RESEARCH ARTICLE

RehabilitationofMaxillaryAnteriorToothSpacing UsingDigitalSmileDesigningwithIPSe.maxLaminateVeneers:ACaseReport

Abstract:

IPSe.max,a lithiumdisilicateglass-ceramic,exhibitsoutstandingestheticandmechanicalproperties,includingsuperiortranslucency,flexuralstrength,and longtermdurability.Thesecharacteristicsrenderitparticularlyadvantageousforconservative,minimallyinvasiverestorationsintheanteriormaxillaryregion, wherebothestheticsandfunctionarecriticallyimportant.Thiscasereportpresentsthecomprehensive prosthodonticmanagementofmaxillaryanteriorspacingwithDigital SmileDesigningsoftwareusingIPSe.maxceramicveneers.The treatmentwasmeticulouslyplannedwiththeaidofDigitalSmileDesigning(DSD),acontemporarytoolthatenhancesdiagnosticaccuracy,facilitatesinterdisciplinarycommunication,andallowsfor precisevisualizationoftheproposedestheticoutcome.Throughthisdigitalworkflow,apatient-specific,predictive,andminimallyinvasiveapproachwasdevelopedtoachieveoptimal diastemaclosurewhilepreservingtheintegrityof naturaltoothstructureandmaintainingharmoniousdentalproportions.Thefinalresultdemonstrated excellentintegrationwithadjacentdentition,superiorestheticoutcomes,andhighpatientsatisfaction .Thiscaseunderscorestheclinical efficacyofcombiningDigitalSmile Designingwithlithiumdisilicateveneersto achieveapredictable,conservative,andesthetically pleasingsolutionforanterior spacing.

[Keywords: Lithium Disilicate, Ceramic Veneers, Digital Smile Design, Spacing Closure, Minimally Invasive Dentistry]

1.Introduction:

Achievingpredictableandlong-lastingoutcomesinestheticdentistryrequiresnotonlytechnicalprecisionbutalsoacomprehensiveunderstandingoftheunderlyingetiologybehinddentalanomalies.Onesuchcommonclinicalchallengeisthepresenceofspacinginthemaxillaryanteriorregion,whichcansignificantlyimpactbothfacialestheticsandpatientconfidence.Theseinterdental spaces whethercongenital,developmental,oracquired-mustbeaddressedthroughasystematic,evidence-basedapproachthatconsidersthebiological,functional,andaestheticaspectsoftreatment.

Anteriortoothspacing,particularlyinthemaxillaryregion,posesauniquechallengeduetoitshighvisibilityanddirectinfluenceonsmile esthetics5.Whetherarisingfromdevelopmental,periodontal,or pathologicalcauses,thesespacesrequireathoroughprosthodonticevaluationandacarefullydesignedrestorativeplan.

Inprosthodontics,theemphasisliesinachievingoptimalestheticintegrationwhilepreservingthehealthandintegrityoftheremaining toothstructure[14,15].Modernprosthodonticsemphasizesnotonlytheclosureofdiastematabutalsotheestablishmentofharmonioustoothproportions,incisalsymmetry,andgingivalarchitecture[14,15].TheintegrationofDigitalSmileDesigning(DSD)intothediagnosticandplanningphaseallowsclinicianstovisualizeandsimulatetheproposedestheticoutcomewithhighaccuracy.DSDfacilitatesenhancedcommunicationbetweenthedentalteamand thepatient,ensuringshareddecisionmakingandgreaterpredictabilityintherestorativeoutcome[8,13].Facialanddentalanalyses,performedthroughdigitalworkflows,aidinaligningrestorationswiththepatient'suniqueestheticparameters,suchassmileline,lipdynamics,andmidlineorientation and proportionsof the faceand the individualtooth.

Softtissuecontourand healthplayavitalroleinenhancingthevisualappealofrestorations.Proceduresaimedatimproving

gingivalarchitecture,suchascrownlengthening,maybenecessaryinselectedcasestoestablishpropertoothproportionsandharmoniousgingival symmetry.In thecontextofminimallyinvasivedentistry,ceramic laminate veneers particularly thosefabricatedfromlithiumdisilicatematerials,suchas IPSe.max-offeranidealsolutionduetotheirsuperioraesthetics,translucency, strength,andabilitytobond reliablytoenamelsubstrates[1,7,9].

Thiscasereportpresentstheprosthodonticmanagementof maxillaryanteriortoothspacingusingIPSe.maxveneers.Ithighlightstheclinicaldecision-makingprocess,materialselection,andexecutionofaminimallyinvasiverestorativeapproachthatresultedinahighlyestheticandfunctionallystableoutcome.

2.CaseReport:

A26-year-old femalereportedtoourinstituteDr.R.Ahmeddentalcollegeandhospital,Kolkataindepartment ofprosthodonticsandcrownandbridge,withthecomplaintofspacinginmaxillaryfrontregiona nd inaestheticappearance.Intra-oralexaminationrevealsspacingof2 mm inbetweenlateralincisorandcentralincisorandcaninebilaterally.The probingdepthof2 mm wasnotedwithnogingivalrecession.Clinicallythereis noenamel hypoplasiaorcraze linesfoundontheenamel ofthe correspondingtooth. No Tetracycline stains, toothfractureorpreviousrestorationand mobilitynoted.The patient is having a gummy smile.Thepatienthadbilateral ClassI molar relationwithnormaloverjetandoverbiteanteriorly.Onmandibularmovementsitwasnotedthatthepatientwas havingcanineguidedocclusion.Onprotrusivemovementofthemandiblethereisan edgetoedgeincisalrelationofthemaxillaryandmandibularanteriortooth.Marginal gingivalin the anterior maxillary region shownno sign of inflammation.

Radiographic examinationsweredone to eliminateother probableetiology.Bothcentralincisor andcanine bilaterally showsno sign ofpathologybothclinically andradiologically.(Figure 1,2,3,4)

Figure1: Pre-OperativeView(E/O)

Figure2: Pre-OperativeView(I/O)

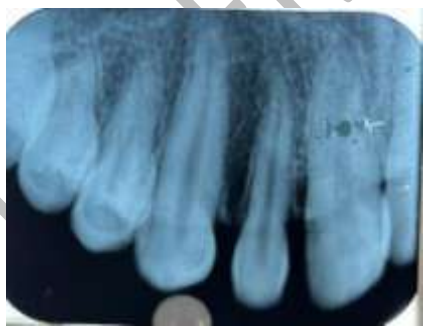

Figure3: Pre-OperativeRadiographicView

Figure4: Pre-OperativeView(I/O)

Figure5: Pre-OperativeView(I/O)

The treatmentoptionsgiventothepatientwereorthodonticclosureofspace,direct restorationbycompositeresin,andporcelainlaminateveneers(PLV).ThepatientoptedforthePor celainlaminateveneersduetoitsconservativeapproach,moreestheticallypleasantandshortdurati onoftreatment.

Thediagnosticimpressionsweremadeusingirreversiblehydrocolloidimpressionmateri al(Algingum:PrimedentalproductPvtLtd.)andpouredwithTypeIIIdentalstone(BNSTONE:BN CHEMICALS),and thestudycastswasretrievedfortreatmentplanning.studycastwasusedforthediagnosticmock-upofthemaxillarycentralincisorsandlateralincisors.Itwasexplainedtothepatientthatrestoringb oththecentralincisorsandlateralincisorsbilaterallywillachieveaharmoniousand proportionateappearance.

Aftergettingtheconsentfromthepatientthedigitalsmile designingwasdoneusingtheDSDsoftware(PROTEETH AI) on Tablet(iPad).Theresultsofthedigitalsmiledesigningwasachievedbymaintainingtheprostheti cconsiderationandgoldenproportionandtheharmonywiththesurroundingstructures.Thedigit almockupwasshownto thepatienttoshowtherealtime changevirtuallybymeansofthetoothshape,size andshadefollowingtreatmentandnecessarychangesweredoneaccordingtothepatient'sacceptance(Figure6). Prosthetic restoration was planned in tooth number 11,12,21 and 22. Tooth number 11 and 21 were added in the restoration to maintain the proportions of the restoration as the patient is having a gummy smile.

Figure6: DigitalSmileDesigning

The treatmentplanwasfinalizedthatrestoringboththecentralincisorandlateralincisorbilaterallybyPorcelainVeneerwillbenecessarytoachieve thetreatmentoutcome.Theincisaledgeoverlappingdesignoftheveneerwasfinalisedduetotheedge toedgebiteofthepatient duringthemandibularprotrusivemovementandthepalatalbuttendwasgiventogivestrength totheceramic veneer.The depthoftheveneerpreparationwasdone0.5 mm as therewas noneedtochangethetoothshade.Thepatientwassatisfied withthenaturaltoothshade.

Informedconsentwastakenpriortotreatmentthatexplainedthebenefits, drawbacks,andcomplicationsassociatedwiththetreatment.

ShadeselectionwasdoneusingVITAToothguide3DMASTERbeforepreparation.

Thefinal preparationswerethenstartedfortheceramicveneerson11,12,21and22usingtaperedchamferand depthcuttingdiamondbur.Thedepthofthepreparationwaslimitedto0.5mm.Mesiallyanddistall

ytheproximalpreparationwasextendedbeyondthe mesialanddistaltransitionallineanglebutnotinvolvingthemarginalridgespalatally.Preparationdesigninvolvedtheincisaloverlaptoendon palatalbuttjoint. Butt joint waskept 2 mmawaywiththeoccluding surfaceofthemandibularincisor to the palatalsurfaceofthemaxillaryincisors.Thefinalimpressionwasthenmadewithputtyandlightbody additionsiliconeimpressionmaterial(Photosil:DPI)(Figure7and8).

Figure7: FinalToothPreparation

Figure8: FinalSiliconeImpression

The DSD done previously with DSD software on iPad is transferred to the lab. Lab made the design on CAD software by taking the DSD outcome as reference. CAD-CAMfabricatedwaxtry-inwasdonebeforefabricatingthefinal prosthesistocheckthedesign,theproportionsandthefitoftheprosthesis.(Figure9&10).

Figure9: WaxTry-in (LabialView) Figure10: WaxTry-in(PalatalView)

After try-in was approved, lab fabricated the Porcelain laminate veneering(PLV).

TryinofthePLVweredoneusingthetryintransparentgel(TopCEM Try-in gel :HUGE) andwasevaluatedfortheoverallcontour,sizeandshape,theadjacentcontactsandfit,palatalsmoothfinishlineandanyshadechangewithtry-ingel.Thepatient'sapprovalwastakenwithrespecttosizeandshapeandshadeoftheceramicveneer(Figure11&12)

Figure11: BisqueTry-in (LabialView)

Figure12: BisqueTry-in (PalatalView)

Thecementationofveneerswasthenstartedwiththe11and12firstandthe21and22respectively.Theadjacentteethwereisolatedwithmylarstripsto protectfrom theetchant.The cramicveneerwasetchedwithporcelainetch(9%BufferedHydrfluoricAcid-WaldentProcelainEtch)for90secondsfollowedby5 mins ofUltrasoundcleaning.The 11,12,21,22tooth isetched(Ivoclar Vivadent Eco-Etch) for30secsfollowed by15sec washingwith water.

Bondingagent(5th gen)isappliedtothepreparedtoothsurfaceswithfreshapplicatortips.SilaneCoupling agent(PrevestDenproSilane-X)was appliedto thebondingsurfaceoftheceramic veneersandletitdry.Thelutingresincement(ColteneSolocemTransparentself-adhesivedualcureresincement)wasusedtocementtheceramicveneers.5sec oflightcuringwasdonetohaveinitialsetofthecement.The excesscementwasremovedthoroughlyaroundtheveneersandfromthegingivalsulcus. AfterthatfinalCuringwasdonebylightcuringmachinefor40seconallthesurfacesoftheveneeredtooth.Post-operativeinstructionsweregiventothepatient.Thepatientwassatisfiedwith theoverallaestheticsandshadeoftheIPSe-

Figure14&15: FinalProsthesis(I/O)

3.Discussion:

Maxillaryanteriortoothspacingrepresentsafrequentlyencounteredaestheticconcerninadult patients,oftenpromptingthemtoseekprosthodonticorestheticrehabilitation.Definedasaninter dentalgap of 0.5mmorgreater,thesespacesaremostcommonlyobservedintheanteriormaxillaandmayresultf romarangeofdevelopmental,anatomical,or pathologicalfactors[5,14].Along with the gummy smile , the visibility of the tooth becomes more prominent which hinders the estheics.Althoughsuchspacingmayappeartobea primarilyaestheticissue,itcansignificantlyimpactphonetics,masticatoryfunction,and psychosocialwell-being.

Acomprehensiveevaluationoftheetiologicalfactorsunderlying anteriorspacingisimperativeforaccuratediagnosisandlong-termtreatmentsuccess.Commoncausesincludediscrepanciesintoothsizeormorphology,ag enesisormicrodontiaofmaxillarylateralincisors,and generalizedspacingdue toa mismatchbetweenthesizeoftheteethandthe arch.Whilephysiologicspacingmayself-correctduringthemixed dentitionphasefollowingtheeruptionofpermanentmaxillarycanines,residualspacingpersis tingintoadulthood-particularlycasesinvolvinggapsexceeding2mm-typicallywarrantsactiveintervention.

Acriticalcomponentofthediagnosticandtreatmentplanningphaseinvolvedtheuseof Digita lSmileDesigning(DSD).Throughfaciallydrivendigitalanalysis,DSDenabledprecisevisualizat ionofthepatient'sexistingdentalconditionandsimulationoftheproposedrestorativeoutcome.Th isdigitalworkflowprovidedareliableplatformforevaluatingtoothproportions,midlinealignmen t,incisalcurvature,andsmilesymmetrybeforeinitiatingirreversibleprocedures.Importantly,the DSDprocessfacilitatedimprovedcommunicationwiththepatient,allowinghertobetterunderstan dtheproposedestheticchangesand activelyparticipateintheplanningprocess.Italsoenhancedcollaborationbetweentheclinicianan

dlaboratorytechnician,ensuringthatthefinal restorationsweretailoredpreciselyto thepatient'sfacialfeaturesandestheticexpectations[8,13].

Inthepresentclinicalcase,thepatientdemonstratedapproximately3-4mmofspacingdistallytomaxillarycentralincisorwithlateralincisorsandcaninesbilaterally. Avarietyoftreatmentmodalitieswereconsidered,includingorthodonticspaceclosure,directresin compositebuild-ups,andindirectporcelainlaminateveneers(PLVs). After adetaileddiscussionoftheadvantages,limitations,andprognosisofeachoption, thepatientelectedtoproceedwithPLVs,giventheirconservativepreparationrequirements,excellentaestheticpotential,andshortertreatmentdurationrelativetoorthodontic therapy.

DigitalSmile Designing withPorcelainveneersarewidelyrecognizedasahighlyeffectivemodalityforaddressingaesthetic deficienciesintheanteriordentition.Comparedtodirectresinrestorations,veneersoffersuperior optical properties,long-termcolorstability, enhancedresistancetowear,andgreateroverallclinicalpredictability[1,5,9].

Amongtheavailableceramic systems,lithiumdisilicate-basedmaterials-particularlyIPSe.maxhavegainedsignificantclinicalacceptancedue totheirfavorablemechanicalproperties,biocompatibility,andnaturaltranslucency.IPS e.maxexhibitsexcellentflexuralstrengthandfracture resistance,whilesimultaneouslyachievinghighaestheticoutcomesduetoits enamel-likelighttransmission[1,7,9].

Inthiscase,fourIPSe.maxveneerswereplacedon teeth11,12,21,and22.Thepreparationdesignincorporatedanincisaloverlap,chosenbasedonclinicalconsiderationsincludingincisaledgeintegrity, anticipated loaddistribution,and theneedforoptimalaestheticintegration.The incisaloverlapdesignwas doneasthepatientwashavingedgetoedgeocclusionofthemaxillaryandmandibularanteriorteethinthemandubularprotrusivemovements.Apalatalbuttjointisincorporatedtoenhancetheintegrity oftheporcelain veneers.Theselectionofveneerdesignsignificantlyinfluencesboththemechanicalperformancea

ndlongevityoftherestoration.

Although**Meijeringetal**.observednostatisticallysignificantdifferencebetween preparationswithand withoutincisalcoverage[3].

Smalesetal.reportedanotablyhighersurvivalrate(96%)forveneerswithincisal coveragecomparedtothosewithout(85%).Thisevidencesupportsthedesignrationaleadoptedin thepresentcase.Thedepthofthepreparationwas limitedto0.5 mmtokeepthepreparationwithintheenamelitselfandas therewas noneedtochangetheshadeofthenaturaltooth,keepingthetranslucentveneerwithintheenamelwi llenhancethenaturaltoothshadeofthepatient[4].

Calamia&Calamia(1994)adviseda minimal reduction(0.3mmcervically, 0.5 mm middle,0.7 mmincisal)whensome modificationofanatomyorthicknessisneeded— butifnocolorchangeisrequired,"ultrathin"or"no-prep"optionsmaybe usedtoconserveenamel[1].

Magne&Belser(2002)inBondedPorcelain RestorationsintheAnteriorDentition ,Stressedtheimportanceofenamel preservation[2].

Peumanset al.(2000s)inClinicalstudiesandreviewsonveneerlongevityfoundthatveneersbondedtoenamel withminimalpreparation(~0.3mm)havebettersurvivalthanthoseinvolvingdentin orthickerreduction— especiallywhennomajor estheticmodification(suchas shadechangeorshapechange)isrequired[5].

Fradeani(2007)– InEstheticRehabilitationinFixedProsthodonticsrecommendsbetween0.3– 0.5mmfacialreductionforshadeandshapecorrection,and0.2 mm forpurelysurfaceadjustments[6].

JiakangZhuetal(2022) intheirstudystatedthatbondstrengthto enamelis higherthanto dentin,and higherpercentagesofpreservedenameltranslateto higherShearbondstrengthand betterclinicalsurvival(20MPa forenamelbondingand 10MPa whenbonding isentirelyto dentin).Literaturereviewand evidencesmatcheswiththepreparationforthiscase as itwas doneenitirelyinontheenameltohavea betterbondstrength[7].

As we were usingthetranslucentdualcure resincement

forluting,theshadeofthefinalveneerwouldnotbe affectedbythelutingcement.

Thepatientwassatisfied withthefinaloutcomeoftheprosthesiswhichwasmadeby evidencebased prostheticdesingalongwithreal timevirtualsmile designing.

4.Conclusion:

Themanagementofmaxillaryanteriortoothspacingnecessitatesamethodical approachencompassingaccuratediagnosis,appropriatematerialselection,andmeticulousatt entiontobiomechanicalandaestheticconsiderations.

Theincorporationof DigitalSmileDesigningplayedapivotalroleinenhancingthediagnosticprecisionandesthetic predictabilityofthetreatment.Byenablingdigitalvisualizationoftheproposedrestorativeout comes,DSDfacilitatedeffectivecommunication,improvedtreatment planning,andensuredthatthefinal resultharmonizedwiththepatient'sfacialfeaturesandestheticdesires[8,13].Whencombinedwit hcontemporaryceramicmaterialsandconservativeprosthodonticprinciples,digitalworkflo wssuchas DSDsignificantlyelevatethestandardofcare, contributingtohighlypersonalizedand predictableoutcomesinestheticdentistry.

Inthisinstance,IPSe.maxporcelainlaminateveneersprovidedaminimallyinvasi ve,highlyaesthetic,anddurablesolutiontailoredtothepatient'sclinicalandpersonalexpectations[1,7,9].

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None.

6. Conflict of Interest

None.

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