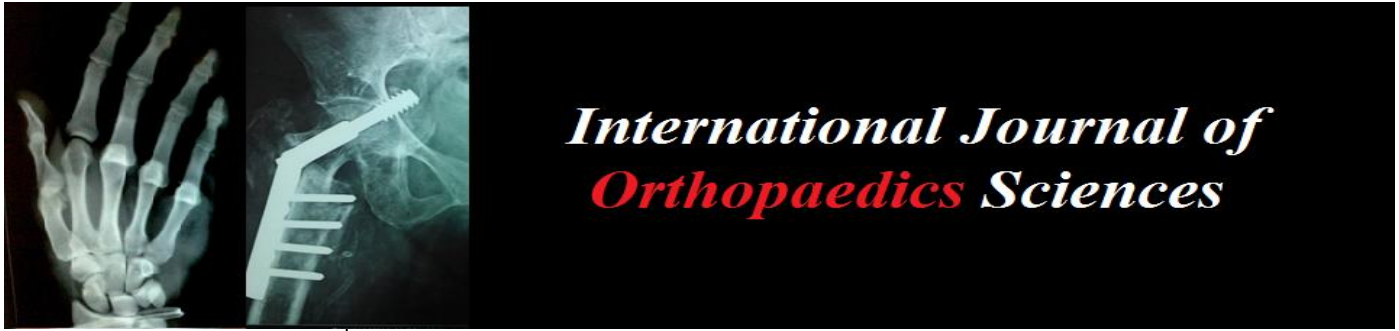




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Strategies in the management of femoral fractures in post-polio limb a retrospective analysis of 10 patients with 3-year follow-up

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Abstract

Background: Out of 10–20 million people in the world with post-polio sequelae, around 6.5 million of them are in India. Due to its eradication, survivors have lived through their life and crossed 40–50 years of age. Falls and subsequent fractures are common in these patients, which are difficult to manage and cause considerable morbidity. We conducted this study to analyze the various strategies used in the management of fractures in a post-polio limb.

Methods: This is a retrospective study analyzing a total of 10 adult patients with post-polio sequelae complicating the fractured limb, which was managed with varied treatment options such as locking compression plate, dynamic hip screw, and hemiarthroplasty. The functional status of the patient was evaluated with Vignos grade of disability.

Results: All the patients (mean age of 34 ± 12 years) were treated with extramedullary internal fixation devices such as locking compression plating in 6 patients, dynamic hip screw fixation in 1 patient, cancellous screw fixation in 2 patients, and total hip replacement in one patient. Of the 10 cases, 8 were fresh fractures, and 2 presented with a failed fixation for repeated fracture sustained later on. The mean follow-up period was 37.8 ± 16.4 months. Bony union was attained at a mean duration of 3.5 ± 1.4 months in all the patients undergoing fracture fixation. None of the included had secondary implant failure or other complications.

Conclusion: Patients with limbs involving post-polio sequelae are more prone to fractures and are difficult to manage using the standard treatment protocols. Extramedullary internal fixation device provides effective stability for bony union and optimal functional results without major complications in these small, deformed, osteoporotic, and hypo-vascularized femurs.

Keywords: Post-polio, femoral fractures, union, locking compression plating, complications

Introduction

Out of 10–20 million people in the world with post-polio sequelae, around 6.5 million of them are in India ^[1]. Due to the eradication of polio, we do not face cases of fresh polio infection but the survivors have lived through their life and crossed 40–50 years of age ^[2]. Falls and subsequent fractures are common in these patients, which are difficult to manage and cause considerable morbidity ^[1]. Poliomyelitis being primarily a disease of the motor system leads to flaccid asymmetric paralysis and muscle atrophy which reduces stability, mobility, alters the gait pattern, and hence predisposes to falls ^[3]. Quadriceps weakness in itself is a risk factor for falls and hence fractures ^[4]. In addition, gait imbalance due to deformities, contractures, limb length discrepancies, and improper distribution of muscle forces predispose to falls ^[4, 5].

It has been found by Bickerstaffe *et al.* that the frequency of falls in polio patients is four times higher than the general population ^[4]. Although fractures can occur anywhere in polio limb even with low energy, proximal shaft, and distal femoral fractures are more common ^[6, 7]. The management of such fractures in polio-affected extremities continuous to be a surgical dilemma. Since these unique fractures are unlike the fractures that orthopedic surgeons deal with every day, a unique set of strategies are required in their appropriate management. Osteopenia, small deformed hypo-vascular bones due to impaired skeletal development are some of the factors that jeopardize successful routine management of femoral fracture as done in any other normal individual.

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Lack of adequate muscle strength and limited ambulation may challenge the rehabilitation protocols routinely followed.

This study aims to present the management strategies followed in the fixation of the femoral fractures in polio-affected extremities. Since the condition is not so common, surgeons must be aware of some of the surgical strategies followed in successfully managing these rare complex fracture patterns.

Methodology

This is a retrospective study conducted in a tertiary care hospital between Jan 2015 to Dec 2020, including all patients with a unilateral closed femoral fracture in a polio-affected extremity. Of the 13 shortlisted patients, 3 patients were excluded from the study due to a lack of sufficient follow-up

data in one and polytrauma in the other two. The study finally included 10 patients, with 8 males and 2 females with a mean age of 34 ± 12 years. The fractures were due to trivial falls during activities of daily living in 8 of them and pedestrian accidents in two patients. Of the 10 cases, 8 were fresh fractures and 2 presented with a failed fixation following a repeated fall in the region fractured earlier. 4 cases had a fracture of the neck of femur, while 4 patients sustained a fracture of the femoral shaft, and the remaining two sustained a fracture to the supracondylar femoral region.

Surgery was performed at a mean of 5.6 ± 1.2 days following admission to the hospital. At the final follow-up, the functional status of the patient was evaluated with Vignos Disability Scale and was compared to the status before the fracture. (Table 1)

Table 1: Vignos disability scoring system for lower extremity

Grade	Functional description
1	Walks and climbs stairs without assistance
2	Walks and climbs stairs with the aid of a railing
3	Walks and climbs stairs slowly with the aid of a railing (over 25 seconds for eight standard steps)
4	Walks unassisted and rises from the chair but cannot climb stairs
5	Walks unassisted but cannot rise from the chair or climb stairs
6	Walks only with assistance or walks independently with long leg braces
7	Walks in long leg braces but requires assistance for balance
8	Stands in long leg braces but is unable to walk even with the assistance
9	In a wheelchair, elbow flexors more than antigravity
10	In a wheelchair or bed, elbow flexors less than antigravity

Surgical Strategies

All the surgical procedures were carried out in a supine position in a radiolucent operating table and for 3/10 patients traction table was used. Of the 4 patients who sustained a fracture of the neck of the femur, two presented with failure of the fixation of the fracture with cancellous screws following a secondary insult to the fixation. Of the two cases, one underwent total hip replacement due to a lack of sufficient bone stock to attempt osteosynthesis and the other underwent dynamic hip screw (DHS) fixation as shown in Figure 1. While the other two index cases of fracture of the

neck of the femur underwent cancellous screw fixation. We encountered difficulty in positioning the patient due to the spinopelvic obliquity. We employed minimal traction, intentional internal rotation of more than 50° to counter the excessive anteversion noted in the hip. We also tilted the fracture table to 20° for the convenience of fixation by the surgeon and we also employed abduction of more than 30° to achieve fracture reduction. The more posterior the entry that was taken, the easier the procedure was and the better the placement of the screws in cannulating the narrow valgoid neck of deformed femurs.

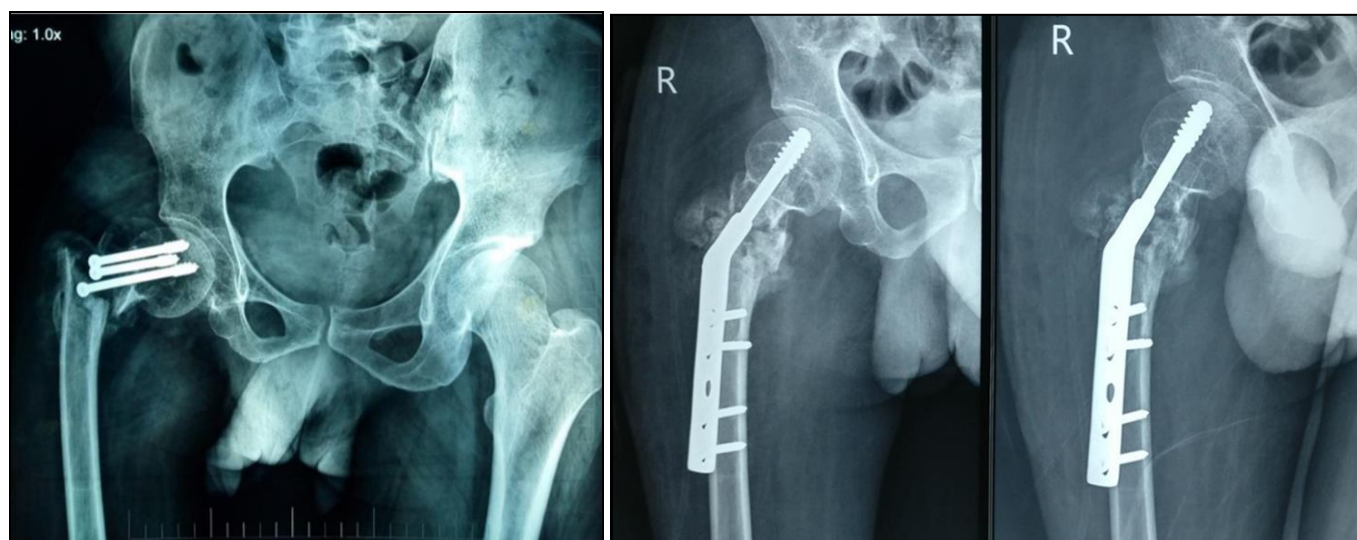


Fig 1: Fixation of failed implant fixation for a neck of femur fracture in a post-polio limb with a pediatric dynamic hip screw fixation.

In the case of fixation fractures of the shaft of these deformed femurs, we preferred an extramedullary internal fixation device such as a locking compression plate. All 4 patients who sustained shaft of femur fractures were operated on

through a longitudinal, lateral femoral incision. The subcutaneous tissue was incised in line with the skin and fracture ends were exposed and reduction was achieved with manual traction. Manual traction was preferred since the bulk

of the muscles was reduced and flexion deformity of the extremity. Then the extramedullary internal fixation device was used for the final fixation. Two patients sustained a fracture of the supracondylar region of the femur. We employed a distal femur locking compression plate for their fixation in a standard fashion. The anatomical plates were not suitable for fixation since the native bone is of tiny size. Hence the smallest size possible for the given implant must be made available.

The mean duration of surgery was 78 ± 34 minutes. Mean intraoperative blood loss was 120 ± 314 ml. None of the patients required a blood transfusion. We did not use any bone grafts to augment the fusion process. Passive movements were started on the second postoperative day, followed by active exercises the next day. Gradual progression to pre-fracture weight-bearing was dependent on the progress of the radiological union. Venous thromboembolism prophylaxis with low molecular weight heparin was given to all patients. Patients were regularly followed up at postoperative six weeks, three and six months, and one year. At each follow-up visit, anteroposterior (AP) and lateral radiographs of the femur were taken for the evaluation of callus formation and fracture union. Bony union was defined as callus bridging being present in at least three out of four cortices on AP and lateral views.

Results

The mean postoperative period of hospital stay was 6 ± 3 days. We noted significant callus formation that bridged the fracture ends in 6/9 patients that underwent fracture fixation at 6 weeks follow-up. Bony union was confirmed in all the patients at a mean period of 3.5 ± 1.4 months. Ambulation started with axillary crutches on the postoperative second day. If there was no limb length discrepancy, the patients were encouraged to contact the fingertip for balance from the second postoperative day until the sixth week. Then patients were continued to slowly increase the weight as much as can tolerate after the post-operative sixth week. Gradually abandonment of the use of assistive devices was recommended. The home rehabilitation program was administered to all patients, given the difficulty of accessibility and lack of transportation. All patients returned to the same pre-fracture Vignos grade of disability and ranges of motion of the related joint at the final follow-up examination. We did not note any of the included cases to present with non-union, implant failure, or any significant complication due to the management protocol followed at a mean follow-up period of 37.8 ± 16.4 months.

Discussion

We do not have much literature on the surgical strategies for the management of femoral fractures in extremities with post-polio sequelae. The management of femoral fracture of polio-affected extremities can show good results with extramedullary internal fixation devices instead of intramedullary internal fixation devices. In this study, fixation of proximal, distal and diaphyseal femoral fractures in polio-affected extremities with standard DHS, cancellous screws, or locked plates was found to have a high bone union rate without any reported complication, such as non-union, malunion, or infection.

Considering the rarity of the situation, the management of these fractures in the extremities with post-polio sequelae poses a problem. Early fixation and mobilization, which is one of the main goals of orthopedic treatment, are also

important for these patients. Prolonged casting and immobilization in these patients may worsen osteopenia and joint contracture, and may also bring about associated complications, such as bed sores and non-union^[8]. 96% of outpatient post-polio patients had osteopenia or osteoporosis, of which 38% of them experienced a fracture at a 5-year follow-up^[9]. Another study about polio survivors reported that 61% of 233 community-based participants had falls for which they needed medical care, including 35% who had sustained a fracture^[6].

In general, most of the post-polio extremities have small and deformed bones. This affects and determines the surgeon's choice of treatment. Due to the aforementioned drawbacks, implants used for femoral fractures under normal conditions may not be suitable for fractures in polio-affected extremities. In a study of 16 postpolio patients, a locked compression plate was applied to distal femur fractures^[10]. Locked compression plates are one of the gold standard treatment modalities in distal femoral fractures^[11]. However, anatomic locking plates or intramedullary nailing may not be appropriate for postpolio fractures, so custom-made implants or implants for different anatomic regions are recommended for postpolio femoral fractures^[12]. A similar scenario was faced in our series and we had to use a pediatric DHS and plate system for one of the proximal femur fixations in our series, as shown in Figure 1. Extramedullary fixation devices can be used instead of using intramedullary fixation devices or custom-made fixation devices in these unusual fractures. A polio-affected extremity is a risk factor for disuse osteoporosis^[9]. The prevalence of osteopenia and osteoporosis is much higher in polio-affected extremities compared to the general population^[4]. Quadriceps muscle strength and regular exercise are important predictive factors associated with disuse osteoporosis^[13]. Due to the increased risk of regional osteoporosis in post-polio syndrome, regional osteoporosis must be checked and if the patient has osteoporosis, this should be treated accordingly as there is a higher risk of fracture. The Vignos disability scale can be used in the evaluation of post-polio survivors.

In a study of 13 femoral fractures of polio-affected extremities, callus formation and Vignos grade were statistically significantly correlated^[14]. In the current study, all patients returned to the same pre-fracture Vignos grade of disability at the final follow-up examination. The proximal femoral nail is the recommended fixation device for fixing the most extracapsular hip fractures. The main problem in treating proximal femoral fractures in polio-affected extremities was the presence of a narrow intramedullary canal, which prevented using a proximal femoral nail (PFN)^[15]. The extramedullary internal fixation devices were used to resolve this problem. The use of locking compression plates in femoral fractures of polio-affected extremities is beneficial because they may be contoured to the non-anatomic shape of the bone and are indicated in osteoporotic/disused bone^[14]. AO surgery reference recommends PFN and DHS for most intertrochanteric fractures and intramedullary nailing for most femoral diaphyseal fractures. However, the recommendations are not valid for most polio-affected femoral fractures^[16]. In this study, the surgical fixation method and implant choice for these different fracture patterns conflict with AO surgery principles. Although intramedullary fixation is the standard gold treatment for proximal and diaphyseal femoral fractures with normal anatomy, extramedullary fixation was selected for all patients because of the deformed anatomy of the postpolio femur (narrow intramedullary canal; increased bowing; decreased neck-shaft angle)^[10]. It is difficult to

manage these unusual patterns with a common fracture management protocol, and decisions must be made on an individual patient basis. Limitations of the present study include the small sample size, non-homogeneous implants, the retrospective nature of this study, and the absence of a control group.

Conclusion

Patients with limbs involving post-polio sequelae are more prone to fractures and are difficult to manage using the standard treatment protocols. Extramedullary internal fixation device provides effective stability for bony union and optimal functional results without major complications in these small, deformed, osteoporotic, and hypo-vascularized femurs.

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