**MEDICAL REHABILITATION IN PATIENT WITH RIGHT TIBIAL PLATEAU FRACTURE**

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**ABSTRACT:** Tibial plateau fractures are frequently complex intra-articular injuries with a variety of fracture patterns, portending a poor prognosis due to associated complications, i.e. compartment syndrome, cartilage destruction, soft-tissue envelope damage, post-surgery infection, knee instability or stiffness, and post-traumatic osteoarthritis. Because tibial plateau fractures present numerous challenges for restoration, surgical fixation is often necessary. However, although most of these injuries are treated surgically, nonsurgical management is considered for a subset of patients with minimal fracture displacement (MFD). The goal of treatment is to restore anatomic contours to the articular surface, to prevent posttraumatic degenerative joint disease, allow soft-tissue healing in optimal position, and prevent knee stiffness with a painless range of motion and function.

**ABSTRAK:** Fraktur tibial plateau pada umumnya merupakan cedera intra-artikular kompleks dengan berbagai pola fraktur, menandakan prognosis yang buruk karena komplikasi terkait, yaitu sindrom kompartemen, kerusakan tulang rawan, kerusakan selubung jaringan lunak, infeksi pasca operasi, ketidakstabilan atau kekakuan lutut, dan osteoartritis pasca trauma. Karena fraktur tibial plateau memiliki banyak tantangan untuk restorasi, fiksasi bedah seringkali diperlukan. Namun, meskipun sebagian besar cedera ini dirawat dengan pembedahan, manajemen non-bedah perlu dipertimbangkan untuk sebagian pasien dengan *minimal fracture displacement* (MFD). Tujuan perawatan di sini adalah untuk mengembalikan kontur anatomis pada permukaan artikular, mencegah penyakit sendi degeneratif pasca trauma, memungkinkan penyembuhan jaringan lunak pada posisi optimal, dan mencegah kekakuan lutut dengan rentang gerak dan fungsi yang tidak nyeri.

**BACKGROUND**

Tibial plateau fractures are often the result of various forces across the knee secondary to high energy trauma and account for 1% of fractures treated in the United States.These fractures are caused mainly by axial loading with concomitant varus/valgus or flexion/extension bending, and have various morphology involving the lateral, medial or both tibial condyles with many degrees of articular depression widening and angulation.1

Tibial plateau fractures are frequently complex intra-articular injuries with a variety of fracture patterns, portending a poor prognosis due to associated complications, i.e. compartment syndrome, cartilage destruction, soft-tissue envelope damage, post-surgery infection, knee instability or stiffness, and post-traumatic osteoarthritis. There is a wide spectrum of fracture patterns that involve either the medial tibial plateau (10-23%), the lateral tibial plateau (55-70%), or both (11-31%).2

It is reported that at least 20% of unilateral tibial plateau fractures are associated with ligament rupture of the opposite compartment. The bone fails in compression and shear, with the ligament in tension. This is not easy to determine clinically, because of pain and motion at the fracture site. A thorough neurovascular evaluation should be recorded.3

Many different classification systems have been proposed, none with universal acceptance. In a system devised by Schatzker et al, the fractures are classified into types I through III for those involving the lateral plateau and types IV through VI for those involving the medial aspect or both sides of the plateau. The Schatzker classification; type I: split fracture of the lateral plateau, type II: split-depression of the lateral plateau, type III: depression of the lateral plateau, type IV: medial plateau fracture, type V: bicondylar fracture, and type VI: a fracture with metaphyseal-diaphyseal dissociation. Proper classification is based on quality radiographs, including oblique views if necessary. If fat is present in the knee aspirate and plain films fail to show any obvious fractures, occult injury needs to be ruled out. CT and more recently, MRI have all been used successfully for this purpose.4,5,6,7,8

Because tibial plateau fractures present numerous challenges for restoration, surgical fixation is often necessary. However, although most of these injuries are treated surgically, nonsurgical management is considered for a subset of patients with minimal fracture displacement (MFD) who do not meet the criteria for surgical treatment. MFD defined as 2 mm of articular depression or a 1-mm fracture gap and ,5 mm of condylar widening, or surgery precluded (SP) by patient characteristics, such as severe comorbidities at the time of treatment, delayed presentation, or advanced arthritic change.9-10

A drawing of a person

Description generated with high confidenceThe goal of treatment is to restore anatomic contours to the articular surface, to prevent posttraumatic degenerative joint disease, allow soft-tissue healing in optimal position, and prevent knee stiffness with a painless range of motion and function. Minimally displaced stable fractures should be treated with protected mobilization*.* Both closed and open treatment can achieve these goals. The choice will depend on multiple factors, including the patient's age and general medical condition, the degree of displacement and comminution of the fracture, associated local soft-tissue and bony injuries, local skin condition, residual knee stability, and fracture configuration. Closed treatment with a cast or fracture brace is appropriate for minimally displaced fractures with no ligament instability. Definite varus and valgus laxity at full extension is a poor prognostic sign for closed treatment. Articular step-off of 3 mm or less and condylar widening of 5 mm or less can be treated conservatively. Lateral or valgus tilt up to 5 degrees is well tolerated. Medial plateau fractures with any significant displacement should be surgically stabilized. Articular step-off > 3 mm should be anatomically fixed. Bicondylar fractures with any medial displacement, valgus tilt > 5 degrees or with significant articular step-off should be surgically stabilized.1,2,11

Achieving fracture reduction and stabilization is only the initial step; good postoperative rehabilitation is necessary as early mobilization may limit complications following intra-articular fractures, including knee joint stiffness, muscle and bone atrophy, synovial adhesions and capsular contractions to adversely impact on outcomes. Early range of motion is allowed according to the stability of the construct. Weight bearing is occasionally allowed at 6-8 weeks and more frequently after 12 weeks.12 Functional Independence Measure (FIM) in this patient was used to evaluate the improvement. FIM consist of seven item in which each have a specific specification with the total score is 126.

Figure 1. The Schatzker Classification of Tibial Plateau Fracture6

**CASE REPORT**

**I. Identity**

1. Name : Mr. AM
2. Age : 31 Years old
3. Sex : Male
4. Religion : Christian
5. Nationality : Indonesian
6. Occupation : Nurse
7. Address : Singkil
8. Phone Number : 085397746651
9. Examination Date : August 10th 2017

**II. Anamnesis (Autoanamnesis)**

**Chief Complaint :** Difficulty to walk normally

**History of Present Illness**

Difficult to walk normally since approximately 2 months ago ( June 7th 2017) after patient got accident. He was driving his motorbike on his way home after work when suddenly the car in front of him stopped so he suddenly pressed the brake and he fell down to the right side with his right lower limb still stuck in front of his motorbike. When he managed to stand up, he felt pain on his right knee that made him difficult to stand up. He raised his right lower limb with the help of his left hand and the pain was getting worse. He is then was taken to Wolter Monginsidi Hospital where he works as a nurse there. His right lower limb was immobilize with back slap and 9 days later his right lower limb was performed with CT Scan. He was suggested to keep immobilize his right lower limb with back slap. He uses back slap for only about 3 weeks and he started to walk with the help of bilateral axillary crutches.

**History of Past Illness**

No history of hypertension ,diabetes mellitus and dyslipidemia in this patient

**Family History**

There is no family member that has the same complaint

**Socio Economic History**

* His health insurance was covered by BPJS
* He is a nurse working in Wolter Monginsidi Hospital. He works as an assisted nurse in the operation room
* He lives with his uncle and aunt and his little sister that he supports financially for her sister’s education
* He lives in 1 floor permanent house, 3 bedrooms , 2 bathrooms using squatting toilet and temporarily patient modified a chair for toileting. No stair step in the house where he lives.

**Psychological Status**

Patient has adequate orientation to person, place, time and situation. He has good memory skills and judgment. Patient has an anxiety about his condition because he is afraid that he might lose his job because he is just a non-permanent employee. He has to support his sister’s education so he has to go back to work as soon as possible.

**III. Physical Examination**

**General Status**

Karnovsky Performance Scale : 80 ( some symptoms; normal activity with some effort)

Compos mentis, independent ambulation with bilateral axillary crutches

 BW : 89 kg BH : 165 cm BMI : 32.72 (obese)

 BP : 120/70 mmHg HR : 70 x/minutes

RR : 20 x/minutes

 Head and neck : no anemis, icterus, cyanosis & dyspnoe, JVP not increase

 Thorax :

Heart :

Auscultation : S1-S2, single, regular,

murmur (-), gallops (-)

Percussion : heart margins normal

Palpation : ictus cordis at ICS V

Lung :

Auscultation : vesicular **+**/+, ronchi -/-, wheezing -/-

Percussion : sonor/sonor

Palpation : symetrical chest expansion, fremitus N/N

 Abdomen : distended (-), meteorismus (-), bowel sound N, hepar and lien unpalpable

 Upper Extremities : No abnormality

 Lower Extremities : see local status

Visual Analogue Scale (VAS) – 2

**Physiatric Examination – Table 1.** **Musculoskeletal Status**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Region | Joint Movement | | Muscle Strength | |
| Movement | Range of Motion | Muscles | MMT |
| Cervical | Flexion  Extension  Lateral flexion  Rotation | Full (0-450)  Full (0-450)  Full/Full (0-450)  Full/Full (0-600) | Flexor  Extensor  Lateral flexor  Rotator | 5  5  5/5  5/5 |
| Trunk | Flexion  Extension  Lateral flexion  Rotation | Full (0-85º)  Full (0-30º)  Full/Full (0-35º)  Full/Full (0-45º) | Flexor  Extensor  Lateral flexor  Rotator | 5  5  5/5  5/5 |
| Shoulder | Flexion  Extension  Abduction  Adduction  InternalRotation  External Rotation | Full/Full (0-180 º)  Full/Full (0-60 º)  Full/Full (0-180 º)  Full/Full (0-45 º)  Full/Full (0-90 º)  Full/Full (0-70 º) | Flexor  Extensor  Abductor  Adductor  Internal Rotator  External Rotator | 5/5  5/5  5/5  5/5  5/5  5/5 |
| Elbow | Flexion  Extension  Pronation  Supination | Full/Full (0-135 º)  Full/Full (135º-0)  Full/Full (0-90 º)  Full/Full (0-90 º) | Fleksor  Ekstensor  Pronator  Supinator | 5/5  5/5  5/5  5/5 |
| Wrist | Flexion  Extension  Radial Deviation  Ulnar Deviation | Full/Full (0-80 º)  Full/Full (0-70 º)  Full/Full (0-20 º)  Full/Full (0-35 º) | Flexor  Extensor  Radial Deviator  Ulnar Deviator | 5/5  5/5  5/5  5/5 |
| Fingers &  Thumb | Flexion  Extention  Abduction  Adduction | Full/Full  Full/Full  Full/Full  Full/Full | Flexor  Extensor  Abductor  Adductor | 5/5  5/5  5/5  5/5 |
| Hip | Flexion  Extension  Abduction  Adduction  Internal Rotation  External Rotation | Full/Full (0-125 º)  Full/Full (0-30 º)  Full/Full (0-45 º)  Full/Full (0-20 º)  Full/Full (0-45 º)  Full/Full (0-45 º) | Flexor  Extensor  Abductor  Adductor  Internal Rotator  External Rotator | 5/5  5/5  5/5  5/5  5/5  5/5 |
| Knee | Flexion  Extention | 110 º / 130°  Full/Full (0º) | Flexor  Extensor | 5- pain/5  5/5 |
| Ankle and Foot | Dorsoflexion  Plantarflexion  Evertion  Invertion | Full/Full (0-15 º)  Full/Full (0-50 º)  Full/Full (0-20 º)  Full/Full (0-35 º) | Dorsofleksor  Plantarfleksor  Evertor  Invertor | 5/5  5/5  5/5  5/5 |

**Local Status of Lower Limbs :**

Inspection : Swelling (-/-), Muscle Atrophy of Right Thigh and Calf (+/-)

Palpation :

* Warm (-/-), Crepitation (-/-)
* No tenderness on palpation at the right and left knee
* Pulsation of a. Dorsalis pedis, a. Tibialis anterior, a. Poplitea, a. Femoralis is adequate, symmetric between right and left.

Measurement :

* Apparent Leg Length : 93/93
* True Leg Length : 91/91
* Thigh Circumference : **51**/54
* Calf Circumference : **40.5**/42

Sensory test : normal sensation on right and left lower limbs

Proprioception : able to identify direction and position on both extremities

**Activities of Daily Living (ADL) examination :**

**Table 2. Functional Independence Measure (FIM) :**

|  |  |  |
| --- | --- | --- |
| Self care |  | Score |
| 1. Eating | Complete independence | 7 |
| 1. Grooming | Complete independence | 7 |
| 1. Bathing | Modified Independence | 6 |
| 1. Dressing (upper part) | Complete independence | 7 |
| 1. Dressing (lower part) | Modified Independence | 6 |
| 1. Toileting | Modified Independence | 6 |
| Sphincters |  |  |
| 1. Bladder management | Complete independence | 7 |
| 1. Bowel management | Complete independence | 7 |
| Transfer |  |  |
| 1. Transfer: chair/wheelchair | Modified Independence | 6 |
| 1. Transfer: toileting | Modified Independence | 6 |
| 1. Transfer: tub/shower | Modified Independence | 6 |
| Locomotion |  |  |
| 1. Locomotion: walk/wheelchair/crawl | Modified Independence | 6 |
| 1. Locomotion: stairs | Total assistance | 1 |
| Communication |  |  |
| 1. Comprehension | Complete independence | 7 |
| 1. Expression | Complete independence | 7 |
| Psychosocial |  |  |
| 1. Social interaction | Complete independence | 7 |
| Cognition |  |  |
| 1. Problem solving | Complete independence | 7 |
| 1. Memory | Complete independence | 7 |
| Total |  | **113** |

**IV. Supporting Examination**

A picture containing sitting, indoor

Description generated with high confidence

**Figure 2.** CT Scan of right lower leg (June 16th 2017)

**V. Diagnosis**

Clinical diagnosis : Type I Schatzker Right Tibial Plateau Fracture (S 82.1)

Topical diagnosis: Lateral of Right Tibial plateau

Etiology diagnosis : Traumatic

**Table 3.** Functional Diagnosis Based on 2001 ICF :

|  |  |  |
| --- | --- | --- |
| ICF Code | Description | Patient’s Condition |
| Body Function | | |
| b280 | Sensation of pain | Pain on Lateral of right tibial plateau |
| b749 | Muscle functions,other specified and unspecified | Muscle athrophy of right thigh and calf |
| Body Structure | | |
| s710 | Structure of Right Lower Extremity | Lateral tibial plateau fracture |
| Activities and Participation | | |
| d450.3 | Walking | Walking with the help of walking assisted device (bilateral axillary crutches) |
| d230 | Carrying out daily routine | Toiletting and Climbing Stairs |
| d930.3  d910.3 | Religion and spirituality  Community life | Can’t participating in ‘Ibadah Kolom’ and other social activity |
| d8451.4 | Maintaining a job | Can’t work |
| Environmental Factor | | |
| e1650.3 | Financial assets | Low financial/economic status |
| e260.+1 | Air quality | Ventilation and indoor/outdoor air quality is quite good |
| e315.+3 | Extended family | His uncle and aunt give shelter and financial support |
| e580.+3 | Health services, systems and pollicies | Covered by BPJS |

**VI. PROBLEM LIST**

* Surgical : -
* Medical : Lateral of Right Tibial Plateau Fracture
* Physical and Rehabilitation Medicine

**Table 4.** Functional Diagnosis Based on 2001 ICF :

|  |  |
| --- | --- |
| Mobilization | Ambulation with bilateral axillary crutches |
| ADL | Limitation of ADL (toiletting and climbing stairs) |
| Communication | - |
| Psychological | Worried because of his illness |
| Social economy | Low Financial Status |
| Vocational | Cant’t work since he got accident |
| Others | * Muscles atrophy of right thigh and calf * Limitation ROM of right knee * Knee pain (VAS 2) |

**VII. GOAL SETTING**

**Short term goals:**

1. Decrease pain in the right knee
2. Increase ROM of right knee
3. Increase muscle mass of right thigh and calf
4. Improve transfer and ambulation
5. Improve Activity of Daily Living.
6. Decrease patient’s anxiety.
7. Educate and reassure the patient about the condition.

**Long term goals:**

1. Restore function of the involved limb for normal function
2. Back to work again.
3. Improvement in quality of life
4. Maintain muscle strength
5. Improve mobilisation, transfer, ambulation and Activities Daily Living/ ADL disturbance
6. Prevent fall
7. Restore normal gait

**VII. PLANNING**

Surgical : -

Medical : -

Physical Medicine and Rehabilitation

**Planning Diagnostic : -**

**Planning Therapy :**

* Modality :
* Magnetotherapy on right lower limb, the first exposures are best performed daily in first two weeks with duration 20 minutes pulse frequency is above 10 Hz and intensity of the magnetic field range from 1-50 Gauss.
* LASER at tender point on lateral of right tibial plateau, with griding technique, continuous mode, effectiveness 100%, dose 0.5-3 J/cm2 with frequency 3-6 x/week.
* ROM exercises
* Move the right lower extremity segmen through its complete pain-free ROM, smoothly & rhtmically.
* Patient should have full knee extension an at least 90 degrees of knee flexion
* Strengthening Exercise

**Table 5.** Isometric Exercise (Weeks 2-4)

|  |  |
| --- | --- |
| Frequency | 2-3 day/week |
| Intensity | 60-80% max isometric contraction |
| Time | 10 seconds (2’ rise time, 6’ hold time, 2’ fall time) |
| Type | Isometric |
| Repetition | 20x repetition, exercise at different specific angle |
| Progression | As tolerated |

Resistance Exercise (Weeks 8-12)

|  |  |
| --- | --- |
| Frequency | ≥ 2-3 day/week |
| Intensity | 50 % of voluntary maximal contraction (gradually increased) |
| Time | No specific duration |
| Type | * Involved each muscle group of the upper extremities * Gentle resistive to the quadriceps, hamstrings and ankle musculature * Use exercise equipment and or body weight |
| Repetition | 8- 10 Repetition |
| Sets | 2-4 set |
| Pattern | Rest interval 2-3 minutes between set |

Stretching Exercise ( Weeks 1-6)

|  |  |
| --- | --- |
| Frequency | ≥ 2-3 day/week with daily being most effective |
| Intensity | Stretch to the point of feeling tightness or slight discomfort |
| Time | Holding static stretch for 10-30 s is recommended for most adults. |
| Type | Static Flexibility |
| Repetition | 2-4 Repetition is recommended |

* **Table 6.** Cardiovascular Exercise : (Week 6-12)

|  |  |
| --- | --- |
| Frequency | Start with ≥ 2-3 days/week |
| Intensity | Start with low intensity  Low intensity : 40%-60% Maximum Heart Rate (MHR)  Moderate intensity : 60%-70% MHR  Vigorous intensity : 70%-80% MHR |
| Time | * 30-60 minutes of moderate exercise * 20-60 minutes of vigorous exercise |
| Type | Regular, continuous, rhythmic exercise that involve major muscle group |
| Volume | ≥ 500-1000 MET-min /week ; step count ≥ 7000 step/day |
| Pattern | One continuous session or multiple session of ≥ 10 min /day |
| Progression | Gradual adjusting duration, frequency, and intensity |

* Multi-plane ankle strengthening non weight bearing (Ankle Pumping)
* Aggressive gait training at week 8 as follows :
* Week 8 : Toe Touch Weight Bearing
* Week 9 : 25% Weight Bearing
* Week 10 : 50% Weight Bearing
* Week 11 : 75% Weight Bearing
* Week 12 : Full Weight Bearing
* Orthesa : Hinged Knee Support while walking (Week 8-12)
* Walking aid : Bilateral axillary crutches
* Occupational therapy : educate patient in principles of joint protection, training in ergonomics and education in body mechanics and posture.
* Psychologist :
* Assess patient’s anxiety using questioner
* Mental support to overcome the patient's anxiety and also looking for more information of the patient's psychological problems that may affect the successful process of the overall therapy.
* Social Medic :
* Psychosocial therapy to enable reinsertion of patients into social and professional life

**Planning Monitoring :**

* VAS
* FIM
* ROM of Right Knee
* Measurement of thigh and calf circumference

**Planning Education :**

* Explain about his condition & therapy given to him
* Continue strengthening and ROM exercise at home. Hydrate before & rehydrate after each exercise session to prevent dehydration.
* Routinely control at PMR Departement

**VIII. PROGNOSIS**

* ad vitam : bonam
* ad functionam : dubia ad bonam
* ad sanationam : dubia ad bonam

**Table 7. PROGRESS NOTE**

|  |  |
| --- | --- |
| Follow up : August 28th 2017 (12 weeks post back slap) | |
| S | * No pain on the right knee * Walking with the help of bilateral axillary crutches |
| O | Local status of right lower limb  Inspection : Swelling (-/-), Muscle Atrophy of Right Thigh and Calf (+/-)  Palpation :   * No tenderness on palpation at the right and left knee   Measurement :   * Thigh Circumference : 51/54 * Calf Circumference : 40.5/42   ROM right knee   * Extension - Flexion : 0º - 0 - 110º   C:\Users\Asus\AppData\Local\Microsoft\Windows\INetCache\Content.Word\P_20170810_103804.jpg  **Figure 3.** Goniometry  FIM   |  |  |  | | --- | --- | --- | | Self care |  | Score | | 1. Eating | Complete independence | 7 | | 1. Grooming | Complete independence | 7 | | 1. Bathing | Modified Independence | 6 | | 1. Dressing (upper part) | Complete independence | 7 | | 1. Dressing (lower part) | Complete independence | 7 | | 1. Toileting | Modified Independence | 6 | | Sphincters |  |  | | 1. Bladder management | Complete independence | 7 | | 1. Bowel management | Complete independence | 7 | | Transfer |  |  | | 1. Transfer: chair/wheelchair | Modified Independence | 6 | | 1. Transfer: toileting | Modified Independence | 6 | | 1. Transfer: tub/shower | Modified Independence | 6 | | Locomotion |  |  | | 1. Locomotion: walk/wheelchair/crawl | Modified Independence | 6 | | 1. Locomotion: stairs | Total assistance | 1 | | Communication |  |  | | 1. Comprehension | Complete independence | 7 | | 1. Expression | Complete independence | 7 | | Psychosocial |  |  | | 1. Social interaction | Complete independence | 7 | | Cognition |  |  | | 1. Problem solving | Complete independence | 7 | | 1. Memory | Complete independence | 7 | | Total |  | 114 |     **Figure 4.** Patient’s ambulation |
| A | ROM limitation on knee post back slap caused by lateral right tibial plateau fracture |
| P | * Modality : Magnetotherapy and Laser therapy on lateral of right tibial plateau * AROM Exercise of Right Hip, Knee and Ankle * Strengthening Exercise : * Isometric and Resistance Exercise of right lower extremity (Gluteus, Hamstring, Quadriceps, Gastrocnemius and Anterior Tibial Muscles) * Resistance exercise of both upper extremities * Ankle Pumping * Gentle stretching of right lower extremity * Gait training partial weight bearing with bilateral axillary crutches * Mental support for the patient * Social medic |

|  |  |
| --- | --- |
| Follow up : November 22nd 2017 (24 weeks post back slap) | |
| S | * No pain on the right knee * Walking independently |
| O | Local status of right lower limb  Inspection : Swelling (-/-), Muscle Atrophy of Right Thigh and Calf (+/-)  Palpation :   * No tenderness on palpation at the right and left knee   Measurement :   * Thigh Circumference : 51/54 * Calf Circumference : 41/42   ROM right knee   * Extension - Flexion : 0º - 0 - 120º   A picture containing person, indoor  Description generated with very high confidence  **Figure 5.** Goniometry  FIM   |  |  |  | | --- | --- | --- | | Self care |  | Score | | 1. Eating | Complete independence | 7 | | 1. Grooming | Complete independence | 7 | | 1. Bathing | Complete independence | 7 | | 1. Dressing (upper part) | Complete independence | 7 | | 1. Dressing (lower part) | Complete independence | 7 | | 1. Toileting | Modified Independence | 6 | | Sphincters |  |  | | 1. Bladder management | Complete independence | 7 | | 1. Bowel management | Complete independence | 7 | | Transfer |  |  | | 1. Transfer: chair/wheelchair | Complete independence | 7 | | 1. Transfer: toileting | Modified Independence | 6 | | 1. Transfer: tub/shower | Complete independence | 7 | | Locomotion |  |  | | 1. Locomotion: walk/wheelchair/crawl | Complete independence | 7 | | 1. Locomotion: stairs | Total assistance | 1 | | Communication |  |  | | 1. Comprehension | Complete independence | 7 | | 1. Expression | Complete independence | 7 | | Psychosocial |  |  | | 1. Social interaction | Complete independence | 7 | | Cognition |  |  | | 1. Problem solving | Complete independence | 7 | | 1. Memory | Complete independence | 7 | | Total |  | 118 |     **Figure 6.** Patient’s Ambulation |
| A | ROM limitation on knee post back slap caused by lateral right tibial plateau fracture |
| P | * AROM Exercise of Right Hip, Knee and Ankle * Strengthening Exercise : * Isometric and Resistance Exercise of right lower extremity * Ankle pumping * Stretching right lower extremity * Gait training full weight bearing * Orthesa : Hinged knee support while walking |

|  |  |
| --- | --- |
| Follow up : April 26th 2018 (10 months post back slab) | |
| S | * No pain on the right knee * Walking independently |
| O | Local status of right lower limb  Inspection : Swelling (-/-), Muscle Atrophy of Right Thigh (+/-)  Palpation :   * No tenderness on palpation at the right and left knee   Measurement :   * Thigh Circumference : 51/54 * Calf Circumference : 41.5/42   A person posing for the camera  Description generated with high confidence A picture containing person, clothing, indoor  Description generated with very high confidence A picture containing person, indoor, clothing, wall  Description generated with very high confidence  **Figure 7.** Anthropometry  ROM right knee   * Extension - Flexion : 0º - 0 - 120º   A picture containing person, indoor, curtain, wall  Description generated with very high confidence  **Figure 8.** Goniometry  FIM   |  |  |  | | --- | --- | --- | | Self care |  | Score | | 1. Eating | Complete independence | 7 | | 1. Grooming | Complete independence | 7 | | 1. Bathing | Complete independence | 7 | | 1. Dressing (upper part) | Complete independence | 7 | | 1. Dressing (lower part) | Complete independence | 7 | | 1. Toileting | Complete independence | 7 | | Sphincters |  |  | | 1. Bladder management | Complete independence | 7 | | 1. Bowel management | Complete independence | 7 | | Transfer |  |  | | 1. Transfer: chair/wheelchair | Complete independence | 7 | | 1. Transfer: toileting | Complete independence | 7 | | 1. Transfer: tub/shower | Complete independence | 7 | | Locomotion |  |  | | 1. Locomotion: walk/wheelchair/crawl | Complete independence | 7 | | 1. Locomotion: stairs | Modified Independence | 6 | | Communication |  |  | | 1. Comprehension | Complete independence | 7 | | 1. Expression | Complete independence | 7 | | Psychosocial |  |  | | 1. Social interaction | Complete independence | 7 | | Cognition |  |  | | 1. Problem solving | Complete independence | 7 | | 1. Memory | Complete independence | 7 | | Total |  | 125 |     **Figure 9.** Patient’s ambulation |
| A | ROM limitation on knee post back slap caused by lateral right tibial plateau fracture |
| P | * AROM Exercise of Right Hip, Knee and Ankle * Strengthening Exercise : * Isometric and Resistance Exercise of right lower extremity * Ankle pumping * Stretching right lower extremity * Orthesa : Hinged knee support while walking * Educate patient to do aerobic (cardiovascular exercise) like   walking |

**DISCUSSION**

In this case report, we discuss about a male, 31 years old patient who was diagnosed with Type I Schatzker right Tibial Plateau Fracture. Tibial plateau fractures are often the result of various forces across the knee secondary to high energy trauma and account for 1% of fractures treated in the United States.1 These fractures are caused mainly by axial loading with concomitant varus/valgus or flexion/extension bending, and have various morphology involving the lateral, medial or both tibial condyles with many degrees of articular depression widening and angulation.2 Of these fractures, 80% are motor vehicle–related injuries, and the remainder are sports-related injuries. Trauma can be direct or can be related to a fall from a height, an industrial accident, or a sports injury.3 This patient suffered from right tibial plateau fracture after he got motorbike accident on June 7th 2017.

 The three main stages of fracture healing as described by Maxey & Magnusson, 2013 are (a) the inflammatory phase (10%), (b) the reparative phase (40%), and (c) the remodeling phase (70%). These phases overlap, and events that occur mainly in one phase may begin in an earlier phase. Phases of bone healing:6

**Figure 10 A**.Inflammatory phase of secondary bone healing. A fracture hematoma has been invaded by inflammatory cells and the periosteum is elevated. Osteoblasts begin to absorb necrotic bone. This phase lasts for 1 to 2 weeks.

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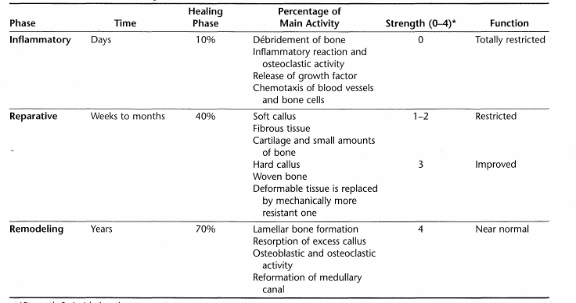


**Figure 10 B**. Soft callus formation of the reparative phase of bone healing. The hematoma begins to organize and is invaded by chondroblasts and fibroblasts that lay down the matrix for callus formation. The soft callus is composed mainly of fibrous tissue and cartilage with small amounts of bone.

**Fig.C**. Hard callus formation, reparative phase. Osteoblasts are responsible for mineralization of the soft callus, converting it to hard callus, the woven bone. The soft callus is replaced by a mechanically more resistant one. This phase lasts for several months.



**Figure 10 C** Hard callus formation, reparative phase. Osteoblasts are responsible for mineralization of the soft callus, converting it to hard callus, the woven bone. The soft callus is replaced by a mechanically more resistant one. This phase lasts for several months.

The goal of treatment is to restore anatomic contours to the articular surface, to prevent posttraumatic degenerative joint disease, allow soft-tissue healing in optimal position, and prevent knee stiffness with a painless range of motion and function. Minimally displaced stable fractures should be treated with protected mobilization*.* Both closed and open treatment can achieve these goals. The goal of fracture treatment is for the fracture to heal so that the mechanical function of the bone (its ability to withstand weight bearing and provide joint motion) is restored. The race is between fracture healing and negative sequelae such as loss of fracture reduction, tissue stiffness, and muscle wasting.1,2,11,13

**Table 10.** Bone Healing Phases

In this patient anatomic contours of his right tibial plateau was restored by using back slap for about 3 weeks then he started to walk with the help of bilateral axillary crutches.

A drawing of a person

Description generated with high confidenceImaging Studies in radiologic diagnosis and evaluation of tibial plateau fractures could be Radiography, Computed Tomography, and Magnetic Resonance Imaging. Most tibial plateau fractures are easy to identify on standard anteroposterior (AP) and lateral projections of the knee**.** Magnetic resonance imaging (MRI) is acknowledged as a reliable and accurate tool for assessing meniscal, collateral, and cruciate ligamentous injury, as well as for identifying occult fractures of the tibial plateau. A major advantage that MRI has over CT is that MRI does not use ionizing radiation. Disadvantages include the higher cost and greater time needed to complete the study (25 minutes for MRI vs 20 seconds for CT), which means that motion artifact can be a problem.8 Radiologic diagnosis and evaluation of tibial plateau fracture in this patient was performed with CT Scan. According to the theory many different classification systems have been proposed, none with universal acceptance. In a system devised by Schatzker et al, the fractures are classified into types I through III for those involving the lateral plateau and types IV through VI for those involving the medial aspect or both sides of the plateau. The Schatzker classification; type I: split fracture of the lateral plateau, type II: split-depression of the lateral plateau, type III: depression of the lateral plateau, type IV: medial plateau fracture, type V: bicondylar fracture, and type VI: a fracture with metaphyseal-diaphyseal dissociation.4,5,6,7,8 This patient was diagnosed with tibial plateau fracture schatzker tipe I as we can see from his CT scan showed that there is split fracture of the right lateral tibial plateau.

A picture containing sitting, indoor

Description generated with high confidence

**Figure 11.** Split fracture of lateral tibial plateau Schatzker Tipe I

Not all fractures of the tibial plateau require surgery. The first challenge in the management of upper tibial fractures is to decide between nonoperative and surgical treatment. [Treatment and management](http://emedicine.medscape.com/article/1249872-treatment) for Fracture displacement ranging from 4-10 mm can be treated nonoperatively; however, a depressed fragment greater than 5 mm should be elevated and grafted.

|  |  |
| --- | --- |
| Week | Tibial Plateau Fracture |
| 0-1 | Precaution: no varus/valgus stress/PROM  ROM: AROM&AAROM flx/ext: 40-60˚ flx 90 flx (after 1 w)  Muscle Strength: no strength exc to knee  Functional Activities: NWB stand/pivot transfer & ambulation with crutches  Weight Bearing : none |
| 2-4 | Precaution: no varus/valgus stress/PROM  ROM: AROM-AAROM flexion/extension up to 90˚  Muscle Strength: isometric exc quadricep  Functional Activities : NWB stand/pivot transfer & ambulation with crutches  Weight Bearing: NWB on affected extremity |
| 4-6 | Precaution: no varus/valgus stress/PROM  ROM: AROM-AAROM knee  Muscle Strength: no strength exc to the knee  Functional Activities : NWB transfer & ambulation with crutches  Weight Bearingv: none |
| 8-12 | Precaution: no varus/valgus stress  ROM: AROM,AAROM,PROM knee  Muscle Strength: gentle resistive exc to the quads & hamstring  Functional Activities : WB transfer & ambulation at the end of 12 w  Weight Bearing : PWB to Full WB (end 12 w) |

The following are absolute indications for surgery4:

1. Open plateau fractures
2. Fractures with an associated compartment syndrome
3. Fractures associated with a vascular injury

The following are relative indications for surgery4:

1. Most displaced bicondylar fractures
2. Displaced medial condylar fractures
3. Lateral plateau fractures that result in joint instability

Contraindications for surgical treatment include the following4:

1. Presence of a compromised soft-tissue envelope (for immediate open reduction)
2. Fractures that do not result in joint instability or deformity and can therefore be treated with nonoperative modalities.

### Indications for nonoperative treatment are as follows1,4:

1. Nondisplaced stable split fractures

**Table 10.** Tibial Plateau Fracture Rehabilitation

1. Minimally displaced or depressed fractures
2. Submeniscal rim fractures
3. Fractures in elderly, low-demand, or osteoporotic patients

Advantages of nonoperative treatment are as follows1,4:

* 1. Simple technique
  2. No surgical trauma or risk for sepsis
  3. Shorter hospital duration stay
  4. Early joint mobilization (only if functional cast brace is used) and delayed weight-bearing.

Disadvantages of nonoperative treatment are as follows1,4:

* Risk of displacement and need for surgery (follow-up with imaging studies every 2 weeks for 6 weeks; activity restriction for 4-6 months).
* Prolonged immobilization and related complication. If traction is used, good motion is obtained at the cost of a lengthy hospital stay and the risk of pin-tract infection,14 related complications of recumbency can include pulmonary embolism or phlebitis.
* Joint stiffness (if immobilization >2-3 weeks)
* Instability and posttraumatic arthritis in the long term

In this patient for his right tibial plateau fracture was treated only with back slap for about three weeks time because his fracture met the criteria of non-operative tibial fracture management where his tibial plateau fracture type is split fractures of the lateral tibial plateau (Schatzker type I ) with minimal displacement and valgus or varus instability does not exceed 10 degrees and no posterior wedge fracture is present.

Guideline physical therapy for tibial plateau Fracture are as follows4 :

This patient came to the PMR outpatient clinic after 9 weeks from the accident. His chief complaint was he couldn’t walk normally, he walked with the help of bilateral axillary crutches. He came to the PMR outpatient clinic with the hope that he can walk normally without assistive device. This patient was treated with the work of the team of physiatrist, physiotherapy, orthotic prosthetic, occupational therapy, psychology and social worker.

The programs for this patient including modalities and exercises. Modalities that were used for this patient was magnetotherapy and laser therapy on right knee. According Assiotis A, et all, pulsed electromagnetic fields is an effective non-invasive method for addressing non-infected tibial union abnormalities. Magnetotherapy is defined as the use of time-varying magnetic fields of low-frequency values (3 Hz – 3 KHz) to induce a sufficiently strong current to stimulate living tissue. Magnetotherapy are claimed to relieve pain and to have therapeutic value against a large number of diseases and conditions. Pulsed electromagnetic fields which induce measurable electric fields have been demonstrated effective for treating slow-healing fractures and have shown promise for a few other conditions. Relatively few studies have been published on the effect on pain of small, static magnets.Magnetotherapy can be used clinically to increase circulation, reduce inflammation, speed recovery from injuries. Hence, magnetotherapy has analgesic, anti-inflammatory and antiedemaatous effects; moreover, it accelerates the processes of fractured bone union and soft tissue regeneration. 14

In this patient was given Magnetotherapy on right lower limb for about 2 weeks (12 treatments) with duration 20 minutes pulse frequency was 20 Hz and intensity of the magnetic field was 50 Gauss.

The use of low level laser to reduce pain, inflammation and edema, to promote wound, deeper tissues and nerves healing, and to prevent tissue damage has been known for almost forty years since the invention of lasers. This review will cover some of the proposed cellular mechanisms responsible for the effect of visible light on mammalian cells, including cytochrome c oxidase (with absorption peaks in the Near Infrared (NIR)). Mitochondria are thought to be a likely site for the initial effects of light, leading to increased ATP production, modulation of reactive oxygen species, and induction of transcription factors. These effects in turn lead to increased cell proliferation and migration (particularly by fibroblasts).15 In this patient was given LASER at tender point on lateral of right tibial plateau, with griding technique, continuous mode, effectiveness 100%, dose 4.5 J/cm2 duration 6 minutes with frequency 3-6 x/week.

Because of prolonged immobilization and related complication, patient came to PMR Outpatient clinic with chief complaint he couldn’t walk normally because he walk with the help of bilateral crutches and on physical examination was found atrophy of his right thigh and calf and also there is a limitation of ROM of his right knee.

Beside the modalities that was given , this patient also was prescribed some of exercises to regain full ROM of his right lower extremity and to regain the muscle mass of his right thigh and calf and also gait training was given to this patient. his ROM exercises was according to tibial plateau fracture guideline management from Derek A.Kram and Vasantha L.Murphy. Strengthening exercises was given isometric and resistance exercises for right lower extremity and also strengthening exercise for both upper extremities because temporarily patient walk with bilateral axillary crutches. Motion exercises are exercises that aims to maintain flexibility and joint mobility and reduce joint stiffness.16

According to clinical judgment and radiographic evaluation, the next program were stretching exercise of right knee, strengthening exercise of right lower extremity, gait training with weight bearing. Aggressive gait training at week 8 as follows :

* Week 8 : Toe Touch Weight Bearing
* Week 9 : 25% Weight Bearing
* Week 10 : 50% Weight Bearing
* Week 11 : 75% Weight Bearing
* Week 12 : Full Weight Bearing

In this patient, gait training initially use crutches as assistive devices for ambulatory with partial weight-bearing as tolerated and progressing to full weight-bearing at weeks 24 because this patient still feel unconfident to do full weight bearing on weeks 12.

For stretching on right lower extremity is technique exercise that used to enhance the extensibility tissue structure which is pathologically shortened with the aim of increasing the range of motion.In this patient was given stretching exercise from the first time when he came to the PMR clinic at week 9 after he got accident.

Also this patient was educate to do cardiovascular exercise for his endurance and it started after this patient can walk without walking assistive device on weeks 24. For aerobic exercise this patient was educate to do walking exercise at least 3 days/week with recommended step count ≥ 7000 step/day.16,17 :

For occupational therapy unit, educate patient in principles of joint protection, training in ergonomics and education in body mechanics and posture. Assessment of the home and the work site. Joint protection is a self-management approach that aims to maintain functional ability through altering working methods and movement patterns of affected joints, using assistive devices and pacing activities. This helps reduce pain, inflammation and stresses applied to joints during daily activity and may help preserve the integrity of joint structures longer term and reducing the risk of documented complications, particularly posttraumatic arthritis.In OT the patient was given programs for exercise to increase ROM on right knee with some activity and give guidance in functional activity. Patient given instructions to wear pants on the first limb pain and release of a healthy limb first. For the toileting problem we given instruction to elevated toilet seat because the right knee can not bend or use a chair that has a hole in the middle and put it on top of his squatting toilet. Also in OP this patient was given knee immobilizer when walking to give more stabilization for this patient while walking.

In psychological unit, it is important to understand the patient general thoughts about his illness. Most people manage to make an appropriate adjustment to their lives following the development of a physical illness, a significant number experience difficulties adapting to their illness or to the limitations it imposes upon them. Others develop symptoms that cannot be easily explained by medical examination or investigations and they can feel misunderstood or not helped by doctors.

In the hospital setting, Medical Social Workers play an important role in coordinating patient discharge planning and after-care services following the physician's notification that the patient is ready for discharge. There are a number of factors that influence the timing of discharge; in private, community hospitals, it can be costly to allow patients to remain inpatient when it is no longer medically necessary. Social workers also assist patients and families, access in-home health care services, arrange for in-home medical equipment, provide for transportation, coordinate follow-up treatments, and refer patients to a wide variety of community social service agencies. Medical Social Workers are often also responsible for helping patients access financial assistance and health insurance coverage. This patient was work as a nurse in the operation room and now this patient has been transferred to work in outpatient clinic of internal medicine.

At last follow up on April 22nd 2018, the patient was walking independently, no more knee pain and also patient can bend his knee while toileting (squatting) without pain and he is now going back to work and work as per usual without worried about his right lower leg but the atrophy of his right thigh remain the same with 3cm difference from his left thigh. This is because strengthening exercise that was given not adequate because only strengthen hamstring and quadriceps muscles. This patient will train to strengthen his hip abductor and adductor muscles on next follow up.

Functional Independence Measure (FIM) in this patient was used to evaluate the improvement. FIM consist of seven item in which each have a specific specification with the total score is 126. On initial treatment in this patient FIM score was 113 and slightly increasing day by day and 10 month after the accident, the FIM score of this patient reaching score of 125. His only limitation on climbing stairs. He could climbing stairs but he need device to help him because he still feel a little bit weak and stiffness on his right knee and a little bit unconfidence when climbing stairs.

Prognostic of this case is bonam because the patient only got minimal displacement of his right tibial plateau fracture and his functional limitation is gradually getting better.

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