

Original article

# Proximal interphalangeal joint fractures treated with a dynamic external fixator: A multicenter and retrospective study of 88 cases

*Traitement des fractures de l'articulation interphalangienne proximale par fixateur externe dynamique. Une étude multicentrique et rétrospective, à propos de 88 cas*

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## Abstract

Ligamentotaxis is now a well-established treatment method for proximal interphalangeal (PIP) joint fractures. Despite satisfactory results, the technique is considered complex and the devices cumbersome. The aim of this study was to evaluate a miniaturized dynamic external fixator (Ligamentotaxor<sup>®</sup>) for the management of these fractures. Eighty-six patients with 88 fractures of the PIP joint were treated at 10 European hand surgery centers. The device was applied within eight days of the injury and was removed 40–45 days after the injury. Treatment complications included superficial infection (4 cases), osteoarthritis (1 case), and localized but resolving complex regional pain syndrome (4 cases). The fracture healed in all cases. At final follow-up (mean: 15.2 months), average range of motion was 70° (range: 0–110°). Functional results were comparable between the 10 participating centers. Pain occurred upon exertion in 47% of the patients, 40% were sensitive to weather changes and 26% experienced constant pain. The mean QuickDASH score was 15.7 (range: 11–37) and 83.7% of the patients had no limitations during their daily activities. The results of this series are similar to those reported in other studies of PIP fracture treatment with external fixators. This technique is reliable and reproducible. The device is easy to handle by surgeons and well tolerated by patients. We think that this simple, reliable technique could be relevant for the management of PIP joint fractures.

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*Keywords:* Proximal interphalangeal joint; Fracture; External fixator; Dynamic

## Résumé

Le principe du ligamentotaxis est maintenant un traitement courant des fractures de l'articulation interphalangienne proximale (IPP). Malgré des résultats satisfaisants, cette technique est considérée complexe et le matériel parfois jugé encombrant. Le but de cette étude était d'évaluer l'utilisation d'un fixateur externe dynamique miniaturisé (Ligamentotaxor<sup>®</sup>) dans le traitement de ces fractures. Quarante-huit patients (88 fractures) présentant une fracture de l'IPP ont été opérés dans dix centres européens de chirurgie de la main. Le fixateur externe était mis en place dans les huit jours suivant l'accident et laissé en place 40 à 45 jours. Les complications du traitement étaient à type d'infection superficielle (4 cas), d'ostéoarthrite (1 cas) et de syndrome douloureux complexe localisé et résolutif (4 cas). Toutes les fractures ont consolidé. Lors de l'évaluation finale (moyenne : 15,2 mois), l'arc de rotation moyen de l'articulation était de 70° (0–110°). Les résultats étaient comparables dans tous les centres participants. Une douleur à l'effort était ressentie par 47 % des patients, 40 % étaient sensibles au changement de temps et 26 % ressentaient une douleur permanente. Le score QuickDASH moyen était de 15,7 (11–37) et 83,7 % des patients ne ressentaient aucune gêne dans leurs activités quotidiennes. Les résultats de cette étude sont proches de ceux publiés dans d'autres études. L'appareil est simple à manipuler par les chirurgiens et bien toléré par les patients. Nous pensons que cette technique simple, fiable et reproductible pourrait avoir un intérêt dans le traitement des fractures de l'articulation IPP.

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*Mots clés :* Articulation interphalangienne proximale ; Fracture ; Fixateur externe ; Dynamique

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## 1. Introduction

Digital intra-articular fractures are common and serious injuries. Fractures of the proximal interphalangeal (PIP) joint have been extensively studied because loss of motion at this joint has the most serious impact on a patient's daily life. The severity of these fractures is related to the sequelae induced by these lesions, such as joint stiffness, persistent edema and chronic pain. Severity is also related to the socio-economic impact of these fractures, which often results in extended time away from work and prolonged rehabilitation.

Many functional and surgical treatments have been proposed; as soon as 1922, Hawk [1] described the principle of joint traction to achieve fracture reduction. Based on later studies by Salter and Vidal [2], Schenck introduced a treatment by ligamentotaxis combining joint distraction and early mobilization [3]. The principle behind this procedure is preventing stiffness, edema and tendon adhesions, while promoting joint healing and remodeling. Encouraging results have been published and many devices have been developed to facilitate this procedure [4–13].

The present study reports on 88 PIP joint fractures treated with a dynamic external fixator (Ligamentotaxor<sup>®</sup>). The aims of this multicenter study were to evaluate the results obtained with this device and to determine whether this technique is easy to perform, reliable and reproducible.

## 2. Material and methods

This multicenter, retrospective study involved 86 patients with PIP joint fractures who were treated at 10 European hand emergency centers in four countries. Inclusion criteria were a recent (less than 8 days) digital intra-articular fracture and a minimum of 6 months follow-up. Exclusion criteria were associated neurovascular and/or tendons lesions, or need for internal fixation (screws or plates). The clinical result was evaluated after a minimum follow-up of 6 months.

Fractures were classified according to Pélissier's classification [14] based on the initial radiographs. Briefly, this classification is derived from the AO classification and was adapted for phalangeal fractures. In this classification, joint fractures are labelled as B (lateral and proximal fractures of the middle phalanx), C (pilon fractures) or D (fracture involving proximal and middle phalanges) and are graded from 1 (one fragment) to 3 (comminuted). Since this classification only addresses to the frontal appearance of fractures, we added two categories, namely E (corresponding to dorsal lip fractures) and F (corresponding to palmar lip fractures), which were also graded from 1 to 3 according to the size of the detached fragment (Fig. 1).

The fixation device consisted of a dynamic external fixator (Ligamentotaxor<sup>®</sup>, Arex<sup>™</sup>, Palaiseau, France) with three pins (1.2, 1.2 and 1.8 mm diameters) and two springs. This dynamic external fixator was placed percutaneously during ambulatory surgery under regional anesthesia. Application of the device was previously described by Körting et al. [15] and is summarized in Fig. 2. Briefly, the proximal 1.2-mm pin was

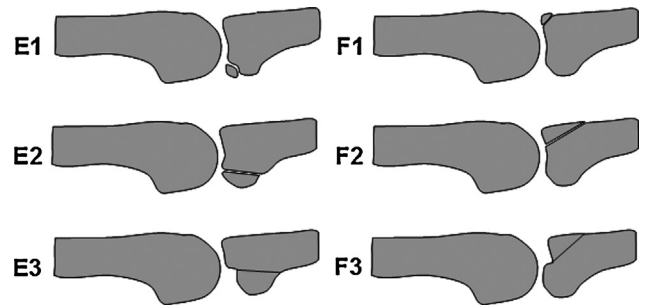


Fig. 1. Additional categories for the Pélissier's classification. Type E corresponds to dorsal lip fractures and type F corresponds to palmar lip fractures.

placed approximately at the center of the condyles of the proximal phalanx (joint rotation axis), perpendicular to the finger axis. The distal 1.2-mm pin was placed parallel to the proximal pin using a drilling guide, and was as far as possible from the proximal pin. Both pins were then bent at a 90° angle to accept the traction springs. The springs were screwed counterclockwise until satisfactory fracture reduction and joint distraction were obtained, and then verified by fluoroscopy. The 1.8-mm pin was occasionally used to counter axial rotation. It was then folded into a U-frame and passed through both traction springs. When the fluoroscopy control of the fracture was unsatisfactory and a fragment remained displaced, reduction could be achieved and maintained by inserting another 1.2-mm pin evenly through the spring. No matter its position, this additional pin did not interfere with the device.

Following recovery from anesthesia, the distraction effect was felt directly by the patient, who was then instructed on how to adjust the spring tension on the device. The patient was then able to assess whether or not the distractor was effective, and could adjust the spring tension as needed. The postoperative

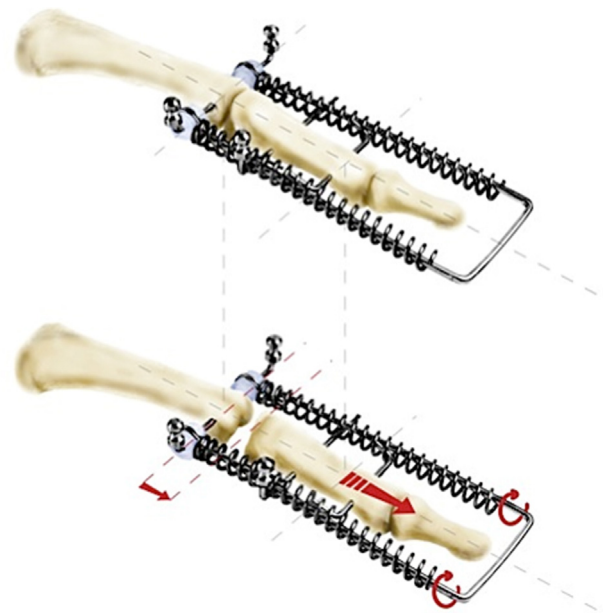


Fig. 2. Application of Ligamentotaxor<sup>®</sup> (above) and adjustment of the spring's tension (below).

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