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Treatment of Adult Femoral Shaft Fractures Using the Perkins Traction at Addis Ababa Tikur Anbessa University Hospital: The Ethiopian Experience

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This is a prospective study to evaluate the efficacy of the Perkins traction in the treatment of adult femoral shaft fractures from October 1, 2007, to the present at the Black Lion Hospital in Addis Ababa University Hospital in Ethiopia. All femur fractures admitted to the hospital were reviewed and evaluated for treatment. Black Lion Hospital (Tikur Anbessa) is the university hospital in Addis Ababa and the highest tertiary teaching hospital in a country of 85 million inhabitants. A 67-bed orthopedic department offers the main ground for teaching to the undergraduate medical students. The hospital is also the pivotal center for the formation of the orthopedic residents. Patients from different parts of the country are referred to this institution for orthopedic care. A total of 68 adult (older than 16 years) patients with 69 femoral shaft fractures were considered for treatment during the study period. Consent was obtained and prospective treatment initiated. A standard Perkins traction was applied by an orthopedic team composed of consultants, orthopedic residents, physical therapists, and nurses. A protocol was developed for patients undergoing such traction. The physiotherapists will supervise all individual or group therapy sessions. Progressive knee range of motion to facilitate quadriceps and hamstring muscle strengthening exercises were implemented four times a day and recorded. Demographic information, fracture patterns, duration of traction, thigh circumference leg length discrepancy, and pin sites were routinely monitored and

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charted. Data were computerized and analyzed weekly, and appropriate adjustments were made accordingly. Clinical evidence of a competent callus and confirmation by radiographic studies will influence the cessation of traction to allow gait training with toe-touch crutch ambulation. Progress will be monitored during the following outpatient visits in the fracture clinic. A total of 68 consecutive patients with 69 femoral shaft fractures were treated with the Perkins traction. There were 60 men (88.2%) and only 8 women (11.8%), for a ratio of 8 men to 1 woman. The age of the cohort patient varied between 18 and 28 years.

The mechanisms of injury for most of the fractures were motor vehicle accidents, resulting in an isolated femoral shaft fracture in 49.2% of the patients. Half of the fractures were by means of closed injury (n = 44; 64.7%). One patient with a bilateral femoral shaft fracture was also added to the study. The right side was more often involved, with 41 fractures (60%), than the left, with 28 fractures (40%). Most of the fractures involved the proximal third of the femur (n = 34; 50%), but the most common fracture pattern was transverse (n = 29; 42.6%), followed by a comminuted pattern (n = 18; 26.5%). Three segmental fractures were also encountered.

The mean hospital stay was 45 days (33 patients; 48.5%), with the length of time in traction varying from 30 to 40 days. Only 2 patients remained in traction for a period of 60 days. At the end of the traction period, 8 patients (11.8%) showed a decrease in the quadriceps mass, and 7 patients (10.3%) showed stiffness of the knee with a range of motion limited to 0° to 90°. Most patients were discharged after about 8 months of treatment. One patient suffered a nonunion, and one was malunited. Superficial pin care infections were noted in 8 patients (11.8%) and treated appropriately.

The conservative treatment of 69 femoral shaft fractures using the Perkins traction at Black Lion University Hospital in Addis Ababa, Ethiopia, has been proven to be a safe and effective method. It should be encouraged in countries like ours where it is a luxury to have a C-Arm in the operating room and where the hardware often is not available to perform a stable stabilization of the long bone fractures.

Key words: Perkins traction – Femoral shaft fracture – Conservative treatment – Quadriceps and hamstring exercises

Adult femoral shaft fractures can be treated using many different ways, conservative or surgical. The choice of method to use depends on several factors, including surgeon's experience, availability of implants, cost, desired anatomic and functional outcomes, and complication rates.[1–4] In underdeveloped countries, the lack of well-trained surgeons and other health care providers, appropriate and affordable equipment, and clean surgical environments may increase the risks of surgical complications for orthopedic procedures to an unacceptable level. Conservative management of femoral fractures with traction remains the best and very often the only option.

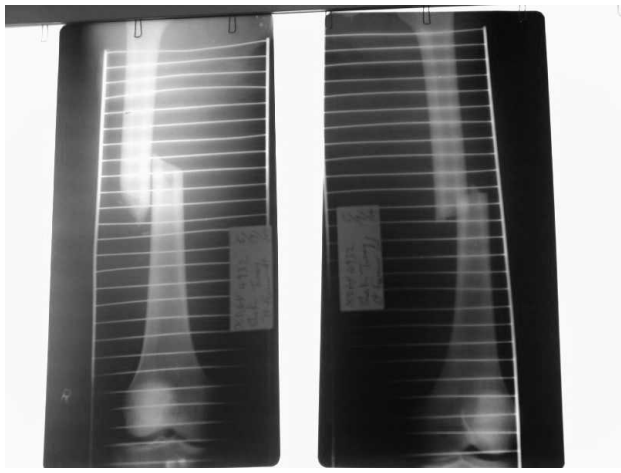
Traction has been used for years, and the underlying central principle remains the same: alignment of a long bone fracture can be achieved and maintained by continuous isotonic traction over the lower extremity in line with its longitudinal axis.[5] In general, skeletal traction is preferred to skin traction for adult femoral shaft fractures. Different configurations, with or without suspension or frames, have been advocated. These include straight longitudinal (Buck) traction,[6] rigid frame (Bohler-Braun frame),[5] or combinations in mobility and suspension, such as those of Thomas-Pearson[7] or Russell.[8] Among the proponents of traction, one area in particular has long been controversial: does motion at the fracture site promote or prevent bone formation and healing? Rest and immobilization were advocated for a long time by some renowned orthopedic leaders, such as Watson-Jones, John Hilton, and Apley.[5,9] George Perkins (1892–1979), a brilliant orthopedic surgeon who served in both world wars, started to question this orthodoxy in his famous lecture ''Rest and Movement.'' In 1953, he introduced a technique starting a very early active range of motion of the knee for adults kept in

skeletal traction for femoral shaft fractures through a tibial pin.[10] He believed the push-pull action of the muscular contractions on the fracture fragments was beneficial to the inflammatory process, in stimulating osteogenesis.[11] We have applied this principle in modern techniques of internal fixation using elastic or flexible nailing, or less-invasive surgical stabilization procedures.

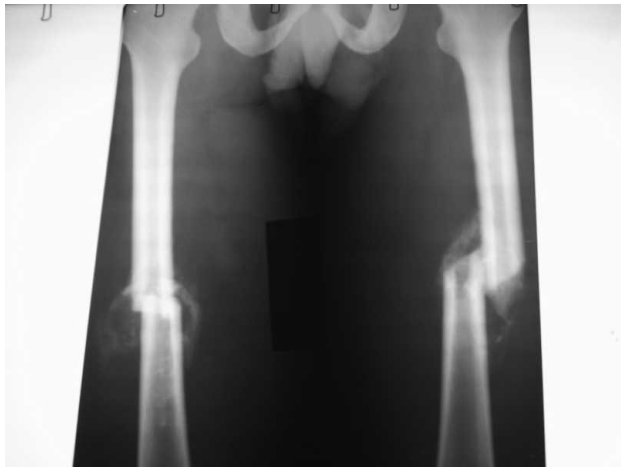
This principle has also been applied in underdeveloped countries, where traction is very often the only mode of treatment for femur fractures.[12] In 1981, Moulton et al[6] reported their series of 45 consecutive patients with femoral shaft fractures treated by straight longitudinal traction, supplemented by functional bracing at around 6 weeks.[6] All fractures healed, one with a varus component. The average length of stay was 8 weeks, and at 6 months the average knee flexion was 0° to 127°. May and Neufeld[13] reported good results with their use of a single rope suspension with a dynamic traction method. Gates[14] modified and adapted this technique to fit the needs and materials available in underdeveloped countries. The Perkins method is even simpler. It does not require a hinged cast brace or an overhead Balkan-type frame. When comfortable and safe with ambulation, the patient is discharged with instructions to keep using his crutches and to return to the outpatient clinic for further radiologic follow-up.

The orthopedic department at Addis Ababa Tikur Anbessa University Hospital was established two decades ago and has been running a residency program in general orthopedics in a country of 85 million that is well known for its road traffic accident case fatalities. It has a relatively better infrastructure and is better staffed than similar hospitals in other African countries. Our infection rate after internal fixation is less than 1%, which is better compared with other hospitals in East Africa. The average hospital stay for major limb trauma as published 5 years ago from our department was 35.4 days.[15]

With the current expansions in our infrastructure, it seems that there is a great potential to address Ethiopian orthopedic problems. Last year the hospital received about 150 femoral fractures. Some individuals were lucky to get admitted for treatment. Most femoral fractures are treated conservatively, but interlocking nails, K-nails, and plates are reserved for selected cases. The main problems in our department are the shortage of operating time, beds, and implants. The reactivation of the Perkins technique was initiated by one of the authors



Picture 1 Initial x-ray.



Picture 2 Final x-ray.

Picture 3 Perkins' system knee flexion.

following his extensive international experience in treating patients in Africa and Asia. Currently, this technique is alternatively used to address closed or open femoral shaft extra-articular fractures in the adult population, mainly following trauma. The purpose of this prospective study was to evaluate this method in our hospital and to identify potential problems in its implementation.

Objectives

This prospective study aims to:

1. Evaluate the beneficial effect of the Perkins technique in the treatment of adult femoral shaft fractures; and
2. Review the femoral fractures referred to Tikur Anbessa (Black Lion) Hospital, Ethiopia.

Patients and Methods

All consecutive traumatic adult femoral shaft fractures admitted to the orthopedic department were considered for treatment. Fractures in the pediatric population (age <16 years), as well as pathologic and intra-articular fractures were excluded from the study.

After the initial clinical diagnosis and radiologic analysis of the fracture, a single Steinmann pin is inserted under local anesthesia just deep and distal to the tibial tubercle on the day of the admission. Wound debridement and lavage are done under general anesthesia for any open fractures. Straight longitudinal traction with an initial weight of 3 to 4 kg (7–9 lbs) is applied, with the foot of the bed elevated on wooden blocks. The lower limb length is measured bilaterally. If the fractured extremity is longer, distraction at the fracture site is suspected, and additional X-rays are taken while the limb is in traction, to justify weight reduction. If there is shortening, more weight is added for a few days. A posterior bump or pillow may be used for a posterior angulation greater than 10° to 15°. No underneath pillow in proximal third fracture is needed. A special format or chart was developed by the experienced senior author to stimulate discussion among the orthopedic team daily. This format protocol consists of variables like patient demographics, mechanism of injury, characteristics of the fracture, duration in traction, thigh circumference, knee range of motion, limb length, pin site condition, and any additional complications.

The patient is instructed to perform knee flexion-extension exercises 4 times a day (8 hourly) for

Picture 4 Extension exercise.

Picture 5 Clinical union straight leg raising test.

Picture 6 Bearing weight.

30 minutes each session. Two of these sessions are attended by a physiotherapist, whereas the other two sessions are done by the patient alone or in a group with similar patients located in the ''Perkins' corner'' of the orthopedic ward. A format is posted at bedside on the wall next to the patient and is filled every day. The pin sites are covered and cleaned daily with antiseptics.

Usually, within 3 to 4 days of the admission, and almost always within a week, active range of motion of the knee is started: the distal half of the mattress is taken down or removed. Then, the patient is encouraged to sit while a therapist cups the affected heel to support the leg, and while the extremity remains in traction, gentle active flexion and extension of the knee is started. Pain management is necessary for the first few days, but the pain will become tolerable with a surprising rapidity. Flexion-extension range of motion regimen of the knee is performed for half an hour, 2 to 4 times a day, preferably by a physiotherapist. The patient is encouraged to exercise alone or in group therapy. At this point, active flexion of the knee usually reaches 90°. The important steps in the Perkins method are shown in Pictures III to VII.

The hip musculature can also be exercised with the patient standing upright on the unaffected opposite limb. At 6 weeks, the clinical healing is assessed by palpation of the callus, motion at the fracture site to determine the capability to do straight leg raises (except in proximal third fractures). X-rays are taken. Depending on clinical and/or radiologic healing, the traction is reapplied for 2 weeks or discontinued. Mobilization is started using a walker or crutches. A cast, or preferably a hinged cast brace, may be used for added protection in any delayed union. Usually, in the otherwise healthy, young, and compliant patient, protected ambulation with crutches and toe-touch weight bearing is started the next day after removing the traction. Once he/she becomes a safe ambulate, he/she is discharged home with instructions to keep using the crutches until the outpatient follow-up visit in 6 weeks. Consolidation is assessed clinically by the ability to do straight leg raises (except in proximal third fractures) without any deformity or pain, and later on by pain on weight bearing.

All patients in the Perkins group had X-rays taken prior to discharge and at subsequent follow-ups. Delayed union was diagnosed when motion at the fracture was still appreciated. Healing with more than 10° of varus or valgus in the frontal plane, or 15° of anterior/posterior angulation in the sagittal plane was considered malunion. A pin tract was considered infected when purulent drainage, loosening, or ring sequestrum on X-rays were noted, but not only with local inflammatory signs. Statistical analysis was facilitated using Excel (Microsoft, Redmond, Washington) and SPSS version 11 (IBM, Armonk, NY, USA) to support our statistical analysis.

Picture 7 Patient walking.

Results

After exclusions by criteria, a total of 68 patients with 69 femoral shaft fractures were enrolled. A total of 60 (88.2%) were men, and only 8 (11.8%) were women, for a ratio of 8 men to 1 woman.

Fig. 1 shows that the age of about half of the patients varied between 18 and 28 years. Road traffic accident was the most common mechanism of injury, found in nearly half of the patients (49.2%).

Table 2 displays the distribution for all adult femoral fractures presented to the radiology department at the Black Lion University Hospital in a half-year period just prior to the beginning of our study (March–August 2007).

The right side was more commonly involved (n = 41; 60%) than the left (n = 28; 40%). Two thirds of the fractures (n = 44; 64.7%) were closed. There was 1 patient with bilateral fracture, and the initial and final X-rays of this patient are shown in X-ray Pictures I and II.

Half of the fractures (n = 34; 50%) occurred at the proximal third of the femur. The transverse fracture pattern was the most common (n = 29; 42.6%), followed by the comminuted pattern (n = 18; 26.5%). The remaining fracture patterns are shown

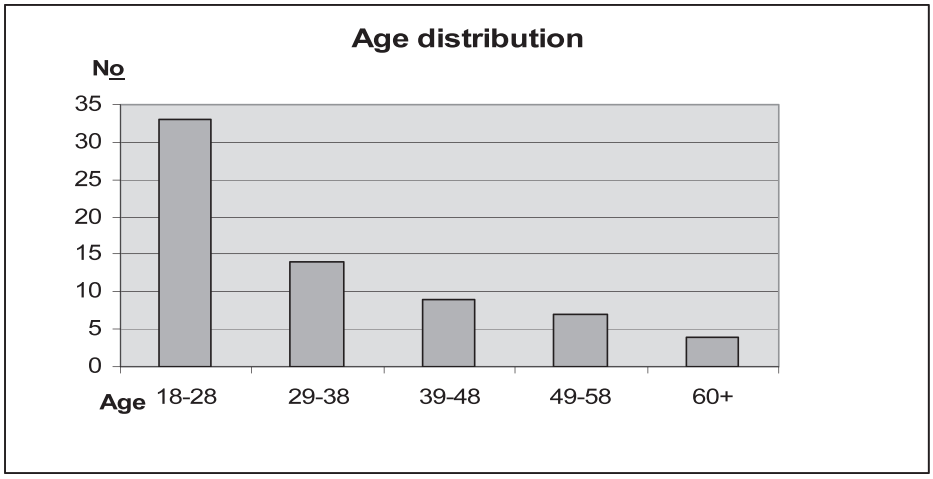


Fig. 1 Age distribution of adult femur shaft fractures treated using the Perkins method at Black Lion Hospital, October 2007–May 2009.

in Table 1. Only 3 segmental fractures were admitted. The mean hospital stay was 45 days, and for most (33 patients; 48.5%), duration of traction was between 30 and 40 days, and only 8 patients remained in traction for more than 2 months. The hospital stay is shown in Table 3. Shortly after the end of the traction period, the circumference of the thigh was found to be reduced only in 8 patients (11.8%); the distribution is shown in Fig. 2. Knee range of motion was 0° to 60° in 10 patients and between 0° and 90° in 50 patients. It was more than 90° in 7 patients (10.3%). In a mean follow-up of 8 months (range, 4–21 months), only 1 patient ended up with a nonunion, and 1 with a malunion. Shortening of more than 2 cm was noted in 11 patients (16.2%). Overall pin tract infection rate was 11.8% (n = 8).

Discussion

Forty years ago, developed countries shifted toward aggressive surgical treatment of long bone fractures, and today surgical fixation generally gives better results than conservative treatment, in terms of anatomic and functional outcomes, complication rates, and even costs, particularly in polytrauma patients.[1–4] This is true in industrialized countries, but not necessarily the case for poorer nations. The lack of well-trained surgeons and other health care providers, lack of appropriate and affordable equipment and implants, and asepsis in the surgical environments have increased the risks for surgical complications during orthopedic procedures, often to an unacceptable level. Conservative management of femoral fractures with traction remains a sure—and very often the only—option for countries with poor resources. Conservative management for adult femoral shaft fractures is used frequently in our institution. This will remain the case until we can provide surgical fixation in a safe and reliable manner. The union rate is consistently reported as being above 90%.[16,18,19] Prolonged hospital stay and rehabilitation, with their associated direct and indirect costs, are usually not as much of an issue as in richer countries. In the transitional environments

Table 1 Distribution of the pattern of adult femur shaft fractures treated using the Perkins method at Black Lion Hospital, October 2007–May 2009

Pattern of Fracture	No. of Fractures (%)
Transverse	27 (39.7)
Comminuted	18 (26.5)
Oblique	12 (17.6)
Spiral	7 (10.3)
Segmental	3 (4.4)
Bilateral	1 (1.5)
Total	68 (100)

Table 2 Distribution of causes of all adult femur shaft fractures presented to the Black Lion Hospital radiology department, October 2007–May 2009

Cause	Frequency of Fractures (%)
RTA	202 (47.9)
Fall	126 (29.9)
Machine	28 (6.6)
Blow/assault	21 (5.0)
Crush	10 (2.4)
Bullet	19 (4.5)
Hit by stick	13 (3.1)
Pathologic	2 (0.5)
Stab	1 (0.2)
Total	422 (100)

RTA, routine traffic accident.

Table 3 Duration of hospital stay of adult femur shaft fractures treated using the Perkins method at Black Lion Hospital, May 2007–May 2009

Days	No. of Patients (%)
30–40	33 (48.5)
41–50	10 (14.7)
51–60	17 (25.0)
60+	8 (11.8)
Total	68 (100)

of an underdeveloped economy, the risks and benefits to a conservative treatment still need to be weighed against those of a surgical fixation by overly enthusiastic but inadequately trained hands working in less than favorable conditions. Complications such as malunion, excessive shortening, and refracture are comparable with data reported by others who have used the Perkins technique. In our hands, the pin tract infection rate of 11.8% was comparable with other groups with the same reported as 15%,[18] was higher than an 8.6% report,[19] and was much lower than 36%[6] and 41.7%.[20] Once a patient is able to flex the knee about 90°, permanent functional disability will be insignificant.[21]

A study conducted in our department in 2003 revealed that the mean length of stay in the hospital between admission and elective operation was 11.7 days. The postoperative stay was 20.6 days. The average length of hospital stay for all patients admitted was 35.4 days. The bed occupancy rate was 97.4%, with an average time between the discharge of one patient and the admission of another (turnover interval) of 24 hours. According to a recently published study from our hospital, the radiology department received 68 adult femoral fractures (68 of 422; 15.1% of all fractures) just in half a year, March–August 2007, and road traffic accidents constitute the largest proportion, at 202 (47.9%) among traumatic causes, followed by falls for 126 (29.9%) and gunshot assaults for 28 (6.6%; Table 3).[22] The level of the fractures in this study in the radiology department (n = 68; proximal shaft, 44.1%; middle shaft, 41.1%; distal shaft, 11.7%; and intra-articular, 2.9%) is comparable with our study, even though it was done few months earlier (n = 68; proximal shaft, 44.1%; middle shaft, 41.1%; distal shaft, 11.7%; and intra-articular, 2.9%). Other complications are similar to other published reports. Fracture healing in a good position can be achieved almost more than 95% of the time, with a better knee motion than other methods. The Perkins method in our institution was found to be a safe and valuable treatment option.

Conclusion

The outcomes of the Perkins method of treating femoral shaft fractures in an adult population at the orthopedic department in Addis Ababa Tikur Anbessa University Hospital in Ethiopia are encouraging. The Perkins technique remains safe and effective. This may be the cheapest and best alternative way of treatment for femoral shaft fractures in underdeveloped nations where there is

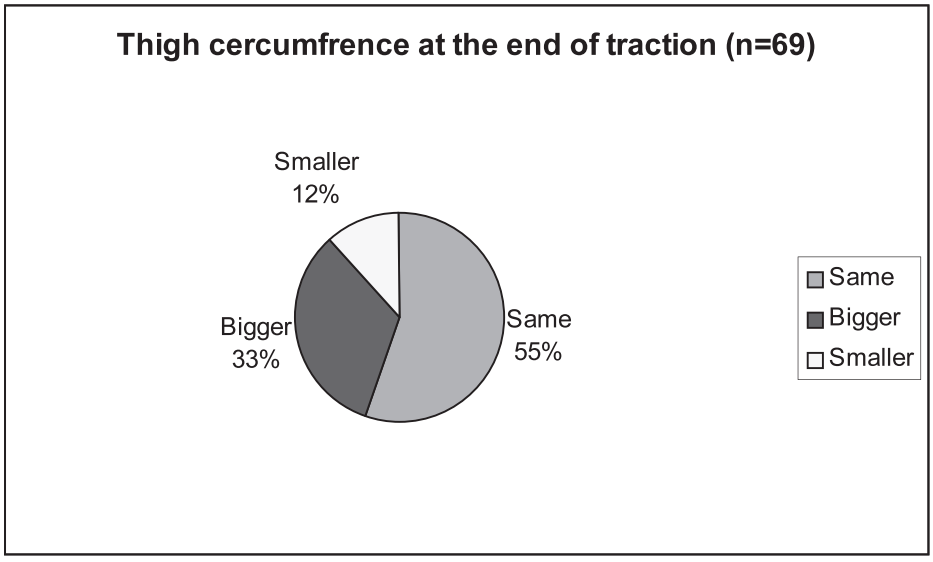


Fig. 2 Comparison of thigh circumference at the end of treatment of adult femur shaft fractures treated using the Perkins method at Black Lion Hospital, October 2007–May 2009.

also a lack of experienced operating room staff, implants, and theater facilities.

Recommendations

Based on the findings of this study on the treatment of traumatic femoral shaft fracture in the adult, we recommend the following:

1. In a healthy and well-motivated patient, the Perkins technique is the best alternative way to treat an uncomplicated femoral shaft fracture. This is a dynamic traction.
2. Surgical treatment is reserved for intra-articular fractures, established nonunions, or unacceptable malunions.
3. Exposing orthopedic and surgical trainees in underdeveloped countries to different methods of fracture treatment is advantageous.
4. Group exercise among patients treated on the Perkins ward can motivate and encourage them to adhere to the Perkins treatment protocol.
5. Less weight on the traction (3–4 kg) for African and Asian patients may decrease the rate of nonunion–avoiding distraction at the fracture site, and may decrease the need for frequent X-ray check while on traction.
6. Simple format/protocol to document and monitor Perkins technique facilitates a steady outcome.
7. In terms of complications, removing traction too early is worse than leaving it too long.

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