BASIC REHABILITATION PROTOCOL FOR ICRC HOSPITAL PROJECTS:

FEMUR FRACTURE UNDER SKELETAL TRACTION

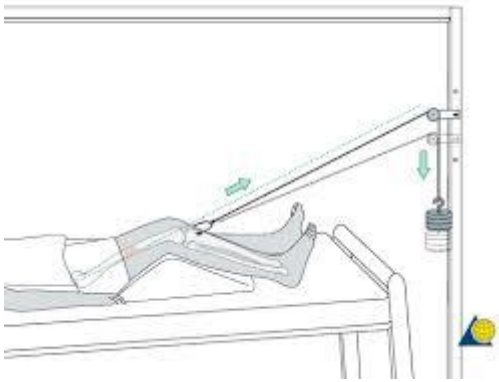


FIGURE 1

INTRODUCTION

Conservative treatment of femur fracture by skeletal traction [3, 14] has been widely described in the literature as suited for less resourced contexts [1, 2, 4, 7, 8 ,10, 11, 12]. Despite a questionable cost-effectiveness compared to more invasive methods [9, 13] it is still widely used and recommended where surgical skills, hygiene standards and nature of injury (e.g. high velocity impact) cannot guarantee safe healing after an internal fixation [2, 7, 8, 10].

From a physical rehabilitation point of view, skeletal traction for femur fractures is an ideal combination of conservative treatment and active rehabilitation. Early mobilisation of both knee and hip joint as well as strengthening of key muscles facilitate optimal functional outcomes in late rehabilitation. This is mainly empirical evidence derived from patients with differing levels of performance and thus different outcomes

With regards to published evidence on physical rehabilitation modalities for conservatively treated fractures the medical literature offers only few data. Some authors give recommendations or more or less precise descriptions of rehabilitation contents [1, 2, 3, 4, 5, 6, 8, 10, 11, 14, 15] and name generic outcomes such as knee range of motion without measuring more complex functions or daily life activities [1,2, 3, 8, 11, 12].

Although evidence and quality of studies are moderate there are a number of convincing reasons for early mobilization. Various texts agree on the theory that it stimulates callus formation during confinement in bed [3,8,10,14]. From a functional point of view, early mobilisation is favourable in order to avoid complications caused by bedrest [12], to facilitate and shorten subsequent rehabilitation and to promote the best possible outcome for a person's activities and participation.

In many hospitals the existing beds do not allow the original setup of a Perkin's traction (fig. 2). Patients keep their affected leg under traction in a Bohler-Braun-splint (fig. 5). Other than in the Perkins model the patient cannot stand up for his rehabilitation whilst still under traction, but hip and knee mobilisation are possible directly after traction setup. The bandage of the splint ends at knee joint level so that knee exercises can be performed throughout the day in a supine or a sitting position (fig. 3,4). For rest and sleep the leg is put on a cushion block (fig. 5)[7].

Cornelia Barth July 2015 Bukavu

Despite of a number of studies in low resource settings describing detailed setups [1,2,5,8,11,12] these are not necessarily applicable to challenging contexts as experienced in some ICRC supported hospitals.

Challenges in certain contexts can include: no electricity, only very basic material, ad hoc trained staff without previous medical knowledge, but also a population not necessarily used to physical rehabilitation and standardized protocols. In a conflict or disaster context it can also mean a volatile overall situation hampering a systematic long-term rehabilitation, a population presenting poor nutritional status and complex injuries such as open comminuted fractures with soft tissue loss, nerve and vascular damage, plus additional injuries in other body parts.

No easily applicable protocols exist to optimize rehabilitation in such contexts taking into account that qualified staff is often lacking and that functional outcome should comprise more than sufficient knee flexion.

The following protocol is based on clinical experience and backed up by the above mentioned evidence. It shall serve physiotherapists and rehabilitation assistants as well as patients and family members as a guideline for simple and effective rehabilitation after femur fracture.

Figure 2

Figure 3

Figure 4

Figure 5

PRELIMINARY REMARKS

(a) The following should be considered by the **therapist**:

- Verify proper positioning and alignment each morning before the medical visit as well as before and after each physiotherapy session:
    - hip, knee and ankle joint in one line (mechanical axis), see fig. 6
    - foot points straight up or in external rotation (no internal rotation!); in case of drop foot or if the foot falls into internal rotation, it can be fixed with a bandage, see fig. 7
    - Nurses, the patient and family members should be instructed in alignment correction
    - In a proximal femur fracture it can happen that the proximal fragment is being pulled into abduction. This can lead to an important angulation of the femur resulting in shortening and leg length differences, see fig. 8 and 9. To promote optimal alignment and consolidation with the least possible angulation, the leg under traction is being positioned in abduction, see fig. 10
    - To avoid pressure sores the heel (and Achilles tendon if tenderness on palpation) should not sit directly on the splint but either be exposed in the air or supported by a water-filled hygienic glove or a piece of cotton-wool, see fig. 11
- Exercises must start as soon as possible (depending on overall health status of the patient) after traction setup aiming at the fullest possible ROM of the knee joint
- All specifications of timing, exercises etc. below should be discussed with the treating surgeon or a senior physiotherapist
- Also for complicated injuries and any signs of complications or unusual symptoms always consult the surgeon or a senior physiotherapist
- Check if the patient has understood the above measures and the reason for exercises and, if necessary, keep explaining and encouraging them

(b) The following should be explained to the patient:

- The exercise program during the weeks of bedrest is **crucial for fracture healing. Bone consolidation** is stimulated by **muscle activity** and depends thus on regular participation in the below exercises
- The exercise program during the weeks of bedrest is **crucial for later function. Locomotion and recovery of function** after traction removal depend on regular participation in the below exercises
- It is recommended to **repeat** the exercises 2-3 times a day; the more and longer a patient exercises during bedrest the faster he will recover and gain function

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

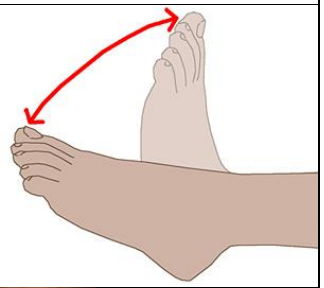
PROGRAMME (30-40 MIN PER SESSION)

- ⇨ Key exercises are in ***bold-italics*** – in case of time pressure limit yourself to these exercises!
- ⇨ Give patients a short rest between the exercises (30 sec) and use the break for **respiratory exercises**

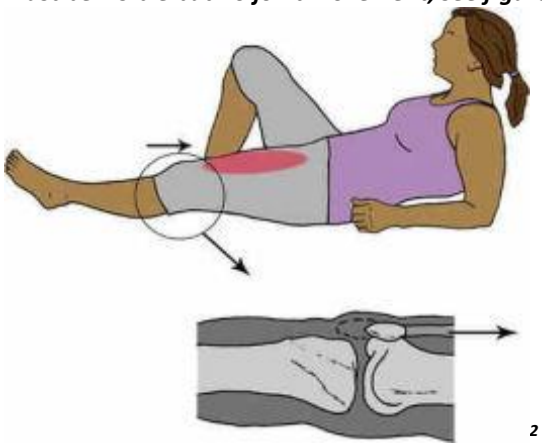
ABBREVIATIONS:

ADL	Activities of daily living	CVS	Cardiovascular system	PNI	Peripheral nerve injury	Q	Quadriceps muscle

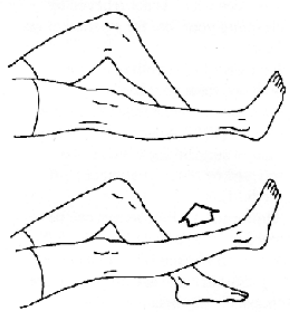
WEEK 1 UNDER TRACTION:

	BODY PART	MOVEMENT /EXERCISE	REPETITIONS/TIMING	REASONING/OBJECTIVE	PLEASE NOTE!
1	ANKLE	Extension/Flexion ; bilateral	20-100	-activates CVS -keeps ankle joint mobile for later walking -thrombosis prophylaxis	If PNI: Passive mobilisation by means of a belt/ towel or by the therapist 
2	PATELLA (affected leg)	passive mobilisation; directions : left, right, up, down, diagonal	A few minutes	Patella needs to be mobile for isometric Q activation and later for knee flexion	 [1]

[1] http://thenakedphysio.com/2014/09/23/the-knee-patellofemoral-pain/

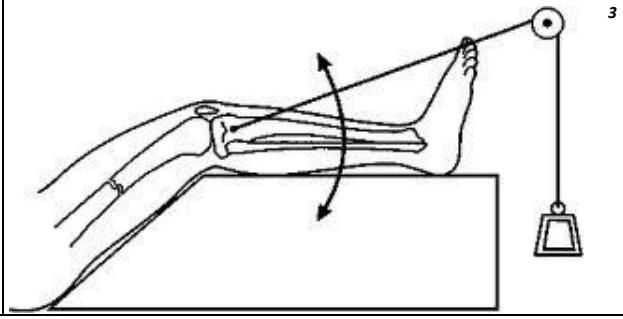
3	***QUADRICEPS***	***isometric bilateral contraction***	***10-50 x contract 1 sec/ relax 1 sec***	***-helps to maintain Q muscle tonus and perception -prepares for later muscle strengthening and prevents atrophy -promotes healing by: -reducing swelling -preventing ischemia in fracture/wound complex -increasing circulation and metabolism***	***The leg under traction remains on the splint in flexion and must not move. Only the patella movement and the Q contraction must be visible but no joint movement, see figure***  [2] ***Initially isometric exercises may cause discomfort => use painkillers!, when practiced regularly they help reducing pain***
4	BOTTOM	isometric bilateral contraction	10-20x contract 1 sec/ relax 1 sec; remain for 10-20 sec	-activates hip extensors -prepares for bridge exercise (nr 13)	The patient squeezes his bottom (gluteal muscles), a slight hip extension is visible
5	***BOTH LEGS***	***isometric bilateral contraction (feet in dorsiflexion, patellae pulled towards the hip joints, hip extensors contracted)***	***Progressively up to 30 sec of contraction***	***See nr.3&4***	***The therapist puts his hands against the toes and the patella in order to stimulate an isometric contraction ; day 1-3 : the leg under traction must not move ; from day 4 and:*** ***1. after consultation of the surgeon*** ***2. sufficient quadriceps force in isometry (visible movement of the patella and quadriceps contraction for at least 15 sec isometry);*** ***3. no complications*** ***The foot of the leg under traction is in dorsiflexion and moves up for a complete knee extension (passive-active)***

[2] http://www.sw.org/misc/health/images/%7BA613F547-7F99-4BFF-833B-53180BD14E84%7D.JPG

6	SOUND LEG	Foot in dorsiflexion, knee in extension, the leg is lifted up straight (hip flexion)	20-50	-keeps sound leg active for later transfers out of bed -Prepares for gait training and strengthening of the sound leg (necessary for the initial gait training) -"carry over effect": the affected leg also gets activated (light isometry)	The leg under traction must not move, but an isometric contraction should be visible 
7	SOUND LEG	Foot in dorsiflexion, knee in extension, ab- and adduction of the hip	20-50		
8	SOUND LEG	Foot in dorsiflexion, knee in extension, circles in the air with the leg	20-50		
9	BOTH ARMS	Alternating elevation of the arms	20-100	-activates the CVS -prepares arms for gait training on crutches	1-2 kg of weight in each hand 
10	BOTH ARMS	Alternating elbow flexion	20-100		
11	BOTH ARMS	Extension of the arms towards the ceiling (inverted push-ups)	20-100		
12	TRUNC	Sit up in bed (by means of the trapeze bar or a cord if needed)	Remain a few minutes	-ADL (eating, communicating etc.) -activates the CVS	

From Week 2 under Traction:

Exercises 1-12, then: after setup of the traction passive mobilisation of the knee can start directly within the first week after installation of the traction

	BODY PART	MOVEMENT /EXERCISE	REPETITIONS	REASONING	PLEASE NOTE!
13	***Dorsal body part***	***bridge: sound leg in knee flexion, heel is pressed into the mattress, use push-up bars and lift the body whilst extending the arms***	***10-20x up-down; Remain for 3-20 sec***	***ADL (body hygiene); activate CVS; advanced muscle strengthening***	***Prerequisite for this exercise : exercise 5 is being held for at least 15 sec without losing isometric contraction ; The muscle status of the affected leg should be sufficient to allow a prolonged isometric co-contraction. A slight angulation at fracture site is possible => observe by standing laterally of the patient's leg, this "mobilisation" of the fracture is tolerated, probably even beneficial for consolidation Insist on pain management prior to physiotherapy***
=> IF THE PATIENT IS IN GOOD PHYSICAL CONDITION GO DIRECTLY TO EXERCISE 14 B					
14 A	***Knee (affected leg)***	***1. remove the support (bandages, cushion) under the calf up to the level of the knee joint, 2. passive mobilization of the knee in flexion; 3. passive mobilization of the knee in extension***	***10-15x***	***-prevents knee joint stiffness -Prepares for gait training and ADL***	***Verify alignment before starting mobilisation (the support of the leg by the traction splint ends exactly on knee joint level); the movements of the leg must not be abrupt and always in the movement axis; A slight angulation at fracture site is possible => see ex. 13 Insist on pain management prior to physiotherapy***  [3]

[3] http://www.nzdl.org/gsdl/collect/who/archives/HASH4db6.dir/p23.gif

FROM WEEK 3 UNDER TRACTION UNTIL TRACTION REMOVAL

Exercises 1-13, then

	BODY PART	MOVEMENT /EXERCISE	REPETITIONS	REASONING	PLEASE NOTE!
14 B	***Knee (affected leg)***	***1. remove the support (bandages, cushion) under the calf up to the level of the knee joint; 2. active-passive mobilisation in flexion ; 3. active-passive mobilisation in extension; maximum possible ROM***	***10-50***	***Preparation of gait training and ADL***	***Verify alignment before starting mobilisation (the support of the leg by the traction splint ends exactly on knee joint level); the movements of the leg must not be abrupt and always in the movement axis ; The knee remains in maximum flexion (heel resting on mattress) for some time after the exercises before putting the support back under the calf***

WEEK 1-6 AFTER TRACTION REMOVAL

Exercises 1-14, then

	BODY PART	MOVEMENT /EXERCISE	REPETITIONS	REASONING	PLEASE NOTE!
15	***Whole body***	***In bed and bedside transfers*** ***1. Patient trains transfers in bed whilst keeping the affected leg in isometric co-contraction (knee blocked in extension) : supine-side lying (both sides)-prone*** ***2. Therapist holds affected leg in his hands during transfer supine-bedside sitting-supine*** ***3. Patient "splints" his affected leg with the sound one during transfer supine-bedside-supine***	***Every transfer 3-5x***	***Preparation of gait training and ADL***	
16	***Knee (affected leg)***	***Bedside sitting, mobilisation in flexion (passive-active)***	***10-50***	***Preparation of gait training and ADL***	
17	***Knee (affected leg)***	***Bedside sitting, strengthening in extension (passive-active)***	***10-50***	***Preparation of gait training and ADL***	

According to some protocols the patient stays in bedrest for one week after traction removal. The program for that week: Exercises 1-17.

EXERCISES FOR THE FIRST STANDING-UP AND INITIAL TO FUNCTIONAL GAIT TRAINING:

1. **Standing on bedside**

Start with a walking frame. The patient gets up standing fully on his sound leg.
If the patient has sufficient balance, strength and no dizziness, he can use crutches right away.

2. **Gait training without weight transfer (6 weeks)**

Option A: The leg is kept in the air without touching ground (positive: no weight transfer is guaranteed; negative: the femur is under influence of gravity with a slight hip flexion which according to some surgeons [4] might promote an angulation of the fracture; no touching also leads to an unnatural gait pattern, swelling of the affected limb occurs more often when the limb is hanging instead of rolling on the ground, which activates the muscle pump and resembles a normal gait cycle)
Option B: The foot is touching with a normal heel and toe strike (imagine walking over ants without crushing them)

If the patient shows good understanding option B is preferential. The patient can even start with cautious forms of weight bearing in a controlled environment, eg. standing in a walking frame, walking in parallel bars etc., guided by the sensation of pain. However, in many contexts patients might not be used to rehabilitation at all so it is advisable to stick to a strict protocol of no touching over a period of 6 weeks.

3. **Functional gait training with increasing to full weight bearing**

The level of weight bearing must be discussed with the treating surgeon. The surgeon must also be consulted for more advanced exercises (nr 5, 6) where the fracture site is exposed to increased stress.
Rehabilitation contents include:

1. Patient stands on two scales to exercise weight bearing and weight shift
2. Increase difficulty and weight bearing by adapting mobility aids: parallel bars >> walking frame >> axillary or elbow crutches >> walking stick >> without walking aid but walking along furniture/ walls >> free gait
3. Balance exercises must begin as soon as full weight bearing is allowed, even if the patient still requires a walking aid
4. Functional strengthening exercises of the lower limbs: squats and lunches, ergometer cycling, walking stairs
5. Combine strength, balance and endurance exercises by training on a balance cushion / board, in an obstacle course, on rough ground, in the patient's natural environment, walking sideways and backwards with abrupt direction changes
6. Start training additional skills like running, jumping, climbing if the patient's context requires

REFERENCES

1. Bezabeh B, Wamisho BL, Coles MJM. Treatment of adult femoral shaft fracture using the Perkins traction as Addis Ababa Tikur Anbessa University Hospital: the Ethiopian experience. *International Surgery* 2012;**97**:78-85
2. Bezabeh B, Wamisho BL. Treatment of adult femoral shaft fracture using Perkins' traction as Addis Ababa University: An Ethiopian experience. *East African Orthopaedic Journal* 2010;**4**:12-18
3. Buxton RA. The use of Perkins' traction in the treatment of femoral shaft fractures. *J Bone Joint Surg Br*. 1981;**63 B**:362-6.
4. Demmer P. Proximal femur fracture management with minimal resources. https://www2.aofoundation.org/wps/portal/surgery/?showPage=redfix&bone=Femur&segment=Proximal&basicTechnique=Proximal%20femur%20fracture%20management%20with%20minimal%20resources (accessed 2 July 2015)
5. Eggers I, Mennen U. Application of a quadriceps endurance programme to patients with femur fractures immobilized by skeletal traction. *South African Medical Journal*. 1992;**81**:258-260.
6. Friedel F, Ngota DO. Plaster of Paris and limb traction, ICRC Physiotherapy Reference Manual. International Committee of the Red Cross: Geneva 2009.
7. Giannou C, Baldan M, Molde A. War Surgery, Working with limited resources in armed conflict and other situations of violence, Volume 2. International Committee of the Red Cross, 2013.
8. Gosselin R, Lavaly D. Perkins traction for adult femoral shaft fractures: a report on 53 patients in Sierra Leone; *International Orthopaedics (SICOT)* 2007;**31**:697-702
9. Gosselin RA, Heitto M, Zirkle L. Cost-effectiveness of replacing skeletal traction by interlocked intramedullary nailing for femoral shaft fractures in a provincial trauma hospital in Cambodia. *International Orthopaedics* (SICOT) 2009; **33**:1445–1448
10. King M, Bewes P (Editors). Primary Surgery, Volume 2, Trauma. New York: Oxford University Press, 1993.
11. Mandrella B. Die konservative Behandlung von Oberschenkelbrüchen mit dem Verfahren nach Perkins [The conservative treatment of femur fractures by Perkins traction. Management in adverse situations]. *Unfallchirurg* 2002;**105**:923-931.
12. Musajee M. Outcome of skeletal traction in patients with femoral shaft fractures at Kenyatta National Hospital [Dissertation]. Nairobi: University of Nairobi. 2012
13. Opondo E, Wanzala P, Makokha A. Cost effectiveness of using surgery versus skeletal traction in management of femoral shaft fractures at Thika level 5 hospital, Kenya. *Pan African Medical Journal* 2013; **15**:42
14. Perkins G. Rest and movement. *J Bone Joint Surg Br.* 1953;**35 B**:521-39
15. Tylman D, Siwek W. Longterm results of functional treatment in intraarticular knee fractures and multifragment fractures of the shaft of femurs. *Clin Orthop Relat Res* 1991;**272**:114-121.