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CASE SERIES

Role of Continuous Passive Motion in Tibial Plateau Fracture

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A B S T R A C T

Background: The use of continuous passive motion (CPM) in postoperative treatment of tibial plateau fractures is increasing. CPM is possible to increase flexion/extension in a controlled manner that is immediately obvious to the patients and can assist in giving the patients a goal to strive.

Objective: The objective of this study was to determine the effects of a continuous passive motion (CPM) device on knee range of motion after postoperative treatment of tibial plateau fractures.

Methodology: A consecutive case series study was conducted with seven tibial plateau fracture patients underwent for open reduction and internal fixation in the Institute of Orthopedics Research & Accidental Surgery, Devadoss Multispecialty Hospital, India. A total of 7 patients were selected, in which 6 were male and 1 was female. The CPM was used for early knee mobilization with standard physiotherapy treatment in postoperative hospitalization period. The primary outcome was knee joint active range of motion; it was measured by universal goniometry, assessed before initiating of knee flexion exercise at day 'six' post-operative treatment and initiation of discharge process at day 'twelve' post-operative treatment.

Results: A statistical significant difference seen between day 'six' post-operative treatment (24.3±6.075) and day 'twelve' post-operative treatment (75±15.546) in study patients (Mean difference-50.701, (p-value 0.000). The results revealed that the knee joint active range of motion was increased with help of CPM at the time of discharge from hospital, (p value 0.000).

Conclusions: The results of this study suggest, use of CPM in the post-operative period following treatment of tibial plateau fractures benefit with regard to knee motion at discharge from hospitalization.

Introduction

The tibial plateau is one of the most critical load-bearing areas in the human body. Early detection and appropriate treatment of these fractures are essential in minimizing patient's disability and reducing the risk of complications.[1] Injuries to the proximal weight-bearing surface of the tibia or tibial plateau account for 1% of all fractures, of the tibia fracture 8% of fractures in the elderly.[2] It occurs in a bimodal distribution, with high energy fractures occurring in the young secondary to falls from heights, car bumper injuries, and strong valgus or varus forces as occur in football games or skiing, and a second peak in the elderly from low energy, relatively minor valgus forces causing lateral injuries. The open reduction internal fixation (ORIF) is the treatment of choice for most tibial plateau fractures to preserving knee function is early range of motion to prevent arthrofibrosis and a stiff knee.[3]

Physical therapy of joints following surgery focuses both passive motion to restore mobility and active exercises to restore strength. While passive motion can be administered by a therapist or continuous passive motion. CPM is thought to improve recovery by stimulating the healing of articular tissues, circulation of synovial fluid, reducing local edema, and preventing adhesions in joint. CPM may be used immediately after certain intra-articular fracture or after surgery to preserve synovial sweep and maintain articular cartilage nutrition. Regular rhythmical motion can act as an analgesic and

stimulate circulation; it may assist in reduction of swelling. CPM is possible to increase flexion/extension in a controlled manner that is immediately obvious to the patients and can assist in giving the patients a goal to strive [4]. Most of the surgeon prefers to remove surgical suture on end of second week post-operative day and followed by initiation of discharge process. Therefore, the aim of this study was to determine the effects of continuous passive motion device on knee range of motion after operative treatment in tibial plateau fractured patient at day 'twelve' post-operative treatment in hospitalization.

Methodology

A consecutive case series study was conducted in the Institute of Orthopedics Research & Accidental Surgery (IORAS), Devadoss Multispecialty Hospital, Madurai, Tamil Nadu, in India from October, 2008 to November, 2008 (two months duration). The seven patients (six males and one female) aged from 31 to 65 with an isolated fracture of the tibial plateau and underwent for surgical treatment of Open Reduction and Internal Fixation (ORIF) were included in the study. Those who have a fracture somewhere else in the limb, a contra-lateral lower limb fracture, and multiple traumas were excluded. Obtained verbal informed consent from seven patients and physiotherapy treatment was started.

The primary outcome was knee joint active range of motion (AROM). It was measured by universal goniometry in two stages, one at before initiating of knee flexion exercise at day 'six' post-operative treatment and another one at initiation of discharge process on day 'twelve' post-operative treatment. The obtained data were entered into SPSS version 16 for analysis and data is presented in form of table and appropriate bar chart. The descriptive statistics of mean and standard deviation was calculated and the paired sample't' test was done between day 'six' post-operative treatment and day 'twelve' post-operative treatment to measure the significant of CPM on tibial plateau fracture. This study was approved by the Institute of Orthopedics Research & Accidental Surgery (IORAS), Devadoss Multispecialty Hospital, and Madurai.

Physiotherapy treatment procedure:

On the day of operation: Respiratory and circulatory exercises were encouraged to the patients. Isometric exercise to knee extensor muscles and active ankle toe movements exercise to the fractured limb. Strengthening exercise were performed to both upper limb and unaffected lower limb. *Post-operative day 'one' and 'two'* on the day of operation exercise was continued with Passive patellar movement, passive assisted with active hip abduction and passive assisted with active straight leg raising (SLR) exercise for fractured limb. *Post-operative day 'three, four and five'* Day 'two' exercises were continued. Applied knee brace on the fractured limb and initiated non-weight bearing (NWB) on fractured limb gait training after reducing post-operative pain with support of elbow crutches. *Post-operative day 'six'* CPM was used for passive movement on knee joint and knee flexion range of motion was set between 0 to 45 degree depends upon pain free range. The day 'five' exercise was continued and initiated following exercise; Knee flexion exercise in lying and high sitting, short arc exercise for vastus medialis muscle (VOM) and isometric hamstring exercise. *Post-operative day 'seven to twelve'* Continued all the above-mentioned exercises and CPM was stopped once the knee ROM achieved 70 degree actively by the patients and continued vigorous exercise till to achieve 90 degree of active knee ROM. After two weeks the patient must be able to do active and active-assistive range of motion exercises, obtaining 0° to at least 90° of knee flexion.[1]

Protocols will be followed after discharge from hospitalization:

Delay weight bearing until healing is evident on radiographs; usually it takes 'eight' to 'twelve 'weeks. Weight bearing exercises will be initiated gradually from partial to full weight bearing after completion of 'twelve' weeks post-operative treatment. Closed chain exercises were started once weight bearing is allowed. Patients will resumption of normal activities after the 28 weeks (6 months).

Results

Of the seven patients, four were below 45 years; one female, three male. All of them had history of fracture occurred by road traffic accident, of this four were had fracture on right side of knee joint. Of the seven patients, four of them are diagnosed as Type-IV Shatzker classification of tibial plateau fracture, two patient were

Type II and one patient diagnosed as Type V (Shown in Table 1).

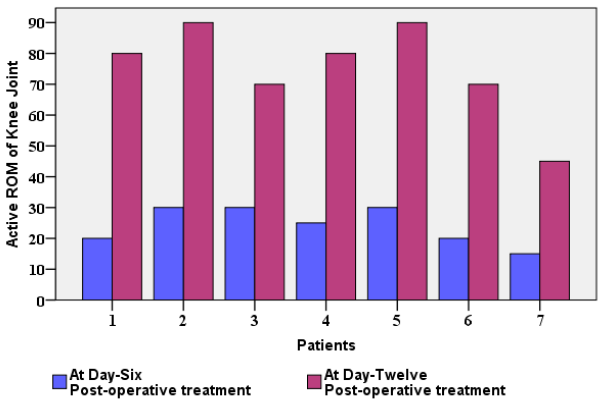
Table 1: Patients profile and their treatment status

Patients	Age	Sex	Side	Mode of Injury	Diagnosis** Shatzker classifications	AROM obtained at post-operative treatment	
						Day-Six	Day-Twelve
1	65	Male	Left	RTA*	Type IV	20°	80°
2	32	Female	Left	RTA*	Type IV	30°	90°
3	31	Male	Left	RTA*	Type IV	30°	70°
4	47	Male	Right	RTA*	Type II	25°	80°
5	40	Male	Right	RTA*	Type V	30°	90°
6	59	Male	Right	RTA*	Type IV	20°	70°
7	43	Male	Right	RTA*	Type II	15°	45°

* *RTA-Road Traffic Accident*

** *Shatzker classifications: The most common classification system for plateau fractures is the Shatzker Classification. It is simple, descriptive, and separates to some extent low (Types I-III) from high energy (Types IV-VI) fractures.*

Graph 1: Knee active range of motion obtained after CPM.



Graph-1. Showed the comparison of Knee joint AROM between day 'six' post-operative treatment and day 'twelve' post-operative treatment. The results revealed that the knee joint AROM was increased with help of CPM at the time of discharge from hospital.

Table 2: Paired samples't' test for the study patients (n=7).

Post-Operative Period	Mean	Std. Deviation	t value	p-value
At Day-'Six'	24.3	6.075	-11.468	0.000
At Day-'Twelve'	75.0	15.546		

A statistical significant difference seen betweenday 'six' post-operative treatment (24.3±6.075) and day 'twelve' post-operative treatment (75±15.546) in study patients (Mean difference-50.701, p-0.000). The results revealed that the CPM had great effect in post-operative treatment for tibial plateau fractured patients and assisted to increase the knee joint AROM (P value 0.000)

Discussion

The prolonged immobilization in a cast has chance to increase stiffness in the joint. Early range of motion (ROM) of the knee and the maintenance of non-weight bearing (NWB) on the affected leg are reducing the postoperative complication.[5] CPM machines have been widely used after elective knee arthroplasty in an effort to improve motion.[6] Orthopedic surgeon may advice or prescribes a continuous passive motion (CPM) machine, with ROM exercise to increase from 15 to 70 degrees, depending on incision healing. Patients are advised to use a hinged knee brace to avoid varus and valgus strain at the fracture and collateral ligaments.[7] CPM used to facilitate a more rapid achievement of knee flexion and to decrease the number of patients requiring postoperative knee manipulation.[8] Use of CPM may helps to less development of arthrofibrosis in tibial plateau fractures.[9]

The study was conduct with aimed basically on the effects of CPM on tibial plateau fractured patients and result in prognosis of knee flexion/extension ROM and probable reduction in complication. Biyani et al done a study with elderly patients with tibial plateau fractures and found that better results in patients who used a CPM for 'three' to 'seven' days after surgery compared with those who did not use a CP.[10] Similar study conduct by Hill et al (2015), found that CPM used patients had greater knee flexion at 48hrs from surgery than the standard physiotherapy.[11] In this study, seven subjects with different age group were diagnosed as tibial plateau

fracture, were managed with CPM machine with standard physical therapy, showed excellent recovery at the day of discharge from hospital and achieved 90 degree active knee range of motion, except one patient due to un-cooperation of treatment procedure. In this study, few patients had extensor lag during the treatment session, and it was improved by vigorous exercises. All the patients are had 90° degree knee flexion range of motion without knee extensor lag at the discharge time from hospitalization.

Sample size of the study was small to derive accurate conclusion, because availability of the tibial plateau fractured patient's in time limit of the study period. However, the study shows significant improvement on knee flexion range of motion. Similar study need to conduct with larger sample of patient in longitudinally with the tibial plateau fractures.

Conclusion

The results of this study shows that CPM is favor of patient's treatment for post-operative mobilization. This study conclude that the CPM machine plays a vital role in tibial plateau fracture to initiate earlier knee mobilization to gain active knee ROM and it can help to the patient return to normal life pattern within shorter span.

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