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Reconstruction of Unstable Hips with Ilizarov Technique. Role of Pelvic Support and Distal Lengthening Realignment Osteotomy

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SUMMARY

Background. Hips can suffer severe damage due to untreated developmental dysplasia, septic arthritis, tuberculosis, a neglected fracture of the neck of femur and neglected hip dislocation. The Ilizarov technique offers an effective treatment by providing a stable hip with abolished Trendelenburg lurch and equalizing limb length discrepancy through distal lengthening realignment osteotomy.

Material and methods. 20 patients with hip instabilities due to various etiologies were treated with the Ilizarov technique of pelvic support osteotomy and distal lengthening realignment osteotomy. There were 12 females and 8 males in the study group and the age range was 13 to 30 years. Average limb length discrepancy was 5.95cms (range 4-8.5cms).The pre-operative and post-operative range of motion and Harris hip score was collected and data analyzed by Student's paired t test. A p value of < 0.05 was taken to be statistically significant

Results. The functional Harris hip score improved in all the patients at final follow-up. The mean Harris hip score was 56.95 (range 33-71) pre-operatively, which improved to 83.25 (range 73-85) at final follow up and was statistically significant (P-value < 0.05). The mean length achieved was 5.53cms (4-8cms). The mean external fixation time was 8.6 months and the mean healing index was 1.54 months /cm.

Conclusions. 1. Ilizarov hip reconstruction is an excellent method of salvage in patients with unstable hips of diverse etiologies especially in this part of the world, where patients demand unrestricted range of motion at hip, and in the younger age group, where other procedures do not offer a long term solution. 2. It provides an excellent functional outcome in hips of different etiologies. 3. However, for an excellent outcome, surgical expertise, patient compliance and meticulous follow-up are mandatory.

Key words: Ilizarov hip reconstruction, pelvic support osteotomy, unstable hips

BACKGROUND

Hip instability in adolescents and young adults is a challenge to orthopedic surgeons. The etiology includes untreated developmental dysplasia, septic arthritis, tuberculosis, a neglected fracture of the neck of femur or a neglected hip dislocation. Whatever the etiology, an unstable hip joint is a source of great discomfort to the patient due to pain, limp and limb length discrepancy. An unstable hip results in a marked Trendelenburg gait which is ineffective and stressful to the spine and other joints [1]. Treatment goals are to provide a stable, painless mobile functional hip with minimal limb length discrepancy. Various treatment options are described in the literature. Total hip arthroplasty, arthrodesis and resection arthroplasty are well described. Arthrodesis can be a satisfactory salvage operation for unilateral hip pathologies but provides an immobile stiff hip, as a result of which ipsilateral knee problems are the main consequences. Total hip replacement has become the first choice of treatment for patients with unstable hips as it provides a painless hip with a good range of motion. However, in the younger age group, these prostheses are subjected to substantial mechanical stresses and consequently early failures [2,3,4]. The procedure may not offer full correction of limb length discrepancy. Moreover, patients in this part of the world do not accept restrictions to squat and to kneel for prayers, which are not advisable for hip arthroplasty patients.

For the salvage of unstable hips in which arthrodesis or hip arthroplasty is not appropriate, the pelvic support osteotomy is a useful reconstructive surgical procedure. It is a procedure that has much to offer the adolescent or young adult who has painful limping, restriction of hip motion and limb length discrepancy. A well performed Ilizarov hip reconstruction provides a stable hip and an energy efficient gait by abolishing the Trendelenburg lurch and equalizing the limb length discrepancy through distal realignment lengthening osteotomy.

The primary aim of this study was to evaluate the functional results of pelvic support osteotomy in salvage of unstable hips of different etiologies. The secondary aim was to assess the complications arising thereof.

MATERIAL AND METHODS

The study involved 20 patients with hip instabilities of different etiologies in adolescents and young adults who were admitted consecutively in our institution from December 2005 through March 2012. (Table 1) All patients who presented with limp, Trendelenburg lurch and limb length discrepancy were evaluated for etiology of hip instability by meticulous history, radiographs and other investigations. Patients with bilateral hip instabilities were excluded from the study. The study group included 12 females and 8 males in the age group of 13 to 30 years. Right side involvement was seen in 13 and left side in 7 patients. Hip instability was due to post-septic sequelae in 12 patients, tuberculosis in four patients, neglected hip dislocation in two and a neglected fracture of the neck of femur in two patients. Average limb length discrepancy was 5.95cms (range 4-8.5cms). Patients with post-septic sequelae not deemed suitable for total hip arthroplasty were chosen for the procedure for obtaining pelvic support as well as correction of limb length discrepancy. Four patients with tuberculosis and one patient with failed open reduction for neglected hip dislocation with severe restriction of motion were first subjected to excision arthroplasty to render them unstable but mobile. One of the patients with a neglected fracture of the neck of femur had been operated with valgus osteotomy, which, however, failed to unite the fracture and left the head and neck completely resorbed. All patients gave written informed consent to be included in this study and the study was approved by the local ethical committee of the institution. A detailed clinical evaluation was performed in all patients which included limb length discrepancy, presence or absence of the Trendelenburg sign and gait, grading of limp (as per Paley classification [5]), range of motion of the hip and knee, any previous surgery and functional assessment in the form of the Harris hip score (Fig. 1).

Pre-operative planning/ Evaluation

The initial evaluation of the patients involved a conventional AP radiograph of the pelvis with both hips and a lateral radiograph of the affected hip. All patients had a full length radiograph/scanogram to assess the deformities and limb length discrepancy (Fig. 2). Additional radiographs included a radiograph of the pelvis with the affected hip adducted to assess the level of pelvic support osteotomy and a pelvic X ray with affected limb stance to assess the available adduction at the affected hip to calculate the drop of pelvis. The amount of valgus at the proximal osteotomy was calculated using Paley's method [6]. The realignment lengthening osteotomy was planned using the intersection between the tibial axis drawn proximally and the mechanical axis from the acetabulum. Before proceeding with the Ilizarov hip reconstruction, four patients with ankylosed hips were initially treated with Girdlestone excision to make these hips mobile but unstable. The frame construc-

Fig. 1. Preoperative scanogram showing non-union fracture of neck of femur with proximal migration of trochanter

Fig. 2. post-operative radiographs showing two osteotomies with lengthening and varusization at distal ostoetomy

tion consisted of a 5/8th ring at the level of patella, a dummy full ring connected to an Italian arch through oblique posts and rods with hinges to allow varusization during realignment. Another Italian arch was used at the trochanteric region to fix the pelvic support osteotomy

Surgery

Surgery was performed under spinal/epidural anesthesia on a fracture table under C Arm control. After proper draping, the preplanned ring fixator was mounted on the femur starting with a 5/8 ring at the level of patella. The proximal arch was fixed using threaded half pins in the longitudinal plane. The proximal pelvic support osteotomy was performed at a level where the adducted femur approached the ischial tuberosity. Once the osteotomy was completed, the limb was abducted as per the pre operative planning and the two Italian arches were connected with threaded connecting rods. At this stage, the site of the distal realignment osteotomy was selected at the junction of the extrapolated tibial mechanical axis and the mechanical axis of the femur through pelvic support osteotomy. Intra-operatively we performed this using long Iliarov wires as the axis plotters. A low energy corticotomy was performed at this site and the ring stabilized. Small incisions at the osteotomy site were closed with silk and antiseptically dressed.

Fig. 3. Post-operative scanogram showing equalization of limb length, restoration of mechanical axis and abductor tightening

Post operative management

All patients were ambulated on the 2nd post operative day and gradual range-of-motion exercises across the knee were initiated. Patients were discharged on the 3rd post-op day after being taught the methods of distraction. Distraction in a differential manner was started on the 5th day in children and 7th day in adults to create lengthening and varusization for realignment along the new mechanical axis of the affected limb (Fig. 3). The patients were followed initially weekly to assess the correct methods of distraction and thereafter at three weeks' interval till union of the pelvic support osteotomy, equalization of limb length and consolidation of the regenerate (Fig 4, 5, 6). The frame removal was performed at the time of appearance of at least three cortices on two-plane radiographs. Throughout the follow-up all patients were encouraged to perform range-of-motion exercises across the hip and knee.

Statistical analysis

The pre-operative and post-operative range of motion and Harris hip score was collected and data analyzed by Student's paired t test. A p value of < 0.05 was taken to be statistically significant.

RESULTS

The functional Harris Hip score improved in all the patients at final follow-up (Table 2). The mean Harris hip score was 56.95 (range 33-71) pre-operatively, which improved to 83.25 (range 73-85) at final follow-up and was statistically significant (P-value < 0.05). The mean follow-up period was 4.1 years. Pre-operatively all patients presented with limp which was Grade I in three patients and Grade II in 17 patients. At final follow-up only one patient persisted with Grade II limp while as Grade I limp was seen in 8 patients. The mean length achieved was 5.53cms (4-8cms). The mean external fixation time was 8.6

Tab. 1. Demographic and pre-operative clinical data

Patient No.	Age(years)	Gender	Side involved	Etiology	Limb length discrepancy (centimetres)	Previous Surgery	Pre-op Trendelenburg test	Pre-op grading of Limp
1	16	F	RIGHT	PSS	5	None	Positive	Grade I
2	15	M	RIGHT	NDH	6	Failed Open Reduction	NA	Grade II
3	27	F	RIGHT	PSS	7		Positive	Grade II
4	20	F	LEFT	TB HIP WITH FIBROUS ANKYLOSIS	6	Excision Arthroplasty	Positive	Grade II
5	31	F	LEFT	TB HIP WITH FIBROUS ANKYLOSIS	6.5	Excision Arthroplasty	Positive	Grade II
6	16	F	RIGHT	NEGLECTED #NOF	4	Valgus osteotomy - now with resorbed head	Positive	Grade II
7	19	F	RIGHT	NEGLECTED #NOF	4	None	Positive	Grade II
8	22	F	RIGHT	PSS	5	None	NA	Grade II
9	26	F	RIGHT	TB HIP WITH FIBROUS ANKYLOSIS	4	Excision Arthroplasty	Positive	Grade II
10	23	F	LEFT	PSS	7	None	Positive	Grade II
11	20	M	RIGHT	PSS	6	None	Positive	Grade II
12	18	F	LEFT	PSS	7	None	Positive	Grade II
13	30	M	RIGHT	PSS	8.5	None	Positive	Grade II
14	17	M	RIGHT	TB HIP WITH FIBROUS ANKYLOSIS	5	Excision Arthroplasty	Positive	Grade I
15	23	M	LEFT	POST # DISLOCATION HIP	8	None	NA	Grade II
16	21	F	RIGHT	PSS	5	None	Positive	Grade II
17	16	F	RIGHT	PSS	4	None	Positive	Grade I
18	15	M	LEFT	PSS	6	None	Positive	Grade II
19	15	M	LEFT	PSS	7	None	Positive	Grade II
20	19	M	RIGHT	PSS	8	None	Positive	Grade II

PSS=POST SEPTIC SEQUELAE; NDH=Neglected Dislocation Hip; TB Hip= Tuberculosis Hip; #NOF= Fracture of Neck of Femur; NA= Not applicable; ROM= Range of motion; F= Female; M= Male.

Tab. 2. Harris Hip Score and other parameters

Patient No	Pre-op HHS	HHS at final follow-up	Healing Index (months/CM)	External fixation Time (months)	Lengthening (centimeters)	Post-op Trendelenburg test	Post-op grading of Limp	Follow-up (years)	Complications
1	60	88	1.6	8	5	Negative	Grade 0	6	
2	33	77	1.4	8.4	6	NA	Grade I	6	
3	51	78	1.7	8.5	5	Negative	Grade I	6	
4	70	88	1.65	9.9	6	Negative	Grade 0	6	
5	71	88	1.7	7.6	4.5	Negative	Grade I	5	
6	48	88	1.2	4.8	4	Negative	Grade 0	5	
7	62	85	1.8	7.2	4	Negative	Grade I	5	
8	55	75	1.45	7.25	5	NA	Grade II	5	Re-fracture at lengthening site fixed with plate
9	70	83	1.4	5.6	4	Negative	Grade I	4	
10	53	73	1.6	11.2	7	Negative	Grade I	4	Anterior bowing of the regenerate, painful hip
11	66	89	1.6	9.6	6	Negative	Grade 0	4	
12	52	78	1.4	8.4	6	Negative	Grade 0	4	
13	71	90	1.75	12.25	7	Negative	Grade 1	4	
14	65	85	1.4	7	5	Negative	Grade 0	3	
15	50	78	1.7	13.6	8	Negative	Grade 0	3	
16	60	88	1.65	8.25	5	Negative	Grade 0	3	
17	62	85	1.2	4.8	4	Negative	Grade 0	3	
18	70	88	1.4	8.4	6	Negative	Grade 0	2	
19	53	73	1.6	10.4	6.5	Negative	Grade 0	2	
20	71	88	1.75	11.25	6.7	Negative	Grade 1	2	

months and the mean healing index was 1.54 months/cm. The mean time to union at proximal osteotomy was 14 weeks. 80% patients who were positive for Trendelenburg test at preoperative assessment became negative for the same at final follow-up. In a majority of the patients, the range of motion at the knee decreased during the lengthening procedure. It, however, improved in all patients at final follow-up.

We encountered few complications in our study, like re-fracture at the site of lengthening in one patient which was managed with plating. Anterior bowing of the regenerate in one patient did not require any interventions. One instance of pin breakage was managed by readjustment of the wire. Minor complications were in the form of recurrent superficial pin tract infections which were managed with oral antibiotics and pin care.

DISCUSSION

Pelvic support osteotomy (PSO) aims at improving hip stability, hip pain and limb length equalization in patients of hip instability of various etiologies. It is a highly demanding procedure but with minimal complications in expert hands. Perhaps, it is the only solution to hip instability of different etiologies in adolescents and young adults with gross limb length discrepancy in whom total hip arthroplasty and arthrodesis would be inappropriate. Although hip joint is not directly approached in this procedure, improved stability at the hip is achieved due to actual support of the pelvis on the osteotomized proximal part of the femur [7]. Total hip replacement in this group of patients may include extensive soft tissue release and need for customized implants. The recurrence of infection in patients with previous infective pathologies is a genuine concern.

In our series, patients between 15 to 31 years of age were included. Mean age in our series was 20.45 years. Age at the time of pelvic support osteotomy can affect successful results. As per the literature, PSO gives best results in patients over 15 years of age; otherwise the procedure may need to be repeated due to loss of correction at the proximal osteotomy site [3,4,8,9]. Ilizarov states that the mean loss of correction at the osteotomy site was 3 to 13 degrees for patients between 9 and 17 years of age [10]. A 5 degree loss of correction in a 12-year-old patient who had pelvic support osteotomy has been reported in

Tab. 3. Comparison of various series utilizing different modifications of Ilizarov hip reconstruction for the treatment of unstable hips

Parameter	Paley et al.	Emara	Bowen et al.	Mandar et al	Present series
Age (years)	11.2 (7.8–14.2)	51.9 (45–61)	25.3 (17–39)	19.1 (7–49)	(15-31)
Number	8 pts	11 pts	16 pts	23 pts	20
Etiology	Septic hip sequelae	Post-excision	Septic sequelae, DDH, poliomyelitis	Septic sequelae, DDH, SED poliomyelitis	Post-septic sequelae, tuberculosis, neglected dislocation, neglected fracture neck
Method used	Ilizarov	Ilizarov	Monolateral fixator	Hybrid external fixator	Illizarov
Harris Hip Score					
Pre-operative	51	43.5	50	63.43	59.65
Post-operative	73	70.9	87.6	75.17	83.25
Pin tract infection	3 out of 8 (all superficial)	7 out of 11 (severe)	2 out of 16 (all superficial)	12 out of 23 (all grade I)	14 (Grade 1)
Knee stiffness	Two required quadricepsplasty	One	No permanent stiffness	No permanent stiffness	Nil

the literature.[3] We did not see loss of correction in any of our patients as we included only patients above 15 years of age. Likewise El-Mowafi did not report any loss of correction in patients aged between 19 and 35 [11].

Pelvic support osteotomy has been found to be very effective in eliminating the Trendelenburg gait and sign, one of the hallmarks of unstable hips. Correction of Trendelenburg sign depends on the age at the time of operation and the volume of the gluteus medius muscle.[12] In our series we reported correction of Trendelenburg gait in 16 of 20 patients but in rest of the four patients, Trendelenburg gait persisted but improvement was recorded. El-Mowafi reported a correction of Trendelenburg gait in 20 of his 25 patients [11]. Kocaoglu et al. reported a correction of Trendelenburg gait in 11 of their 14 patients [3]. Manzotti et al. reported correction in 9 of their 15 patients and Inan and Bowen in 12 of 16 patients [13-14]. Except for arthrodesis, no other method has been able to successfully address this aspect of the problem. In contrast to arthrodesis, it preserves an acceptable, painless range of motion of the hip.

Lower extremity length discrepancy of a variable degree is seen in almost all patients with hip instability of chronic nature. To improve gait mechanics, equalisation of lower limb extremity is very important because without equalization of the lower-extremity length, pelvic drop cannot be prevented [4,5]. To achieve this, distal osteotomy with gradual lengthening and varusization is done at the same time as pelvic support osteotomy. Mean lengthening achieved in our series was 5.53cm (range 4-8 cm).

Mean range of motion at hip increased after this surgery in all patients. There was a decrease in the mean flexion and adduction range of motion associated with a corresponding increase in mean extension and abduction after the procedure. In this series, the mean hip flexion decreased by 20% and the mean abduction increased by 17%. Rozbruch et al. reported a decrease in mean hip flexion of 26% and an increase in hip abduction mean range by 20% [2]. Results of different series in the literature and comparison with the present series have been tabled (Table 3).

One of the important applications of these principles in our series perhaps was the restoration of stability and function in patients with ankylosed hips wherein first instability was created to improve motion by Girdlestone excision and the instability and limb length discrepancy managed by Ilizarov hip reconstruction. Though the number of such patients in our series was less, the results were promising. A larger series would certainly define it better.

The final evaluation done by Harris hip scoring improved from a mean pre-operative score of 59.65 to a mean of 83.25 at final follow-up, which was statistically significant (p-value < 0.05).

CONCLUSIONS

1. Ilizarov hip reconstruction is an excellent method of salvage in patients with unstable hips of diverse etiologies especially in this part of the world, where patients demand unrestricted range of motion at hip, and in the younger age group, where other procedures do not offer a long term solution.
2. It provides excellent functional outcome in hips of different etiologies. However, for an excellent outcome, surgical expertise, patient compliance and meticulous follow-up are mandatory.

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