Interlocked Intramedullary Nail Without Fluoroscopy

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KEYWORDS

• Education • Appropriate implants • Visual versus tactile sense • SIGN family of surgeons • Interlocked intramedullary nail • Fluoroscopy

KEY POINTS

- Education and implants that can be used without power equipment are key to enable interlocked intramedullary nailing without fluoroscopy in developing countries.
- The same implants and instruments are used to treat all long bone fractures.
- Open reduction is usually necessary.
- Results of Surgical Implant Generation Network surgery are equivalent to series of other implants in developed countries.

ORTHOPEDIC CLINICS: INTERLOCKED INTRAMEDULLARY NAIL WITHOUT FLUOROSCOPY

Five key points must interconnect to enable interlocked intramedullary nailing without fluoroscopy in developing countries:

- Patients who need this technology
- Skilled surgeons who understand the need for intramedullary nail interlocking screw system to treat their patients
- Appropriate implants designed to be used in austere environments
- Appropriate instruments designed for these implants and other conditions in austere environments
- Education for the surgeons using these implants and instruments
- Validation of surgical results using these implants and instruments.

Increasing Numbers of Patients with High-Energy Fractures

The numbers of patients in developing countries who need stabilization of high-energy fractures due to road traffic accidents are predicted to increase 67% by the year 2020. Every year, 20 to 50 million people are injured or disabled by road traffic accidents.[1] Global conflicts are causing increasing numbers of fractures. Blast injuries are an extreme example of high-energy open

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fractures. The SIGN system is being used to treat civilians in Iraq, Afghanistan, Syria, South Sudan, and Pakistan, and is used in hospitals in 48 other developing countries.

Collaboration with Surgeons in Developing Countries

The development of the SIGN system has been facilitated by the combined efforts of many surgeons throughout the world. These surgeons work hard to treat the increasing number of severe fractures. They work hard because there are not enough orthopedic surgeons in developing countries.

Not only do these surgeons have an increasing number of patients with high-energy fractures to treat but treatment of these fractures is more difficult because the patients often have surgeries 2 to 6 weeks after injury. Surgical reduction of these fractures takes longer as the number of patients awaiting surgery increases (Fig. 1).

SIGN was originally designed for stabilization of tibia fractures because a delay in treating an open tibia fracture has serious consequences for the patient. In developing countries, the patient and the family must purchase their implant before surgery can be done. This delays surgery while the funds for the implant are gathered by the family. SIGN was founded when we observed the need to combine education with the appropriate implants to implement the education. In 2011, 2.8 billion people in the world were living on less than 2 dollars per day and, therefore, could not afford the proper implant to stabilize the fracture.[2]

Often, no fluoroscopy is available. Surgeons must use tactile sense to substitute for the visual images seen on C-arm screens. They feel vibrations coming from the far end of the instrument and internally visualize the location of the far end of the instrument instead of concentrating on the near end of the instrument while looking at a fluoroscopy image. For example, during reaming, they recognize the tactile difference as the increasing size of the reamers become tighter in the canal and produce chatter. They place the interlocking screws accurately and efficiently using instruments designed to be guided by tactile sense.

Fig. 1. Patients waiting for surgery occupy beds that could be used for other patients. (*Courtesy of* SIGN Fracture Care International; with permission.)

Surgical Implant Generation Network Technique for Tibial Nailing

The SIGN technique can be used in treatment of a high-energy tibia fracture or fractures of the femur and humerus.

A fractured tibia can be treated by closed reduction within 1 week of injury (Fig. 2). Tactile sense facilitates this reduction. The hand reamers and nail are passed across the fracture site using vibratory sense. Development of tactile sense is procedural memory similar to riding a bicycle. The vibrations from the seat and handlebars keep us from falling off. This ability to feel vibrations and discern their meaning is not easily forgotten. Procedural memory allows a person to return to riding a bicycle years later without falling.

Reduction is accomplished by closed methods if possible. It is very difficult to reduce a fractured tibia closed 10 days after surgery. The fracture is stressed in all directions before attempting reduction; these maneuvers are repeated during reaming and placement of the nail. The surgeon has a baseline of instability before reduction and can judge when the reamers and the nail have been inserted past the fracture site.

The bone entrance is made through a longitudinal incision in the patella tendon. A guidewire is not used to determine the proper location because there is no fluoroscopy. The bone entrance is made with a curved awl that is also used to contour the channel anteriorly for 4 cm. This anterior channel created by the curved awl makes posterior penetration of the nail less likely. The fat pad is not disturbed.

The 7 to 9 mm reamers are pointed and the 10 to 14 mm reamers are blunt tipped (Fig. 3). The reamers are guided down the canal using tactile sense. If the tibia fracture is in the proximal third, the Fig. 4position is used for reaming and placement of the nail. Pressure is placed posteriorly on the proximal fracture if the fracture site is apex anterior. A blocking screw can be used for proximal tibia fractures; however, it is usually not necessary using Fig. 4 position. After the pointed reamers have been passed, the surgeon passes the blunt-tipped reamer through the fracture site,