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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF FIBRE REINFORCED COMPOSITE RESIN OVER CONVENTIONAL BAND AND LOOP FOR SPACE MAINTENANCE IN CHILDREN

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Fibrereinforcedcompositeresin[FRCR], Bandandloop[BL], Spacemaintenance[SM], WongBakerFacesscale,Patientacceptance, Esthetics, Bondedspacemaintainers

Abstract

Aim: TocomparetheclinicalsuccessrateofFiberReinforcedCompositeResinspacemaintainerwiththatofConventionalBandandLoopspacemaintainerinchildrenofagegroup6-8years.
Methodology: Atotalof60subjects(31girlsand29boys)ofagegroup6to8yearsrequiringspacemaintenanceduetoprematurelossofprimarymolars.ChildrenwhoreceivedFibreReinforcedCompositeResinandBandandLoopspacemaintainerswerecategorizedasGroup1andGroup2respectively.Subjectswererecalledattheendof1st,3rd,and6thmonthsforevaluationofbothtypesofspacemaintainerswhenclinicalsuccessrateofbothtypesofspacemaintainerswereevaluated.Treatmentacceptabilityduringandaftertheprocedurewascheckedusingsix-pointWong-BakerFacesScale.
StatisticalAnalysis: Thestatisticalanalysiswasperformedbyusingastatisticalsoftwarepackage SPSS version 25 statistical software. Quantitativevariableswereexpressedasmeanandstandarddeviation.Comparisonofquantitativevariablesbetweenthetwogroupswereanalyzedbyunpaired‘t’test.Qualitativevariableswereexpressedasfrequencyandproportion.Comparisonofqualitativevariablesbetweentwogroupswereanalyzedbychi-squaretest.A‘p’valuelessthan0.05wasconsideredasstatisticallysignificant
Results: ThisstudycomparedthesuccessratesofSixty spaceMaintainers;BandandloopandFRCRsin30childreninthe Department of Pediatric Dentistry at Government Dental College, Thiruvananthapuram. 60 spacemaintainerswereevaluatedattheendof6months,30bandandloopspacemaintainerswereevaluated,6failedand24weresuccessful.Outof30FRCRspacemaintainers,5failedand25wereconsideredsuccessful.Theclinicalsuccessratewasfoundtobe83.3%forFRCRand81.7%forbandandloop.Thedifferences,however,werenotstatisticallysignificant(P>.05).
Conclusion: Althoughstatisticallynosignificantdifferenceinsuccessratesbetweenthesetwotypesofspacemaintainers,FibreReinforcedCompositeResinspacemaintainerhadslightedgeoverBandandloopspacemaintainerintermsofclinicalefficiency.Patientacceptancetowardsthemwerealsofound FRCRspacemaintainerswasfoundtobeslightlybetterthantothatofbandandloopspacemaintainers.Onasubjectiveopinionmanyofthesubjectspraisedtheestheticquality of FRCR. Theevidenceobtainedsuggeststhat FRCR isasuitablealternativetoBandandLoopforshorttermspacemaintenanceinyoungchildren.

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Introduction:-

Primarydentitionplaysavitalroleinthegrowthanddevelopmentofthechild.Itaidsinspeech,mastication,appearance,prevention ofdeleteriousoralhabits,andguidingpermanentteethduringaneruption[1].

Thelossofaprimarytoothbeforethetimeofitsnaturalexfoliationisknownasearlyorprematurelossandisapublichealthproblem.[2]Whenaprimarymolartoothislostprematurely,theteethbothmesialanddistaltothespacetendtodriftorbeforcedintoit[3]and mayreducethearchlengthrequiredforthesucceedingtooth,andpredisposescrowding,rotation,andimpactionofthepermanentteeth[4],formationofcrossbites,differencesinthemedianlineofteeth,andsupra-eruptionoftheantagonisticteeth.Itisalsoreportedtohaveanegativeimpactonchildren'squalityoflifeandemotionalwell-being.[5]

Bandandloop,oneofthemostfrequentlyusedappliancesisacantilevertypeoffixedspacemaintainerthatconsistsofabandcemented commonlytothetoothposteriortotheedentulousspaceandaloopofwireacrosstheedentulousspaceabuttingtheanterior toothhasbeenusedsincelongasaspacemaintainerwithhighsuccessrates.But,inspiteofgoodpatientcompliance;disintegration ofcement,solderfailure,cariesformation,inabilitytopreventrotationandtippingmovementofabutmentteeth,atendencyto getembeddedingingivaltissues,cariesformationalongthemarginsoftheband,theneedforacastormodel,theneedforasecond visit,increasedchairsideandlongconstructiontimearesomeofthedisadvantagesassociatedwiththem.[6]

Fiber-reinforcedcompositeresinshavebeendevelopedfordentaluse,theirapplicationinpediatricdentalpracticeisstilllimited.The variousadvantagesofthismaterialincludeitseaseofadhesiontodentalcontours,fasttechniqueofapplicationandgoodstrength.[11,15,7]Hence,FRCRcouldbeanalternativetotheconventionalandcommonlyusedband-and-loopspacemaintainer.[8]

Hence,theaimofthepresentstudywastoevaluatefiberreinforcedcompositeresinasaspacemaintainerandtocompareitsefficacywiththatoftheconventionalband-and-loopspacemaintainer.

Aim:-

TocomparetheclinicalsuccessrateofFiberReinforcedCompositeResinspacemaintainerwiththatofConventionalBandand Loopspacemaintainerinchildrenofagegroup6-8years.

Objectives:-

Primary

1. Tocompareclinicalsuccessratesoftwospacemaintainers;FiberReinforcedCompositeResin(FRCR)spacemaintainerstoconventionalbandandloopSpacemaintainersinchildrenofagegroup6to8yearsattendingtertiaryhealthcaresetting.
2. SECONDARY
3. TocomparethepatientacceptanceofFiberReinforcedCompositeResin(FRCR)spacemaintainerstoConventionalBandandloopSpaceMaintainerusingWongBakerFACESScale**.**

Methodology:-

Study Design

The present study was hospital-based, prospective observational study.

Study Setting

Tertiary dental health care setting (Government Dental College, Thiruvananthapuram)

Study Participants

Children who reported to the outpatient wing, Department of Pedodontics and Preventive Dentistry, Government Dental College, Thiruvananthapuram in the age group of 6-8 years with mandibular primary molars requiring space maintenance and satisfying the inclusion criteria as given below, were selected for the study.

Verbal assent of children above 7 years and written consent of parents participating in the study were obtained.

The principal investigator observed and recorded the study procedure done routinely in the Department.

Inclusion Criteria
Patients who required space maintenance were grouped into two categories according to the type of space maintainer planned.
Group 1: Children who received Fibre Reinforced Composite Resin space maintainer
Group 2: Children who received Band and Loop space maintainer

A. Clinical criteria
1. Premature loss of primary first molar in the mandibular quadrants.
2. Sound and healthy abutment teeth.
3. Presence of Angle's Class I molar relationship and/or presence of flush terminal primary molar relationship.
4. 6 to 8-year-old patients for whom either FRCR or Band and Loop space maintainer was indicated.

B. Radiographic criteria
1. Absence of periapical pathology.
2. Presence of succedaneous tooth bud.
3. Presence of more than 1 mm bone overlying the succedaneous tooth germ and/or only less than one-third of the root of the permanent tooth had formed.

Exclusion Criteria
1. Absence of teeth on mesial and/or distal side of edentulous area.
2. Presence of abnormal occlusal relationship such as cross bite, open bite, and deep bite.
3. Children with Frankl behaviour rating of 1 and 2.
4. Consent not obtained for the study/procedure.

Sampling
In this study, the sample size was rounded off to 30 in each group which made a total of 60 subjects by Consecutive samplingtechnique.Verbal assent of children above 7 years and written consent of their parents in the study were obtained.Children who received Fibre Reinforced Composite Resin and Band and Loop space maintainers were categorized as Group 1 and Group 2 respectively.

Technique for construction of FRCR space maintainer
The distance from the mesiobuccal line angle of the mandibular primary canine to the distobuccal line angle of mandibular second primary molar was measured to determine the adequate length of Ribbond fiber required. After administration of adequate topical anesthesia and application of rubber dam, the abutment tooth (second primary molar) was cleaned and air dried.Adhesive was applied and light cured for 20 seconds. A thin layer of composite was applied to the buccal and lingual surfaces of abutment tooth and required length of Ribbond fiber was placed on this composite, extending from the buccal aspect of the primary second molar to primary canine and a loop was formed touching the primary canine and the end was adapted to the lingual surface of primary second molar.

The ends of the fiber were be adapted to tooth surface with a plastic filling instrument. Preliminary curing for 40 seconds was done individually at each end of the fiber framework. An additional layer of flowable composite was applied over the area where the fiber abutted the tooth surface and light cured for 40 seconds. Any uncovered fiber was further covered with flowable composite. The space maintainer was checked for gingival clearance and occlusal interference. Finishing was done using composite finishing burs. Finally, bonding agent was applied over the fiber frame and light cured at multiple points for the purpose of reactivation.

Technique for construction of band and loop space maintainer
Conventional band and loop space maintainer was given as per the technique described by Graber and Finn. It was cemented using luting glass ionomer cement (type I) mixed according to manufacturer's instructions. Excess cement in the interdental region was removed with floss. Both the space maintainers were checked for gingival clearance and occlusal interference.

Instructions on oral hygiene and appliance maintenance were given to both children and parents. They were instructed to return if the appliance is dislodged, or fractured.

Outcome Measurement:-

All the patients were recalled at the end of 1st, 3rd, and 6th months for evaluation of both types of space maintainers. Treatment acceptability during and after the procedure was checked using six-point Wong- Baker Faces Scale.

outcome variables

Clinical success rate of both types of space maintainers were evaluated by the following criteria at the end of 1st, 3rd, and 6th months.

Group I (FRCR) was evaluated for;

Debonding of enamel-composite
Debonding of fiber-composite
Fracture of fiber-frame
Visible Caries

Group II (Band and Loop) was evaluated for;

Cement loss
Dislodgement of band
Fracture of loop
Visible Caries

Patient acceptability towards the treatment was checked with the help of Wong-Bakers Faces Scale.When any of the above-mentioned criteria was observed in the groups under study, the space maintainer was deemed a failure and were refabricated or alternatives were used.

Plan Of Analysis

1. Quantitative variables were expressed as mean and standard deviation.
2. Comparison of quantitative variables between the two groups were analyzed by unpaired t test.
3. Qualitative variables were expressed as frequency and proportion.
4. Comparison of qualitative variables between two groups were analyzed by chi-square test.
5. Data were entered and analyzed using SPSS version 25 statistical software.
6. A ‘p’ value less than 0.05 was considered as statistically significant.

Duration Of Study

The study was conducted for a duration of 18 months, 1st to 12th months for the procedure including data collection and 12th to 18th months for analysis and generation of report.

Ethical Considerations

IEC clearance obtained from Government Dental College Institutional Ethics Committee IEC (IEC/E/24/2020/GDCT dated 19.12.2020).

Figure 1:- Band and Loop space maintainer.

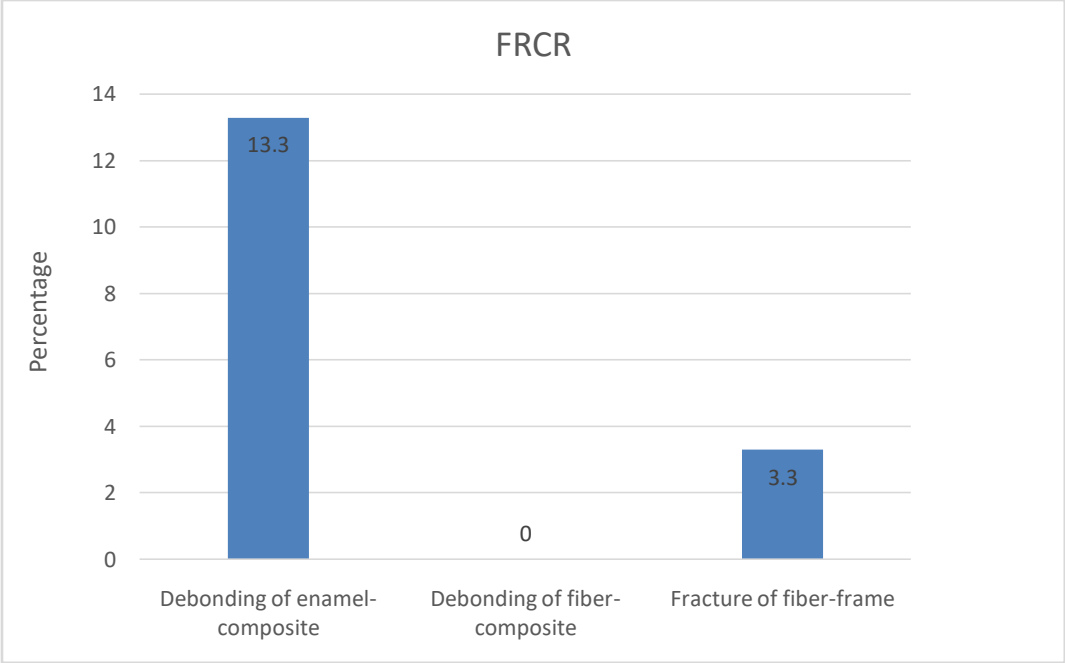
Figure 2:- FRCR space maintainer.

Figure 3:- Post-operative: FRCR SM.

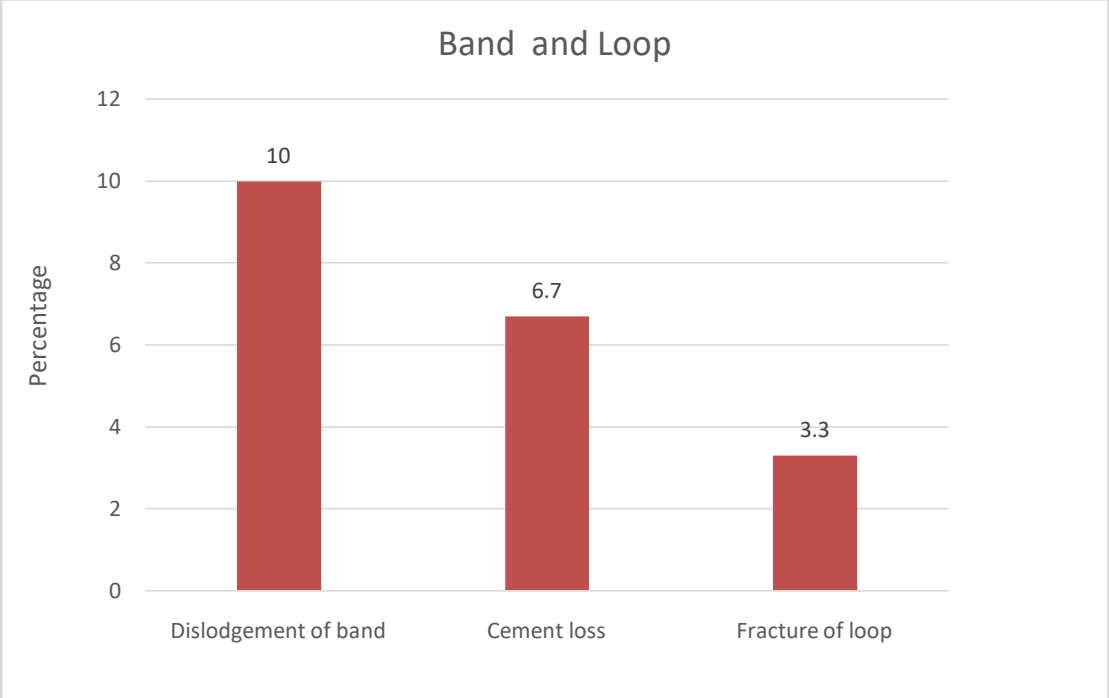
Results:-

Evaluationattheendof1st month,3.33%casesofbandandloopfailedbecauseofbanddislodgement,6.66%ofcasesinFRCRgroupfailedbecauseofdebondingofenamel-compositeinterface.Atthe3rdmonth,86.6%successwasobservedwithFRCRspacemaintainers.The13.3%failurewasduetodebondingattheenamel-compositeinterfaceand3.33%duetofractureofthefiberframe.90%successwasobservedintheband-and-loopspacemaintainergroup6.66%showedbanddislodgementand3.33%showedcementloss.Atthe6thmonth,83.3%successwasobservedwiththeFRCRspacemaintainer.Failureswereduetodebondingattheenamel–compositeinterface(13.3%),fractureofthefiberframe(3.33%),andnoincidenceofdebondingatthecomposite–fiberinterface.Theband-and-loopspacemaintainershowed80%success;10%failedduetobanddislodgement,6.66%duetocementlossand3.33%duetofractureofloop.Noincidenceofcarieswasobservedineithergroups.Onanalysis,therewasstatisticallynosignificantdifferenceinsuccessratesbetweenthesetwotypesofspacemaintainers.(P>.05).

Duringtreatment,intheFRCRgroup,8.7%ofsubjectsgaveatleastscorevalue2(hurtlittlebit)inWongbakerfacesscaleand91.3%subjectschosescorevalue0(nohurt).Inthebandandloopgroup,16.8%ofsubjectsgaveatleastscorevalue2(hurtlittlebit)inWongbakerfacesscaleand83.2%subjectschosescorevalue0(nohurt).Inthecurrentstudy,bothFRCRandBandandloopscoredamedianscoreof2(hurtalittlebit)duringtreatmentandmedianscore0(nohurt)aftertreatmentThedifferences,however,werenotstatisticallysignificant(P>.05).



Graph 1:- Evaluation of FRCR Space Maintainer.



Graph 2:- Evaluation of Band and Loop Space Maintainer.

Table 1:- Evaluation of FRCR and Band and Loop on basis of caries incidence on abutment tooth.

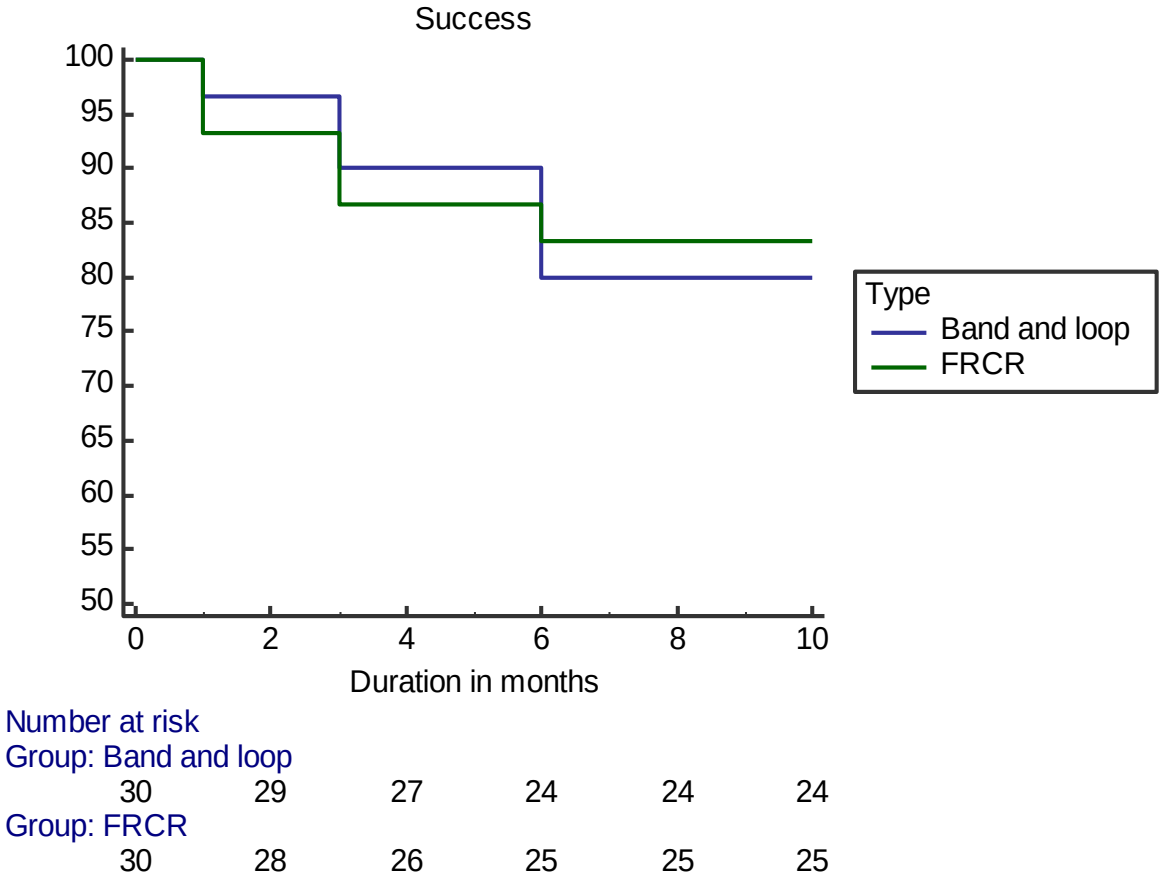
Caries	FRCR		Bandandloop		Total		χ^2	df	p
	N	%	N	%	N	%			
Yes	0	0	0	0	0	0			
No	30	100	30	100	60	100			
Total	30	100	30	100	60	100			

Table 2:- Comparison of Space maintainers based on patient acceptance score during treatment.

	Acceptanceduring-treatmentscore		P
	Median	IQR	
FRCR	2	0-2	0.943
Bandandloop	2	0-2	

Table 3:- Comparison of Space maintainers based on patient acceptance score after treatment.

	Acceptanceaftertreatmentscore		p
	Median	IQR	
FRCR	0	0-0	0.232
Bandandloop	0	0-0	



Graph 3:- Comparison of two groups for cumulative success rate through 6 months of evaluation.

Discussion:-

Theconventional-fixedspacemaintainers,Bandandloopbeingthemostcommonlyusedareeasytofabricate,adaptseasilytothechangingdentitionandiseconomical.Althoughthebandedappliancesarebeingusedsuccessfully,theydohavecertaindisadvantageslikerequirementoftwovisits;therefore,cannotbeplannedinpatientsundergeneralanesthesia,mayleadtotippingorrotationoftheabutmentteeth,occasionally,requiressomepreparationintheabutmentteeth,requirescumbersomelaboratoryprocedures.Asitisacantilevertypeofanappliance,slippingoftheloopgingivallymayresultinimpingementofthesofttissues,plaqueaccumulationattheband-toothinterfacecouldleadtocariouslesionsandgingivalinflammation,haspotentialforallergicreactiontometals.[9,13]

Swaineetal.wasthefirsttousebondedspacemaintainersandreporteda70%successrate.Overthepastfewdecades,adhesivetechnologyisbeingharnessedtoreplacetheconventionalspacemaintainerintheformofdirectbondedspacemaintainers(Ribbond®),Fiber-reinforcedcompositeresinspacemaintainers(SuperSplint®),andprefabricatedspacemaintainers(Splint-In®).[10]Simseketalevaluatedtheclinicalperformanceofsimplefixedspacemaintainersbondedbyusingaflowablecomposite resinfor12to18monthsandtheyconcluded95%successrate.Inthisclinicalstudy,attheendof6months83%weresuccess,47 %successat12monthsand33%successat18months.[11]

Inthepresentstudy,weobservedthat,inthe1stmonthfollow-up,3.33%casesofbandandloopfailedbecauseofbanddislodgement,6.66%ofcasesinFRCRgroupfailedbecauseofofdebonding ofenamel-compositeinterface.Atthe3rdmonth,86.6%successwasobservedwithFRCRspacemaintainers.The13.3%failurewasduetodebondingattheenamel-compositeinterfaceand3.33%failedduetofractureofthefiberframe.90%successwasobservedintheband-and-loopspacemaintainergroup6.66%showedbanddislodgementand3.33%showedcementloss.Atthe6thmonth,83.3%succeswasobservedwiththeFRCRspacemaintainer.Failureswereduetodebondingattheenamel–compositeinterface(13.3%),fractureofthefiberframe(3.33%),andnoincidenceofdebondingatthecomposite–fiberinterface.Theband-and-loopspacemaintainershowed80%success;10%failedduetobanddislodgement,6.66%duetocementlossand3.33%duetofractureofloop.Noincidenceofcarieswasobservedineithergroups.Onanalysis,therewasstatisticallynosignificantdifference insuccessratesbetweenthesetwotypesofspacemaintainers.

ThefailureofFRCRSMduetodebondingofenamel-compositeinterfacecouldbedueto;(a)negativeinfluenceofprismlessenamelonresinretention,[12,7](b)tangentialandcompressiveforcesactingonthehangingfiberbridge,[13](c)transmissionofforcesfromfiberframetobondingmarginsbetweentoothandRibbondoneithersideoftheframework,[14](d)impropersurfacepreparation,(e)disturbancesduringtheadhesivesettingprocessand(f)moisturecontamination.Theaforementionedobservationsmadeby Tuncetal.[14]wereinaccordancewiththestudiesconductedbyZachrissonetal.[15],Soaresetal.[16]Itwasalsoobservedthatthemajorityofdislodgedspacemaintainerswerefoundtobeinthemandiblewhichmaybeattributedtotheexcessiveloadingofmasticatoryforceandmultidimensionalmovements ofthemandible.

Conclusion:-

Thepresentstudywasconductedtocomparetheclinicalsuccessratesoftwospacemaintainersnamely,FiberReinforcedCompositeResin(FRCR)spacemaintainerstoconventionalbandandloopSpacemaintainersinyoungchildren.This study gives evidence to promote a newer alternative to the available varieties of fixed space maintainers, with much ease of fabrication, eliminating impressions and cumbersome laboratory procedures.Loss of space or rotation of the abutment teeth had no influence on the results obtained. Conclusions drawn from a 6-month follow-up cannot determine the long-term success of the space maintainers.

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