Retrograde Tibial Nail for Femoral Shaft Fracture with Severe Degloving Injury

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We report an unusual case involving a motorcycle-vehicle collision, in which a 21-year-old woman sustained severe bilateral lower extremity degloving injuries and an associated right femoral shaft fracture. The trauma team was consulted to treat this disastrous event. Due to extensive contamination of the open wound around the entry site, retrograde intramedullary nailing was chosen to fix the fractured femoral shaft in preference to antegrade intramedullary nailing. A tibial interlocking nail was used as a substitute for immediate bony stabilization to facilitate soft tissue debridement and subsequent reconstruction. The excellent range of motion achieved in the right knee joint, without infection, limb-length discrepancy, rotational instability or angular malalignment, was encouraging. (Chang Gung Med J 2004;27:454-8)

Key words: retrograde nailing, tibial nail, femoral shaft fracture.

Femoral shaft fractures are typically the result of high-energy trauma, and thus, are usually associated with multiple injuries. Closed static locking intramedullary nailing is the treatment of choice for femoral shaft fractures, with a union rate above 95% and low complication rates. Retrograde nailing has been developed for successful management of femoral peritrochanteric fractures since 1980, however, an intra-articular knee entry is used. Long-term degeneration has still not been resolved, and remains a major concern. Recently, several research teams have investigated the indications for, and the feasibility of, retrograde intramedullary nailing for femoral shaft fractures. However, these specifically designed retrograde femoral nails are reserved for properly selected cases and particular situations.

CASE REPORT

A 21-year-old woman had a motorcycle-vehicle collision and sustained severe injuries, with bilateral lower extremity degloving and an associated right thigh deformity. She was sent to the emergency room at Chang-Gung Memorial Hospital and had a brief period of hypovolemic shock. Her hemodynamic status was stabilized after emergency resuscitation. The diagnosis included a Winquist type III right distal femur fracture and a Tscherne grade III injury with crushing-avulsion-degloving of the soft tissue over the bilateral buttock, thigh and lower leg, constituting about 20% of her total body surface area (Figs. 1 and 2). Urgent debridement and bony stabilization were performed within six hours. Due to extensive contamination of the open wound around the entry site of trochanter, retrograde intramedullary nailing was chosen to stabilize the fractured femoral shaft in preference to antegrade intramedullary nailing. Since a standard, specialized retrograde femoral nailing device was not available, the Russell-Taylor tibial interlocking nail was utilized as a substitute. Rapid access through the knee in the supine position facilitated retrograde nailing, and allowed several surgical
procedures to be completed in one stage. A T-loop diversion colostomy was also performed to avoid defecation soiling. Consecutive surgical debridements to create an aseptic and suitable soft tissue environment, accompanied by coverage with split thickness skin graft harvested from the scalp were performed during the subsequent hospitalization (Fig. 3). The patient was placed in intensive care in the trauma ward until soft tissue recovery was achieved. No skeletal complications were noted during this period. She was discharged one month later after a rather uneventful recuperation.

**Fig. 1** Severe degloving injuries of the bilateral lower extremities.

**Fig. 2** Radiograph demonstrates a Winquist type III fracture of the right distal femur.

**Fig. 3** Stable internal fixation allowed extensive serial debridement to create a suitable soft tissue environment for skin graft coverage.

**Fig. 4** Radiograph shows good alignment and bony union of the right fractured femur after retrograde intramedullary nailing with a tibial nail and a locking bolt.
Since discharge, this young woman has been regularly followed up at our outpatient department and has received a supervised rehabilitation program (Fig 4). The acceptable range of motion (0-130 degrees in extension-flexion) achieved in the right knee joint, without infection, limb-length discrepancy, rotational instability or angular malalignment (Fig 5). The nail was removed 15 months later, after solid bony union of the fracture site had been demonstrated via plain radiography. After 24 months follow-up, the patient was able to perform normal daily activities, including squatting, and ascending or descending stairs without any late complications.

**DISCUSSION**

Retrograde intramedullary nailing, first described by Harris in 1980, has become common recently. For critical patients with multiple injuries, femoral shaft fractures can be stabilized quickly and efficiently, and bilateral lower extremity injuries can be treated simultaneously in the supine position.\(^{(5-10)}\) Although the absolute indications for the use of retrograde nails are still the subject of some debate, relative indications include morbid obesity, multisystem trauma, ipsilateral floating knee and/or tibia injuries, bilateral femur fractures, ipsilateral acetabulum and/or femoral neck fractures, uncontaminated traumatic knee arthroplasties, through-knee amputations, pelvic ring injuries, pregnancy, gross contamination around the insertion point for antegrade nailing, unstable spine injuries, and multiple fractures.\(^{(11)}\) For properly selected cases, limited use of retrograde nailing is recommended by most researchers. Ostrum et al have suggested, however, that there may only be relative contraindications rather than indications for retrograde nailing.\(^{(7)}\) Retrograde insertion of a reamed intramedullary titanium nail through an intercondylar approach was used for femoral shaft fractures in their series. Subtrochanteric fractures within three centimeters of the lesser trochanter, skeletal immaturity and grade IIIB/IIIC open fractures were the only contraindications. They concluded that antegrade and retrograde nailing appear to be comparable as far as union rates and bony fusion latency are concerned.\(^{(7,8)}\)

With the severe crush injuries and the resultant multiple soft tissue degloving associated with the right distal femur fracture, the present case was especially complicated, with this complexity extending across multiple fields. Given the unstable vital signs and potential for neurovascular injuries, general, plastic and orthopaedic surgeons were consulted for the emergency surgery. Retrograde nailing was advised to treat the fractured femur because of the advantage of rapid access and feasibility in combination with other surgical procedures in the supine position. Particularly, extensive contamination of the open wound surrounding the right thigh (only the knee had intact overlying skin), precluded the use of an external fixator or plate. Since no standard, specialized, retrograde femoral nail was available, a Russell-Taylor tibial nail was substituted in this critical situation. Clinically, the key point is that the tibial nail is designed with a 15° anterior bend 45 mm from...
the top of the nail, allowing the device to enter the proximal portion of the tibia anteriorly. As the distal femur flares into two posteriorly curved condyles, however, the retrograde tibial nail must be inserted into the medullary canal with the 15° bend oriented in a posterior direction to keep the nail aligned with the distal segment. Accordingly, an unreamed tibial nail, with as large a diameter as possible, is introduced into the canal along the guided pin. The thicker nail engages the anterior curvature of the femoral medullary canal and isthmus, ensuring adequate stability. The locking screw is then threaded to fix the distally displaced fragment, avoiding rotational instability and angular malalignment.

The anterior aspect of the intercondylar notch is selected as the starting point as in placement of the intramedullary guide rod during total knee arthroplasty. In comparison to insertion through the medial femoral condyle, damage to the articular cartilage is limited using this insertion point. The nail is introduced along an inserted guide pin and countersunk under the intercondylar notch to preclude the possibility of damage to the patellofemoral joint or other articular structures and resultant late degenerative joint disease. For our patient, potential complications associated with retrograde nailing, including knee stiffness or impaired function, quadriiceps atrophy, articular or cruciate ligament damage, and septic joint, were not detected. Nevertheless, a specifically designed, commercial retrograde femoral nail is doubtless the ideal device for properly selected femoral shaft fractures. A tibial nail is only a substitute in particular situations, such as the present case. In order to rigorously evaluate the feasibility of this technique, therefore, investigation of more cases with long-term follow-up is required.

REFERENCES

以逆行性脛骨骨釘治療股骨骨折合併嚴重的脫手套撕裂傷

楊士階 蘇君毅 于尚文 杜元坤

我們報告一見罕病例，因與汽車追撞，造成此摩托車騎士下肢嚴重脫手套撕裂傷，合併右股骨骨折。創傷小組會診討論，共同治療此困難病例。由於大片污染的開放性傷口，含蓋順行性骨髕內釘入口（僅有膝部皮膚完整），相較下，逆行性骨髕內釘更適合用來固定此股骨骨折。我們以股骨骨釘代替，立即完成穩定的骨折固定，以便進行軟組織的清創手術，以及之後的重建手術。完好的膝關節活動度，無併發傷口感染、患肢不等長、不穩定、角度不良等後遺症的手術結果，很令人滿意。(長庚醫誌 2004;27:454-8)

關鍵字：逆向骨釘，股骨骨釘，股骨骨折。