“ComparisonoftheSurgicalOutcomesofVariable-AngleLockingCompressionPlatingandLigamentotaxisforIntra-ArticularDistalRadiusFractures:ARetrospectiveStudyataRuralTeachingHospitalinIndia.”

Abstract

Background: Distalradiusfracturesarequitecommon,withanagingpopulation(duetoosteoporosis)andanincreaseinoutdooractivity(higherenergyfractures)beingpossiblereasonsfortheincreasingfrequencyofsuchinjuries.Althoughmanydistalradiusfracturesaretreatedconservatively,around20percentofcasesrequiresurgery.Thesurgicalmanagementofdistalradiusfractureshaschangedoverthelast30yearsfromtheuseofcastimmobilizationtovarioussurgicaltechniques,someofwhichinvolvevolarlockingdevicesandexternalfixation.

Aim: Tocomparetheefficaciesofligamentotaxisandvariable-anglelockingcompressionplatingforthetreatmentofintra-articulardistalradiusfractures.

Methodology: Ahospital-basedretrospectivestudywasconductedamong40patientswhohadundergoneelectiveligamentotaxis(groupA,whichconsistedof20patients)orvariable-anglelockingcompressionplating(groupBwhichalsoconsistedof20patients)forintra-articulardistalradiusfracturesattheDepartmentofOrthopaedics,R.L.JalappaHospital,Tamaka,Kolar,Karnataka,India.

Results: Malesoutnumberedfemalesinbothgroups.Therewasastatisticallysignificantdifferencebetweentheconsideredvariablescores6monthsaftersurgery.PatientsingroupA(patientswhohadundergoneelectiveligamentotaxis)exhibitedbetteroutcomescomparedtothoseingroupB(patientswhohadundergonevariable-anglelockingcompressionplating).

Conclusion: Forcomminutedintra-articularandunstableextra-articularwristinjuries,externalfixationandligamentotaxisyieldsuperiorfunctionalandanatomicaloutcomes.Thefunctionaloutcomeoftreatingdistalradiusfracturesdependsonthecoroncomitantsofttissueinjuriesandarticulardamage,aswellasthedegreetowhichanatomicalrepairofthearticularsurfaceissuccessful.

Keywords: Intra-

articulardistalradiusfractures,surgicaloutcome,anglelockingcompressionplate,ligamentotaxis.

Introduction

Comparedtounstableextra-articularfractures,intra-articulardistalradiusfracturespresentamoresignificanttreatmentchallenge[1].Distalradialjointanatomicalrestorationservesasthebasisforsurgicaltreatment.Moststudieshavefoundanegativeassociationbetweenradiographicarthrosisandoutcomes,whereassomereportshavereportednone[2].Inlogicaltreatmentplanning,itisimportanttocarefullyevaluatethedegreeofarticularsurfacedisplacementanddisruption;thestabilityandreducibilityofeachfracture;andanyconcurrentinjurytosurroundingnerves,tendonsand/orcarpalstructures[2,3].

Theproximalradioulnarbones,theforearmbones,andtheinterosseousmembraneconstitutethecomplexarticulationknownastheproximalradioulnarjoint,whichpermitstheforearmtopronateandsupinate.Thejointisphysicallyandphysiologicallyrelatedto“theulnocarpaljoint.”Althoughtheycanoccurinisolation,distalradiusfracturesarefrequentlylinkedtoulnarnerveentrapmentanddistalradialarterydamage.Acuteorchronicinstabilityandseveredistalradioulnarjointarthritisarepossiblepresentations.Bothclinicalexaminationandanunderstandingofanatomyarenecessaryforthediagnosisandtreatmentoftheseconditions[4].

Becausethewristjointtransmitsloads,itiscrucialtopreserveitsanatomicalstructurethroughoutsurgicaltreatment.Accuraterestorationoftheskeletalstructurebymeansofclosedoropentreatment,theidentificationandrepairofrelatedinjuries,andcloselymonitoredrehabilitationbylicensedtherapistsarethegoalsofoptimalcare[5,6].Clinicalconsequencesofdistalradiusfractures,suchasdecreasedrangeofmotion,diminishedgripstrength,andradiographicabnormalities,maynotalwayscorrespondtothepainanddisabilityoftheinjuredwrist[7]. Thetwomostusedsurgicalapproaches,namelyvariable-anglelockingcompressionplatingandligamentotaxis,aswellastheirrespectivepostoperativerehabilitationregimens,differsignificantly.Currently,theliteraturedoesnotprovidesufficientdatatodeterminewhetherexternalfixationorvolarlockedplatingproducesbetterresults;hence,thecurrentstudywasconducted[8].Thisstudyaimedtocomparetheefficaciesofligamentotaxisandvariable-anglelockingcompressionplatingtreatmentstrategiesforthetreatmentofintra-articulardistalradiusfractures.

Methodology

Ahospital-basedretrospectivestudywasconductedamong40patientswhohadundergonetreatmentforintra-articulardistalradiusfracturesattheDepartmentofOrthopaedics,R.L.JalappaHospital,Tamaka,Kolar,Karnataka,India.Thesepatientsweredividedintotwogroups:ThoseinGroupA(20individuals)underwentelectiveligamentotaxis,whereasthoseinGroupB(20individuals)weretreatedbymeansofvariable-anglelockingcompressionplate.

Samplesize

ThesamplesizewascalculatedusingOpen-Episoftware(confidenceinterval=95%,power=80%,)andratioofpatientstreatedwiththeuseofvariable-anglelockingcompressionplatetothosewhounderwentligamentotaxistobe40.Thepatientswereclassifiedintotwogroups:GroupA(20)receivedligamentotaxis,whilegroupB(20)wastreatedwithvariable-anglelockingcompressionplatingforintra-articulardistalradiusfractures.

Afterobtaininginformationfrompatientmedicalrecords,allpatientswhohadundergoneelectiveligamentotaxisorvariable-anglelockingcompressionplatingforintra-articulardistalradiusfractureswereretrospectivelyevaluated.Followingsurgery,allpatientsweremonitoredfor6months,duringwhichtimetheirlevelofdiscomfort,gripstrength,wristrangeofmotion,andactivitywererepeatedlymeasured.Thepatientswerethengradedusingthe GreenandO’Brienratingsystem.Ascoreoflessthan65wasregardedaslow,whilescoresbetween65and79,80and89,and90and100wereregardedasfair,good,andexcellent,respectively.Beforethestudybegan,theInstitutionalEthicalCommittee(IECno527)gaveitsapproval.Weobtainedwritteninformedconsentfromeveryresearchparticipant.

MicrosoftExcelwasusedfordataentry,andtheStatisticalPackagefortheSocialSciencesversion26wasusedforanalysis.MeanandSDwereusedtosummarizeallcontinuousvariables.Fractionsandpercentageswereusedtosummarizecategoricalvariables.A*t*testwasusedtocomparequantitativevariablesbetweenstudygroups,andusingthechi-squaretest,qualitativefactorswerecomparedbetweentheresearchgroups.A*p*valueoflessthan0.05wasdeemedstatisticallysignificant.

Results

Mostofthestudyparticipantsfellintotheagegroup41–50years.Onlyonepatientineachgroupwaslessthan20yearsold(Figure1).

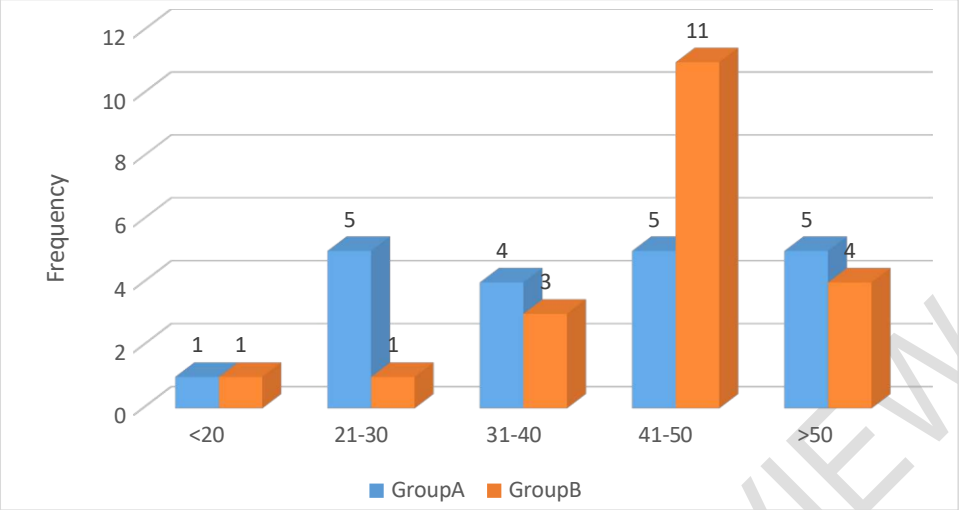

Figure1:Agegroup-wisedistribution

ThemeanageoftheparticipantsingroupAwas39.45years,whereasthatoftheparticipantsingroupBwas43.4years.Inbothgroups,malesoutnumberedfemales.Overall,29participantsweremaleand11females.Nostatisticallysignificantdifferencewasidentifiedbetweenthetwogroupsintermsofmeanageorgenderdistribution.(Table1).

Table1.Comparisonofsociodemographicinformation

Variables	GroupA	GroupB	*P*value
Age(Mean ±SD)	39.45 ±13.8	43.4 ±9.9	0.345
Male	15	14	0.219
Female	5	6	

Themeanpainscorebeforesurgerywas13.65forgroupAand13.5forgroupB.ThemeanGripscorebeforesurgerywas15.4ingroupAand16.1ingroupB.ThemeanROMscorebeforesurgerywas17.4forgroupAand18.6forgroupB.Themeanactivityscorebeforesurgerywas18.5forgroupAand17.1forgroupB.

Finally,themeantotalscorebeforesurgerywas54.05forgroupAand55.4forgroupB.Nostatisticallysignificantdifferenceswereidentifiedbetweenthescoresfortheinvestigatedvariablesforbothgroupspriortosurgery(Table2).

Table2.ComparisonofGreenandO'Brienscoresbeforesurgeryamongbothgroups

Variables	GroupA (Mean±SD)	GroupB (Mean±SD)	*P*value
Pain	13.65 ±2.5	13.5 ±2.2	0.841
Grip	15.4 ±2.1	16.1 ±2.3	0.321
ROM	17.4 ±5.7	18.6 ±6.9	0.552
Activity	18.5 ±3.8	17.1 ±4.7	0.274
Total Score	54.05 ±4.1	55.4 ±5.9	0.406

Sixmonthspost-surgery,themeanpainscoreforgroupAwas20.65,whereasthatforgroupBwas18.6.Themeangripscoreforgroup Awas22.6,whereasthatforgroupBwas17.1.ThemeanROMscoreforgroupAwas27.4,whereasthatforgroupBwas23.4.Themeanactivityscoreforgroup Awas28.1,whereasthatforgroupBwas25.4.Finally,themeantotalscoreforgroupAwas79.25,whereasthatforgroupBwas75.4.Statisticallysignificantdifferenceswereidentifiedbetweendifferentvariablescoresforbothgroupsof6monthspost-surgery.PatientsingroupAachievedbetteroutcomesthanthoseingroupB(Table3).

Table3.ComparisonofGreenandO'Brienscores6monthsaftersurgeryamongbothgroups

Variables	GroupA (Mean±SD)	GroupB (Mean±SD)	*P*value
Pain	20.65 ±3.5	18.6 ±2.1	0.0306
Grip	22.6 ±2.1	17.1 ±5.4	0.0001
ROM	27.4 ±4.2	23.4 ±3.7	0.0028
Activity	28.1 ±4.9	25.4 ±6.1	0.013
Total Score	79.25 ±3.3	75.4 ±4.6	0.004

Discussion

Distalintra-articularradialfractures,whicharesignificantlymorecommonthanunstableextra-articularfractures,presentatherapeuticchallenge,andtheoptimalcourseoftreatmentremainsunclear.Theevaluationtechniqueemployedmayhaveanimpactonpatientoutcomes.Toeffectivelytreatthesefractures,medicalcarebeyondphysicalimpairmentandradiographyisrequiredsincetheprognosismayalsodependonpost-fracturerehabilitation[9].

Theoperativemanagementofdistalradiusfractureswithopenreductionandinternalfixationhassignificantlyimprovedsincetheintroductionofvolarlockingplates.Incasesofextra-articularandsimpleintra-articularfracturesthatmaybelessenedbyclosedmanipulation,restorationofanatomy,jointcongruity,andstabilityallowsforearlyfunctionalmobilization.Nevertheless,recentrandomizedcontrolledstudieshavequestionedwhethertherearecleartfunctionalbenefitsovermoreconservativeapproaches[10,11].

Inarandomizedprospectivestudy,McQueenetal.[8]comparedtheeffectivenessofnonbridgingandbridgingexternalfixatorsinrestoringnormalanatomy,carpalalignment,andhandfunctionforthetreatmentofintra-articulardistalradialfractures.Bothduringthefirstanalysisandatone-yearfollow-up,theauthorsfoundthatthepainoutcomemetricsforthebridgingandnonbridgingfixatorswerecomparable.Atthefinalfollow-up,therewerenostatisticallysignificantdifferencesincarpaldiscomfortbetweenthetwogroups.

Evidence-basedmedicineindicatesthatuntiltheendoffirstyearpostsurgery,thereisnoappreciabledifferenceinpainlevelsbetweenpatientstreatedwithexternalfixationandthosetreatedwithclosedreductionandcasting[12].Thereisstilldisagreementoverwhichapproach(bridgingornonbridging)ispreferablefortreatingdistalradialfracturesusinganexternalfixator.

Atroshietal.[13]determinedthatnonbridgingexternalfixationwasmoreeffectiveinpreservingradiallengthbuthadnoclinicallysignificantbenefitoverwrist-bridgingfixation.Intheirresearch,Huangetal.[14]treated70casesofintra-articulardistalradiusfractureswithclosedreductionandexternalfixationusingextremelysmallAOexternalfixators.Theauthorsproposedthatbridgingexternalfixationisamoresuitableandreliablemethodthannonbridgingfixationforthetreatmentofintra-articulardistalradialfractures.Theyconcludedthattherigorousfixationandcautious

reductionachievedthroughtreatmentusingasmallAOexternalfixatorwereprimarilyresponsibleforthegoodfinalclinicaloutcomesobservedintheirtrial.

Throughprospectivecohortresearch,Grewaletal.[15]aimedtodeterminetheassociationbetweenpainandage,gender,comorbidity,educationalattainment,andcompensationclaims.Thisstudyalsoinvestigatedthecorrelationbetweenradiologicalandclinicalresults.Theauthorsfoundnoevidenceofasignificantrelationshipbetweenbaselinepatientcharacteristicsandextra-articulardistalradialfractureinjuriesorthelikelihoodofpainandimpairmentoneyearaftersurgery.

Rosentaletal.[16]comparedthefinaloutcomesofpercutaneousK-wirefixationwiththoseofunstablecomminuteddistalradialfracturestreatedbyopenreductionandinternalfixationusingvolarplates.Theauthorsfoundnoappreciablevariationintheresultsbasedonthethebasedonthescoresfordisabilitiesofthearm,shoulderandhand.However,theyconcludedthatvolarplatescouldhastenthehealingprocessfordistalintra-articularradialfracturesinpatientswhorequirearapidreturntofunctionafterinjury.

Limitations

Thepresentstudyfocusedonasmallgroupofpatients.Therefore,amulti-centriclongitudinalstudywouldberequiredtoallowforgeneralizablefindings.Inthepresentstudy,nofollow-upwasdone,sothelong-termcomplicationsoftheinvestigatedtreatmentsandpatientprognosisremainunknown.

Conclusion

Superiorfunctionalandanatomicaloutcomescanbeachievedwithligamentotaxisandexternalfixationforcomminutedintra-articularandunstableextra-articularwristinjuries.Inadditiontotheanatomicalrestorationofthearticularsurface,thefunctionalresultoftreatingdistalradiusfracturesdependsonconcurrentsofttissueinjuriesandarticulardamage.At6-monthfollow-up,ligamentotaxisoutperformedvolar-lockedplatingproceduresonceallpatientsundergoneadequateradiologicalreduction.

References

1. Cooney WP, Linscheid RL, Dobyns JH. External pin fixation for unstable Colles' fractures.TheJournalofBone&JointSurgery.1979Sep;61(6):840– 5.
2. Wolfe SW, Pike L, Slade JF, Katz LD. Augmentation of Distal Radius FractureFixationWithCorallineHydroxyapatiteBoneGraftSubstitute.The Journal of Hand Surgery. 1999 Jan;24(4):816–27.
3. OrbayJL,FernandezDL.Volarfixationfordorsallydisplacedfracturesofthedistal radius:Apreliminaryreport.TheJournalofHandSurgery.2002Mar;27(2):205–15.
4. MusgraveDS,IdlerRS.VolarFixationofDorsallyDisplacedDistalRadius Fractures Using the 2.4-mm Locking Compression Plates. The Journal of Hand Surgery. 2005 Jul;30(4):743–9.
5. KarnezisIA,FragkiadakisEG.Associationbetweenobjectiveclinicalvariablesand patient-rated disability of the wrist. The Journal of Bone and Joint Surgery British Volume [Internet]. 2002 Sep 1 [cited 2023 Jul 12];84(7):967–70.
6. AnzarutA,JohnsonJA,RoweBH,Robert,BlitzS,MajumdarSR.Radiologic and patient-reported functional outcomes in an elderly cohort with conservatively treated distal radius fractures. 2004 Nov 1;29(6):1121–7.
7. SarmientoA,PrattG,BerryN,SinclairW.Colles' fractures.Functional bracing in supination. The Journal of Bone & Joint Surgery. 1975 Apr;57(3):311–7.
8. McQueen MM. Redisplaced unstable fractures of the distal radius: A randomised, prospectivestudyofbridging*versus*non-bridgingexternalfixation.Thejournalof bone and joint surgery. 1998 Jul 1;80(4):665–9.
9. Abdel-Ghany M, Tohamy TG, Shaaban WM, Atallah AHA, Abdel-Rahman TM. LigamentotaxisversusOpenReductionandInternalFixationforDistalRadiusIntra-Articular Fractures. Open Journal of Orthopedics. 2017;07(01):21–31.
10. Karantana A, Downing ND, Forward DP, Hatton M, Taylor AM, Scammell BE, et al. Surgical Treatment of Distal Radial Fractures with a Volar Locking Plate Versus Conventional Percutaneous Methods. Journal of Bone and Joint Surgery. 2013 Oct 2;95(19):1737–44. DOI: 10.2106/JBJS.L.00232
11. Costa ML, Achten J, Parsons NR, Rangan A, Griffin D, Tubeuf S, et al. Percutaneous fixationwithKirschnerwiresversusvolarlockingplatefixationinadultswith

dorsallydisplacedfractureofdistalradius:randomisedcontrolledtrial.BMJ.2014 Aug 5;349(aug05 2):g4807–7. 10.1136/bmj.g4807

12. LeeHD,MonsivaisJJ,PomeranceJ,etal.:Appropriateusecriteriafortreatmentof distal radius fractures. AAOS Evidence-Based Medicine Unit 2013. https://www.aaos.org/globalassets/quality-and-practice-resources/distal-radius/drf_auc.pdf.
13. AtroshiI,BrogrenE,LarssonGU,KloowJ,HoferM,BerggrenAM.Wrist-bridging versus non-bridging external fixation for displaced distal radius fractures: a randomized assessor-blind clinical trial of 38 patients followed for 1 year. Acta Orthopaedica [Internet]. 2006 Jun 110.1080/17453670610046389
14. Huang T, Huang C, Yu J, et al.: Operative treatment of intra-articular distal radius fractures using the small AO external fixation device. J Chin Med Assoc. 2005, 68:474-89. 10.1016/S1726-4901(09)70077-2
15. Grewal R, MacDermid CJ, Pope J, et al.: Baseline predictors of pain and disabilityone year following extra-articular distal radius fractures. HAND. 2007, 2:104-11. 10.1007/s11552-007-9030-x
16. Rozental TD, Blazar PE, Franko OI, et al.: Functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation. A prospective randomized trial. J Bone Joint Surg [Am]. 2009, 91:1837-46. 10.2106/JBJS.H.01478