Evolution of Implants for Trochanteric Fracture Fixation: The Engineer’s Point of View

H. Müller-Daniels

Trochanteric Intramedullary Fixation Devices

More than 65 years ago, in November 1939, Gerhard Küntscher implanted his first intramedullary nail in a shipyard worker who had fallen off the dock and broken his femur. This implant had been developed by Küntscher and manufactured by Ernst Pohl in Kiel, Germany. This initial treatment was the beginning point for the breakthrough of closed intramedullary nailing, which today is accepted as “state of the art” in fracture treatment.

Starting with this initial experience, Gerhard Küntscher was constantly refining and improving the implants. He was constantly working on new ideas for implants to treat more and more different types of fractures.

For the treatment of proximal femur fractures he developed the Y-nail in 1960. At that time Küntscher recognized that intramedullary fracture fixation in proximal thigh bones significantly improves the biomechanical stability in comparison to a conventional side plate construct. This was due to the shorter lever arm, as measured by \( d < D \), especially in terms of load-bearing (Fig. 4.7.1).

Nowadays side plates are called compression hip screws (CHS); the majority of them were not designed for the treatment of unstable proximal and subtrochanteric femur fractures and allowing full weight-bearing postoperatively. Treating these types of fractures with CHS as they were developed by McLaughlin in 1947 or Pohl in 1950 very often led to implant failures due to biomechanical overload. The dynamic hip screw, invented by Synthes in 1980, also did so [17–20].

Dr. Grosse at CTO in Strasbourg, France, as well as Dr. Halder and Mr. Gill in Halifax, UK, further developed in parallel and independent from each other the idea of intramedullary fixation at the beginning of the 1980s. After both designs were finalized in the Gamma nail, the so-called standard Gamma nail (SGN) was launched in 1988 (Fig. 4.7.2a). This was the first intramedullary hip fracture fixation device allowing full weight-bearing because of its strong implant design. That is why it was able to treat all stable and unstable as well as ipsilateral and pathological femur fractures.

Clinical support for the Gamma nail was given by A. Grosse and G. Taglang from CTO, Strasbourg, France, from the beginning. Since the market introduction the product range was completed by long Gamma nails and special nail shapes for the Asian population, the so-called AP and AP-J Gamma nails.

In 1997, the second-generation nail, the trochanteric Gamma nail (TGN), was launched (Fig. 4.7.2b). Its design was based on 9 years of clinical experience with the SGN. The TGN was improved by shortening the nail by 2 cm and reducing the medial–lateral bend from 10° to 4°. These changes led to an optimized shape of the nail and to an even better clinical outcome [9–15] of the implant. More than 750,000 Gamma nail implantations have been performed so far. This seems to be very clear evidence that this is the right direction for intramedullary treatment with Gamma nails [1–8] in trochanteric fracture fixation. In 2001, a full range of tita-

![Fig. 4.7.1. Biomechanical advantage of intramedullary fixation versus extramedullary fixation](image-url)
nium implants was launched under the name of Dyax-Asiatic and Gamma-Ti, mainly in Japan and Europe, to address surgeons’ needs.

The concept of the Gamma nail has been copied by more than 20 orthopedic companies during the past decade.

After more than 15 years of clinical experience, the development of the third generation of Gamma nails started in the year 2001 with the contribution of leading surgeons of the AIOD and other trauma associations. Benchmarking the clinically successful TGN, the targets for the third genera-