

Manipulation with Schanz screws for closed reduction of femoral shaft fractures during intramedullary nailing

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ABSTRACT

الأهداف: استخدام مسامير سكانز كطريقة بسيطة وفعالة في إجراء عملية الإرجاع المغلقة لكسور عظمة الفخذ.

الطريقة: أجريت دراسة حالية جماعية في مركز الشهداء للعظام - تبريز - إيران، خلال الفترة ما بين يناير 2004م وحتى فبراير 2005م. شملت الدراسة ثلاثين مريضاً بالغاً بمتوسط عمر 29 عاماً (18-65 عاماً) والذين يعانون من كسور في عظم الفخذ، خضعوا لعملية إرجاع مغلقة باستخدام مسامير سكانز. تمت متابعة حالة المرضى لمدة 12 شهراً.

النتائج: بلغت نسبة الرضا في عملية الإرجاع 93.3% من المرضى. كان متوسط وقت الإرجاع أقصر بشكل ملحوظ إذا تمت المعالجة خلال 48 ساعة الأولى، وإذا وصلت كمية الشد قبل العملية 15% من وزن الجسم. كان وقت الإرجاع أيضاً أقصر في نوع كسور وينكويست - هانسين الثالث والرابع من كسور النوع الأول والثاني (5.9±0.2 دقيقة مقابل 15.7±0.4 دقيقة). كان هنالك نسبة 13% من التشوه الأروحي⁰ 5-10، 33% من خلل الدوران⁰ 5-15، 37% من القصر 1-3cm. لم نواجه حاجة لإجراء عملية نقل دم أو ترقيع للعظم.

خاتمة: تقدم مسامير سكانز طريقة فعالة جداً للإرجاع المغلق لكسور عظم الفخذ والمضاعفات مشابهة، أو أقل من الطرق الأخرى، خاصة إذا تم إجرائها خلال 48 ساعة الأولى بعد التعرض للإصابة إذا وصل وزن الجر قبل العملية إلى 15% من وزن الجسم.

Objectives: To use Schanz screws as a simple and effective method for closed reduction of femoral shaft fractures.

Methods: In the present cohort study, which was carried out in Shohada Orthopedic Center, Tabriz, Iran between January 2004 and February 2005, 30 adult patients, with a mean age of 29 (18-65 years) with femoral shaft fractures underwent closed reduction with Schanz pins. The patients were followed up for 12 months.

Results: Reduction was satisfactory in 93.3% of patients. The average time for reduction was significantly shorter if treated in the first 48 hours, and if the amount of pre-operative traction approached 15% of the body weight. Reduction time was also shorter in Winquist-Hansen type III and IV fractures than in type I and II fractures (5.9±0.2 minutes versus 15.7±0.4 minutes). There was 13% valgus deformity (5-10°), 33% external mal-rotation (5-15°) and 37% shortening (up to 1-3 cm). We encountered no need for blood transfusion or bone grafting.

Conclusions: Schanz screws provide a very effective method for closed reduction of femoral shaft fractures, and complications are similar to or less than other methods, especially if carried out in the first 48 hours after the trauma and if the weight for pre-operative traction approaches 15% of body weight.

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Since the development of Kuntcher's closed technique of intramedullary nailing, reamed intramedullary nailing is widely regarded as the treatment of choice for patients with femoral shaft fracture.¹⁻³ Nowadays, almost all orthopedic surgeons have had some experience in using this method. As closed intramedullary nailing requires some expertise and technical skills, open reduction is still the most commonly used method in developing countries.⁴ Many studies have shown that open reduction is associated with lower union and higher infection rates.^{4,5} However, there are numerous aspects to the procedure that requires expertise to ensure a good result with minimal complications. Obtaining

and maintaining reduction of the femoral shaft can be difficult and is required during several key stages of nailing. There are some techniques that can facilitate reduction, such as, the use of manual traction, femoral distractor, or fracture table.⁶ Percutaneously placed joysticks can also facilitate closed reduction without opening the fracture site.⁷ However, open reduction is mandatory in some occasions due to failure of these maneuvers. The aim of the present study, is to represent a new method of closed reduction for femoral shaft fractures that is simpler, more available, less complicated, and less expensive than other methods. In this method, Schanz screws are used for obtaining reduction. The authors have also used one or more percutaneously placed pins as joysticks.

Methods. Between January 2004 and February 2005, approximately 57 adult patients with femoral shaft fractures were admitted to Shohada Orthopedic Center, Tabriz, Iran. Patients with bilateral femoral shaft fractures, contralateral acetabular fractures, significant chest or spinal trauma, proximal or distal metaphysical femoral fractures, pathological fractures, open fractures, vascular injuries, unstable pelvic fractures, and those who refused or could not participate in the study were excluded from our series. The remaining 30 patients (21 male, 9 female) with a mean age of 29 years, (range, 18-65 years) were operated on by antegrade interlocking nailing using percutaneously placed half pins (5 mm Schanz screws) for closed reduction. The Ethics committee/ institutional research board approval was obtained, and the patients were asked to sign an informed consent form. Twenty-one patients were operated on in the first 24 hours after admission and the rest in the following 3 days. Fractures were classified according to Winquist-Hansen criteria.⁸ All the patients underwent preoperative skeletal traction up to 15% of body weight. After induction of general or spinal anesthesia, patients were positioned on a conventional radiolucent table in a lateral decubitus position (Figures 1-7). A starting awl was used to open the piriformis fossa, and a short small-diameter nail was placed into the proximal fragment, allowing control of the proximal segment, and passage of the guide wire. In the next step, depending on the fracture configuration, one or 2 half pins were placed unicortically in the distal fragments through small laterally placed stab incisions. After attaching a T-handle chuck to each pin, the pins were used to manipulate the fractures in the coronal and sagittal planes under an image intensifier while longitudinal traction was applied by an assistant. The reduction was maintained during guide-wire passage and also during reaming. To avoid damage to the reamers, the tip of the pins were removed back from

the intramedullary canal to hold only the proximal cortex. Finally, the internal fixation was achieved by inserting an interlocking intramedullary nail. Length, rotation and angulations of the limb were determined by the meter stick, hip rotation, and cable techniques. Post-operative isometric exercises were started the day after the surgery and weight bearing to tolerance by 2 crutches was encouraged on the second day after the surgery. Cephazolin was administered 30 minutes before the surgery and was continued for 24 hours in 4 divided doses as prophylactic antibiotic. Prior to discharge, a plain radiograph of the involved femur and a CT scan of both femora were obtained in order to measure the quality of the reduction. An independent assistant evaluated the patients at 6 weeks, 3 months, 6 months, and one year post operatively. Evaluation of patients included assessment of fracture union, range of motion of hip and knee joints, muscle force of lower limb, and possible complications such as surgical site infection or neurovascular injuries. Satisfaction of the patients with the results of surgery was evaluated subjectively; they were asked whether they were satisfied with the result and to mark their satisfaction on a Lickert scale.⁹

All data were analyzed by using SPSS software, version 14. The authors used descriptive methods to report the characteristics of the patients involved, to compare fracture types and time of operation, we used independent sample t-test. *P*-value less than 0.05 was considered significant.

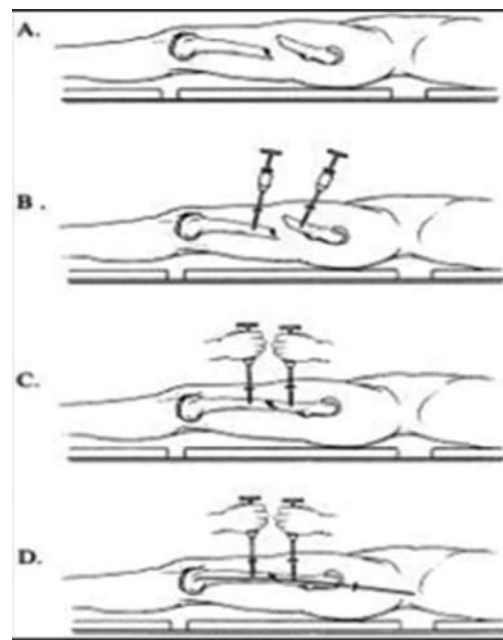


Figure 1 - Schematic diagram of manipulation with schanz showing, a) pre-reduction b) insertion of schanz c) manipulation and reduction, and d) passing of guide.

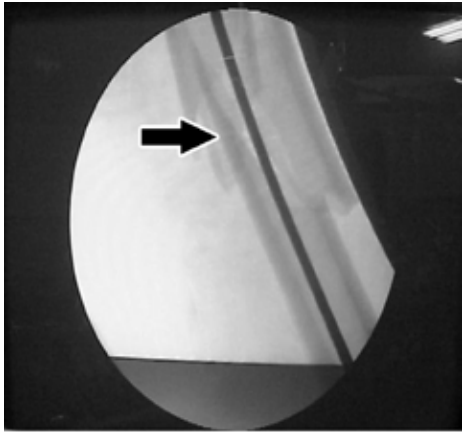


Figure 2 - Passing of guide.

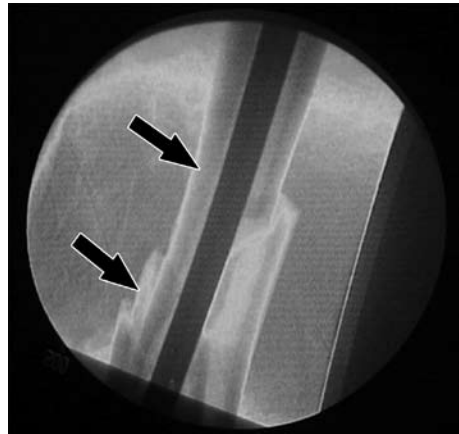


Figure 5 - Inserting an inter locking intra medullary nailing.

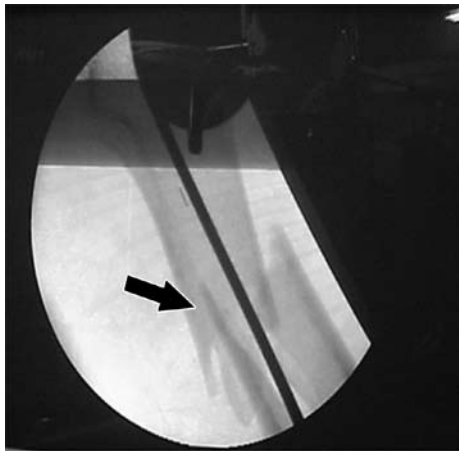


Figure 3 - Evaluation and assessment of reduction by fluoroscopy.



Figure 6 - Control of distal of femur (after inserting intra medullary nailing).

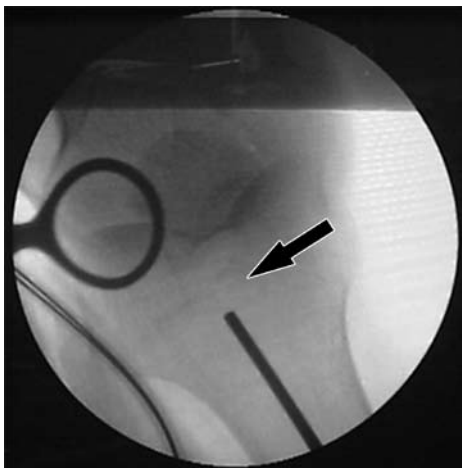


Figure 4 - Control of distal of femur.

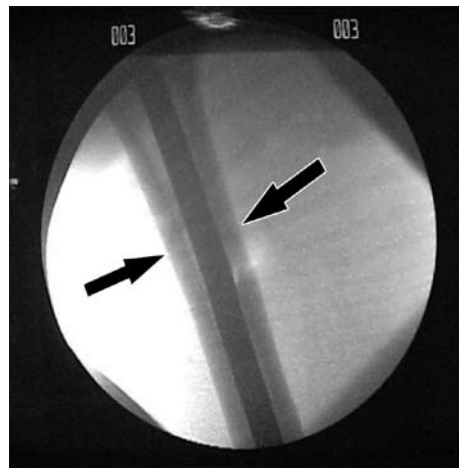


Figure 7 - Nearly anatomic reduction after complete insertion of intra medullary nailing.

Results. According to the Winquist-Hansen there were 12 type I (40%), 7 type II (23%), 5 type III (17%), and 6 type IV (20%) fractures. Five fractures occurred in the proximal third, 18 in the middle third, and 7 in the distal third of femora. Closed reduction was successful in 28 (93.3%) patients and in 2 (7%) cases we had to use the open reduction method. In the closely reduced group, we used femoral distractor in 5 (17%) cases. Regarding evaluation of patients during the follow up period, approximately 87% of patients had no valgus or varus angulation. All 4 cases of valgus angulation occurred in the distal third of femora. Ten patients (33%) showed signs of external mal-rotation of 5-15°. Shortening of limb was encountered in 11 patients, but was not more than 3 cm. There was no case of extension lag in knee joints; however, in 3 patients with distal third femoral fractures there was limited knee flexion of 10-25° in the last follow up visit. The time needed for reduction was significantly lower in patients who were operated on in the first 24 hours (9.2 ± 0.2 minutes versus 19.7 ± 0.4 minutes, p -value=0.035). The time needed for fracture reduction also depended on fracture type according to Winquist-Hansen classification (5.9 ± 0.2 minutes in type I and II, 15.7 ± 0.4 minutes in type III and IV, p -value=0.023). With regard to possible complications, there was no case of deep infection in our series. The only case of superficial surgical site infection at the site of nail insertion was treated by local wound care and oral antibiotics. The mean union time was 18 weeks (range, 12-36 weeks). There was inadequate callus formation at the end of 6 months, which was treated by dynamization and ended in progressive callus formation and union. All the patients had completed the union at the end of follow up period. No neurovascular complication was reported by the authors.

Discussion. Closed intramedullary nailing is the preferred method for dealing with femoral shaft fractures. It is associated with less soft tissue injury, preservation of bone's blood circulation, less surgical site infection, and higher rate of union. Despite these factors, the closed reduction method is difficult to perform, so it is not the routine procedure in many trauma centers, especially in developing countries. As a result, introduction of a simple, cost effective, and easily available method of closed reduction seems mandatory. Operation on the fracture table can be associated with sciatic, pudendal, and femoral nerve injuries. It may also lead to compartment and crush syndromes in the uninjured leg.⁶ According to the authors; no neurovascular injury or compartment syndrome was reported during or after surgery. This finding is similar to the reports of Sirkin et al⁶ and Stephan et al.¹⁰ The mean age of the patients was 29.63 years, which is similar

to the studies carried out by Wolinsky et al¹¹ (27.2 yr), Jarasama et al¹² (28 yr), Arpacioğlu et al¹³ (30.5 yr), and Olasinde (35 yr).¹⁴ It indicates that femoral shaft fracture occurs in the young and productive population and requires serious attention.

The overall incidence of angular deformities after femoral nailing is 7-11%, which occurs most commonly in the proximal and distal third femoral fractures. Arpacioğlu et al¹³ reported 9% varus angulation, 4.5% valgus, and 2.3% posterior angulation in 48 cases of femoral shaft fracture. In Winquist et al's series,¹⁵ there was 5% valgus deformity. In the present study, there were no varus or anterior-posterior angulations.¹⁵ However, valgus angulation occurred in 13% of patients. It may be due to the lateral decubitus position, which is associated with valgus angulation. The exact degree of mal-rotation that can be tolerated by the patient is unknown, but the need for surgical correction increases in mal-rotations more than 15°.¹⁶ Some authors believe that mal-rotation is significant when it prevents forward facing of the patella during walking. In a series of 110 patients with femoral shaft fractures who were treated by interlocking intramedullary nailing, approximately 38% of patients with at least 15° mal-rotation and 12% of patients with 10-15° mal-rotation were symptomatic, and patients with less than 10° of mal-rotation were symptom free.¹⁷ In our series, 30% of patients had less than 10° of external mal-rotation and were all symptom free. Only one patient had a 15° external mal-rotation, but he didn't have any symptoms either. The authors reported no case of internal mal-rotation. Significant shortening (>2.5 cm) occurred in only one patient (3.3%). Significant shortening occurred in 2% of patients in Winquist et al's series,¹⁵ approximately 4.5% in Arpacioğlu et al's series¹³ and 7.5% in Olasinde's series.¹⁴ Determining the accurate length of the nail by preoperative planning and correct placement of the nail during surgery by concurrent use of a meter stick was helpful in preventing limb length discrepancy. The authors reported limited knee flexion in 3 (10%) of patients, all of which occurred in patients with fractures of the distal third of femora. The incidence of limited knee extension is reported in 2-5% of patients with femoral fractures who undergo closed intramedullary nailing.⁵ However, there was no case of extension lag in our series. The overall union rate of femoral shaft fractures is 97-99.1% in different studies.^{1,11,13} In the present study, there was no case of non-union at the end of study. The time needed for union is similar to other studies, that is to say approximately 18 weeks. It is significantly lower than the time needed for union in open fractures, which amounts to 20 weeks.⁵ According to some papers, traction on fracture table results in neurovascular injury in 10% of cases.¹⁰ However, in our

series there was no neurovascular complication. In the present study, the earlier the surgery was performed, the better were the results. This is confirmed by the other studies, such as those performed by Winquist et al¹⁵ and Olasinde.¹⁴ At the end of the follow up period, approximately 96.7% of patients were satisfied with the surgery. In general, 88.6% of patients with femoral shaft fracture are satisfied with their surgical treatment. Using Schanz pins for closed intramedullary nailing is associated with better results compared to other methods of intramedullary nailing in treatment of femoral shaft fractures. It is mandatory to follow up the patients for a longer period in order to arrive at the definitive conclusion, but at the moment, the above method can replace most cases of open reduction and also other techniques of intramedullary nailing. The authors suggest that more research be carried out in order to confirm the use of this method and to determine the probable complications.

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Ethical Consent

All manuscripts reporting the results of experimental investigations involving human subjects should include a statement confirming that informed consent was obtained from each subject or subject's guardian, after receiving approval of the experimental protocol by a local human ethics committee, or institutional review board. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.