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Outcomes of open reduction and internal fixation by k-wires for Bennett'sfracture, Aprospective study

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ABSTRACT:

Objective:Thepurposeofthisprospectivestudyistoassesstheoutcomesofopenreductionandinternalfixationwithkwireforbennetfracture.

Methods: fifty patients were considered for study as per inclusion criteria. Openreduction and internal fixation with k wire was performed through dorso-radialapproach and rehabilitation was done according to southeast Georgia health system.Radiologicalunion,postoprangeofmotion,pitchandgripstrengthandcomplicationwere assessed by associate professor at 14 days, 1 month , 3 months , 6 months, 1year,2years,3years

Results: Mean adduction / abduction at 1st MCP joint at 14 days is 75 +/- 4.5 ,at1month 82.5 +/- 3.2, at 3 months 85.3 +/- 2.7, at 6 months 87.5 +/- 2.6, at 12 months90+/-2.5,at2 years95+/-0.9° , at 3 years 97+/-0.7 and Mean flexion/ extension At 1stMCP joint 14 days is 42+/-5.3 ,at1 month is 46+/- 4.7, at 3 months 48+/-3.2 , at 6months53+/-2.9,at12months57+/-1.7,at2years60+/-1.2,at3years62+/-1.1.

Meanpinchpower(kg)is10.5+/-0.2andMeangrippower(kg)is52+/-1.3at3years

Conclusion: In Bennett fracture anatomical reduction and proper stabilization offracture is of utmost importance in case of preventing post-op pain and post -oparthritis and for early mobilization and better outcome. These goals are very wellachievedbymeansofORIFwithkwireswithverylowcostandmoderateresources.

Keywords: Bennettfracture,openreductionandinternalfixation,k-wire

Table

	14 days(SD)	1 month(SD)	3 months(SD)	6 months(SD)	12 months(SD)	24 months(SD)	36 months(SD)
DASH	14+/-3	12+/-2	11+/-1	10+/-1	5+/-1	3+/-1	2+/-1
Tinglingsensationandnumbness	2	2	0	0	0	0	0
ArthritisStage 1 Stage2 Stage3 Stage4	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	2 2 0 0	2 2 0 0
Meanadduction /abductionAt1st MCP joint	75+/- 4.5	82.5+/-3.2	85.3+/- 2.7	87.5+/- 2.6	90+/-2.5	95+/-0.9°	97+/-0.7

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Meanflexion/extensionAt1st MCP joint	42+/-5.3	46+/-4.7	48+/-3.2	53+/-2.9	57+/-1.7°	60+/-1.2°	62+/-1.1
Meanpinch power(kg)	5.2+/-0.7	6.3+/-0.5	7.2+/-0.6	8.7+/-0.5	10.2+/-0.4	10.3+/-0.3	10.5+/-0.2
Mean grip power(kg)	32.3+/-3.7	38.6+/-2.9	41.5+/-2.6	43.5+/-1.8	46.3+/-1.5	49.9+/-1.4	52+/-1.3

Table 1:showingoutcomeof ORIFtreatedpatients.

Figure

Figure
Clickheretoaccess/download;Figure;photo 2Bennett.jpg

Figure

Figure

I. INTRODUCTION:-

1stCMCjointisasaddletypeofsynovialjointwhichis positionedin peculiarmannerof40°abduction,50°flexionand80° pronationinanormalfunctionalpositionthathelpsinim provedopposition,powergripandfinegrip.Henceanyi mpairmentofthisjointleadstosignificantrestrictionso fthedaytodayactivities.Nonetheless,thisjointisalsoth esecondmostcommonjointpronetoosteoarthritis.**1**]In 1972GreenandO'Brienclassifiedfractureofbaseof1st metacarpal.Thisclassificationdefines5typesoffractur enamelyRolando'sfracture,Bennett'sfracture,epiphy seal,transverseextra-articularandobliqueextra-articular.**2**]EdwardHallaranBennett,whowasaprofes sor ofsurgery(1837–1907)describedit"asafracturepassing obliquelythroughthe baseofthe1stmetacarpal, wherethe greaterpartofthearticularsurface isdetached ;thepieceofbonewasprojectedtowardthepalmoftheha ndwhichwasonsurface.Thelargefragmentwasseparat ed,andtheresultantdeformityseemstobeadorsalsublu xationofthe 1stmetacarpal''.**3**]Inadults,onethird

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ofthefractureofbaseof 1st metacarpalareBennett's fracture.**4**)Thepeculiarpattern ofthisfractureisduetothemuscleactionofadductorpollicisandabductorpollicislonguswhich displacethegreaterfragment,i.e.theshaftof the1st metacarpal.Thereisvolardisplacementofthe smallerfracturefragmentasitisattachedtothepalmaro bliqueligament..**3**] Treatmentofthesefractureshavebeenreportedsince1950whichshowedbetterresults whenthesewereretreatedsurgically.**5,6**Varioussurgical techniqueshavebeensuggestedinthefollowingyearsa ndtherehasbeenintroductionofnewtechniques.Vario usmodalitiesinclude:Closedreductionandimmobiliz ationincast,closed reductionwithpercutaneouspinningandopenreductio nwithinternalfixation.Asthereisintraarticularextensi onofthefractureline andtheactionofmusclesonthefracturefragments,thecl osedreductionmethodsmayleadtodisplacementandw orseningofthestep-offofthefracture.BymeansofORIF,fractureswerered ucedunderdirectvisionensuringanatomicalreduction ofthefragmentsandthesepatientsshowedtohavegood outcome.**7,8,9**]DuringCRPF, step-offsandgapswerelessevident byfluoroscopy .**10**toovercomethis,surgeryassistedbyarthroscopyor byopenmeans wereadvisedfor thisfracture.**11**]Therehasbeencontroversialevidence sregardingaccuracyoffracturereductionleadingtopos ttraumaticarthritis.Thedilemmaforselectingthebests urgicalmanagementforthisunstablefractureisduetosh orttermfollowupofsmallgroupofpatients.**12,13**]toov ercomethis,thestudygroupshouldbelargeandhavealo ngerfollowuptoevaluateoutcomeofORIFwithkwires andtheirlongtermcomplications.**14**]hencethisstudyw asdonetoasseslongtermclinical,functional andradiologicaloutcomes.

II. MATERIALS AND METHODS

Thiswasaprospectivestudyconductedatourtertiaryca recenter,aftertakingaformalapprovalfromtheinstituti onalethicalcommittee.Ourstudygroupincludedpatie ntsfrom2013(may)till2019(June)fortheperiodof73m onths.Theinclusioncriteriawereskeletallymaturepati ent,age>15years&<60years,Geddatype1fracturewit houtotherhandinjuries,nootherconcomitantinjuriesa ndpatientgivingconsentforsurgery.Theexclusioncrit eriawereskeletallyimmaturepatient,age<15yearsor> 60years,openfractures,patientunfitforsurgeryandpati entnotgivingconsentfoesurgery.50patientsmetthe inclusioncriteria.patientswithBennettfracture(Gedd atypeI,fracturewithsingleulnarfragmentandsubluxat ionofmetacarpalbase)weretreatedwithKwirebymean ofORIF;minimumageattimeofsurgerywas15yearsan dmaximumagewas58years.Openreductionandintern alfixationthrougharadio-dorsalapproach withthehelpof2k-wireswasdone(fig1and 2).Kwiresizewas1.6or2.0mm.surgerywasperformed underguidanceunderguidanceofsinglesurgeonwhois associated professoratourinstitute.Postopevaluationswereperfo rmedunderguidanceofsameconsultant.outpatientass essment doneatpostopday7.Usuallysutureremovedonpostopd ay12th.Kwiresremovedafter3weeksandfollowupdon eat firstmonth,thirdmonth,sixthmonth, oneyearand everyyearafterthat.pre-op andpost-ophandstrengthwasmeasuredusinga musclestrength Scaleconsistof0to5Scoreandcomparedwith normalhand.ForpostoperativeevaluationDASH scorewasused.Postoperativecomplications(lossofre duction, infection,pain,tinglingornumbness) wereseen.examinationofsensesoftheoperated thumbwereevaluatein comparisonwithnormalhandandgrouped asintactnormalsensation,tinglingornumbness. strengthofgripand pinchofbothhandswere measuredbydynamometers.Strengthofpinchandgrip were measured inkgs. percentagecalculationwasused toseethecomparisonofthestrengthofpinchandgrip betweentheoperated andnormalhand.RehabilitationdoneaspersoutheastG eorgiahealthsystem.Whichincludes Post-op10-14Days:•Edemacontrolisinitiatedasnecessary.Mostc ommonly,thisincludeseither3"elastic bandageorelasticstockinette.•Awristandthumbstatic splintwiththeIPjointfreeisfittedtowearbetween exercisesessions&atnighttoprotectthehealingfractur e.Thesplintisfittedwiththethumbmidwaybetween radialandpalmarabduction. Post-opWeek6:•Active&gentlePROMexercisesareinitiat edtothethumbinflexion/extension,abductionand adduction&circumduction.ROMexercisesareinitiate dtothewrist.•Thethumbspicasplintiscontinued betweenexercisesessionsandatnight.•NMESmaybea ddedtothetherapyprogramtofacilitateIPflexion,as needed. Post-opWeek7:•Dynamicflexionsplintingmaybeaddedifd orsalcapsulartightnessispresentattheMPorIP jointofthethumb.Typically,thesplintisworn3-4timesadayfor45minsessions. Post-opWeek8:• Thewrist&thumbstaticsplintisdiscontinuedduringth

eday,exceptforheavylifting.•Gentle strengthening maybeinitiatedtothehandandwrist. Post-opWeek10:• Thepatientmaybeginusingthehandinnormaldailyactivities.Ifcastimmobilizationisthe methodoftreatmentfortheinitial6weeks,thetherapyprogrambeginsat6weeksasoutlinedabove.Thecourse oftherapyissimilarforbothconservative&post-opmanagement.
Radiographicimagesweretakenintwoseparateviews(AP andOblique).post-traumaticarthritiswas evaluated usingthoseradiographsusing modificationsby theVanNiekerkandOwensoftheEatonandLittlerclassification.
Accordingtothisclassification noclearchangesofarthritisconsideredasstage1,presenceofosteophytessmaller than2mmconsideredasstage2,narrowedjointorgreater than2mmosteophytesconsideredasstage3andif jointspacegetsdisappeared,itconsideredasstage.**15**,**2**]
Statisticalanalysisdoneusingmeanwithstandarddeviationwasusedfornormallydistributed continuousdata

III. RESULTS

Followupof50patientsdoneandtheirclinical,radiologicalandclinicalexaminationdoneateachfollowup.3 yearswasthemean offollowup.34yearsagewastheaverageageforinjury.outofthose50patients 80% patients(40) weremaleand20%patients(10)werefemale. patientsinjuredtheirdominantside.injuryoccurredby variousmeanlikeinjuriesduringsportsactivities(56%), motor-vehicleinjuries(26%), assault(10%)andothers(8%).ORIFwasperformedwithin 5daysdurationofinjury. managementinpost-operativeperiodwasdonebythumbspicaslabfor7days andremovablesplint afterthat period.
PatientswereexaminedandoutcomeofORIFatpostop 7days,14days,1month,3months,6months,1year,2 years,3years,4yearsand60months isshownintable1.which showsMeanadduction/abduction At1stMCPjointat14daysis75+/-4.5 ,at1month82.5+/-3.2, at3 months85.3 +/-2.7,at 6 months87.5 +/-2.6, at 12 months 90+/-2.5,at2 years95+/-0.9° , at 3 years 97+/-0.7 and Mean flexion/ extension At 1st MCP joint 1days is 42+/-5.3 ,at1 month is 46+/-4.7, at 3 months 48+/-3.2 , at 6 months 53+/- 2.9 , at 12 months 57+/-1.7,at2years60+/-1.2, at 3years62+/-1.1.
Complications:- Seenin8patients.infectionoccurredinthree patientwhichwereoperatedbyORIFmean.Thisinfection managedbyantibioticsperoralroute,removalofk-wiredoneafter3weeksandusuallyfractureshealedby 14 weeks(fig3).Examinationof48patientsrevilednormal results.2patientshadsensoryissuesliketinglingand numbness.
RadiographsshowEaton–LittlerGradeIIIorIV ofarthritisin4patients.step-offorgapgreaterthan2mmafter surgeryandpost-traumaticarthritisshowsignificantcorrelation.

IV. DISCUSSION

ourstudygroupisoflowsocio-economicclassmainlylaborers.Inthempriorityisregainingofpowerandgrip strengthearly.thisfractureisveryunstableduetotheabductorpollicislongusmuscleandadductorpollicismuscle pullonfragmentsoitisquietchallengingtobothreduceitproperlyandstabilizeit.**3**]thisstudyshowsstep-offorgapgreaterthan2mmaftersurgeryandpost-traumaticarthritisshowsignificantcorrelation.**16,8**]variousstudies shownbetteroutcomeswhenlesser2mmstepoffandgapseenpostoperatively.**17,18**]Anatomicalreductionby ORIFwithkwires,aimstopreventpost-traumaticarthritis.**17**]BydoingsurgeriesinORIF withkwires, injury causedbymultipleattemptsinCRPFcanbeprevented. Earlymobilization postoperativelyinORIFwithkwires treatedpatientsshowsimportantadvantageofthistechnique.**19**]Earlymobilizationpossiblein ORIFbecausewe

aresureaboutanatomicalreductionandproperfixation. Postopscarandadhesioncanbepreventedby meticulousdissectionduringORIFwithkwires.CASTINGcanbeconsideredforundisplacedfracture. Thisstudy showssignificantlybetterclinical,radiologicalandfunctionalresultsforpatientswhichweretreatedbyORIF with kwiresmean duringfollow-upof5years.**7**,**20**,**8**,**19**,**21**]Duetopain therewasdecreasedstrengthofpinchand gripandIncreasedDASHscore. thesefindingwereverymuch clinicallysignificant.meticulousdissection duringsurgeryexplainstheveryless chancesofdamagetoimportant

structureswhileperformingsurgerybymeanofORIF.**22,23**]Thereportedearly postoppainwascorrelatedwithinadequatereductionandlatesequelispost-traumaticarthritis(Eaton–Littler stage)whichleadtopainduring movement.Gripandpinchstrengthmeasuredusingdynamometerofoperated handandcomparedwithuninvolvedoppositehandwhichshowsverygoodresultsinseeninpatientstreatedby ORIFwithkwiremean.Advantageofthisstudyisthatpatientswerefollowedupforlongerperiod toseethe complicationsandoutcomes.Cullenetal.**24**]conductedastudyinwhichhesuggestedthattherearenochances ofposttraumaticarthritisat1st CMCjointafter fracturehas healedwitha stepof2-mm.ourresultsseemdiffer fromthatofCullenetal. **24**],duetothefactthatCullendidhisstudyoncadavers, whileinaclinicalsituation,the resultswouldbedifferent. AsperstudyofGeddaandMoberg,1953thearthritisseeninpatientstreatedwithORIF weredegenerative(degenerativechangesinthejointoccurredduetotheageofthepatients)ratherthanpost traumaticwhichusuallyappearswithin5yearsofoperationasseenin ourstudy. Limitationsofourstudythatwehavenotperformed computerizedaxialtomographyscantoevaluatethejoint reductionandarthritisascomputerizedaxialtomographyscanisthegoldstandardinevaluatingjointsurface detailsandweusedonly dorso-radialapproach. Selectionbiasisthereduetopersonalchoiceofsurgeon.

V. CONCLUSION

InBennettfractureanatomicalreductionandpropersta bilizationoffractureisofutmostimportanceincaseof preventingpost-oppainandpost-oparthritisandforearlymobilizationandbetteroutcome. Thesegoalsarevery wellachievedbymeansofORIFwithkwires withverylow costandmoderateresources.

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Fig1Fracturereductionandplacementof2 kwire.
Fig2Dorso-radialapproach
Fig 3Post opx-rayat3weeks