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Case Report

A rare case of total hip replacement in an 11-year-old female: rehabilitation goals and challenges - a case report

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ABSTRACT

This case report describes a unique pediatric patient, the first and youngest in India, who underwent total hip replacement (THR) for right ankylosed hip. Patient presented with preoperative musculoskeletal deformities, posing challenges for postoperative rehabilitation. This 11-year-old female presented with non-traumatic insidious right hip pain, limping, right hip flexion and abduction deformity. Patient was diagnosed with idiopathic chondrolysis of the hip through exclusion and clinico-radiological findings. Patient underwent surgery for ceramic-on-ceramic THR. Fusion of triradiate cartilage and epiphysis and Risser's skeletal maturity staging were confirmed. Postoperative examination revealed right hip flexion and abduction deformity resulting in pelvic obliquity, which led to limb length discrepancy and functional scoliosis. There was increased anterior pelvic tilt, altering the gait pattern. Adhering to THR restrictions, rehabilitation strategies were tailored to restore normal pelvic orientation and address deformities through manual stretching of right hip abductor, tensor fascia latae, iliopsoas and rectus femoris. A left-sided shoe raise was also given. Lumbar segmental muscle activation, pelvic floor muscle training and gait training were crucial parts of the rehabilitation protocol. At ten-week, prodigious outcomes were achieved in the form of complete pain relief, complete correction of abduction and flexion deformity, normal pelvic alignment in the frontal plane and independent, stable full weight-bearing ambulation after two years of disabling ordeal suffering. However, minimal compensation of the anterior pelvic tilt persisted. Rehabilitation of this challenging patient with multiple deformities achieved excellent outcomes at ten-week post-rehabilitation. Thus, a tailored meticulous rehabilitation program can significantly improve quality of life.

Keywords: Pediatric rehabilitation, Physiotherapy rehabilitation, Pediatric total hip replacement, Idiopathic chondrolysis, Rare case, Hip contractures

INTRODUCTION

Total hip replacement (THR) in the pediatric population is uncommon owing to fears about wear and early multiple revisions. However, due to advancements in implant quality, bearing surface design and surgical techniques, THR has emerged as a viable option even for the pediatric population. Its utilization has significantly increased globally in recent decades.[1,2] THR is increasingly used to address a range of pediatric conditions, with a prevalence of 33% in pediatric patients, 12-38% in osteonecrosis patients and 15-27% in systemic inflammatory disease patients.[3] Pediatric populations may present unique challenges for THR due to their increased activity levels, varying skeletal maturity, and diverse medical conditions. This may pose a risk to the long-term survival of implants.[3] In this case report, we present the case of an 11-year-old female patient who was diagnosed with idiopathic chondrolysis of the hip (ICH) with hip flexion and abduction deformities, managed with THR. Postoperative

clinical examination revealed flexion and abduction deformity in the right hip and pelvic obliquity, which resulted in limb length discrepancy (LLD) and functional scoliosis. The patient had remarkably excellent clinical outcomes at six-week and ten-week post-rehabilitation. The present report highlights the emerging successful outcome despite challenges faced during the rehabilitation of this patient due to structural and connective tissue deformities along with limitations posed by THR restriction.

CASE REPORT

An 11-year-old female presented to the hospital outpatient department (OPD) with pain in the right hip and knee and difficulty walking for two years. The patient had no history of trauma, a family history of rheumatologic diseases or Koch's contact. However, the patient was misdiagnosed with Koch's hip and was treated with anti-tuberculosis medication for one year. On examination, the patient had an antalgic gait, flexion and abduction deformities in the right hip and a pelvic obliquity (Figure 1).

Figure 1: Preoperative X-ray.

However, the patient was actually diagnosed with ICH through exclusion and clinico-radiological findings. X-ray and MRI revealed cartilage loss. Following initial conservative management, a multidisciplinary approach was undertaken. After consultation with a pediatric orthopedic surgeon, the decision to perform a THR was made, as it was concluded that no other method of treatment would be effective in view of the long-term prognosis. A ceramic-on-ceramic THR was performed on the right hip after confirming epiphysis and triradiate cartilage fusion, and also as per Risser's skeletal maturity staging. This process utilized a hydroxyapatite-coated femoral stem and a porous-coated cup for the ankylosed hip. The diagnosis was histo-pathologically reconfirmed as ICH postoperatively.

First postoperative day (POD) assessment

The patient was referred for physiotherapy on the first POD. The patient had a pain score of 9/10 on the numeric rating scale (NRS). The skeletal deformity was corrected; however, rehabilitation was extremely challenging because there was connective tissue shortening resulting in hip deformities and pelvic obliquity (Figure 2).

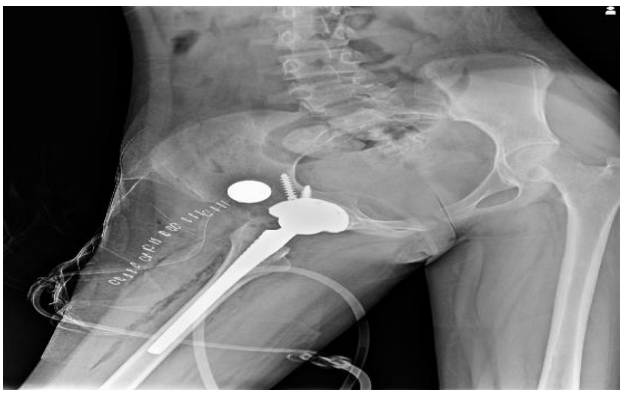

Figure 2: Immediate postoperative X-ray.

Tight hip abductors and tensor fascia latae (TFL) on the right limb, along with weak left hip abductors, resulted in 40 degrees of abduction deformity at the right hip. This led to a lateral tilt of the pelvis, resulting in a pelvic drop on the right side (Figure 3a).[4]

Figure 3 (a-f): Posterior and lateral views of posture, (a) on first POD, the posterior view revealed an abduction deformity in the right hip resulting in pelvic obliquity with a drop on the right side; (b) on first POD, the lateral view revealed anterior tilt of the pelvis; (c) at six-week post-rehabilitation, the posterior view showed a reduction in the abduction deformity at the right hip; (d) at six-week post-rehabilitation, the lateral view revealed a reduction in the anterior tilt of the pelvis; (e) at ten-week post-rehabilitation, the posterior view revealed complete correction of the right abduction deformity; and (f) at ten-week post-rehabilitation, the lateral view showed minimal compensation of the anterior pelvic tilt.

Pelvic obliquity resulted in a secondary apparent LLD of 2.5 inches and functional scoliosis with convexity on the right side. Tight iliopsoas and rectus femoris muscles on the right limb led to 30 degrees of flexion deformity at the right hip. This resulted in compensatory anterior tilting of the pelvis (Figure 3b).[4] The patient demonstrated an

apparent short leg gait compensating for the lateral trunk shift and pelvic tilt on the right side, resulting in a limp.[5] The shorter right lower limb during stance, functionally compensated by hip and knee extension, and ankle plantar flexion.

However, the longer left lower limb showed kinematic deviations, such as knee flexion and ankle dorsiflexion, while walking to clear the ground.[6] This was accompanied by a backward trunk lean during the loading response. The patient also demonstrated excessive lumbar lordosis in terminal stance and left hip hiking during the swing phase.[5]

Zero-to-six-week rehabilitation protocol

Pain was managed with cryotherapy in the form of ice packs, and fentanyl (12.5 µg) was administered on POD six to control pain.[7] To address the deformities, modified positions were used for stretching the shortened connective tissues of the right rectus femoris and TFL, owing to THR restrictions. Static stretching of the right hip abductors, TFL, iliopsoas and rectus femoris was given for 40 seconds, with a rest of ten seconds for six to seven repetitions.[4] Deep lumbar segmental muscle activation, pelvic floor muscle training, and strengthening of hip abductors and extensors were also part of the rehabilitation protocol.[8] Stretching of the left quadratus lumborum, passive corrective exercises and a yogic posture of "Tadasana" were given to correct right dorsolumbar scoliosis. Shoe raise was given on the left side by 2.5 inches.[4] Gait training, emphasizing equal weight-bearing on both legs and avoiding adduction of the left leg, was initiated on a walker. The patient was also given verbal and tactile cues to avoid compensation for lateral trunk leaning and excessive lumbar lordosis during gait.[4]

Frequency

The exercise regimen was conducted twice daily under the supervision of the therapist and thrice daily as a patient's own repetition practice protocol for six days a week. Subsequently, the outcomes were assessed at six-week and ten-week post-surgery.

Six-week post-rehabilitation assessment

The patient improved completely in terms of pain, with an NRS score of 0/10 on POD eight. At six-week, the patient achieved complete correction of the flexion deformity, with a significant reduction in the anterior pelvic tilt and abduction deformity by 20 degrees (Figures 3c and d). This led to a decrease in the apparent LLD by 1.5 inches and a reduction in the lateral pelvic tilt (Figure 4). The patient had reduced lateral trunk lean and lumbar lordosis, which remarkably improved patient's gait pattern.

Six-to-ten-week rehabilitation protocol

Along with the above-mentioned exercises, wall-assisted mini squats, anti-gravity strengthening of the hip muscles, core training for the external and internal oblique, bridging and backward walking were added to the rehabilitation program, and the same frequency was maintained. Gait training progressed from the walker to the cane on the left side. Ascending and descending stairs using a cane, initially one step at a time, was started, progressing to one foot on each step.

Figure 4: Six-week post-rehabilitation X-ray.

Ten-week post-rehabilitation assessment

At ten-week, the patient showed excellent recovery with complete correction of the abduction deformity (Figure 3e). The patient also achieved a normal pelvic alignment in the frontal plane (Figure 5).

Figure 5: Ten-week post-rehabilitation X-ray.

Table 1: Summary of the postoperative outcome measures at baseline, sixth and tenth weeks.

Outcome measures	First POD	Six-week post-rehabilit-ation	Ten-week post-rehabil-itation
NRS	9/10	0/10	0/10
Flexion deformity (^{0})	30	0	0
Abduction deformity (^{0})	40	20	0
LLD (″)	2.5	1	0

NRS=numeric rating scale, LLD=limb length discrepancy, POD=postoperative day

However, minimal compensation of the anterior pelvic tilt persisted (Figure 3f). The patient progressed to full weight-bearing ambulation without any assistive device. Complete correction of the scoliotic curve and the LLD was achieved (Table 1).

DISCUSSION

The present case report of this rare pediatric patient with THR, highlights that despite the challenges, a tailored rehabilitation protocol resulted in excellent outcomes, such as complete pain relief, correction of deformities, improved gait pattern and posture.

The pediatric population presents unique challenges for THR due to their increased activity levels. Activities imposing heavy rotational forces may pose a risk to the long-term survival of the implants.[3] THR precautions, pain and young age were factors limiting the administration of a vigorous rehabilitation program. It also imposed limitations on the duration and position in which stretching was applied. Excessive enthusiastic stretching to correct the deformities could have led to pain or lengthening of the connective tissues. Hence, tailored rehabilitation was carried out owing to the patient's condition.

Pain control using cryotherapy helped reduce inflammation and improve the pain threshold.[7] However, 12.5 µg fentanyl was also administered for pain relief.

Stretching of the hip abductors and TFL on the lower side of the pelvis and strengthening of the contralateral hip abductors helped correct the abduction deformity. This eventually helped in the correction of the lateral pelvic tilt. A shoe raise to correct LLD would not have automatically corrected the malalignment. This underlines and highlights the need to also address the tightness of TFL. However, the shoe raise levelled the pelvis and helped remove tension on the weak gluteus medius. The pelvic obliquity with flexion deformity was addressed by iliopsoas and rectus femoris stretching. Focus on lumbar segmental muscle activation and pelvic floor training plays a crucial role in dealing with anterior pelvic tilt.[4] Correcting the skeletal deformity may not address all components of the deformity. Long-standing skeletal deformities alter the viscoelastic properties of muscles and fascia.[9,10] Static stretching helps decrease the viscosity of connective tissues and increases elasticity.[10] The passive resistance of the tissues was also reduced after stretching. The remodelling of collagen fibres may achieve a new length due to plasticity to maintain this acquired constant length.[9] Weppler and Magnusson put forth that increasing muscle extensibility can be due to subjects' perception of the sensation experienced (pain onset, pain tolerance) at the end-point of stretching or a psychological alteration in sensory perception.[11]

Passive corrective exercises, a yogic posture of "Tadasana" and stretching of the left quadratus lumborum helped to correct right dorso-lumbar scoliosis.[4] Restoring normal pelvic alignment along with strengthening of the gluteus medius and maximus plays a key role in achieving a normal gait pattern. Furthermore, external cues given by the therapist to correct compensations during gait proved to be imperative for restoring a normal gait pattern.

Thus, correcting abduction and flexion deformities helped increase hip stability and restore normal pelvic orientation and the gait pattern.

Given the scarcity of literature, there is a demand for more research on rehabilitation strategies administered to manage hip deformities in such rare pediatric populations operated with THR. It is essential to design a tailored rehabilitation program. Understanding what needs to be stretched and what needs to be strengthened requires accurate assessment and judgment in such complex cases of multimodal involvement of connective tissues.

This is the first case in which the youngest patient in India underwent successful THR for a rare disorder of ICH with excellent mechanical and functional outcomes.

CONCLUSION

This unique pediatric case outlines the post-THR rehabilitation of an 11-year-old female child with ICH who presented with complex skeletal and connective tissue deformities. It can be discerned that the rarity and complexity of the case posed significant challenges for rehabilitation. The hip flexion and abduction deformities were successfully corrected at ten-week post-rehabilitation. Prodigious outcomes were achieved in the form of independent and stable full weight-bearing ambulation after two years of disabling ordeal suffering. Along with surgical management, rehabilitation has played a substantial role in patient's inordinate recovery. Thus, a tailored meticulous rehabilitation program can be promising and can extensively enhance quality of life even in the pediatric population.

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