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ORIGINAL ARTICLE

Functional outcomes and postoperative complications after ilizarov hip reconstruction for abnormal hip joints.

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ABSTRACT… Objective: To evaluate functional outcomes and postoperative complications following Ilizarov hip reconstruction in patients with abnormal hip joints. **Study Design:** Prospective Observational study. **Setting:** Department of Orthopaedics and Spine Centre, Ghurki Trust Teaching Hospital, Lahore. **Period:** December 2024 and May 2025. **Methods:** Ilizarov hip reconstruction was done on forty-one patients between the ages of 15 and 40 years who had chronic, unstable, or abnormal hip joints. The main outcome of the functional activities was measured with the help of the Modified Harris Hip Score (HHS) preoperative and at final follow-up 6 months. The complications that occurred after an operation were documented and assessed descriptively. Statistical processing was done in SPSS, and the p-value of 0.05 was taken to be significant. **Results:** The mean age of patients was 26.4 ± 6.1 years, with 61% males. The mean Modified HHS improved significantly from 48.7 ± 9.6 preoperatively to 82.3 ± 7.4 postoperatively ($p < 0.001$). Postoperatively, 78% of patients achieved good to excellent functional outcomes. Complications occurred in 4 patients (9.8%), including pin-tract infection (4.9%), knee stiffness (2.4%), and delayed union (2.4%), all managed conservatively. No major complications such as deep infection, neurovascular injury, or mechanical failure were observed. **Conclusion:** Ilizarov hip reconstructs are effective on adolescents and young adults with abnormal hip joints and offer a high statistical improvement in terms of short-term functional results and a low complication rate. It is a safe and effective joint-preserving salvage intervention capable of restoring functionality, improving gait, and postponing the onset of total hip arthroplasty in this difficult patient population.

Key words: Abnormal Hip Joint, Functional Outcome, Harris Hip Score, Ilizarov Hip Reconstruction, Pelvic Support Osteotomy, Postoperative Complications.

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INTRODUCTION

In some young people and adolescents, there lies a condition that has become a significant clinical problem: It is abnormal hip joints, usually due to developmental dysplasia, deformity at birth, necrosis of the femoral head, or post-infection and post-traumatic sequelae. These disorders can lead to chronic pain, instability, discrepancy in limb length, abnormal gait, and progressive functional disability, which has a severe effect on quality of life and restriction of daily life activities.[1-5] Although the standard of care approach to end-stage hip disease in the adult population is total hip arthroplasty (THA), surgical intervention is less common in younger patients due to fears about the longevity of the implants, the necessity of revision surgeries, and the willingness to retain native bone and joint functions as long as possible. As a result, the collaborative preservation of the joint is severely required by exploring new surgical options that have the ability to reinstate functions, repair the deformity, and postpone or prevent the need to undertake prosthetic replacement.[1,2,6]

Another significant salvage surgery: Ilizarov hip reconstruction, or pelvic support osteotomy (in young patients with complicated hip pathology, who are not the ideal candidates for THA) has drawn attention in the world of orthopaedics. There have been changes to the original Ilizarov technique, including simplified forms of unilateral external fixation and minimally invasive forms of osteotomy with an external fixator, which have reduced the morbidity and discomfort of surgery and made it more available and tolerable to patients.[1,6]

Clinical research findings are consistent in that they show a significant functional improvement

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after Ilizarov hip reconstruction. According to the reports, patients rated that the Harris Hip Score had increased significantly; most patients experienced improved pain relief, increased walking distances, and corrected limb length discrepancies.[1-4,6] To illustrate, the mean Harris Hip Score improved between 45-53 at pre-operative and 70-87 at the post-operative stages, and the patients progressed to walk unaided and dropped the use of walking aids. This is also an effective procedure in the treatment of Trendelenburg gait and hip and knee movement restoration that will result in improved overall function and patient satisfaction. These benefits have been demonstrated to be lasting over the long term in many patients with excellent functioning outcomes, along with years of no or delayed need for THA.[2,7,8]

Regardless of these advantages, Ilizarov hip reconstruction is associated with a specific set of postoperative complications. Pin-track infections are the most common issues, and they are most likely to respond to local measures and antibiotics, whereas decreased range of motion of the knee is also addressed with physiotherapy.[1-4,6] There are other complications like fractures at the osteotomy site, which are normally treated using conservative methods.[1] Critical complications like failure of the devices, neurovascular injuries, or deep infections occur rarely. When the surgery is performed by skilled surgeons and under close postoperative care.[1,2] Long-term wear of external fixators and the extensive rehabilitation are known limitations. Still, they are masked by the functional advantages in the long term and the prevention of premature prostheses replacement.[2,4]

It has also been demonstrated that the Ilizarov technique is adaptable with numerous applications in the correction of various hip pathologies, such as sequelae of infantile hip infection, chronic instability, and complex deformities secondary to ischemic or post-infective change.[7,9,10] The ability to correct mechanical alignment, restore limb length, and improve gait mechanics has allowed it to fully apply to the difficult cases wherein other reconstructive surgical options have been restricted or contraindicated.[1-7,10]

Given the failure of THA among young patients and the necessity of identifying long-lasting and joint-sparing options, the Ilizarov hip reconstruction provides the world with a new hope. It's an operation with less invasive and less destructive potential and known ability to enhance the functional outcomes and quality of life. It has a low complication profile, and it is being improved consistently, which makes it even safer and more efficient. Therefore, Ilizarov hip reconstruction continues to be an effective surgical technique for the correction of the deformed hip in adolescents and young adults. It ultimately provides a promising prospect of improved mobility and delays the use of a prosthetic intervention. So this study aimed to evaluate functional outcomes and postoperative complications following Ilizarov hip reconstruction in patients with abnormal hip joints.

METHODS

This prospective observational study was conducted at the Department of Orthopaedics and Spine Centre, Ghurki Trust Teaching Hospital, Lahore, from December 1, 2024, to May 2025. Ethical approval was obtained from the institutional review board (Ref. No.2024/12/R-50) prior to commencement of the study. All participants provided informed consent. A total sample size of 41 patients was calculated using a 90% confidence level, 9.5% margin of error, and a reported major complication rate of 16.2%, as described in previous literature.[11] Patients aged 15 to 40 years with chronically unstable or abnormal hip joints presenting with symptoms such as limping, pain, limb-length discrepancy, and a positive Trendelenburg sign were included. Patients younger than 15 years or older than 40 years, those with bilateral hip involvement, neuromuscular hip disorders, malignant bone diseases, or incomplete follow-up records were excluded. Demographic information, such as age, gender, and side of involvement, was taken as baseline data. On the functional outcome, the Modified Harris Hip Score (HHS) was used to measure the changes in functional outcome recorded at both the initial stage of operation and the ultimate postoperative follow-up (after 6 months). Postoperative problems such as pin-tract infection, knee stiffness, delayed union and mechanical axis deviation were also documented.

All patients were thoroughly examined with a

clinical evaluation. Radiographic evaluation entailed anteroposterior radiographs of the pelvis and other radiographs as needed towards surgical preparation, evaluation of deformity, and identification of osteotomy levels. The Ilizarov hip reconstruction was done in a standardized surgical procedure by the highly trained orthopedic surgeons who have undergone training in Ilizarov. All the practices were done in the supine position under fluoroscopy. The amount of the proximal level of the femoral osteotomy was preoperative as per radiographic planning and intraoperative positioning of the limb to provide pelvic support available as well as to correct the hip instability. After locating osteotomy site, Schanz pins and Ilizarov rings or arches were placed on the proximal, middle and distal femur segment in line with the intended correction. The reason was the proximal femoral osteotomy carried in order to produce valgus position and pelvic support. A distal femoral osteotomy was done where necessary to correct mechanical axis deviation and treat limb-length discrepancy. A fixator assembly was then attached to the exterior and manipulated to permit the gradual distraction and controlled correction. Frame stability, completeness of the osteotomies and frame alignment were checked by intraoperative fluoroscopy. After getting the required alignment, the construct was fixed.

Patients were advised to start early postoperative mobilization and physiotherapy when they felt like it. The gradual distraction at the osteotomy site was commenced as per the standard protocols which are usually 1 mm per day and adjusted depending on clinical and radiological results of bone regeneration. In outpatient clinics, patients were monitored in the form of regular follow-ups to determine the presence or absence of functional recovery and postoperative complications. The Modified Harris Hip Score was used to measure the functional outcome where scores of 70 and above were classified as fair, good, and excellent whereas scores below 70 were regarded as poor. External fixator was taken off when good consolidation of the osteotomy locations was observed radiographically. After the removal of the frames, physiotherapy was maintained up to the time of maximum functional recovery.

The data were keyed into the IBM SPSS Statistics software vs. 20, cleaned and analyzed. The sequential analysis was done. The first calculation of descriptive statistics was made in the form of the mean and standard deviation of continuous and frequencies and percentages of categorical variables. To determine the improvement of functional postoperative and preoperative Harris Hip Scores, appropriate paired statistical tests were used to compare the two. The postoperative complications were studied descriptively in order to establish the number and distribution of postoperative complications. Student's t test and chi-square test was applied. The p-value which is less than 0.05 was considered to be statistically significant.

RESULTS

A total of 41 patients were included in this prospective observational study. The mean age of the patients was 26.4 ± 6.1 years (range: 15–40 years). Of the participants, 25 (61%) were male, and 16 (39%) were female. The right hip was involved in 24 (58.5%) cases and the left hip in 17 (41.5%) cases.

Functional outcomes were assessed using the Modified Harris Hip Score (HHS). Preoperatively, the mean HHS was 48.7 ± 9.6, indicating poor hip function in most patients. Postoperatively, at the final follow-up (4–6 months), the mean HHS significantly improved to 82.3 ± 7.4 ($p < 0.001$), showing good to excellent functional recovery.

TABLE-I

Distribution of harris hip score pre- and postoperatively (n=41)

Harris Hip Score	Preoperative (n=41)	Postoperative (n=41)
Poor (<70)	38 (92.7%)	3 (7.3%)
Fair (70–79)	3 (7.3%)	6 (14.6%)
Good (80–89)	0 (0%)	22 (53.7%)
Excellent (90–100)	0 (0%)	10 (24.4%)
Mean ± SD	48.7 ± 9.6	82.3 ± 7.4

Postoperative complications occurred in 4 patients (9.8%), while the majority, 37 patients (90%), experienced no complications. The most common complication was pin-tract infection, seen in 2

patients (4.9%), managed successfully with local care and antibiotics. Knee stiffness was noted in 1 patient (2.4%), improving with physiotherapy. Delayed union at the osteotomy site was observed in 1 patient (2.4%). No critical complications such as neurovascular injury, deep infection, or mechanical failure were reported.

TABLE-II

Postoperative complications (n=41)

Postoperative Complication	Number of Patients (%)
None	37 (90%)
Pin-tract infection	2 (4.9%)
Knee stiffness	1 (2.4%)
Delayed union	1 (2.4%)

Postoperative functional outcomes improved significantly across all subgroups, with a mean Harris Hip Score of 82.3 ± 7.4. Males (83.1 ± 7.2) and females (81.2 ± 7.7), patients aged 26–40 years (83.8 ± 7.6) and 15–25 years (80.5 ± 6.9), and right (82.6 ± 7.3) and left hip (81.8 ± 7.5) involvement all demonstrated comparable functional recovery. The majority of patients (90%) experienced no postoperative complications, and minor complications were evenly distributed across gender, age, and side groups.

DISCUSSION

The current prospective study established that Ilizarov hip reconstruction was associated with high functional gains at a low complication rate in young patients with chronically unstable or abnormal hips. The mean score of the Modified Harris Hip Score (HHS) was 48.7 and 82.3 before and after the surgery, respectively, and 32 out of 41 (89.79%) and 4 out of 41 (9.81%) patients had good and excellent scores, respectively. These outcomes are in line with the previously published Ilizarov hip reconstruction and pelvic support osteotomy series, and in some ways, they are even better. After surgery, the functional Harris Hip Scale mean score increased from 48 (range 35–65) to 83 (range 70–90), with a statistically significant difference.[4]

Evidence suggests that Ilizarov hip reconstruction results in significant improvement in Harris hip scores (HHS). Pal et al. described a single case of a 16-year-old female with post-infectious fracture-dislocation of the hip who had an increase in HHS of 49.2 points at baseline to 94 points after surgery. In addition, this patient was symptomatically improved with no Trendelenburg gait, corrected pelvic tilt, and limb length discrepancy.[11,12] Luo et al. reported changes from 17 patients with HHS of 45.9 points pre-op to 87.2 points post-op using a modified technique of Ilizarov hip reconstruction, and only 1 patient required total hip replacement at an average of 64 months follow-up. Based on their experience with classical Ilizarov hip reconstruction.[13] Marimuthu et al. studied 40 patients who had chronic unstable hips; all had a minimum of 36 months after surgery and experienced an HHS from 44.3 to 70.8.[14] The use of Ilizarov pelvic support osteotomy produced similar results; Kawoosa et al. indicated that their mean HHS improved from an average of 56.9 before surgery to 83.3 after surgery.[14] Furthermore, regardless of hip pathology, the majority of patients showed excellent/good results using Ilizarov pelvic support osteotomy, according to Mahran et al. and Shah & Patel.[16,17] The current cohort's functional improvement from poor preoperative scores (mean 48.7) to mostly good/excellent postoperative scores is consistent with these findings and implies that Ilizarov reconstruction is equally successful in the South Asian setting.

TABLE-III

Association of postoperative harris hip score and postoperative complications with gender, age, and side of involvement (n=41)

Variable	Category	Postoperative HHS (Mean ± SD)	No Complication n (%)	Complication n (%)
Gender	Male	83.1 ± 7.2	23 (92%)	2 (8%)
	Female	81.2 ± 7.7	14 (87.5%)	2 (12.5%)
Age (years)	15–25	80.5 ± 6.9	18 (85.7%)	3 (14.3%)
	26–40	83.8 ± 7.6	19 (95%)	1 (5%)
Side of Involvement	Right hip	82.6 ± 7.3	22 (91.7%)	2 (8.3%)
	Left hip	81.8 ± 7.5	15 (88.2%)	2 (11.8%)

The overall complication rate in this series is 9.8% (4/41 patients), which is significantly lower when compared to previously reported complication rates for Ilizarov hip reconstruction and Ilizarov bone transport of the lower limb. The complications in the current series were 2 pin tract infections, developing in 4.9%, 1 case of knee stiffness in 2.4%, and 1 case of delayed union in 2.4%, which were all treated uneventfully without major sequelae. Pal et al. reported an uneventful union with no major complications in their single case of Ilizarov hip reconstruction.[12] Luo et al., however, observed pin track infection in 4 of 17 patients (23.5%), knee range of motion restriction in 8 out of 17 (47.1%), and osteotomy site fracture in 2 of 17 patients (11.8%) after frame removal.[13] Marimuthu et al. mentioned pin tract infections and knee stiffness as common limitations, and an average period of external fixation of 7.3 months.[14] Kawoosa et al. also mentioned pin tract infection and prolonged wear of the fixator as significant drawbacks despite good functional outcomes. Shah and Patel mentioned that Trendelenburg gait and limb length discrepancy correction were excellent, but complication rates were not quantitatively detailed.[16,17]

Observational data from larger bone transport series make it clear that pin-tract infection and stiffness are common and anticipated problems. Narrative reviews and series have reported rates of pin-tract infection varying from 35 to 65%, and stiffness exceeding 20 to 25% or more for the lower extremity bone transport. 18-21 In their systematic review of Ilizarov treatment for infected nonunion of the tibia and femur, Yin et al. reported knee stiffness in 12% and other complications such as refracture, malunion, and recurrent infection in 4-7%.[22] Feng et al. observed that virtually all patients developed complications, including pin-tract infection in 61.3%, delay union in 25.1%, and axial deviations in 43.2% among 199 patients with tibial bone defect treated by bone transport.[19] For lower limb bone transport, similarly, Liu et al. observed pin-site infection in 66% and stiffness in 24% of patients among 282 hip and knee cases.[23] Even in follow-ups of up to several years' observation for tibial bone transport, complication rates have been found to exceed half in various series. Therefore, even in hip reconstruction series, an overall complication rate of 9.8% without deep infection, neurovascular injury, mechanical failure, or amputation is reassuring and perhaps indicates better patient selection, standardization of the technique, meticulous attention to pin-site care, and proper physiotherapy programs.

Comparison with alternative pelvic support or hip reconstruction strategies using internal devices. It is also compared with other pelvic support or hip reconstruction techniques that make use of internal devices. Metikala et al. mention pelvic support hip reconstruction, which used internal plating and retrograde magnetic nail, and showed no infections or permanent knee stiffness in eight patients, but had plate breakage and mechanical axis deviation in individual cases.[24] These internal device methods do not have the external fixator-related problems but are technically challenging and do not allow the adjustability and gradual remediation of Ilizarov frames. The current literature validates the idea that Ilizarov hip reconstruction can be used to provide a functional outcome that is equal to the internal devices, in case it is done in a specialized center and has relatively low complication rates.

Notably, postoperative HHS gains were equally high in the subgroups in this series: males and females, younger (15-25 years) and older (26-40 years) patients, right vs. left hips, all were at or below the low to mid 80s mean postoperative HHS, with no apparent subgroup more at risk of complications. Similar results in other studies (e.g., pelvic support osteotomy and Ilizarov hip replacement) suggest that better results can be achieved in a broad spectrum of etiologies (developmental dysplasia, post-septic arthritis, neglected fractures, paralytic hips) under the condition that osteotomy levels and mechanical axis reorientation are well considered.[22-25] The results of the present study support the hypothesis that predictors of success and failure can be obtained in any of these etiologies; however, more extensive multicenter studies are needed to confirm predictors of success and failure.

Some of the strengths of this study are that the study has a prospective nature as an observational design, the inclusion criteria are well defined and the Ilizarov surgical technique is a standardized procedure and well executed by experienced

surgeons and the assessment of functional outcome through the use of the standardize Ilizarov surgical procedure and the use of the validated Modified Harris Hip Score allows meaningful comparison with the current literature; further details concerning the postoperative complications supports the validity of the results in the short run. Nevertheless, some limitations must be mentioned, such as the relatively small sample size of one tertiary care center, the rather short-term follow-up period of 46 months, which severely restricts the evaluation of the long-term durability and other late complications, the lack of a control and comparison group, and the absence of standardized radiological measurements and other patient-reported outcomes, like quality of life and return to work. Considering these shortcomings, further research needs to employ larger, multicentric cohorts with extended follow-ups, comparative groups, standardized radiographic and gait assessments, and evaluate the cost-effectiveness and social reintegration to clarify the role of Ilizarov hip reconstruction as a joint-preserving procedure in the long term.

CONCLUSION

Ilizarov hip reconstruction is a useful procedure of joint-preservation in teenagers and young adults with abnormal hip joints, which leads to substantial amelioration in both functional results and ambulation with reasonable complication rates. The process is also effective in alleviating pain in a meaningful manner, increasing hip stability, and improving gait without requiring or postponing total hip arthroplasty in this youthful demographic patient cohort. Despite the good short-term outcomes, more research with more participants, longer-term follow-up, and comparative designs should be conducted to improve the evidence of the long-term sustainability and generalizability of this reconstruction method.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Anees ul Islam:** Conceptualization of study.
2	**Syed Kashif Shah Bukhari:** Data collection.
3	**Jawad ul Haq:** Literature review.
4	**Khadeej Choudhry Ilyas:** Methodology.
5	**Awais Khalid:** Literature review.
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