



# Wireless Dynamic Plate, State of the Art, Design, Possibility of Use and Future Developments

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## Abstract

The medical device called Wireless Dynamic Plate (WDP) is proposed as absolutely innovative, especially in the treatment of complex fractures of the lower limb, in particular of the femur. The objective is to ensure stable fixation during the process of callus formation and allow the patient to resume walking as soon as possible. With the possibility of dynamization of the implant there is therefore a double effect on fracture healing, ensuring that in a first phase the proliferation of the bone callus is stimulated and in the second phase the remodeling and hypertrophy of the bone cells in the advanced stage of healing.

**Keywords:** Wireless Dynamic Plate (WDP); Complex fractures of the femur; Dynamization

## Introduction

The medical device called Wireless Dynamic Plate (WDP) is proposed as absolutely innovative, especially in the treatment of complex fractures of the lower limb, in particular of the femur. The objective is to ensure stable fixation during the process of callus formation and allow the patient to resume walking as soon as possible. With the possibility of dynamization of the implant there is therefore a double effect on fracture healing, ensuring that in a first phase the proliferation of the bone callus is stimulated and in the second phase the remodeling and hypertrophy of the bone cells in the advanced stage of healing. At the moment this possibility is provided by the DIF plate (Dynamic Internal Fixator) which however requires a second surgical operation to remove the block which prevents the mutual sliding of the two components (guide and plate). The WDP project aimed to create a plate that can be dynamized in a controlled and non-invasive way (therefore without carrying out a second surgery), using electromechanical systems that can be activated wirelessly. Furthermore, the mechanotronic characteristics of the device make it possible, in addition to controlled compression, to elongation. In fact, the dynamization of the WDP system takes place in an absolutely noninvasive manner, exploiting the potential of the electromechanical locking/unlocking

system installed inside the system and which can be activated wirelessly, acting directly during a check-up visit in the clinic (Figure 1).



Figure 1: DIF PLATE, model currently on the market.

## The DIF Plate

Bridge fixation with angular stability plates is the most used method in the treatment of metadiaphyseal and periarticular fractures of the femur. Angular stability plates are widely used to

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treat complex fractures, but have a high incidence of non-union. The dynamic internal fixator (DIF) system is composed of an angular stable plate that combines the principles of the internal fixator with the dynamic device. The DIF system combined the advantages of angular stability plates with the possibility of dynamization, increasing compression at the fracture site to modulate and guarantee the healing process. Consolidation delay, non-union and breakages of the fixation devices are often caused by the rigidity of the implants which do not allow load transfer on the stumps. A further clinical problem that can be encountered is the asymmetric formation of bone callus often due to the total rigidity in the walls of the bone segments underlying the plate. The DIF dynamic internal fixator is designed to offer, in addition to the stability guaranteed by the conical coupling of the self-locking screws, the possibility of dynamic compression in the intra- or post-operative phase. With DIF, even if the reabsorption and repositioning occur at the level of the fracture rim, the dynamic compression continues to act along the axis of the femur, thus

allowing a consequent physiological consolidation and reduction of the risk of failure [1-12].

## Use of the system

### DIF plates can be used in two different ways

1. Static, with the possibility of secondary dynamization.
2. Dynamic, carrying out immediate dynamization.

To dynamize the system, unscrew the screw located on the end of the support.

### Benefits and advantages

- The use of O'Nil conical head self-locking screws avoids the loss of primary and secondary reduction even in osteoporotic bones.
- Maintains bone vascularization.
- Early functional mobilization thanks to the correct transfer of forces onto the stumps.
- Reduction of healing times (Figure 2-7).



Figures 2,3,4: DIF Plate.

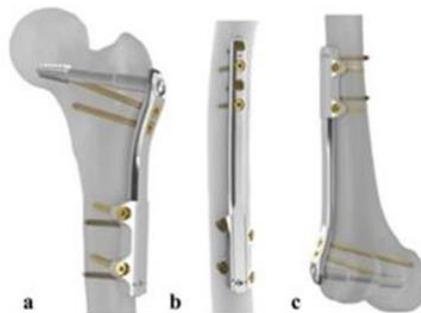


Figure 5: DIF plate for proximal femur (a), Diaphyseal Femur (B), And Distal Femur (C).

## WDP Project

The main objective of the WDP project is the one-stage treatment of complex fractures of the long bones of the lower limb, in both polytrauma subjects and those with single limb trauma. In fact, this system allows the internal fixator to be implanted initially in static mode and a second open or mini-open surgery, but to then perform

its dynamization without further surgical interventions since the possibility of dynamizing the implant is provided by a wireless system, with considerable savings for the patient in terms of hospitalization, anesthesia, surgery with associated possible complications, absences from work for post-hospital recovery times. The national healthcare system would also benefit since there would be significant economic repercussions if this method

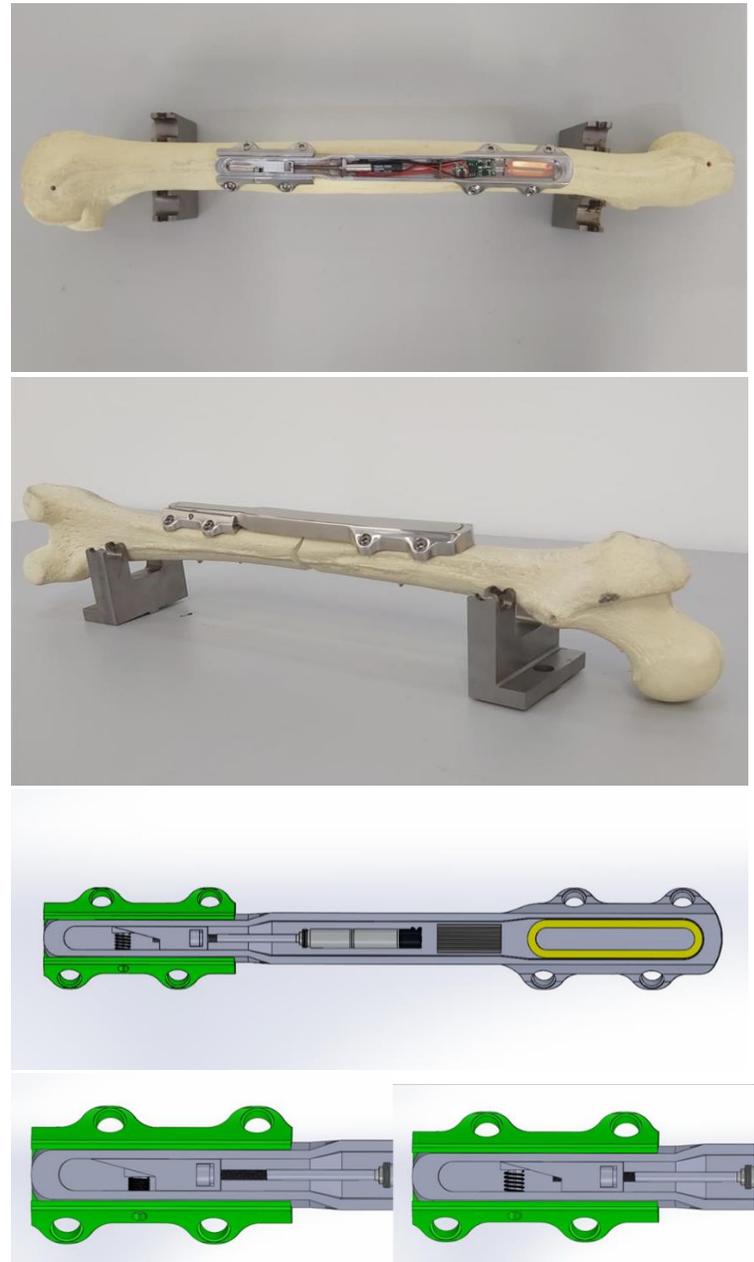
were also applied in other areas. Furthermore, the possibility of lengthening makes it indicated both in growing patients and in the correction of hypometries as an alternative to intramedullary systems or external fixation. It can also be hypothesized that the system communicates to the external station information such as local temperature, instantaneous mechanical deformations (von Mises) [13-18], pH variations and other data useful for studying the evolution of the bone callus and the resistance of the mechanical construct. The WDP project, after market analysis and state of the art, was divided into two parallel design strands. The first of a structural-mechanical nature, the second of an electromagnetic nature in order to develop wireless actuation. From a structural point of view, a dovetail guide has been designed which allows the main body to move by a predetermined maximum length, the initial block to axial sliding is given by a cylindrical pin, pushed by a calibrated spring. From an electromagnetic point of view, the actuation system consists of a direct current micromotor, integrated with a reduction mechanism which guarantees sufficient torque to move the inclined plane. The wireless power supply of the motor is obtained through the inductive coupling between two specially designed coils, which are placed inside a transmission and reception circuit.

### Creation of Implantable Components

In trauma provided for the creation of the components. It is possible to obtain the CE mark and place on the market according to the directives of current legislation in Europe. Implantable metal implants in AISI 316 LVM steel and titanium alloyed with aluminum and vanadium, using CNC machinery, which are certified and guarantee compliance with general safety requirements and performance, with a view to possible obtaining the CE mark and placing on the market according to the directives of the legislation in force in Europe [19-22] (Figures 8-12).



**Figure 7:** Clinical Case. A. Preoperative X-Rays. B. 3d Ct scan. C. Postoperative X-Rays. D. Fracture Healed.



**Figures 8 -12:** WDP Project.

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