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Case report

Novel physiotherapeutic approach towards a case of complex multiple fracture

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ABSTRACT

A straddle fracture of the pelvis is a fracture of the superior and inferior pubic rami which is considered an unstable injury. Injuries most often associated with straddle fracture include sacral fracture, neurological injury, pelvic ring disturbance, lumbar spine fracture, and severe soft tissue injury. A pelvic fracture can happen through the mechanism of either moderate or medium intensity effects. This can range in magnitude from relatively minor mishaps to moderately traumatic fractures that are potentially fatal. L5 transverse process fracture are often associated with pelvic ring fractures, which may indicate high energy trauma. A 35-year-old female with a left-sided straddle fracture, a sacral ala fracture associated with an L5 transverse process fracture L5 was diagnosed by orthopaedic surgeon, on X-ray after a slip and fall sustaining injury to pelvic region, on which open reduction and internal fixation with a 5-hole pre-contoured plate was placed. Temporary reduction was done by K-wire and sacral ala fracture was fixed with 2 CC screws. Post operatively the patient had impaired limb movements and inability to perform daily activities. After operation, patient was managed with physical therapy treatment comprising of static regimens, progressing to dynamic exercises, electrotherapeutic techniques, strengthening exercises, gait exercise for duration of 10 weeks. Patient was given physiotherapy regime for 5 days per week for 10 weeks. This study shows that the operative method and timely recovery in physical therapy contributed to the progress of ROM, strength of muscle, functional activities progressively, which successfully led to further recovery.

Keywords: Straddle fracture, Sacral ala fracture, Internal fixator, Physical rehabilitation.

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INTRODUCTION

A straddle fracture of the pelvis is a fracture of the superior and inferior pubic rami which is considered an unstable injury [1]. Injuries most often associated with straddle fracture include sacral fracture, neurological injury, pelvic ring disturbance, lumbar spine fracture, and severe soft tissue injury [2]. Postoperatively to restore all the functional activities physiotherapy protocol is recommended [3].

The bony pelvis is a complete structure formed with the aid of the usage of the two hip bones and the coccyx, which is lower bounded to the sacrum [4]. The combined skeleton of ilium, ischium, and pubic bones, connected to the sacrum form the anatomical ring.[4] The pelvic fracture can be caused through a trauma [5]. A straddle fracture leading to unstable fracture of the pelvic bone requiring surgical care [1]. Marvin Tile (1988) classifies pelvic fractures on the basis of stability into three types-Type A – Stable, A1- Fractures of the pelvis not involving the ring, A2- Stable, minimally displaced fractures of the ring. Type B – Rotationally unstable, vertically stable. Type C- Rotationally and vertically unstable [4].

According to Young and Burgess (1986) classification [1] vertical shear injuries are unstable injuries (rotationally and vertically) with vertical orientation of rami fractures , disruption of sacroiliac joint and vertical displacement of hemipelvis. Combined mechanism injuries to any combination of lateral compression (LC), anterior posterior compression (APC), vertical shear (VS) injuries [6]. The sacrum consists of vertebral segments that normally combine during adulthood. This vertebral fusion not only increases the functional strength of the sacrum , but also allows a continuous osseous canal to be formed [7]. According to Denis classification, sacral fractures are classified into 3 zones namely zone 1 involving the fracture lateral neural foramina through the sacral ala, zone 2 involving transforaminal fractures, and zone 3 involving the fracture medial to neural foramina and transverse fracture of the sacrum [7]. L5 fracture of the transverse process is linked with pelvic injuries often [8]. Post-operative

physiotherapy rehabilitation shown to be successful and improving the NPRS pain score, mobility activities, increasing strength of muscles, gait pattern, ADLs, etc.[9]. This case report describes a Type A2 classification of pelvic injuries which suggests the minimally displaced fracture of the ring (straddle fracture) and according to Young and Burgess classification, it suggests vertical shear injury and Zone 1 sacral fracture by Denis classification [1][6]. The therapeutic technique divided into 4 categories, starts with adequate protection stage up to a progression of strength training [10]. Post-operatively passive to active assisted activities, physical joint manipulation, incremental exercise performance, gait training strategy, electrotherapy, and proper health education have all been found to be effective in physiotherapy recovery [11]. It is explored in order to include a recovery procedure for unusual displaced straddle fracture along with a sacral ala fracture and a L5 transverse process fracture. The purpose of this case report to help in early recovery of functional activities by using mentioned Novel physiotherapeutic approach towards a case of complex multiple pelvis fracture.

Patient's information

A 35-year-old female patient with a right-handed dominance, a housewife by profession. She slipped and fell, causing damage to the pelvic area, as she was carrying a pot full of water, her leg slipped, and she fell on the same side on which she was holding a pot. After that she was not able to stand up well and the NPRS ranking was 9. After consulting with an orthopedic surgeon at AVBRH, X-ray was performed and report suggested the displaced superior inferior pubic rami fracture (straddle fracture) of left side, sacral ala fracture, transverse process fracture of L5 vertebra. Patient underwent surgical treatment where open reduction and internal fixation was performed. Temporary reduction was done by k wire. A 5 hole pre-contoured plate was placed and fixation was done confirmed under C-ARM guidance. The sacral ala fracture was repaired with 2 cc screw which was done on 26-10-2020. Physiotherapy sessions were started after surgery. Post operatively patient had chief complain of pain, swelling, discomfort and stiffness in the pelvic area. Patient was unable to raise his leg off the bed to walk. Patient had no significant personal or family history.

Clinical finding

A proper written consent was taken from patient. The patient was explained about physical examination and intervention. On general examination patient was conscious, well oriented with time, place, person and cooperative. Patient was hemodynamically stable, febrile with BP-128/78 mm Hg, pulse rate was 84 beats/ min, respiratory rate was 18 breaths per min. Patient had no findings of cyanosis, icterus, clubbing, oedema.

The patient was examined in supine position. On inspection the patient's left leg was slightly abducted and knee and ankle in neutral position. On palpation the temperature of local area was normal. Diffuse swelling over the pelvic area and lower back was present. On examination, suture scar was present 7cm from pubic symphysis extending 5cm distal to ASIS of left side. On NPRS scale pain graded as 6/10 on rest and 9/10 on slight activity, Berg Balance score was 10/56, Dynamic Gait Index score was 3/24. Patient has grade 3 tenderness on pelvic region and bony tenderness was present over L5 vertebra. Range of motion has been mentioned in below table. Hip movements and SLR were not elicited due to pain and pelvic fracture. Active ankle and toe movement was present. Par spinal muscle spasm was present bilaterally. Muscle strength assessment was taken and compared on both limbs in table 4. On neurological examination, all the sensations were present, distal circulation was intact. Reflexes were normal. There was no limb length discrepancy. Pre-operative X-ray are shown in figure and despite post-operative X-ray of fracture fixed with implants i.e. reconstruction plate-1, scwews-3, CC screws-2.

Figure 1. Outlet View X-ray of pelvic

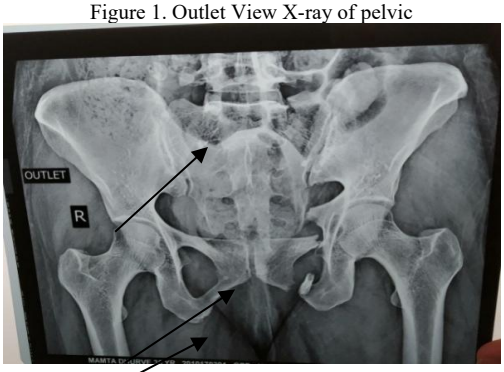

Figure 2. Inlet View X-ray of pelvic

Figure 1 and 2 suggest superior inferior pubic rami (straddle) fracture, sacral ala fracture and L5 transverse process fracture.

Figure 3. Post-operative X-ray

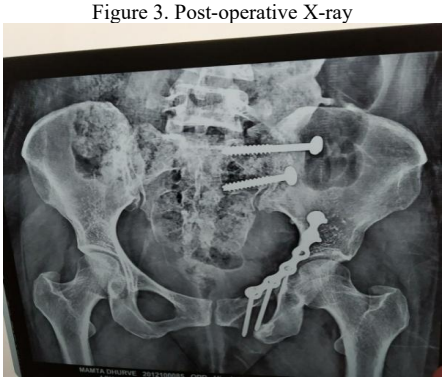

Figure 4. Internal fixator are used at fracture site

Figure 3 and 4 suggest the use of internal fixator- 5 hole pre-contoured plate, cc screw.

Examination Finding

Table 1: Range of motion assessment on day one of physiotherapy treatment

	Joint movement	**Left**		**Right**	
		Active	Passive	Active	Passive
Hip joint	Flexion	NT	$0\text{-}30^0$	$0\text{-}80^0$	$0\text{-}100^0$
	Extension	NT	$0\text{-}10^0$	$0\text{-}10^0$	$0\text{-}15^0$
	Abduction	$0\text{-}10^0$	$0\text{-}30^0$	$0\text{-}40^0$	$0\text{-}45^0$
	Adduction	$10^0\text{-}0$	$30^0\text{-}0$	$40^0\text{-}0$	$45^0\text{-}0$
	Internal rotation	NT	$0\text{-}20^0$	$0\text{-}30^0$	$0\text{-}40^0$
	External rotation	NT	$0\text{-}20^0$	$0\text{-}30^0$	$0\text{-}45^0$
Knee joint	Flexion	NT	$0\text{-}25^0$	$0\text{-}135^0$	$0\text{-}135^0$
	Extension	NT	$25^0\text{-}0$	$135^0\text{-}0$	$135^0\text{-}0$
Ankle joint	Plantar flexion	$0\text{-}30^0$	$0\text{-}40^0$	$0\text{-}40^0$	$0\text{-}45^0$
	Dorsiflexion	$0\text{-}5^0$	$0\text{-}20^0$	$0\text{-}20^0$	$0\text{-}20^0$
	Inversion	$0\text{-}20^0$	$0\text{-}35^0$	$0\text{-}30^0$	$0\text{-}35^0$
	Eversion	$0\text{-}10^0$	$0\text{-}15^0$	$0\text{-}10^0$	$0\text{-}15^0$
Dorso-lumbar	Flexion(Tape)	NT			
	Extension (Tape)	NT			
	Lateral flexion	$0\text{-}20^0$	$0\text{-}30^0$	$0\text{-}20^0$	$0\text{-}30^0$

Table 2: Range of motion assessment on day of completion physiotherapy treatment

	Joint movement	Left		Right	
		Active	Passive	Active	Passive
Hip joint	Flexion	100^0	110^0	120^0	125^0
	Extension	20^0	25^0	30^0	30^0
	Abduction	30^0	35^0	40^0	45^0
	Adduction	$30^0\text{-}0$	$35^0\text{-}0$	$40^0\text{-}0$	$45^0\text{-}0$
	Internal rotation	30^0	40^0	40^0	45^0
	External rotation	30^0	40^0	40^0	45^0
Knee joint	Flexion	110	125^0	140^0	150^0
	Extension	$110^0\text{-}0$	$125^0\text{-}0$	$145^0\text{-}0$	$150^0\text{-}0$
Ankle joint	Plantar flexion	40^0	50^0	45^0	50^0
	Dorsiflexion	20^0	20^0	15^0	20^0
	Inversion	30^0	35^0	30^0	35^0
	Eversion	10^0	15^0	10^0	15^0
Dorso-lumbar	Flexion (Tape)	15 cm			
	Extension (Tape)	11 cm			
	Lateral flexion	$0\text{-}20^0$	$0\text{-}30^0$	$0\text{-}20^0$	$0\text{-}30^0$

Table 3: Manual muscle testing on day one

Joint Movement	Left Side	Right Side
Hip Flexors	1/5	2/5
Extensors	2/5	2/5
Abductors	2/5	2/5
Adductors	2/5	2/5
Internal Rotators	1/5	2/5
External Rotators	1/5	2/5
Knee Flexors	2/5	3/5
Extensors	2/5	3/5
Ankle Plantar flexors	4/5	5/5
Dorsiflexors	3/5	5/5

Physiotherapy Protocol

Physiotherapy rehabilitation for duration of 10 weeks, 5 days per week, home programme and follow up.

Therapeutic Intervention

Physiotherapy rehabilitation protocol was modified every week with different therapeutic exercises. Short Term Goals were Patient education, to reduce pain and tenderness, to prevent respiratory complication, improve range of motion, muscle strength of lower limb and par spinal muscles, promote early mobility and Long Term Goal were to promote independent walking with or without frame, to improve static and dynamic balance, to improve the endurance and restore the functional activities of daily living.

Phase 1: (Zero to Two Weeks)

During first week- wound inspected for any infection and frequent bed turns to avoid bedsores. Cryotherapy applied to minimize the inflammation and swelling for 8 to 10 minutes. To reduce pain application of ice pack and ultrasound was applied for 10 minutes. Hip and knee strengthening exercises 10 repetition 2 times a day. Isometric exercises to par spinal muscles, glutei, hamstring and quadriceps muscle (5 second hold, 10 second relax,10 repetition, 2 sets), Isotonic exercises for ankle (ankle toe movement) to prevent thrombophlebitis and deep vein thrombosis. Gait training started with a non-weight bearing walker holder. Movements, i.e. simple hip abduction, flexion and extension movements, had been performed to reinforce a non-weighted position.

Phase 2: (Two to Six Week)

Many components of phase 1 regime was continued as required. Only 10% of the body weight was used to initiate weight bearing. Phase 2 included the progression of phase 1 rehabilitation to enforce the weight bearing activities. Cryotherapy was continued to control inflammation. Core stabilization activities was given. Strengthening of uninvolved lower extremity had a improved greater significance and recurrence. Power conditioning in the left lower extremity had led to vigorous pain free movement within the spectrum available. The non-weight bearing activities was continued and advanced into distinct assessment tasks including monitoring. Active and active assisted movement of back, hip, knee and ankle was performed for 10 repetitions, twice a day. Ankle isotonic and isometrics for par spinal, hip and ankle (5second hold, 10 second relax,

10 repetition, 2 sets), 3 point gait with crutch or walker suggested toe touch weight bearing.

Phase 3: (Six to Eight Week)

An attempt to optimize flexibility, coordination, kinesthetic, strength preparation, the purpose of the exercises was to optimize the capability of the lower extremity via taking part in phase 3 partial weight-bearing tasks. The rise in exercise duration due to increased tolerance to incremental resistant exercises focused on improving the condition of the patient. In addition, the improvement in strength to the fifty percent norm for aided equipment and the reinforcement of move on a leg lock have also been adopted. Modalities such as CPM was used to increase the range of motion. Electrotherapy has induced faradic activation of quadriceps and hamstrings to improve muscle fiber recruitment for functional exercises dynamic quadriceps movements had improved with little or no assistance. Exercises such as heel to shin movement, bed side sitting, assisted and self-resisted movement for hip and knee progression was done by the use of therabands and weight cuff, active exercises for the back muscles were also given.

Phase 4: (Eight to Ten Week)

In phase 4 rehabilitation, in addition to enhancing stability, balance, fitness and proprioceptive activities were also focused on improving maximum strength capacities in lower extremities. Weight-bearing in locomotion preparation had improved, and served to boost patient trust in ambulances individually. Gait fitness activities such as walking in place, climb stairs, Isotonic and isokinetic exercises, full range of motion active and passive exercises with resisted devices were given to lower limb and back muscles. Isometric exercises were given to pelvic floor muscles. Resistive exercises performed using considerable resistance with raised ROM, such as SLR, heel slides, dynamic exercises to hamstring, quadriceps back muscles, VMO and glutei strengthening were also given

Power conditioning of the left side of the lower limb muscles improved by increasing repetition and retaining duration.

Figure 5 and 6 suggest the full weight bearing ambulation with the help of frame.

Home program

Patients were asked to continue all resistant movements, gait conditioning activities, and complete weight bearing with walkers to avoid the recurrence of collapse due to fatigue and loss of coordination.

Table 4: Rehabilitation Plan

Therapeutic Activity Re-education	Gait Training	Neuromuscular Training	Strength Training
Bed mobility.	Plain surface.	Static sitting and Standing.	Isometric and isokinetic exercises.
Active and passive movements up to pain pain free range.	Uneven surface.	Dynamic sitting and standing.	Seated lower extremity exercises.
Transfer activities Sit-stand-walk	Stair climbing.	Co-ordination and balance training.	Progressive resistive exercises with therabands, weight cuff, dumbbell etc.
Faradic current for muscle re-education.	Progression based on BERG BALANCE SCALE	Close kinetic chain exercises in different position.	Gradual increase in exercise repetition to increase endurance.

Table 5. Detailed rehabilitation was given below

Phase (week wise)	Therapeutic exercise
Phase I: Immediate postoperative phase (Week 1-2)	
Precaution	No active ROM of Hip joint. Avoid activities of daily living. No lifting of heavy objects. Avoid prone and side lying
To reduce inflammation	Cryotherapy application for 8 to 10 minutes
To reduce pain and tenderness	Application of ice pack for 8 – 10 minute Thermotherapy, Ultrasound, two times a day.
To improve range of motion	Hip and knee passive ROM exercises, 10 repetitions x 2 Isometric exercises – static quadriceps, hamstring, glutes (5sec hold ,10 sec relax, 10 repetitions ,2 sets) Isotonic exercises – ankle pumps
Gait Training	Non-weight bearing activities.
Phase II: Protection phase(week 2-6)	
To reduce inflammation	Cryotherapy continued for 8 to 10 min
To reduce pain	Application of ice pack continued for 8 – 10 minutes.
To improve ROM	Progressive active assisted exercises for back, knee and ankle. Progress to passive ROM until full pain free ROM is achieved. Isometric exercises for par spinal, hip, knee, and ankle (5sec hold,10 sec relax, 10 repetitions, 2 sets) Ankle pumps to prevent deep vein thrombosis

To improve strength endurance and functional activities	Core stabilisation exercises. Strengthening of uninvolved lower extremity. Power conditioning in left lower extremity
Gait Training	10 % weight bearing activities. 3 point gait with crutch.
Phase III: Intermediate phase (6-8 week)	
To improve ROM and muscle strength, endurance and functional activities	Active range of motion of lower limb and back Started strengthening program to lower limb muscle with theraband (10×2) Modality- continuous passive motion (CPM), Faradic current-electric muscle stimulation. Exercises such as heel slides, bed side sitting, assisted and resisted exercises of back and lower limb.
Gait Training	Partial weight bearing activities.
Phase IV : Advanced strengthening exercises (week 8-10)	
To improve strength, endurance and functional activities	Active full range of motion and stretching exercises. Enhancing stability, balance, fitness and open-chain proprioceptive activities. Progressive strengthening exercises(10×2) Resisted and dynamic exercises to quadriceps, hamstring, glutei and back muscles
Gait Training	Full weight bearing activities such as walking in place, stair climbing, walking with normal pace etc.

Follow up

Mostly on completion of physiotherapy, the patient reported normal functional activities without pain complaints or limited range of motion. She had a complete range of motion and a muscle strength of 5 degrees on her left lower limb. After that patient had returned to his daily life activities.

DISCUSSION

The approach to the management of each cases needs thoughtful, customized planning and thus views this as the main concept for pelvic fractures. These fractures are generally encountered by gradual and incremental pain in the pelvic area, and are usually operated by ORIF with a 5-hole pre-contoured plate, k wire and cc screw.

The choice of clamping procedure in open pelvic fractures varies widely. Previously, the health results in the operated cases were higher than the non-operated cases, by Majeed ranking in the unclose pelvis fracture group [12]. According to previous studies, only an external fixation approach has been utilized in unclose pelvis fracture cases at a lowered threat of complications. However, it can have less stability for pelvic fractures compared with an internal fixation approach. Previous experience has been in favor of the use of internal fixing in unstable pelvic fractures against significant infection as in fracture zone [12].

Pelvic fracture is a concern because it is related to soft tissue injuries, communication and uncertainty, typically arising from greater impact, which further prolongs the treatment of such complex fracture [13]. Initially cryotherapy is required to reduce pain and swelling. Passive movements are initiated to reduce joint contracture [12][14]. Progressive mobilization was shown to be effective in raising the ROM during recovery and reducing the chance of vascular disease and various methods such as incremental range of motion exercises, soft tissue mobilization, isometric exercises, open and close chain muscle training, muscle strengthening, stretching, body position training have been established [13][10]. Muscle energy technique also used to increase ROM explain by Kucuksen et al.[15] Gabriel's study showed that physical therapy training had a beneficial effect on morale building, enhancing gait in post-operative physical therapy [13]. Dynamic equilibrium and care quality mobility are enhanced by neuromuscular stimulation and adjustment of parameters, gait efficiency and patient ambulation [16][17]. Movement therapy is helpful to restore normal movement of all joints followed by immobilization [18]. Locomotion training started by toe-touching to full weight bearing with frame. Control and spatial awareness preparation can also be used in the recovery phase [18]. Resistive conditioning can be innovative in order to boost muscular endurance. In a research undertaken by Wade Smith et al. (2016), it has been shown to be healthy and successful, with a focus on early weight bearing training is effective explained in the study of Duwelius et al. [19]. Preventive treatment has been established to increase disability, comorbidity and facilitate therapeutic recovery [20]. Accurate electrical stimulation involves stimulation of the damaged muscle with the use of surface electrodes that prompt dependent leg muscles to resolve fatigue [21].

The recovery process will concentrate on enhancing life expectancy. Gradual activity including appropriate pain management are the main priorities of care and home installation to program the need for stairs, handrails, better ventilation, elimination of slippery sheets. Related mobility assistance must also be provided [18]. A fall reduction rehabilitation program can be effective [18]. The patient was directed to conduct all of the activities as part of the home regimen and was presented with a prescribed checklist and recommended for follow-up visits [21]. The objectives of this studies was to focus on the importance of timely surgical treatment and necessary physiotherapy recovery to meet the functional capacity and prognostic objectives.

CONCLUSION

This clinical study shows that the classical surgical approach and the accelerated organized recovery of physiotherapy contributed to the enhancement of functional objectives i.e. decreased pain and tenderness, enhanced ROM, muscle speed and agility, which helped the patient regain physical function.

Abbreviation

ROM- Range of Motion

NPRS- Numerical Pain Rating Scale

NT- Not-Testable

CPM-Continuous Passive Motion

VMO-Vastus Medialis Oblique

CC SCREWS- Cancellous Screw

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