Reconstruction by ilizarov technique for sequelae of pediatric hip septic coxitis: A case study of a new technique with 14 years follow-up

Mikhail Teplenky ^a, Waleed mekki ^{a, b, *}, Edward Parfenov ^c, Evgenii Oleinikov ^c

^a Head of Pediatric Orthopedics Department No. 11, Russian Ilizarov Scientific Center for Restorative Traumatology and Orthopaedics, Russia

^b Pediatric orthopedic surgeon and Post-doctoral Fellow and the Department of Pediatric Orthopedics No. 11, Russian Ilizarov Scientific Center for Restorative Traumatology and Orthopaedics, 6 M.Ulyanova Street, Kurgan, 640014, Russia

^c Orthopedic surgeon, Pediatric Orthopedics Department No. 11, Russian Ilizarov Scientific Center for Restorative Traumatology and Orthopaedics, Russia

ARTICLE INFO

Article history:

Received 27 January 2020

Received in revised form

11 June 2020

Accepted 20 June 2020

Keywords:

Septic hip coxitis

Ilizarov technique

Neck lengthening

Hip reconstruction

Pelvic support osteotomy

ABSTRACT

Pediatric septic hip sequelae represent a challenging condition to the treating surgeons with conventional femoral and pelvic osteotomy being difficult to solve advanced head and neck destruction. Surgeons usually resolve to pelvic support osteotomy which is technically demanding and may require revision if performed before skeletal maturity. We report a 10 years old girl which had sequelae of septic coxitis Hunka type IVb, the patient was treated by a C-shaped pertrochanteric and Salter osteotomy and by applying Ilizarov methods of distraction histogenesis we did reduction and gradual lengthening of the femoral neck stump which was adapted to the acetabular cavity at last assessment, the clinical and radiographic parameters had improved significantly at 14 years long term follow-up and the patient was able to walk painlessly and without support. The case represents an introduction to an alternative surgical technique which makes future joint replacement more feasible.

© 2020 Delhi Orthopedic Association. All rights reserved.

1. Introduction

Although pediatric hip sepsis occurs rarely, it can be devastating and lead to serious sequelae on the hip joint. The potential complications of this condition are diverse and usually result in a marked functional impairment. The main goal of treatment is to improve functional ability of the limb by providing stability and eliminate limping and pain. Reconstructive treatment options can be advocated for grade 4 and 5 joints according to Hunka classification¹ (Table 1) Pelvic support osteotomy (PSO) which is a double level osteotomy, a proximal valgus-extension and a distal varus-lengthening is usually performed and reserved for older children and young adults in whom joint replacement is not amenable.² Although Ilizarov advocated the distal varus osteotomy to overcome mechanical axis deviation resulted from the valgus extension³ the technique still challenging and technically demanding,

the advantages for this technique is to increase pelvic stability and make walking painless and equalize limb length, it should be noted that it would also make further joint replacement more challenging.⁴ Through more than twenty five years of experience of applying Ilizarov technique in treating pediatric hip conditions, we have developed a new procedure which correct the resulting proximal femoral deformity, stabilize the hip and lengthen the remaining neck fragment and limb. The technique is performed through a C-shaped pertrochanteric osteotomy and distraction by Ilizarov frame. The procedure is usually completed by pelvic osteotomy (Fig. 1). To best of author's knowledge this technique has never been used to treat sequelae of septic coxitis.

1.1. Case report summary

A 10 years old female patient presented with left hip grade IVb septic coxitis according to Hunka (Table 1) the patient had a previous operation with attempt of open reduction at age of two years which didn't help to solve her condition, after discussion with the patient guardians they agreed on the operation. This case study is done with approval of our institutional review board (IRB). Clinical features included severe contracture of the left hip joint with 5 cm shortening of the limb. Radiographic

* Corresponding author. Head of Pediatric Orthopedics Department No. 11, Russian Ilizarov Scientific Center for Restorative Traumatology and Orthopaedics, Russia.

E-mail addresses: teplenkiymp@mail.ru (M. Teplenky), waleedmekki@excite.com (W. mekki), ed.ortoped@mail.ru (E. Parfenov), ortho-kgn@mail.ru (E. Oleinikov).

Table 1

Hunka classification of septic hip arthritis sequelae in children.

Type	Description
I	Absent or minimal femoral head changes
IIa	deformity of the femoral head with intact physis.
IIb	deformity of the femoral head with premature physal closure.
III	Pseudoarthrosis of the femoral neck.
IVa	Complete destruction of the capital femoral epiphysis with stable neck fragment.
IVb	Complete destruction of the capital femoral epiphysis with instable small neck fragment.
V	Destruction of both the femoral head and the femoral neck to the intertrochanteric line with hip dislocation.

Fig. 1. Schematic drawing of the technique with neck stump lengthening using Ilizarov frame. the technique is applied with Hunka type IV a-b and the remaining neck stump should be $\geq 30\%$. (a) basal neck curved pertrochanteric osteotomy and application of ilizarov frame. (b) femoral neck distraction. (c) stabilization of femoral neck after completion of distraction by multiple k-wires. (d) maintaining fixation during consolidation. (e) Salter pelvic osteotomy to cover the neck regenerate.

signs were absent femoral head and major part of the neck, the neck stump was at the level of the outer edge of the acetabular cavity, there was also severe dysplasia of the acetabular cavity with acetabular index of 44 and interruption of the Shenton line of about 4 cm (Fig. 2).

1.2. Surgical technique

In the operating room and under general anesthesia and the use of C-arm image intensifier five k-wires with olives are passed through the left iliac wing at least one of them is in opposing

Fig. 2. Pelvic radiographs of a 10 years old female with left septic coxitis sequelae grade IVb Hunka. (a) septic destruction of left hip joint with loss of a large part of neck, severe acetabular dysplasia and pathological dislocation with increased acetabular index (44) and 4 cm disruption of shenton line. (b) Ilizarov frame application with basal neck osteotomy and distraction. (c) After frame removal with healing Salter osteotomy and increase head coverage. (d) three years follow-up at age of 13 years showing consolidation of elongated neck and modeling of a head like structure with improved acetabular index to 10. (e) 14 years follow-up showing complete remodeling of the hip joint with congruent head.

direction so the construct will not slide or migrate over the iliac wing, another four k-wires are inserted into the distal femoral metaphysis. All wires are then connected to the Ilizarov apparatus by arches which are connected together by rods to complete frame assembly (Fig. 1.a). The thigh is set into full extension and 50° internal rotation because of increased femoral anteversion, we then passed three k-wires into the base of the neck stump to stabilize the proximal part during the distraction phase. The wires should be

inserted from the anterior to the posterior direction, with the two wires 35° apart in the axial plane. With radiographic assessment, we determine the location and direction of the osteotomy and insert multiple k-wires along the line from the greater to the lesser trochanter in a C-shaped manner and with partial disassembly of the frame at the osteotomy site and through a 3 cm incision along the anterior surface of the hip joint a 5-mm osteotome is passed along the weakened line made by multiple k-wires, the osteotomy

is then produced by rotation of an elevator inserted into the osteotomy site. We set a prerequisite of neck fragment of $\geq 20\%$ of its original length for the procedure. We started distraction after the sixth day for 52 days to achieve an additional length of 26 mm to the neck at a rate of 0.5 mm per day, the neck fragment is stabilized by a wire connected to the frame so when distraction start it will not change its direction (Fig. 1 b-e). Table 1 The rate was slower than the standard rate of 1 mm per day due to the fact that this was a post infective anatomical region and there could be fibrous and dysplastic tissues, at the end of distraction and in the operating room we inserted multiple wires into the neck regenerate and connect it with the frame the aim of which is to stabilize the regenerate during reduction phase, the proximal femur was then directed to the lower edge of the acetabulum at a rate of 1 mm per day for 34 days. Then within the next 16 days and a rate of 1 mm per day a gradual reduction of the femoral neck into the acetabular cavity is performed. The patient then had a Salter type osteotomy which is connected by a small diameter (3mm) Schanz pin to stabilize the upper fragment of the osteotomy (Fig. 2) postoperatively, patient is encouraged to walk with crutches and after neck consolidation and union of the pelvic osteotomy the device is removed and the patient is recommended to start full hip movements with assistance of a physical therapist. One year later follow-up revealed that patient is able to fully weight bear with no pain and with equal limb lengths. Radiographic imaging also showed the consolidated neck is centered in the acetabular cavity with semi-complete head reformation, Other clinical and radiographic parameters can be seen in (Table 2) and (Fig. 2) with careful pin tract site dressing change the patient didn't show pin tract infection. At eleven years postoperative follow-up radiography showed complete head and neck regeneration, the joint was spherical and congruent, Colman class 1.

2. Discussion

The sequelae of septic hip arthritis present a difficult condition to manage, a wide scope of dysplastic hip conditions are usually treated by femoral, pelvic osteotomies or combination. Other options include hip arthrodesis with its drawback on patient mobility and maladaptive effects on adjacent joints⁸ with restricted hip motion especially in the teenage group who are in need of better range of motion for daily and sport activities. Total hip replacement (THR) at early age (11–19) reported by Masako T et al.⁹ showed out of (132) operated hips the 10-year survival rate was 70%. Moreover,

39 patients had at least 1 revision and 16 patients had 2 or more revisions. They concluded that young patients with hip dysplasia had lower implant survival and bone stock. Until recently hip preserving surgery for such patients is mainly performed by Pelvic support osteotomy (PSO)² which is indicated to relieve painful limping and stiffness associated with hip joint destruction due to septic coxitis or severe hip dysplasia.⁵ A major drawback of this osteotomy is when it's done before skeletal maturity and with child growth and skeletal remodeling at the proximal femoral osteotomy site the deformity will be reproduced with the loss of pelvic support occurring as early as 12 months after the procedure.^{4,5} Another drawback of (PSO) it is the difficulty for future conversion to THR due to distorted anatomy of the proximal femur, Ahmed T et al.⁴ reported a case who had PSO at 14 years old which needed another proximal valgus osteotomy revision after 5 years, they did conversion to total hip replacement 15 years later and encountered difficulty with anterior proximal femur cortex penetration which necessitated a revision surgery to augment the implant. This case showed the need to defer PSO if to avoid deformity revision.

A review of this case showed applying Ilizarov technique for limb reconstruction in treating sequelae of septic hip coxitis utilizing the concept of transosseous osteosynthesis used by Ilizarov.⁶ The concept of femoral neck lengthening in the sequelae of pediatric hip ischemia in developmental dysplasia of the hip (DDH) have been reported with mid-term successful outcome and restoration of clinical and radiographic parameters with hips being stable painless and without lurch or limb length discrepancy.⁷ The structural improvement in the neck is mainly due to the angiogenic effect that occur during distraction osteogenesis which promotes osteochondrogenesis and remodeling.¹⁰ Moreover our patient had a near normal anatomical axis and restoration of NSA, Shenton line and Wiberg angle which indicates a reduced and stable hip. Possible complications that may occur include Pin Tract Infection and loosening of the device components, both of which can be addressed by stable fixation. Another possible complication is injury to the neurovascular structures, we recommend surgeons to be fully oriented about the anatomy of the pediatric hip structures.

3. Conclusion

We believe that this long term follow-up proved that this technique for treatment of sequelae of septic hip coxitis has a good outcome and the advantage of simultaneous femoral neck and limb lengthening, it also doesn't affect the anatomical axis of the femur which makes future joint replacement more feasible. However, this technique require longer duration in frame and an experience with the Ilizarov technique and while PSO might not be a permanent answer for the treatment pediatric hip instability and dysplastic conditions our technique will offer a feasible alternative.

Statement of ethics

Informed consent have taken from the patient for the purpose of publication of the manuscript.

Declaration of competing interest

The Authors declare that they have no conflict of interest with regard to the study submitted.

References

- Hunka L, Said SE, MacKenzie DA, Rogala EJ, Cruess RL. Classification and surgical management of the severe sequelae of septic hips in children. *Clin Orthop*

Table 2
Patient pre and postoperative clinical and radiographic values.

Parameter	Preoperative	Postoperative final
Trendelendburg gait	+ve	-ve
Flexion	80	90
Extension	15	24
Abduction	95	115
Adduction	60	65
Internal rotaion	20	40
External rotation	30	45
Pain	NO	NO
knee Flexion	80	90
Knee Extension	180	180
LLD (shortening)	5cm	—
Acetabular index	44	10
Wiberg angle	0	32
NSA	90	135
ATD	–28 mm	10 mm
Shenton line	4 cm	0.5 cm

LLD; limb length discrepancy NSA; Neck shaft angle ATD; Articulotrochanteric distance.

- Relat Res.* 1982 Nov-Dec;(171):30–36.
2. Pafilas D, Nayagam S. The pelvic support osteotomy: indications and preoperative planning. *Strategies in Trauma and Limb Reconstruction.* 2008;3(2): 83–92. <https://doi.org/10.1007/s11751-008-0039-7>.
3. Ilizarov G. Treatment of disorders of the hip. In: Green S, ed. *Transosseous osteosynthesis.* Berlin: Springer; 1992:668–696.
4. Thabet Ahmed M, Catagni Maurizio A, Guerreschi Francesco. Total hip replacement fifteen years after pelvic support osteotomy (PSO): a case report and review of the literature. *Musculoskelet Surg.* 2012;96:141.
5. Rozbruch SR, et al. Ilizarov hip reconstruction for the late sequelae of infantile hip infection. *J Bone Joint Surg Am.* 2005;87(5):1007–1018.
6. Ilizarov GA. The tension-stress effect on the genesis and growth of tissues. Part I. The influence of stability of fixation and soft-tissue preservation. *Clin Orthop Relat Res.* 1989;238:249–281.
7. Teplenky Mikhail, Waleed Mekki. Pertrochanteric osteotomy and distraction femoral neck lengthening for treatment of proximal hip ischemic deformities in children. *Journal of Children's Orthopaedics.* 2016;10(1):31–39.
8. Thambyah A, Hee HT, Das De S, Lee SM. Gait adaptations in patients with longstanding hip fusion. *J Orthop Surg.* 2003 Dec;11(2):154–158.
9. Tsukanaka Masako, et al. Implant survival and radiographic outcome of total hip replacement in patients less than 20 years old. *Acta Orthop.* 2016;87: 479–484.
10. Pacicca DM, Patel N, Lee C, et al. Expression of angiogenic factors during distraction osteogenesis. *Bone.* 2003;33(6):889–898.