Extension-block pinning for fracture-dislocation of the proximal interphalangeal joint

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Summary

Introduction: Dorsal fracture-dislocation of the proximal interphalangeal joint is an unstable fracture that associates the anterior marginal fracture of the second phalangeal base and the dorsal dislocation of the proximal interphalangeal joint under the influence of the median band traction of the extensor apparatus. Stiffness and residual pain are frequent sequelae. Treatment involves choosing between the various methods with the objective of providing stable reduction allowing early mobilization.

Hypothesis: We relate our experience concerning treatment by proximal interphalangeal extension-block pinning. It consists in reduction by external manipulation and stabilization by extension-block pinning.

Materials and methods: This technique was used in 22 Trojan-type fractures. The average age of our patients was 36 years, with a predominance of males. In half of the cases, the fracture involved more than 40% of the second phalangeal articular surface.

Results: The mean follow-up in this series was 2 years and 7 months. Assessed based on functional, clinical, and radiological criteria, the results were good in 82% of the cases. The proximal interphalangeal joint was painless and the active mobility sector mean was greater than 85°.

Discussion: The dorsal dislocation fracture of the proximal interphalangeal joint is an unstable lesion. Its treatment must provide stable reduction allowing early mobilization. Various therapeutic means are described. We opted for extension-block pinning, a simple and reproducible technique with encouraging results.

Level of evidence: Level IV retrospective study.

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Introduction

The proximal interphalangeal (PIP) joint is a true epicenter of finger movement, whose position in the digital chain, between two long lever arms, makes it a particularly vulnerable joint.
Dorsal fracture-dislocation of the PIP is an unstable fracture associating dorsal dislocation of the PIP with avulsion of an anterior marginal fragment damaging the base of the phalanx. This is a relatively difficult fracture to treat. Different techniques [1] have been proposed such as orthopaedic treatment, osteosynthesis, and dynamic external fixation, with sequelae ranging from painful finger stiffness to degenerative osteoarthritis over the long term.

The objective of this study was to analyze, through a retrospective study of 22 cases, the results of the extension-block pinning technique for these dorsal fracture-dislocations of the PIP joint and to compare the different techniques described in the literature.

Material and methods

We report a series of 36 cases of dorsal Trojan-type fracture-dislocation of the PIP [2], managed between 2000 and 2009.

Inclusion and exclusion criteria

We included in this study patients who were operated on in an emergency setting by the same posterior extension-block pinning technique and by the same operator. We excluded cases with lateral instability and those with less than 12 months of follow-up.

Epidemiological data of the series

The patients’ mean age was 37 years (range, 16–50 years). Thirty-two of the 36 patients were male. In 31 cases, they were manual laborers. The dominant side was affected in 24 of the 36 cases. The ring finger was affected in 27 out of 36 cases.

Treatments

All of the patients were operated on in an emergency setting, or deferred 2 days, in the operating room under general anesthesia with fluoroscopic guidance.

A closed reduction of the dislocation was performed with an external manipulation. Stabilization was attained with a no. 12 Kirschner wire inserted in the head of the first phalanx, with the PIP flexed and slightly lateralized to prevent injury to the median band of the extensor system. The wire thus provided a posterior block preventing it from dorsal redislocation.

A forearm splint with the hand in the intrinsic position was placed immediately postoperative. The wire as well as the splint was kept for a mean 21 days (range, 19–30 days). Rehabilitation was initiated the day after the intervention and included active-passive motion in flexion of the PIP joint protected by the wire.

Assessment methods

These fractures were classified preoperatively using the Schenck classification [3], which takes into account both the percentage of the fractured joint surface and the degree of dorsal dislocation.

### Table 1 The criteria used for analyzing the results and their scoring.

<table>
<thead>
<tr>
<th>Scoring</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall extension deficit</td>
<td>5°–10°</td>
<td>10°–25°</td>
<td>&gt; 25°</td>
</tr>
<tr>
<td>Total active motion</td>
<td>240°–270°</td>
<td>220°–240°</td>
<td>&lt; 220°</td>
</tr>
<tr>
<td>Total passive motion</td>
<td>240°–270°</td>
<td>220°–240°</td>
<td>&lt; 220°</td>
</tr>
<tr>
<td>Pain</td>
<td>Absent or occasional</td>
<td>On exercise</td>
<td>Constant</td>
</tr>
<tr>
<td>Joint profile</td>
<td>Good</td>
<td>Step ≤ 1 mm</td>
<td>Step &gt; 1 mm</td>
</tr>
</tbody>
</table>

0–4 good / 5–7 fair / 8–10 poor.

Fracture grade:

- type I: less than 10% of the surface;
- type II: between 11 and 20%;
- type III: between 21 and 40%;
- type IV: greater than 40%.

Dorsal dislocation grade:

- grade A: less than 10%;
- grade B: between 11 and 20%;
- grade C: between 21 and 40%;
- grade D: greater than 40%.

According to this classification, we found mostly type III grade B fractures.

All patients were examined at revision by an independent examiner. The analysis of the results was based on the clinical, radiological, and subjective criteria described in Table 1, judging the ability to roll and extend the fingers, pain, and the radiological aspect of the joint space. A score ranging from 0 to 10 was assigned with a distribution of the results as follows: 0–4 good results, 5–7 fair results, and 8–10 poor results.

Results

Our patients were seen with a mean follow-up of 2 years and 7 months (range, 1–4 years). Out of 36 patients operated on with this technique, only 22 responded to the request for a visit.

No early complication was reported (infection, reflex sympathetic dystrophy). No secondary displacement or iatrogenic lesion of the median band of the extensor system was found.

The mean duration patients were off work was 2 months. All patients returned to the same work position or the same level of activity. At the follow-up, according to the criteria adopted, we found 18 good results (Fig. 1) and four fair results (Fig. 2). No poor results were noted in this series.

The PIP joint was painless in 12 cases out of 22. Pain upon physical effort was found in nine cases. The original arc of motion was found in nine cases. The mean arc of motion of the PIP was 85°, satisfactory for digitopalmar grip. The mean overall extension deficit was 11.8°. Complete rolling of the fingers was possible in all cases with a good result. For the four cases judged to have a fair result, the PIP was...
painful but only in a single case was the pain constant. The arc of motion was 65°.

A normal joint space was found in 16 cases; in the six other cases, a step less than 1 mm was noted with a PIP arc of motion that was 70° and pain upon physical effort in four cases. In three patients who complained of pain upon physical effort, we found degenerative changes, without significant repercussions on mobility.

The distribution of the results according to the preoperative lesional stage showed that all the fair results occurred after stage III and IV fractures (Fig. 3), whereas for stage I and II fractures, the joint was perfectly painless, the mean arc of motion of the PIP was 95.7°, and the joint space did not present a step.

Discussion

The objective of extension-block pinning, a simple, effective, and easily reproduced technique, uses its posterior block to reduce the fracture and correct the dislocation, while allowing early motion the 1st day after surgery with the PIP in flexion. It is a first-choice therapeutic method in the treatment of dorsal fracture-dislocation of the PIP of the fingers. We used this technique for 22 PIP fracture-dislocations, and despite sometimes insufficient reduction of the fracture or the appearance of degenerative changes, we were able to obtain a mean 85° arc of motion, a painless PIP, and an absence of functional discomfort.

This technique, published for the first time by Inoue and Tamura [4] in 1991, remains relevant today for its simplicity and its efficacy. It is a leading alternative in the treatment of dorsal fracture-dislocation of the PIP, even stage III. The results of their series of 14 patients were excellent, with a mean arc of motion of 94.4°.

The orthopaedic treatment [5] with a PIP stop splint allowing early active and passive flexion, described by McElfresh et al. [6] and Strong [7], theoretically allows one to meet the same objectives. Nonetheless, it is difficult to guarantee that the splintage will be maintained, which involves patient cooperation. Closely spaced radiographic follow-up is necessary to screen for any eccentricity of P2.

When the palmar fragment is large, certain authors recommend internal fixation using a mini-screw [8—10], pins or cerclage [8,11]. In practice [12], this osteosynthesis is extremely difficult to perform without weakening the bony
fragment and the material placed, despite the increasingly small size, does not always provide sufficiently stable fixation for postoperative movement. In addition to central comminution [13], the size and number of fragments often makes osteosynthesis impossible.

Three broad therapeutic processes have been described [14–17]: the dynamic traction system, extension-block pinning, and the palmar shelf arthroplasty. The dynamic traction system [18,19] described for the first time by Schenck [20,21] in 1986, reduces peripheral fragments by ligamentotaxis, corrects subluxation, and finally allows early movement. The results of the first series of 10 patients, whose mean arc of motion of the P2 base was 62°, were excellent, with mean mobility from 5° to 92°. The “banjo” proposed by Schenck, although it is technically simple, with no intrajoint pins, has the major disadvantage of being cumbersome. In 1994, Suzuki et al. [22] proposed an assembly called the PTRS (pins and rubber traction system). It has considerable bulk and patients are often uncomfortable for postoperative movement, particularly if the middle finger is involved. This assembly is technically more difficult with regard to placing a pin in the P1 head, which should ideally pass through the center of the head. The possibilities of early movement depend on the precision of the pin centering. Suzuki et al. used this assembly for four dorsal PIP fracture-dislocations. The mean mobility at the end of treatment was 80°. The advantage of these dynamic techniques [1] is that they take into account the multissurface aspect of the lesions treated. These fractures first and foremost involve the phalangeal epiphyses, but also the capsuloligamentous apparatus comprising the joint capsule reinforced on its palmar side by the palmar shelf, and laterally by the collateral ligaments whose lesions are complicated by retractions caused by scar tissue that can cause invalidating stiffness.

The Suzuki-type assembly has undergone several modifications. The most recent has been described by Körting et al. [23] the Ligamentotaxor®. This new dynamic external fixator is much more complex to put in place, but it provides better postoperative elastic movement and is less bulky. However, Körting et al. found a high incidence of secondary displacement and clinodactyly. Technical improvements remain necessary to limit this type of complication.

Advancement of the volar plate is a technique proposed by Eaton and Malerich [24] for the anterior marginal

Figure 2  a: Trojan-type fracture with dislocation of the PIP; b: extension-block pinning at day 1 after injury; c: radiological result at 1 year; d: complete rolling of fingers with 10° extension deficit.

Figure 3  Distribution of the results by lesional stage.
fracture that is unstable because of the large size of the palmar bone defect. However, for sizable bone loss, progressive impaction of the P1 head is possible, leading to partial recurrence of the subluxation [25]. This technique can of course be used in emergency situations, but it is most particularly a secondary arthroplasty technique.

We find that it is logical to use a simple method that allows active postoperative flexion movement while maintaining an extension block. The stop PIP splint described by McElfresh [6] responds to these criteria but does not guarantee that the assembly is maintained at an optimum extension block angle. The results in our series show that the posterior block with extension-block pinning is a more reliable assembly for maintaining reduction during rehabilitation that should be started on postoperative day 1. In addition, we used this procedure successfully for fractures involving more than 50% of the joint surface and it was possible to obtain anatomical reduction of the fracture.

Conclusion

Dorsal fracture-dislocation of the PIP is an unstable lesion and can compromise digitopalmar grip. Stabilization should not be obtained at the expense of painful stiffness.

Extension-block pinning, a simple and reproducible technique, provides stabilization and early movement of the PIP joint, giving highly satisfactory functional results.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References