

Clinical Evaluation of Retention of Hydrophilic and Hydrophobic Pit and Fissure Sealants in Permanent First Molars: An 18 Months Follow-up: Randomized Controlled Trial

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ABSTRACT

Introduction: Deep pits and fissures are more prone to caries development due to their complex morphological anatomy. Preventive measures, such as pit and fissure sealants, can help in the reduction of dental caries. Conventional sealants being hydrophobic in nature, require isolation. Sealants which are hydrophilic have been introduced as an alternative where isolation is difficult to achieve.

Aim: To compare and evaluate the retention and marginal integrity of hydrophilic pit and fissure sealant (Embrace WetBond) with hydrophobic pit and fissure sealant (Clinpro) in permanent first molars.

Materials and methods: Sealants were applied randomly using the split-mouth design technique on 80 permanent first molars in children aged between 6 and 9 years and evaluation was done at 3, 6, 9, and 18 months.

Results: The difference in retention rates between the groups was not significant using the Chi-squared test, though the WetBond group exhibited better results with 40% complete retention at the end of 18 months while in the Clinpro group, it was 37.50%. The marginal integrity in both the sealant groups was also found to be statistically insignificant. Caries incidence was found to be slightly higher in the Clinpro group.

Conclusion: The clinical performance of Embrace WetBond was better when compared to Clinpro because of its moisture-tolerance capacity. Embrace Wetbond pit and fissure sealant can be the choice of material in cases where moisture control is a challenging issue.

Keywords: Clinpro, Embrace WetBond, Permanent first molars, Pits and fissure sealants.

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INTRODUCTION

The occurrence of caries influences eating, sleeping, work, and social roles. Recurrences of these impacts constitute a silent epidemic in one's life.¹ Deep pits and fissures are particularly more prone to caries and account for 90% of occlusal caries experienced by children and adolescents.² Complex anatomical morphology of pits and fissures make them highly susceptible sites for the development of occlusal caries due to the retention of food remnants and bacteria.³ Application of fissure sealant is effective for preventing caries initiation and progress.⁴

Simonsen stated that pit and fissure sealants, when applied to the occlusal pits and fissures of susceptible teeth, form a micromechanically bonded and protective layer preventing bacteria and food particles from getting entrapped into the fissures and thus prevent caries initiation.⁵ They can be placed in newly erupted permanent molars as these teeth being less mineralized are more prone to acid attack.^{6,7} The contact of a distal marginal ridge of the newly erupted tooth with gingiva leads to the salivary contamination of the occlusal surface thus making sealant placement difficult.^{7,8} Microspores produced during acid etching may get partially occluded by salivary contamination even within one second which can further prevent the ideal resin tags formation, thus leading to sealant retention failure.^{8,9} Traditional pit and fissure sealants based on bisphenol A-glycidyl methacrylate (bis-GMA) are hydrophobic in nature and cannot be retained in the presence of moisture which makes the isolation mandatory and thus require a dry field. The most common cause for the loss of retention of

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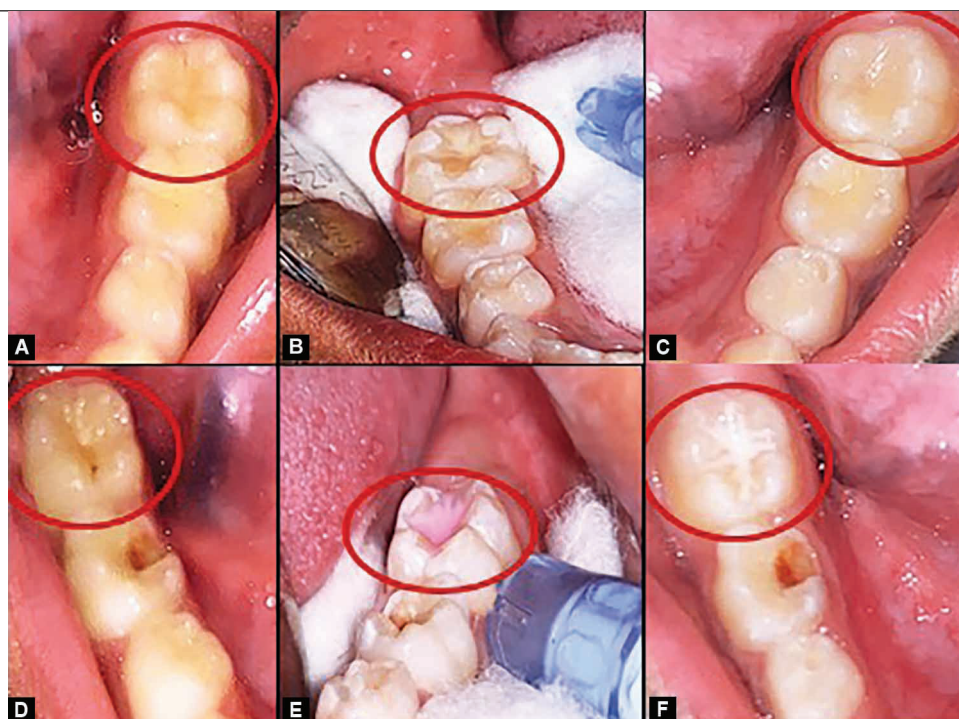
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sealants is salivary contamination. As it is extremely difficult to achieve isolation with erupting teeth, maintaining isolation in children is challenging, which is an important consideration for success in preventive treatment.^{4,10} Recently, a hydrophilic sealant, Embrace WetBond is introduced which is a moisture-resistant resin sealant and does not have bisphenol A or bis-GMA. Di-, tri-, and multifunctional acrylate monomers are present in advanced acid-integrating chemistry which is activated in presence of moisture. It has advantages like better retention, increased fluoride release, and ease of use in uncooperative children.^{11,12} Thus, the study was undertaken to evaluate and compare retention and marginal integrity between moisture-resistant resin and



Figs 1A to F: Showing procedures of Embrace WetBond and Clinpro Pit and fissure sealants

conventional resin-based sealants in permanent molars of young children for a period of 18 months.

MATERIALS AND METHODS

The present randomized controlled split-mouth study was carried out according to the Declaration of Helsinki in the Department of Pediatric and Preventive Dentistry, Maharishi Markandeshwar College of Dental Sciences and Research, Ambala, Haryana, India on 80 permanent first molars in children aged between 6 and 9 years. Ethical approval of the Institutional Ethical Committee (IEC-1438) (CTRI/2019/08/020737) and informed written consent was obtained from parents/guardian. Children with good general health having one pair of bilateral maxillary or mandibular noncarious permanent first molars without any history of any preventive dental treatment from the last 6 months on the respective teeth, with a high risk of developing caries as per the American Academy of Pediatric Dentistry criteria were included. Teeth selected with the International Caries Detection and Assessment System (ICDAS) score of 0 were divided into 2 groups.

In both groups, the occlusal surfaces of molars were cleaned with a blunt probe—washed and dried with a three-in-one syringe. They were then etched with 37% phosphoric acid for 15 seconds. In the study group (group I) the surfaces were then lightly dried with a cotton pellet, leaving the surface slightly moist and glossy. Embrace WetBond was applied to pits and fissures and light cured for 20 seconds. In the control group (group II), the surfaces are dried thoroughly and Clinpro was applied to the pits and fissures and light cured for 20 seconds under proper isolation. After polymerization, the color of the Clinpro sealant changed from pink to opaque off-white. (Fig. 1) Clinical evaluation with recalls at intervals of 3, 6, 9, and 18 months (Fig. 2) for assessment of sealant retention, and marginal integrity was done using the modified United States Public Health Service (USPHS) Ryge criteria (Table 1) and caries

assessment was carried out using the ICDAS criteria for teeth with sealants (Table 2).

Statistical Analysis

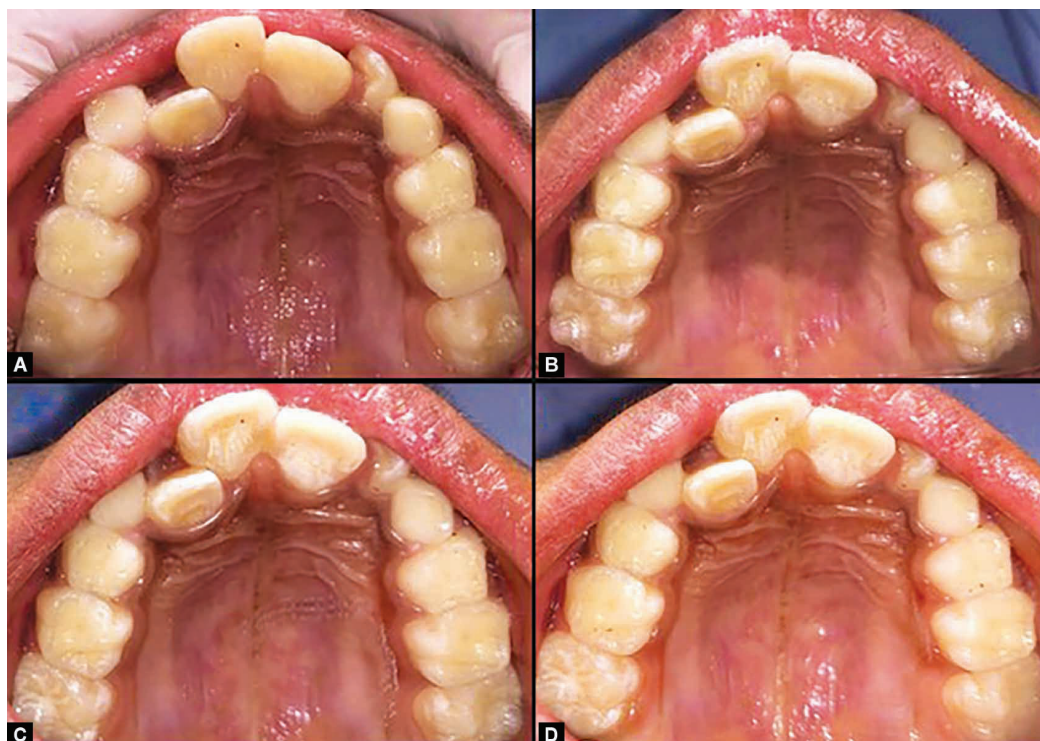
Tabulated data were subjected to statistical analysis using Chi-square and Mann–Whitney *U* test using SPSS version 17.

RESULTS

The obtained data were statistically analyzed and the results were drawn.

At 3 months, in the WetBond group, the retention scores were—Alpha 87.50%, Bravo 10.00%, and Charlie 2.50%, whereas, in the Clinpro group, the scores were Alpha 82.50%, Bravo 10.00%, and Charlie 7.50% with *p*-value being 0.589. At 6 months, in the WetBond group, the retention scores were Alpha 80%, Bravo 12.50%, and Charlie 7.50%, whereas, in the Clinpro group, the scores were Alpha 75%, Bravo 17.50%, and Charlie 7.50% with *p*-value = 0.820. At 9 months, in the WetBond group, the retention scores were Alpha 75%, Bravo 17.50%, and Charlie 7.50%, whereas, in the Clinpro group, the scores were Alpha 62.50%, Bravo 27.50%, and Charlie 10% with 0.476 being the *p*-value. At 18 months, in the WetBond group, the retention scores were Alpha 40%, Bravo 40%, and Charlie 20%, whereas, in the Clinpro group, the scores were Alpha 37.50%, Bravo 42.50%, and Charlie 20% with 0.969 being the *p*-value. No statistically significant difference in retention between the groups was observed at 3, 6, 9, and 18 months (Table 3 and Fig. 3), though Embrace WetBond showed better results.

In terms of marginal integrity, at 3 months in the WetBond group, the scores were Alpha 87.50%, Bravo 10.00%, and Charlie 2.50%, whereas, in the Clinpro group, the scores were Alpha 82.50%, Bravo 10.00%, and Charlie 7.50%. This difference in marginal integrity between the two groups was not statistically significant (*p*-value = 0.589). At 6 months, in the WetBond group,



Figs 2A to D: Showing follow-up visit of Embrace WetBond and Clinpro Pit and fissure sealants

Table 1: Modified Ryge criteria for detection of retention and marginal integrity

Category	Scale	Criteria
Retention	Alpha	Present
	Bravo	Partial loss but clinically acceptable
	Charlie	Clinically unacceptable partial loss or absent
Color match	Alpha	No mismatch to the adjacent tooth structure
	Bravo	Slight mismatch but clinically acceptable
	Charlie	Esthetically unacceptable mismatch
Marginal discoloration	Alpha	No discoloration on the margin
	Bravo	Superficial discoloration on the margin
	Charlie	Deep discoloration penetrated in a pulpal direction
Secondary caries	Alpha	Caries absent
	Bravo	Caries present
Wear (Anatomic form)	Alpha	Anatomy resembles original restoration
	Bravo	Anatomy shows change in contour but not requiring placement
	Charlie	Excessive wear with dentin exposure requiring replacement
Marginal adaptation	Alpha	Continuity at the margin (no ledge or ditch)
	Bravo	Slight discontinuity detectable with explorer but not requiring replacement
	Charlie	Marginal ledge or crevice requiring replacement
Postoperative sensitivity	Alpha	Absent
	Bravo	Present

Table 2: Caries assessment (ICDAS) on follow-up for teeth with sealants

0	Sound tooth surface with restoration or sealant
1	First visual change on enamel
2	Distinct visual change in enamel/dentin adjacent to a restoration/sealant margin
3	Cariou defects of < 0.5 mm with the signs of code 2
4	Marginal caries in enamel/dentin/cementum adjacent to restoration/sealant with underlying dark shadow from dentin
5	Distinct cavity adjacent to restoration/sealant
6	Extensive distinct cavity with visible dentin

the marginal integrity scores were Alpha 80%, Bravo 12.50%, and Charlie 7.50%, whereas, in the Clinpro group, the scores were Alpha 75%, Bravo 17.50%, and Charlie 7.50%. No statistically significant difference in scores between the two groups was observed (p -value = 0.820). At 9 months, in the WetBond group, the marginal integrity scores were Alpha 75%, Bravo 17.50%, and Charlie 7.50%, whereas, in the Clinpro group, the scores were Alpha 62.50%, Bravo 27.50%, and Charlie 10% (p -value = 0.476). At 18 months, the WetBond group scored Alpha 42.50%, Bravo 37.50%, and Charlie 20%, whereas, the Clinpro group scored Alpha 37.50%, Bravo 42.50%, and Charlie 20%. This difference

Table 3: Comparison of retention between groups at different time intervals

		Group I WetBond		Group II Clinpro		p-value
		N	%	N	%	
3 months	Alpha	35	87.50%	33	82.50%	0.589 [#]
	Bravo	4	10.00%	4	10.00%	
	Charlie	1	2.50%	3	7.50%	
6 months	Alpha	32	80.00%	30	75.00%	0.820 [#]
	Bravo	5	12.50%	7	17.50%	
	Charlie	3	7.50%	3	7.50%	
9 months	Alpha	30	75.00%	25	62.50%	0.476 [#]
	Bravo	7	17.50%	11	27.50%	
	Charlie	3	7.50%	4	10.00%	
18 months	Alpha	16	40.00%	15	37.50%	0.969
	Bravo	16	40.00%	17	42.50%	
	Charlie	8	20.00%	8	20.00%	
Total		40	100.00%	40	100.00%	

[#] Denotes statistically not significant using Mann–Whitney U test

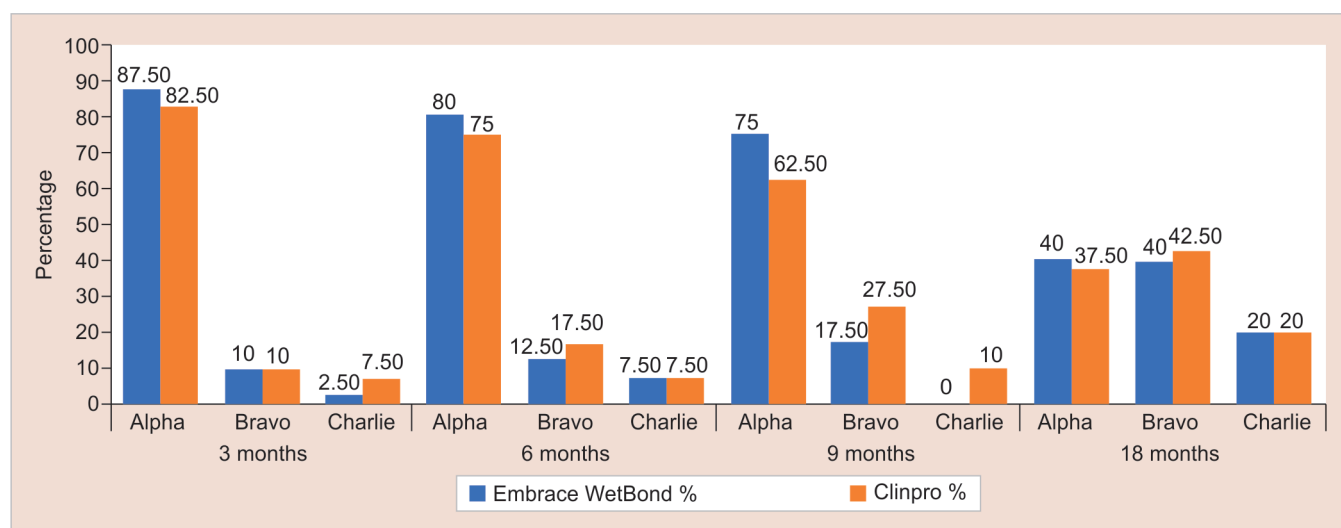


Fig. 3: Comparison of retention between groups at different time intervals

in marginal integrity between the two groups was found to be statistically not significant (Table 4 and Fig. 4).

In terms of caries incidence, at 3 months, in the WetBond group, ICDAS codes were score 0—97.50%, score 1—2.50%, and score 2—0%, whereas, in the Clinpro group, the codes were score 0—95%, score 1—2.5%, and score 2—2.50%. The difference in caries incidence between groups was observed to be statistically insignificant (p -value = 0.603). At 6 months, in the WetBond group, ICDAS scores were score 0—95%, score 1—5%, and score 2—0%, whereas, in the Clinpro group the scores were score 0—92.5%, score 1—5%, and score 2—2.50%. No statistically significant difference was observed between groups (p -value = 0.603). At 9 months, in the WetBond group, the caries incidence using ICDAS codes were score 0—95%, score 1—5%, and score 2—0%, whereas, in the Clinpro group the scores were score 0—85.00%, score 1—12.50%, and score 2—2.50% with p -value = 0.269. At 18 months, in the Wetbond group, caries incidence had score 0—80%, score 1—15%, and score 2—5%, whereas in the Clinpro group the scores were score 0—65.00%, score 1—30%, and

score 2—5%. This difference in caries incidence between groups was not statistically significant (Table 5 and Fig. 5).

DISCUSSION

The pits and fissures on the occlusal surfaces are narrow and tortuous which makes salivary access to these areas difficult, thus minimizing fluoride deposition and remineralization and making them more prone to caries.^{13,14} Since the newly erupted teeth are less mineralized, they are more prone to acid attack and the development of occlusal caries.¹⁵ Preventive resin restorations and pit and fissure sealants should be considered for all the erupting permanent teeth in high-risk patients.

Conventional pit and fissure sealants have superior wear resistance but due to their hydrophobic nature, they are clinically technique sensitive. So the enamel surface should be clean, dry, and etched.^{16,17} If the pit and fissure are contaminated by saliva, sealants show increased microleakage with decreased bond strength.¹⁸ Clinpro is an unfilled, bis-GMA-containing sealant. It is a

Table 4: Comparison of marginal integrity between groups at different time intervals

		Group I WetBond		Group II Clinpro		p-value
		N	%	N	%	
3 months	Alpha	35	87.50%	33	82.50%	0.589 [#]
	Bravo	4	10.00%	4	10.00%	
	Charlie	1	2.50%	3	7.50%	
6 months	Alpha	32	80.00%	30	75.00%	0.820 [#]
	Bravo	5	12.50%	7	17.50%	
	Charlie	3	7.50%	3	7.50%	
9 months	Alpha	30	75.00%	25	62.50%	0.476 [#]
	Bravo	7	17.50%	11	27.50%	
	Charlie	3	7.50%	4	10.00%	
18 months	Alpha	17	42.50%	15	37.50%	0.882
	Bravo	15	37.50%	17	42.50%	
	Charlie	8	20.00%	8	20.00%	
Total		40	100.00%	40	100.00%	

[#] Denotes statistically not significant using Mann-Whitney U test

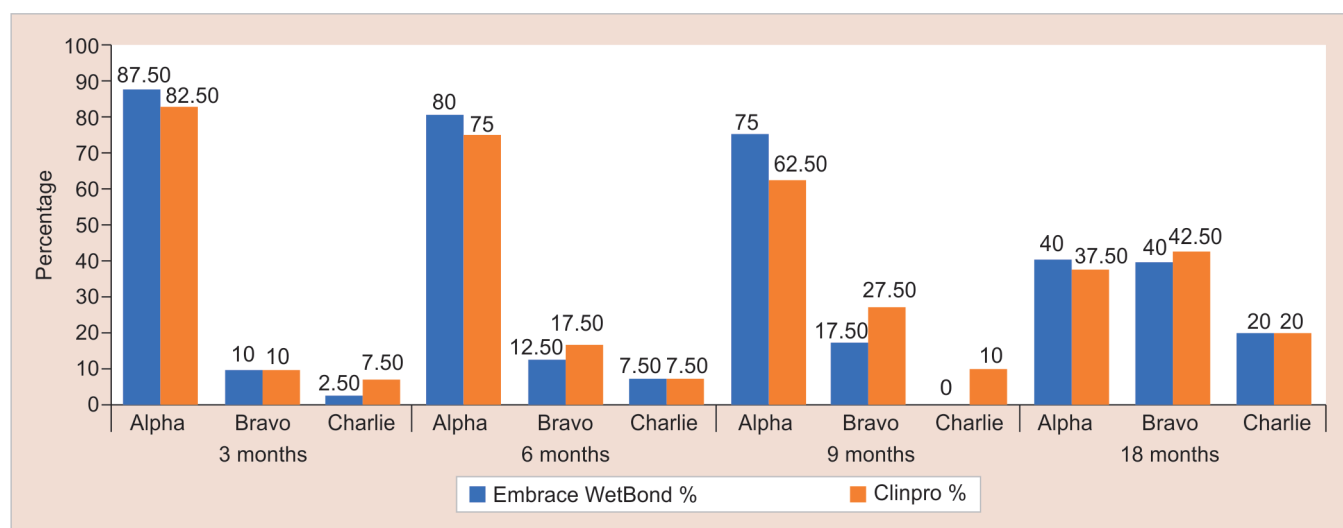


Fig. 4: Comparison of marginal integrity between groups at different time intervals

visible light cure and fluoride-releasing pink sealant, which changes to white colour after polymerization. It has superior wear resistance with better retention as compared to filled sealants.¹⁹

A hydrophilic pit and fissure sealant Embrace WetBond was launched by Pulpdent in 2002.¹¹ It contains 36.6% filler particles. It consists of di-, tri-, and multifunctional-acrylate monomers in an acid integrating network which is activated by moisture and uses moisture-tolerant chemistry.^{11,20,21} Presence of these monomers decreases the viscosity of the sealant.²² It is fluoride-releasing and chemically bonds to the tooth structure.^{22,23} The uncured material has an acidic pH which when placed in the presence of moisture, spreads over the enamel surface.²¹ Thus, a bonding agent is not required. On contrary, hydrophobic sealants do not bond on wet surfaces. The material has neutral pH and physicochemical properties after light curing is the same as that of conventional sealants.²⁴ Embrace WetBond does not contain bis-GMA and is therefore free of its potential toxicity.²¹

The results of the present study demonstrated no statistically significant difference between the retention of the two sealant

groups, though the Embrace WetBond group (40%) was found to be superior to the Clinpro group (37.50%) at the end of 12 months (Table 3 and Fig. 3). The high retention rates in the Embrace WetBond group were probably due to the low viscosity and excellent wetting properties of the material.²⁵ Kane et al.²⁶, in an *in vitro* study, reported Embrace WetBond has superior adaptation and penetration than Clinpro sealant. They found polymerization could play an important role in sealant adaptation to enamel surface and Embrace WetBond sealant showed less polymerization shrinkage. Similar findings were observed by Bhat et al. and Baheti et al. who reported superior retention rates of Embrace WetBond when compared to Clinpro at a 12-month interval.^{19,27} In contrast, Schlueter et al. reported inferior retention in the hydrophilic Embrace WetBond sealant (27%) when compared to a hydrophobic Heliobond resin-based sealant (93%).²⁸ They assumed that water sorption by Embrace WetBond sealant increased solubility thereby leading to a higher risk of disintegration.²⁸ Although in our study, the filler-contained sealant Embrace WetBond showed better performance in retention which could be due to the presence of di-, tri-, and multifunctional-acrylate

Table 5: Comparison of caries incidence (ICDAS score) between groups at different time intervals

	ICDAS Score	Group I WetBond		Group II Clinpro		p-value
		N	%	N	%	
3 months	0	39	97.50%	38	95.00%	0.603 [#]
	1	1	2.50%	1	2.50%	
	2	0	0.00%	1	2.50%	
6 months	0	38	95.00%	37	92.50%	0.603 [#]
	1	2	5.00%	2	5.00%	
	2	0	0.00%	1	2.50%	
9 months	0	38	95.00%	34	85.00%	0.268 [#]
	1	2	5.00%	5	12.50%	
	2	0	0.00%	1	2.50%	
18 months	0	32	80.0%	26	65.0%	0.270
	1	6	15.0%	12	30.0%	
	2	2	5.0%	2	5.0%	
Total		40	100.00%	40	100.00%	

[#]Denotes statistically not significant using Mann-Whitney U test

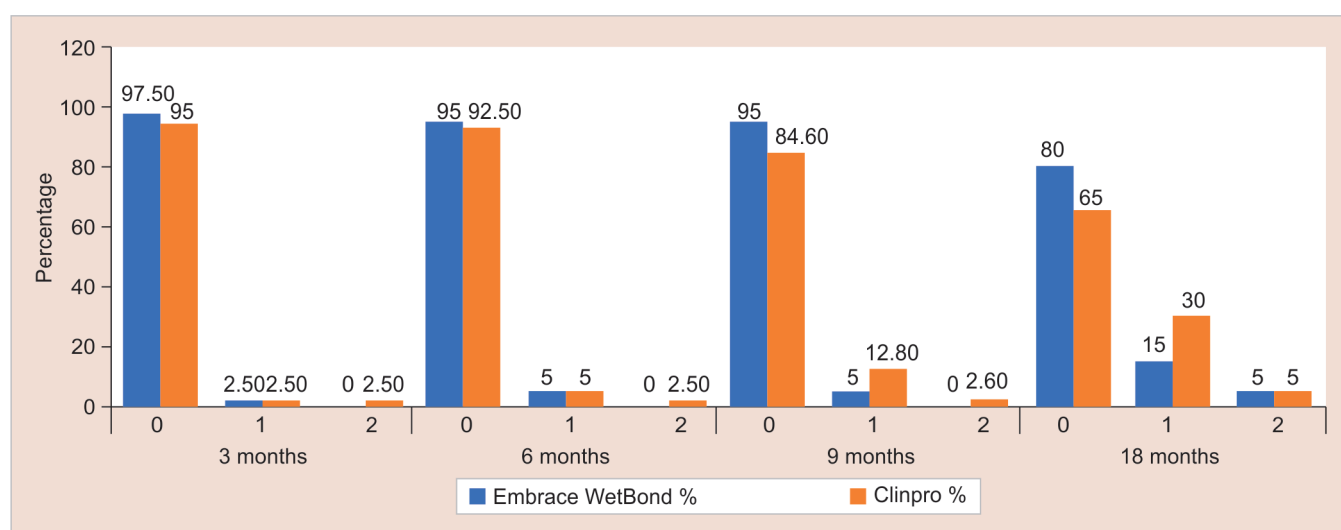


Fig. 5: Comparison of ICDAS score between groups at different time intervals

monomers decreasing the viscosity of the sealant, hence increasing the sealant penetration.^{21,22}

In the current study, the 18 months clinical follow-up showed that marginal integrity in the Embrace WetBond group (42.50%) was superior to the Clinpro group (37.50%) (Table 4 and Fig. 4). As stated by Baheti et al., low viscosity and deeper resin tags in Embrace WetBond leads to good marginal adaptation and also access the deeper grooves compared to bis-GMA sealants.²⁷ However, there was no significant difference observed between the two groups in our study. Kane et al. reported consistently more intimate marginal adaptation with Embrace WetBond as compared with that of Clinpro.²⁶ The study concluded that the poor resin adaptation may occur most probably due to lack of enamel conditioning, air entrapment, or polymerization shrinkage.²⁶

According to Azarpazhooh et al., sealants placement within 4 years after eruption proved beneficial.²⁹ Effectiveness of sealant as a caries preventive agent is dependent upon its retention and marginal integrity. A break in the marginal integrity can represent areas for higher retention of plaque, resulting in the development of caries.³⁰

In the current study, caries incidence was higher in the Clinpro group, where 30% of teeth scored 1 according to ICDAS criteria and 5% of teeth scored 2 while in the Embrace WetBond group, 15% of teeth scored 1 and only 5% of teeth scored 2 at the end of 18 months (Table 5 and Fig. 5). The reason for the low occurrence of caries incidence in the Embrace WetBond group could possibly be due to the higher retention rates and good marginal seal of the material. On contrary, Mohanraj et al. reported higher caries incidence in the Embrace WetBond group and mentioned the presence of higher filler content of Embrace WetBond sealant could be attributed. Filled resins, produce rough surfaces and margins contributing to plaque retention and thus caries development.³¹ Naorungroj et al. in an *in vitro* study observed long-lasting antibacterial activity with Embrace WetBond sealant when in solution, especially against *Streptococcus mutans*.³² Sealant retention was evaluated at intervals over 1 year, using Simonsen's criteria (Subramaniam et al.²³). They showed caries occurrence was low in these teeth. This can be due to the retention of small particles of material attached to the enamel of occlusal fissures even when the material appears clinically totally lost.

Thus, in the present study, Embrace WetBond and Clinpro pit and fissure sealants on 18-month follow-up did not show any statistically significant differences in terms of retention and marginal integrity. Caries incidence was also found to be statistically insignificant. Therefore, both the sealant materials showed acceptable clinical performance after 18 months. However, Embrace WetBond was slightly better than Clinpro when compared for total retention and marginal integrity.

CONCLUSION

Embrace WetBond can be used as a suitable alternative to Clinpro sealant for sealing the pits and fissures of permanent first molars, especially in uncooperative children when it is difficult to maintain isolation and it is highly beneficial in newly erupted teeth when the risk of caries is highest.

Clinical Significance

Pit and fissure sealants should be applied to all the erupting permanent molars, especially in high-risk patients. Hydrophilic sealants are preferred in patients where isolation is a problem.

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