(33.3)	3(20)		
		3, 6, 9 month	0	15(100)	15(100)	15(100)	NA	NA
			1	-	-	-		

Table 3: Comparison of Furcal radiolucency score among three obturation techniques using two different obturating materials at various study visits.

Variable	Material	Follow-up	Score	EPS	PI	NT	χ^2	*p*
Furcal Radiolucency	ZnOE	Baseline	0	3(20)	1(6.7)	2(13.3)	1.15	0.56
			1	12(80)	14(93.3)	13(86.7)		
		3 month	0	1(6.7)	2(13.3)	3(20)	1.15	0.56
			1	14(93.3)	13(86.7)	12(80)		
		6 month	0	4(26.7)	10(66.7)	6(40)	5.04	0.80
			1	11(73.3)	5(33.3)	9(60)		
		9 month	0	7(46.7)	13(86.7)	9(60)	5.43	0.06
			1	8(53.3)	2(13.3)	6(40)		
	EndoF	Baseline	0	2(13.3)	1(6.7)	1(6.7)	0.54	0.76
			1	13(86.7)	14(93.3)	14(93.3)		
		3 month	0	5(33.3)	5(33.3)	5(33.3)	0.9	0.9
			1	10(66.7)	10(66.7)	10(66.7)		
		6 month	0	9(60)	10(66.7)	7(46.7)	1.27	0.52
			1	6(40)	5(33.3)	8(53.3)		
		9 month	0	12(80)	14(93.3)	11(73.3)	2.12	0.34
			1	3(20)	1(6.7)	4(26.7)		

Table 4: Comparison of Length of Obturation score among three obturation techniques using two different obturating materials.

Variable	Material	Score	EPS	PI	NT	χ^2	p
Length of Obturation	ZnOE	1	2(13.3)	1(6.7)	1(6.6)	3.1	0.54
		2	8(53.3)	11(73.3)	7(46.7))		
		3	5(33.3)	3(20)	7(46.7)		
	EndoF	1	1(6.6)	1(6.7)	6(40)	15.60	0.003*
		2	4(26.7)	11(73.3)	5(33.3)		
		3	10(66.7)	3(20)	4(26.7)		

Table 5: Comparison of Completeness of filling (Voids) score among three obturation techniques using two different obturating materials

Variable	Material	Location	Score	EPS	PI	NT	χ^2	P
Voids	ZnOE	Apical	0	5(16.67)	7(23.33)	2(6.67)	3.21	0.20
			1	25(83.33)	23(76.67)	28(93.33)		
		Middle	0	13(43.33)	16(53.33)	18(60.0)	1.69	0.42
			1	17(56.67)	14(46.67)	12(40.0)		
		Coronal	0	21(70.0)	25(83.33)	21(70.0)	1.86	0.39
			1	9(30.0)	5(16.67)	9(30.0)		
	Endoflas	Apical	0	2(6.67)	7(23.33)	2(6.67)	5.17	0.07
			1	28(93.33)	23(76.67)	28(93.33)		
		Middle	0	2(6.67)	19(63.33)	8(26.67)	22.69	<0.001*
			1	28(93.33)	11(36.67)	22(73.33)		
		Coronal	0	15(50.0)	26(86.67)	21(70.0)	9.43	0.009*
			1	15(50.0)	4(13.33)	9(30.0)		

Fig1: Armamentarium and materials used

Fig 2(A) : Obturation using Endodontic pressure syringe,2(B): Obturation using Pastinject,2(C) : Obturation using NaviTip

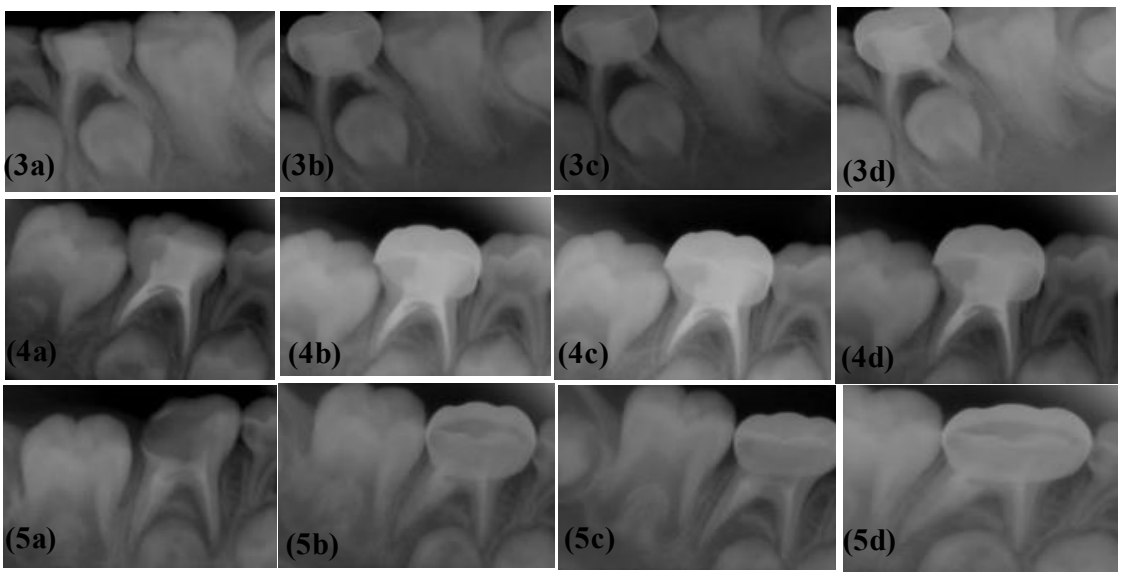

Fig-3 Endodontic Pressure syringe andZOE,Fig-4 Pastinjectand ZOE ,Fig-5 NaviTipand ZOE with a,b,c,d as immediate,3,6,9 months follow up respectively

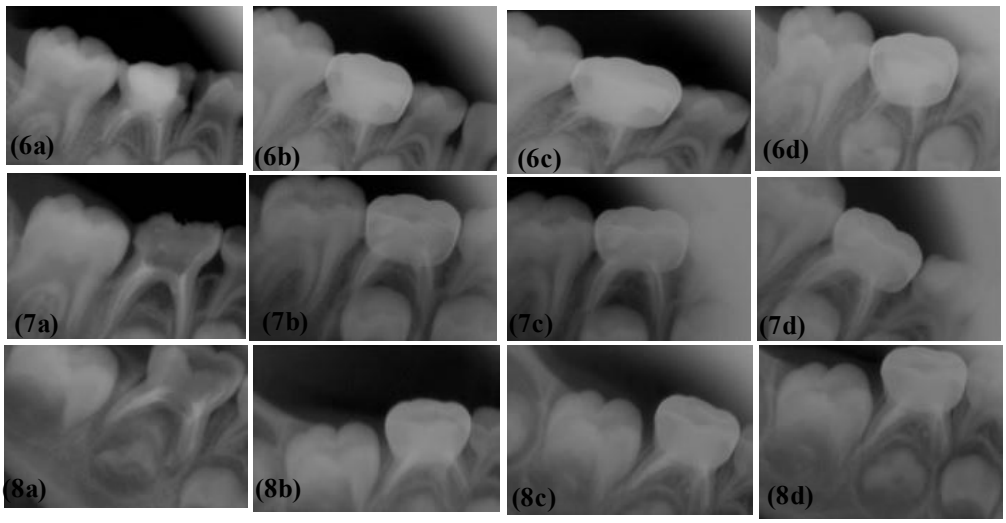

Fig-6 Endodontic Pressure syringeand Endoflas ,Fig-7 Pastinjectand Endoflas ,Fig-8 NaviTipand Endoflas with a,b,c,d as immediate,3,6,9months follow up respectively