

1.1 Introduction

There is a wealth of published literature on intramedullary nailing. With current locking designs, intramedullary nailing indications have been expanded to include a large number of diaphyseal and even metaphyseal fractures in adult patients. Küntscher was the one who pioneered the concept [1], but extensive work had been previously carried out on nailing or pinning techniques in which the nails/pins did not fill the entire transverse section of the diaphysis. The so called alignment nailing technique was widely used by Rush [2] after World War II. These bulky devices were used in forearm fractures, where they allowed maintaining a precarious reduction without any control of the rotatory stability, which made it necessary to use external immobilization. Furthermore, they were associated with postoperative complications such as skin ulceration at the insertion site. Bundle nailing for metaphyseal fractures using two, three, four, or even more thin elastic nails was widely used by Hackethal for treatment of fractures of the upper end of the humerus [3], and by Ender for femoral neck fractures in the elderly [4]. Ender nailing almost completely disappeared from the therapeutic armamentarium due to the incidence of rotational malunion of the femur and nail migration, in favor of more advanced devices. But the notion of “elastic” osteosynthesis was retained, and was used for fixation of certain types of fractures like tibial fractures [5]. Actually, it was even incorporated into the concept of the Ilizarov external fixator, as Ilizarov had fully demonstrated that when traction-compression forces are applied to bone with intact periosteum and blood vessels, healing occurs regardless of the circumstances [6].

The notion of stability can be very simply expressed in terms of stable or unstable equilibrium: a body at

rest is in stable equilibrium if, when slightly displaced, it tends to return to its original position of equilibrium; a body in unstable equilibrium will sooner or later return to stable equilibrium. The best illustration of this is the sailboat with its keel (Fig. 1.1).

In the late 1970s, Dr. Jean-Paul Métaizeau (young Chief Resident), Jean-Noël Ligier (Resident), and Prof. Prévot (Head of the Department of Pediatric Orthopedics, University Hospital, Nancy) were working out a way to stabilize femoral fractures in children. They took up the idea and tailored the system to children’s specific needs. Eventually, on September 27, 1979, Hubert Lanternier and J.N. Ligier performed their first ESIN/chk if full form needs to be given in a 9-year-old child, Mathieu, who had been hit by a car while riding a bicycle. Four 3 mm diameter stainless steel nails were used (Fig. 1.2).

Early constructs used three or four nails; there was even a “Tour Eiffel” frame design. Gradually, the idea of using only two elastic nails with opposing curves took shape. Within a few months, a finalized surgical technique was developed that had the additional advantage of eliminating the need for cast immobilization. On March 17, 1980, Frédéric who had been injured during a football match was operated on by J.P. Métaizeau, who used “only” two nails (Fig. 1.3). However, in the two above-mentioned cases, a long-leg cast was associated with ESIN.

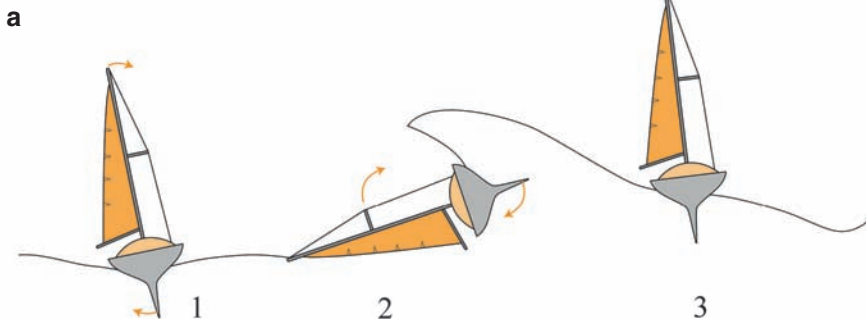
Meanwhile, J.N. Ligier was defending his M.D. thesis in which he reported on the treatment of subtrochanteric fractures in adults by elastic nails [7]. At a time when the rigid internal fixation concept supported by the Swiss Association for Osteosynthesis (AO) was the “Gold Standard” in fracture fixation, and the concept of compression-distraction osteogenesis developed by Ilizarov had not yet been popularized in Western Europe, it was a real provocation.

As early as 1980, ESIN indications expanded dramatically. It was first used in diaphyseal fractures: femur [8], and then tibia, both bones of the forearm [9], and humerus. Later on, metaphyseal fractures were also stabilized using different methods: Hackethal, Ender, or even Foucher for the fifth metacarpal [10]. Although management of humeral neck fractures was complication free [11], it was a different story with supracondylar fractures of the elbow, which are associated with a high risk of malunion, and radial neck fractures, which carry a high risk of postoperative necrosis. J.P. Métaizeau had the idea of using the nail itself as a reduction tool: impaction of the nail into the radial head, rotation of the nail to reduce the head, and then fixation [12, 13]. As for supracondylar fractures, P. Bour had no difficulty in proving that the antegrade divergent construct designed by Métaizeau outperformed all the other internal fixation methods used in children, and minimized the potential risk of malunion

since anatomic reduction is mandatory to obtain a functional construct [14, 15].

Our total number of cases has kept increasing over the years, thanks to all the residents and chief residents who performed at the Clinique Chirurgicale de Nancy, and to whom I am very grateful. Since 1981, I have followed more than 1,700 patients treated with ESIN. I have also organized instructional courses, first at a regional level, then national, European, and finally international level. This is how the ESIN method has gradually spread worldwide. It has become so popular that now surgeons often want to share their own tips and tricks with us! The result of this popularity is that in many countries the original acronym “ESIN” [16] has been changed to “FIN” (Flexible Intramedullary Nailing), which we have eventually adopted to reach a consensus view. As a matter of fact, “stable” does not have the same connotation for all surgeons: some will consider the physics meaning “stable equilibrium”

STABILITY



INSTABILITY

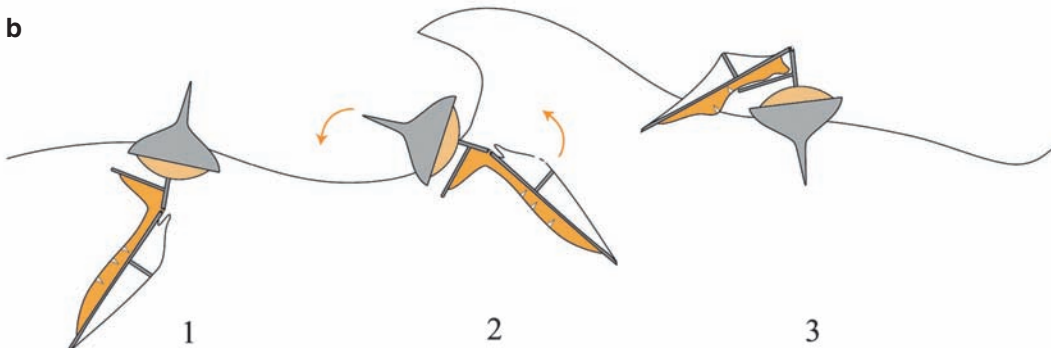


Fig. 1.1 The behavior of a sailboat in waves illustrates the notion of stability (a) and instability (b) 1: initial position; 2: displacement; 3a: return to the initial position = stability; 3b: change to another position = instability

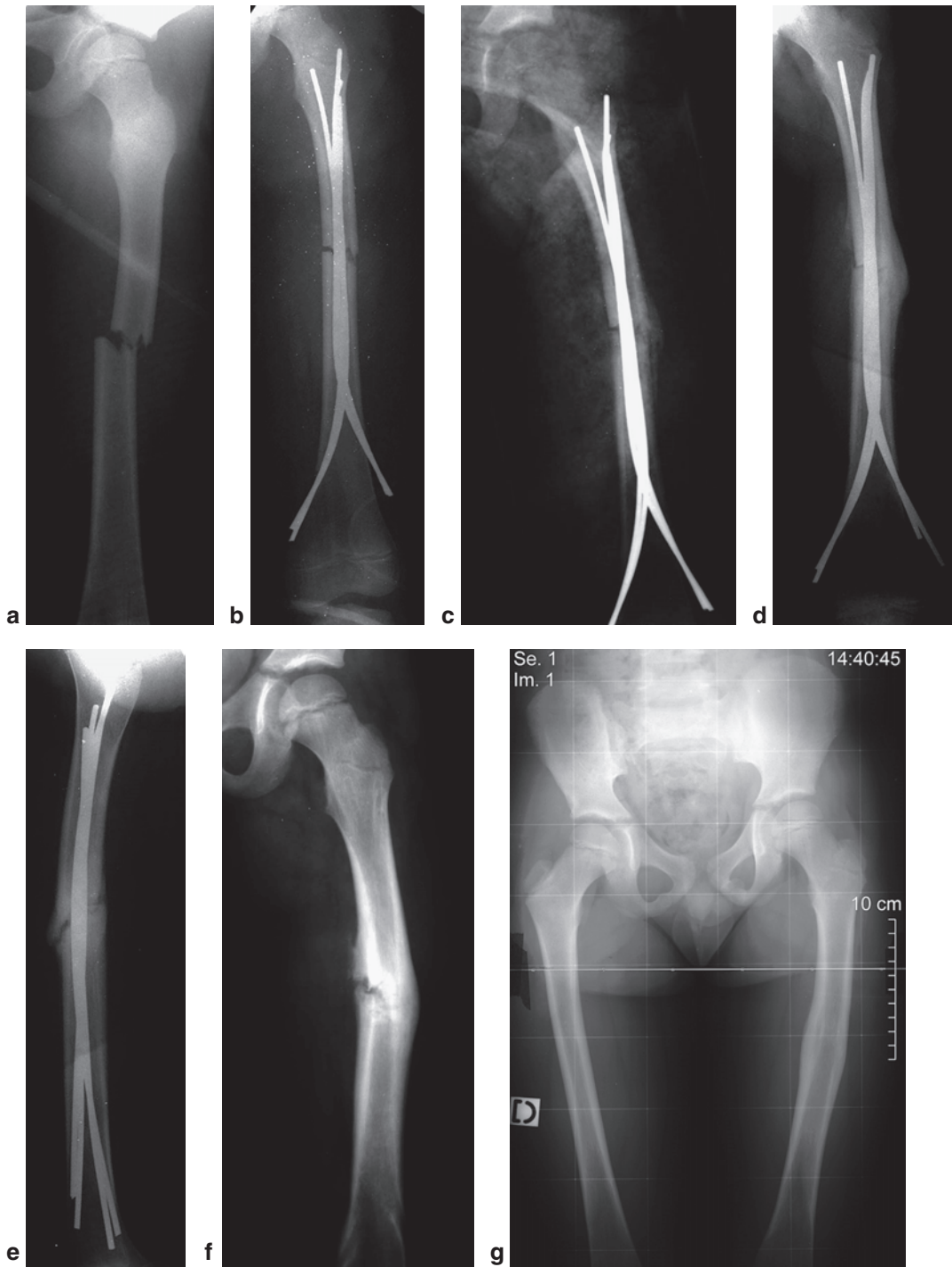


Fig. 1.2 M. B., a 9-year-old boy, was riding a bicycle when he was hit by a car coming in the opposite direction. He sustained head trauma and closed transverse fracture of the middle third of his *left femur* (a). On September 27, 1979, four 3 mm intramedullary nails were inserted using lateral and medial supracondylar approaches according to the Ender technique (b).

Additionally, a long-leg cast was applied for 2 months (c). Follow-up radiographs clearly showed callus formation on the lateral aspect of the femur (d, e). Nails were removed at 5 months. Varus angulation of 10° (f). At 18 months, the fracture was united with a residual varus angulation of 5° and leg length discrepancy of 15 mm (g)

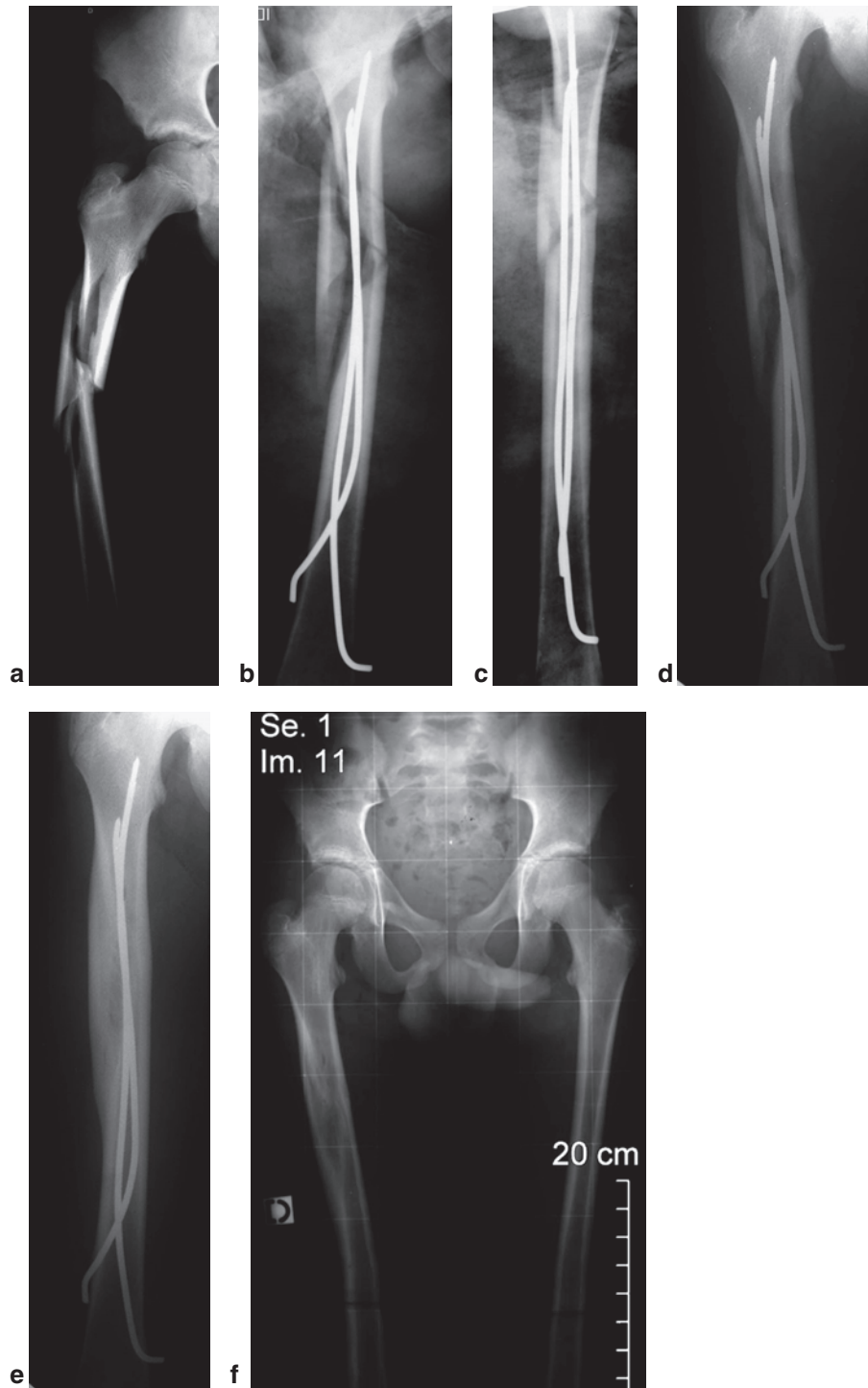


Fig. 1.3 F. T., a 13-year-old boy with spiral fracture (with a third fragment) of the *right proximal femur* sustained during a football match (a). On March 6, 1980, after a few days of traction, closed internal fixation was performed using two threaded K-wires and the child was immobilized in a long-leg cast for 6 weeks (b, c). Stiffness developed in the knee: at 2 months,

aggressive rehabilitation was necessary. Partial weight bearing at 2 months, full weight bearing at 3 months (d). Six months later, bone union was achieved (e). K-wires were removed. Eighteen months later, the boy had normal knee motion but his right femur was 2 mm shorter than his *left femur* (f)

while others will understand “stiffness.” Therefore, in the next chapters, we shall use FIN.

The FIN method, also termed Métaizeau technique [17, 18], Nancy technique [19, 20], or ESIN technique (mainly in Europe) [21] was introduced in the 1980s through instructional course lectures (which we cannot all mention here), numerous medical theses [14, 21–24] and scientific essays. In addition, K. Parsch published, in the 1990s, a detailed history of this method in the treatment of femoral fractures in childhood [25], and informed us of a publication conducted by Moroté Jurado in 1977 (Seville team, Spain). The technical protocol was identical to that used in Nancy. The series included 100 diaphyseal fractures of both bones of the forearm [26] (Figs. 1.4 and 1.5). To recognize the Spanish authorship of this study is only fair.

Almost 30 years after its introduction, the FIN method has now become a universal way of treating fractures. Early criticisms and doubts were eventually laid to rest, and both strategic and technological improvements were made. Now, children can benefit from a low-morbidity functional surgery, which does not interfere with the growth process. The outstanding advantages of FIN over other fixation systems such as intramedullary

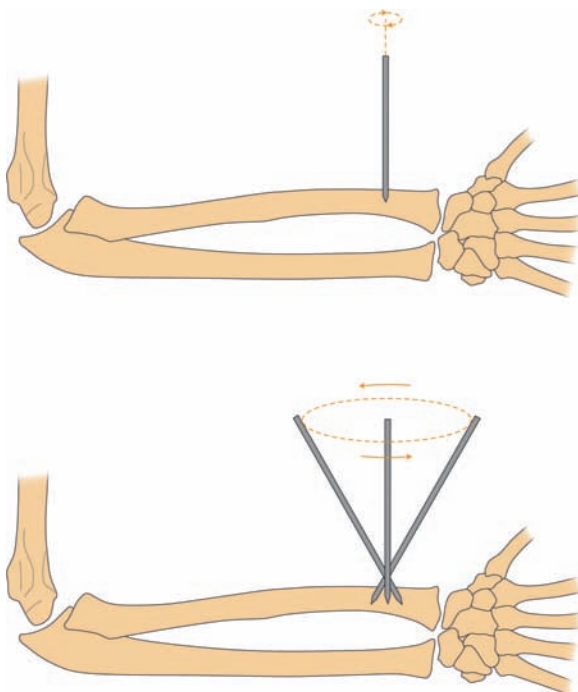


Fig. 1.4 Ideal entry site. Technique used by Perez Sicilia [26] to create the entry hole in the lateral cortex of the radial metaphysis

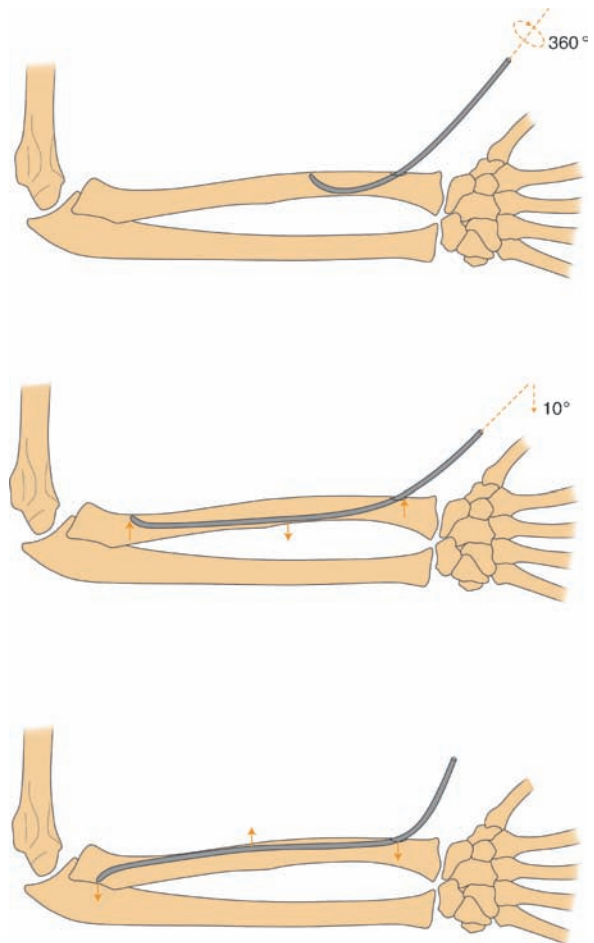


Fig. 1.5 Guided insertion and rotation of the nail for proper stabilization of the bone fragments, according to the Perez Sicilia’s technique [26, 27]

locked nails, screw plates, and external fixators have long been recognized, although there are still specific indications for each of these systems. However, training of new generations remains a priority, which has also inspired this book.

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