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Elastic stable intramedullary nailing in paediatric traumatology at Yopougon Teaching Hospital (Abidjan)

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ABSTRACT

Context: Elastic stable intramedullary nailing has revolutionised the treatment of fractures in children. **Aim**: To report our experience with this current technique of management of fractures in children. **Methods and Materials**: A retrospective study of all children with fractures treated by this method from November 2003 to June 2006 at the Paediatric Surgery Department of Yopougon Teaching Hospital, Abidjan, Côte d'Ivoire. Data were recorded from their medical charts regarding demographics, fracture patterns, associated injuries, morbidity, and outcome. **Results**: A total of 38 children (14 boys; mean age, 11.7 years; range, 9-15 years) with 41 fractures, sited at femur (n=15), humerus (n=8), tibia and fibula (n=6), forearm (n=7), and radial neck (n=5), associated with other injuries in 7 cases, were enrolled in the study. The mean interval for surgery was 6.8 days. Open reduction was required 5 times (12.1%). The hospital stay was in the range 5-12 days. Minor adverse events were 1 (2.4%) early tibial loss of reduction, 3 (7.3%) skin irritations and 2 (4.8%) transient knee limitations. Complications (17.3%) included 2 axial (4.8%) and 1 rotational (2.4%) femoral malunions below 15°; 3 elbow (7.3%) and 1 knee stiffness (2.4%) in openly reduced cases. Solid consolidation was achieved in all cases, with no disturbance in standard union times. At a mean follow-up period of 16 months (range, 9-28 months), all but 3 patients with opened joints recovered full range of motion, and none showed either limp and gait anomalies or re-fracture after removal of wires. **Conclusion**: Elastic stable intramedullary nailing in children fractures is easy to perform and has little complications if a proper technique is used.

Key words: Children, diaphyseal fractures, elastic stable intramedullary nailing

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INTRODUCTION

Elastic stable intramedullary nailing (ESIN) has become the standard treatment for fractures in children for reasons including mini-invasive surgery, no need for casting, early mobilisation and discharge as well as growing concerns toward cost-effectiveness. The use of nails in children was pioneered in forearm fractures by Perez *et al*, 1977[1] and Firica *et al*, 1981.[2] But, the concept of two elastic intramedullary pins facing each other in a secant arc was developed and applied first to femur shaft fractures by the members of surgical staff from Nancy, France.[3] Under their impulsion, ESIN was promoted worldwide and gradually extended to other fractures. Yet, there is a paucity of studies on this topic in Sub-African literature.[4] We aimed to report our first 3-year experience of ESIN in paediatric traumatology focussing on indications, complications, and treatment results.

MATERIALS AND METHODS

We retrospectively reviewed the files of all children fractures, and age range of 0-16 years treated by ESIN between November 2003 and June 2006 at the paediatric surgery unit of Yopougon Teaching Hospital, Abidjan, Cote d'Ivoire. Data extracted from their charts included age and sex, fracture patterns, associated injuries, hospital stays, healing time, morbidity, and outcome.

Operative technique

Under general anaesthesia, antibioprophylaxis, and C-arm control, once reduction was reached by traction device, two K-wires measuring 0.4x of endomedullary width and curved in 'C' were inserted percutaneously, through a hole made just above the physis into the medullary canal. The K-wires were pushed up to the opposite metaphysis by gentle hammering or a 'T' handled introducer. In the forearm, a single nail was used for each bone and the radius alone was nailed in radial neck injury. ESIN was retrograde for humerus

shaft fracture [Figure 1]. For femur fracture, ESIN was retrograde in diaphysis [Figure 2] and anterograde in distal lesion [Figure 3]. Tibial shaft fracture was anterogradely nailed [Figure 4]. After assessing fracture stability and alignment on table, the end of wires were bent towards the fracture and cut at the entry portal and skin wounds were then sutured and dressed. The arm was supported in a Mayo clinic sling. Mobilisation began after fracture was pain-free; it was followed by training for non-weight-bearing, partial, then full weight-bearing crutch walking successively within three weeks. Starting at the third postoperative month, the removal of nails was achieved under anaesthesia during a 1 to 2 days hospital stay.

RESULTS

Of total 287 children with fractures treated during the study period, 38 of 115 eligible for ESIN underwent the procedure. The remaining children could not afford the healthcare costs. A total of 18 boys and 20 girls aged 9-15 years (mean, 11.7 years) had sustained 41 fractures [Table 1]. Associated injuries included one open tibial and three bilateral femoral fractures and one spinal injury in a tibial fracture. Proximal apophyseal and olecranon metaphyseal avulsion was seen in one radial neck fracture each. The mean surgery time was 6.8 days (range, 3-9 days).

No ESIN failure occurred, except 5 cases (12.1%) that required open reduction—1 supracondylar and 1 bifocal femoral fracture for muscle interposition, and 3 severely tilted irreducible radial neck injuries contained in long-arm splint to control pain. Surgical exposure was

Table 1: Topographic repartition of children fractures

Fracture location	Proximal	Midshaft	Distal	Total
Femur	3	10	2	15
Humerus	4	4	-	8
Tibia and fibula	-	6	-	6
Forearm	-	7	-	7
Radial head	-	5	-	5



Figure 1: Retrograde ESIN performed for unstable humeral shaft fracture.



Figure 2: Transverse femoral shaft fracture managed by retrograde ESIN.

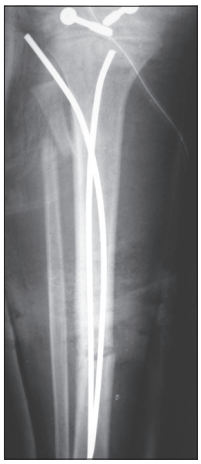


Figure 3: Anterograde ESIN for tibial shaft fracture with epiphyseal injuries.



Figure 4: Open reduced supracondylar femoral fracture anterogradely nailed. This radiograph taken at 21 days showed some external callus.

small, and so were blood loss and periosteal handling. Hospital stay was about 5-12 days, except the patient with polyfracture who stayed longer. We encountered following minor adverse events: 1 (2.4%) early tibial loss of position due to improper nail length needed further casting; 3 (7.3%) skin irritations at the knee caused by prominent nails which had to be cut again; 2 (4.8%) knee limitations receded after removal of protruding nails. Complications (17.3%) included 2 (4.8%) axial and 1 (2.4%) rotational femoral malunions below 15°; 3 (7.3%) multiplanar stiffened elbows in radial head injuries and 1 (2.4%) knee flexion-extension restriction of note 20/20° in a child with tibial spine injury. All fractures united within 10-14 weeks (mean, 10.2 weeks) in lower limb and 8-12 weeks (mean, 8.2 weeks) in upper limb without deep infection or union disturbance. At a follow-up period averaging 16 months (range, 9-28 months), all patients but those with open joints were observed to have recovered full range of motion. Re-fracture was not noted after removal of wires and no patient has complained of gait or limp anomalies.

DISCUSSION

We began applying ESIN to femoral shaft fracture in a child of school-going age, which is its leading indication.[3] Also, other shaft and selected metaphyseal fractures as well children with polyfractures, were in line with current enlargement of ESIN indications.[1-3,5] But, care must be taken for arguable indications reported by Bopst *et al,*[6] such as femur shaft fracture in the preschool child for whom the orthopaedic treatment remains effective, without affecting the school attendance. However, the use of ESIN is much recent and not yet implemented in our routine practice for reasons including insufficient equipment, people with low socioeconomic level, and ineffectual welfare system, making this procedure still looked at critically as compared with the conservative treatment.

In practical view, our inexperience in early years may explain the failure of the closed reduction that became reachable with training. But, failure in reducing femur supracondylar fracture might be related to lack of double-pin traction device for opposing hyperextension of distal fragment by gastrocnemius pull.[7] At this point, Wainwright *et al*, had reported a novel way to reduce femoral fracture without traction device, that can be useful in poor-equipped areas.[8] Radial *neck* joystick relocation of severely displaced fractures has failed in half of our cases. Moreover, trained surgical teams like that of Métaizeau *et al*,[9] cited for lesions over 80° of tilt a substantial failure rate of 33%, increasing difficulties in such injuries.

Postoperative casting is debated in forearm and tibia fractures. Some argued on regular casting in forearm fractures due to recurring instability, while others reported on the need of casting for residual tibial deviation in two-thirds of cases, but their series are larger than ours.[10,11] We resorted not to perform it, except splintage for 3 open joints in the upper limb and 1 tibial casting for loss of reduction. This allowed in our patients early mobilisation, with reduction in hospital stay, especially obvious in femoral fractures. Prompt recovery was trouble-free in patients with upper-limb injury, training for weight-bearing crutch walking was arduous in children less than 8 years of age who may, in our opinion, benefit from physiotherapy.

Nail protrusion causing discomfort at the knee can be avoided if pin ends are cut short or covered with a foam cap as shown by Ligier *et al*.[3] Their series noted this adverse effect only in 13 of 123 femoral fractures versus 5 of 15 in our study. Despite these unpleasant events, our patients found ESIN livable with least negative psychological effects compared to plaster due to early convalescence and discharge.[12] All fractures had united, with neither disturbance nor relevant variation in healing index if referring to standard union times, along with other series. Rapid consolidation due to optimal bridging callus reported in femoral fractures[3,7] was not noted in our study, possibly, due to irregular outpatient follow-up. Also, delayed union primarily affecting the ulna in forearm fractures,[10] nonunion in tibial injuries,[11] and avascular radial head necrosis,[9] were reported in studies, which are yet larger than ours. We encountered no deep infection but delayed femoral osteomyelitis, even if rare, was mentioned in the major series by Ligier *et al*.[3]

We found a 17.3% complication rate, consistent with the 9-30% reported, reliant from a series to another on definition of complication applied and fracture location.[3,4,7] Unlike other investigators, we did not look as a complication any postoperative event without effect on the final outcome. Thus, we noted a malunion rate of 7.2% versus 5% for the large series by Lascombes *et al*,[12] suggesting its prevention by accurate evaluation of stability and correct biplanar linear alignment of fracture on table.[12] Since restricted motion in our study affected only patients who were opening a joint, it may be related to the articular exposure rather than to ESIN method, except severely displaced radial neck injuries indicted of exposing to uncertain results.[9] Similarly, we infer from the study that the key to preventing such

injuries may lie in limiting the recourse of joint opening so that insufficiencies of closed reduction should be preferred whenever possible.[9] Leg-length discrepancy due to post-fracture overgrowth was not assessed in our series, if not promptly objectified by gait anomaly or patients' perception of limp, which is proven to be strongly correlated with this complication.[13] Further, no reliable comment about leg-length inequality can be inferred from this study.

CONCLUSION

ESIN represents a safe mini-invasive closed surgical procedure for children having shaft fractures, with satisfactory results for the patients and families if proper techniques are applied. Hospitals should maintain a less costly inventory, so that large number of children can afford the benefits of this current surgical procedure.

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