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Modified Dunn Procedure /Safe Surgical Dislocation And Capitalrealignment For Moderate To Severe Slipped Capital Femoralepiphysis

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ABSTRACT:

BACKGROUND:

The management of unstable slipped capital femoral epiphysis is controversial and evolvingover the years. The most common complication following unstable slipped capital femoralepiphysis is osteonecrosis of the femoral head leading to secondary osteoarthritis of the hipjoint if left untreated. The modified Dunn procedure through safe surgical hip dislocation hasrapidly gained popularity as a treatment for unstable slipped capital femoral epiphysis withlow complication rates. This study aims to analyze the clinical outcome, radiologicaloutcome,AVNrate,andcomplicationsinpatientsundergoingmodifiedDunnprocedure.

MATERIALSAND METHODS: Prospective study was conducted between 2015 and 2020at our institute for treating moderate-severe SCFE with modified Dunns procedure in 10patients, with a mean age of 13.2 ± 3.4 years (range: 10 - 16.5 years). All the patients wereassessed with slip angle degree, alpha angle, neck-shaft angle, Harris hip score,preoperatively,andpostoperatively.

RESULTS: At recent follow-up with a mean follow up of 22 ± 9.2 months (range: 12 - 46months). Radiologically in all ten patients, significant improvement; with the mean slip anglecorrectedfrom61º±14.4 (47 – 82) preoperativelyto 10º±4.8 (02 – 18) postoperatively,the meanalpha anglecorrected from 90.2 ± 20.4 (59 – 118) preoperatively to 49.1 ± 8º (28 – 60) postoperatively, and the mean femoralnecklengthdifference was8.1±6mm.Functionally,themean Harrisship score(HHS)was86.2 ± 6 (38 – 92), and postoperative Avascular necrosis occurred in only one case (10%). Nopatients developed implant failure, chondrolysis, infection, deep venous thrombosis,heterotopicossification,nonunion,ornervepalsies.

CONCLUSION: Modified Dunn's procedure is a safe and effective treatment method formoderate-severeSCFE,enablingrestorationoftheproximalfemoralanatomyandnormalhipfunctioninpatients.

KEYWORDS: Slipped capital femoral epiphysis, Modified Dunn procedure, Safe surgicaldislocation ofthehip,AvascularnecrosisinSCFE.

I. INTRODUCTION

SCFE is the most common disorder affecting the US adolescent population,with an incidence of 10 per 100000. Treatment of SCFE has been controversial and evolvingover the years[9,10]]. The main goals of SCFE treatment are to prevent further slip progression,achieve stabilization and restoration of hip function, and avoid premature hip osteoarthritis[8]while minimizing the risk of AVN and subsequent proximal femoral deformity[11]. RealignmentOsteotomies have been proposed to restore the proximal femoral anatomy, but historically,AVN complications remaincontroversial.The primary risk associatedwith osteotomy isdamaging the posterior branch of the medial femoral circumflex humeral artery[1-3,6]. Thereforeaiming to correct deformity and to protect the femoral head blood supply, Ganz and hiscolleagues recently described a modified

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Dunn osteotomy performed through the surgicaldislocation of the hip, which could entirely expose the hip joint protecting the retinacularvessels. This approach has gained popularity over the past decade in the treatment ofmoderatetosevereadolescentSCFE.
TherationalebehindcorrectingdeformityistopreventFemoral Acetabular Impingement and future arthrosis and to normalize the hip range ofmotion[12]. The retinacular vessels are protected in a periosteal flap during the femoral headreduction with low complications rate after SCFE, ranging from most severe AVN of thefemoral head to metaphyseal deformity, which may lead to femoral acetabular impingementandcartilageaswellaslabraldamage[4].Inthisstudy,weanalyzedtheclinicaloutcomeresultsbased on Harris Hip scoreRadiological outcome based on South wick Angle, Alfa angle,Head neckoffset, and complicationsfollowingtheprocedure.

II. MATERIALS AND METHODS

This is a prospective study approved by the educational committeeconducted between 2015 and 2020 at our institute to treat moderate to severe SCFE withmodified Dunn procedure in 10 patients with a mean age of 13.2±3.4 (10-16.5 years) andmean BMI ranging from. All patients were assessed with slip angle, Alfa angle, neck-shaftangle,Harriship scorepreoperativelyandpostoperatively.

Surgicaltechnique:

Place the patient in the lateral decubitus position. Make a Gibson approach. Mark the level anddirection of the trochanteric osteotomy with a knife or Bowe. After the osteotomy, the gluteusmedius, the vastus lateralis, and the long tendon of the gluteus minimus will remain attached to thetrochanteric fragment. The maximal thickness of the trochanteric fragment should not exceed 1.5cm. Expose the hip joint capsule by further dissection between the piriformis tendon and gluteusminimus, an interval that offers the best protection for the blood supply to the femoral head. Flipthe greater trochanteric fragment anteriorly by elevating the vastus lateralis along its posteriorborder. Flex and externally rotate the leg to increase the exposure of the capsule. Incise the capsulein the Z-shaped along the posterior border of the acetabulum. Flex and externally rotate the hip andplace the leg into a sterile bag over the table's anterior side to sublux the femoral head. After safedislocationofthehipjointiftheepiphysisismobileorstabilityisquestionable,prophylacticpinningis recommended; however, any attempt at reducing a mobile epiphysis anatomically should beavoided at this time because there is a high risk of pathologic stretching of the retinaculum beforeremoval of the posterior callus. Before surgical dislocation, drill a 2-mm hole in the femoral head todocument blood perfusion. Rotate the leg to make visible the difference in surfaces of the femoralhead and record the actual amount of epiphyseal slip. Frequently moisten the femoral head cartilageduring exposure.Reduce the femoral head into the acetabulum to create the soft-tissue flapconsistingoftheretinaculumandexternalrotatorsandcontainthebloodsupplyforthe epiphysis.

Incise the periosteum of the neck anterior to the visible retinaculum from the anterosuperior edgeof the trochanter physis toward the femoral head. With the femoral head dislocated, use two bluntretractors to expose the femoral neck medially and laterally, avoiding any stretching of theretinaculum. Mobilize the epiphysis in a stepwise fashion with a curved 10-mm osteotome placedanteriorly into the physis. Removal of a posteromedial callus bridge in flexion external rotation mayfacilitate this step. Spontaneous reduction of the isolated epiphysis into the acetabulum may occurat this time. Normally, the exposed epiphyseal bone shows clear bleeding as a sign of intactperfusion. After removal of all callus particles, reduce the epiphysis onto the neck under visualcontrol of the retinacular tension; reduction is more comfortable with internal rotation of the leg. Ifanytensionintheretinaculumoccursduring thismaneuver,immediatelystopthereduction.

Carefully determine the correct spatial orientation of the epiphysis. Use a palpating instrument orfluoroscopytoensurethat the epiphysisborderhasanequaldistancetotheneckinallplanes.

Visually check correct rotation relative to the location of the retinaculum and the fovea capitis. Usefluoroscopy to obtain the correct varus-valgus position.When the right position is obtained,temporarily fix the epiphysis in place with a fully threaded Kirschner wire inserted in a retrogradedirection through the fovea capitis, perforating the lateral cortex of the femur just distal to thevastus lateralis. Pull this wire back so far that its tip is level with the articular head cartilage andreduce the head into the acetabulum to allow final control of alignment with fluoroscopy. If theperfect alignment of the epiphysis is achieved, insert one or two additional fully-threaded Kirschnerwires from the lateral cortex of the subtrochanteric bone. Check the correct wire length visually orwith fluoroscopy. The wires should be parallelly placed. Close the periosteal tube with a

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few stitches,avoiding any tension. Close the capsule, also without any tension. Fix the trochanteric fragment withtwo 3.5-mmcortical of size 52 to 54 in length. Carefully close the subcutaneous adipose tissue inseverallayers;suctiondrainageusually isnotnecessary.

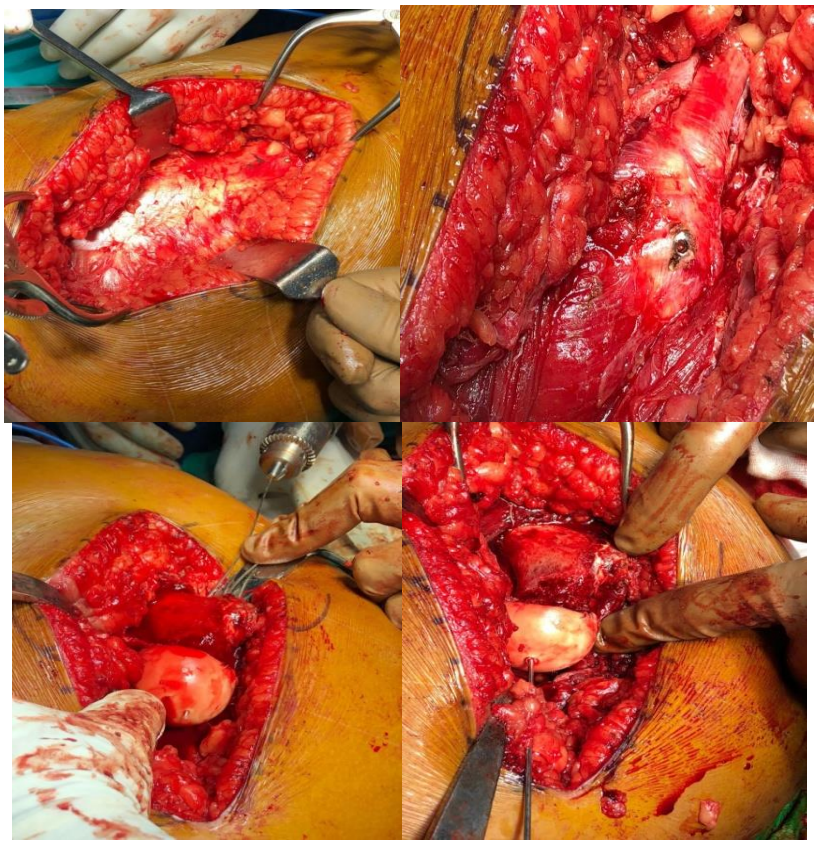

Fig.1 Intraoperative images of the procedure.

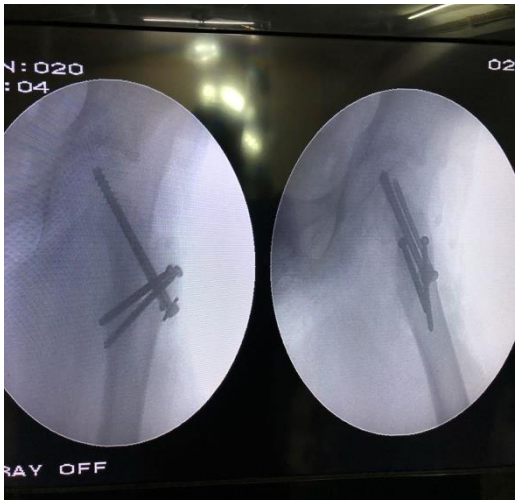

Fig. 2 Intraoperative C- arm image of the procedure.

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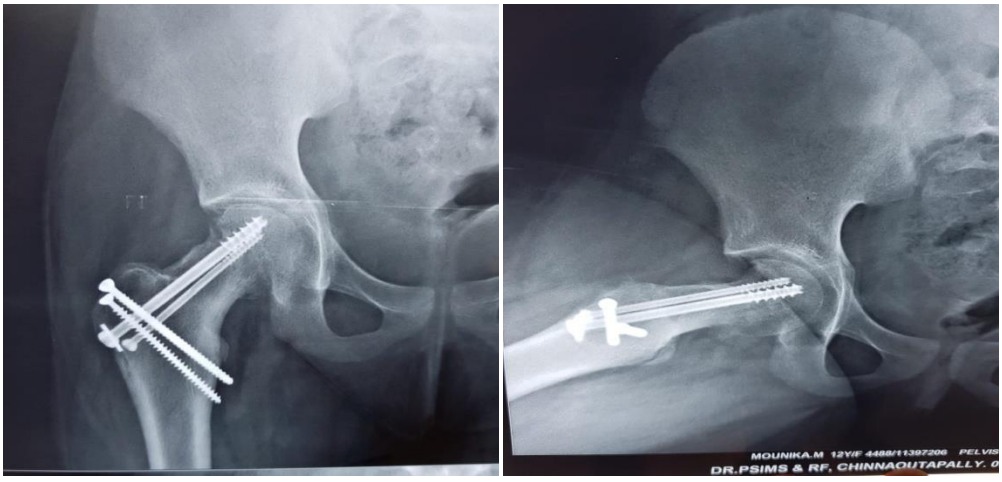

Fig.3 Follow up radiographs after 24 months.

POSTOPERATIVECARE. Continuouspassivemotionisusedduringthepostoperativehospitalstay.Crutches are used for toe-touch walking. Deep venous thrombosis prophylaxis with low-doseheparin is administered to obese patients only. Full weight-bearing is allowed at 8 to 10 weeks ifradiographs showhealingofthetrochantericosteotomy.Strengthening ofthegluteusmediusis begun at 6 to 8 weeks. Implant removal should not be done until complete radiological signs ofhealing are seen.

Table 1: Demographics and preoperative characteristics

Patients	10
Age range(year)	13.2 ± 3.4 (10 – 16.5)
Sex (F:M)	6:4
Hip (L:R)	7:3
Duration of follow up (range) (months)	22 ± 9.2 (12 – 46)
Slip angle (degree)	61 ± 14.4 (47 – 82)
Alpha angle (degree)	90.2 ± 20.4 (59 – 118)

III. RESULTS

At recent follow-up with a mean follow up of 22 ± 9.2 months (range: 12 - 46months). Radiologically all ten patients showed significant improvement; with the mean slipanglecorrected from61º±14.4(47 – 82) preoperativelyto 10º±4.8 (02 – 18) postoperatively,the mean alphaangle corrected from 90.2 ± 20.4 (59 – 118) preoperatively to 49.1 ± 8º (28 – 60) postoperatively, and the meanfemoral neck length difference was 8.1 ± 6 mm. Functionally, the mean Harris hip score(HHS) was 86.2 ± 6, and postoperative Avascular necrosis occurred in only one case(10%). No patients developed implant failure,chondrolysis, infection, deep venousthrombosis,heterotopicossification,nonunion ,ornerve palsies.

Table 2. Radiographic results and clinical findings

Slip angle (°)	10 ± 4.8 (2 to 18)
Alpha angle (°)	49.1 ± 8 (28 to 60)
HHS score (range)	86.2 ± 6 (38 to 92)
complications	

AVN	01
Infection	0
Trochanteric nonunion	0
Implant failure	0

IV. DISCUSSION

Treatment of severe SCFE remains a challenging problem[9,10]. Traditionally thegoal of primary treatment of SCFE has been to stabilize the epiphysis and prevent additionaldisplacement and complications, thereby restoring reasonable function and delaying orpreventing OA[4,5]. To resolve the above issues, the modified Dunn procedure has been apromising technique that can address both physeal stability and residual deformity withpossible lower complication rates in the treatment of SCFE. Our data suggest capitalrealignment of SCFE with open physis through the surgical dislocation approach can beperformed with low AVN rates. We believe this technique is most appropriate for moderate tosevere SCFE and especially for unstable SCFE. The safe execution of this procedurerequires a full understanding of the hip's vascular anatomy by the surgeon. This procedurerestorestheproximalfemoralanatomy,and weassumerestorationofnormalanatomywould lead to good long-term outcomes[14]. This procedure is technically demanding; however,we believe it is worth the investment of effort and skill for a condition that could have lifelongconsequences in an otherwise young patient. Several advantages of the modified Dunnprocedure have to be mentioned. First, it permits the complete removal of the posteroinferiorcallusandallowsepiphysealreduction withoutstretchingorkinkingoftheretinacularvessels. Second, capital realignment and offset at the head-neck junction can be directlyvisualized. Third, the impingement free movement of the hip can be tested intra-operatively.Fourth, the blood supply to the femoral head can be checked during surgery, and measuresfor improvement during surgery are possible. And fifth, the correct extra-articular position ofall implants can be assured without an image intensifier, thus avoiding intra- articular implantpenetration withsubsequentchondrolysis.

V. CONCLUSION

The modified Dunn procedure offers the technical possibility to achieve nearanatomical realignment of the capital epiphysis in SCFE hips and preserving vascular supplyto the epiphysis. Long-term outcome data show good to excellent scores, nearly normal hipfunction, and low rates of AVN or progression of OA. In our opinion, all severity groups ofSCFEshould betreated thesamewayto restorenormalhip function

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