Operative Treatment of Intra-Articular Fractures of the Dorsal Aspect of the Distal Phalanx of Digits*


From Orthopaedic Hospital and the Hand Surgery Service, Department of Orthopaedic Surgery, University of Southern California School of Medicine, Los Angeles

ABSTRACT: Thirty-six digits with an intra-articular fracture of the dorsal aspect of the distal phalanx that involved one-third or more of the articular surface were treated by open reduction and internal fixation with Kirschner wires. After an average length of follow-up of forty-six months, roentgenograms of the distal joint in twenty-six digits appeared essentially normal. Ten digits had minor roentgenographic changes but, with the exception of one digit, the joint space was congruous and free of significant abnormalities. The average loss of extension of the distal joint was 2 degrees, and the average arc of flexion of the distal joint was 69 degrees. The average strength of pinch in all digits that were operated on was essentially equal to the strength of pinch in the contralateral digit. Exact reduction and internal fixation using the technique described resulted in excellent motion and function.

The mallet deformity can be the ultimate result not only of an injury to the extensor tendon of the digit, but also of an intra-articular fracture of the dorsal lip of the distal phalanx. When the fracture involves a third or more of the articular surface, it is usually impossible to obtain an exact reduction of the fracture by closed manipulation and external splinting, and the fracture tends to heal in a displaced position with incongruity of the joint. This may result in some cosmetic deformity and degenerative arthritis, which frequently leads to pain and limited motion. Various suggested methods of treatment include open reduction and use of a pullout wire to stabilize the fracture, use of a wire loop with internal fixation, external skeletal fixation, and transarticular fixation of the distal joint. Such injuries can be treated by open reduction, exact realignment of the articular surface under direct vision, and internal fixation and immobilization of the fracture until it is healed; in this paper we report our results in thirty-six digits that were treated this way.

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† 2300 South Hope Street, Suite 400, Los Angeles, California 90007.
‡ Division of Orthopaedic Surgery, University of Missouri Hospital and Clinics, One Hospital Drive, Columbia, Missouri 65212.

Materials and Methods

From 1975 to 1985, forty-six digits with a displaced intra-articular fracture that involved one-third or more of the articular surface were treated by immediate open reduction and internal fixation. Thirty-three patients (thirty-six digits) were available for follow-up examination. The average length of follow-up was forty-six months, with a range of thirteen to 109 months. Almost one-half were examined at least three years after operation. Thirty were followed for longer than twenty-four months and thirteen, for more than forty-five months.

Operative Technique

The goal is to restore the anatomical configuration of the articular surface. Residual displacement of the distal fragment of more than one millimeter in any plane is unacceptable (Figs. 1-A through 1-F). The fracture is exposed through a curved dorsal incision. One collateral ligament is divided; if this is not done, the fracture and surface of the joint cannot be visualized. Neither the nail matrix nor the extensor tendon is disturbed. If the joint is subluxated or dislocated, a Kirschner wire is passed proximally through the fingertip, volar to the fracture, to the articular surface of the distal phalanx. The joint is then reduced under visualization using a loupe and is transfixed in zero-degree extension by drilling the wire into the middle phalanx. If the joint is not subluxated or dislocated, the transarticular pin may not be essential; even so, it is much easier to reduce the fracture after the distal joint is stabilized. The distal joint was immobilized with a transarticular longitudinal Kirschner wire before reduction and fixation of the fracture in twenty-four of the thirty-six digits. The fracture fragment with the attached extensor tendon is repositioned anatomically and immobilized with one or two 0.028-millimeter Kirschner wires. Roentgenograms are made in the operating room; if the reduction is not anatomical, it is better to remove the small displaced fragment and reattach the extensor tendon to the distal phalanx than to pin the fracture while it is displaced. All wires are cut off beneath the skin, and the collateral ligament is repaired before closure of the skin.

Postoperatively, the digit is splinted for four weeks with the proximal interphalangeal joint in 30 degrees of
flexion. The transarticular pin is removed at one month postoperatively, and then the distal joint is splinted in extension for four more weeks. Most of the fractures in our series were united by two months after operation. Splinting was discontinued when roentgenograms showed that the fracture was healed, and motion of the joint was regained during the following few weeks. Physiotherapy was considered unnecessary. The Kirschner wires were removed under local anesthesia at a convenient time, after bone-healing was demonstrated roentgenographically.

Results

Two thumbs, three index fingers, sixteen long fingers, ten ring fingers, and five little fingers had a fracture. Two digits were involved in one patient and three, in another. The patients' average age was thirty years (range, eleven to sixty-one years). About three-fifths of the injuries occurred in the dominant hand. A ball striking the digit was the reported mechanism of injury in almost two-thirds of the patients. All of the injuries were closed.

According to the patient's subjective rating, the functional result was excellent in about 70 per cent (twenty-five), good in 25 per cent (nine), and fair in about 5 per cent (two) of the digits. No patient complained of pain. For fracture of the dorsal aspect was unable to touch the fingertip to the distal palmar crease by thirteen millimeters. Very few had normal motion of the finger; that is, most had lost a few degrees of motion of the distal joint, but none lost motion of the proximal interphalangeal joint, and no patient complained of pain.

The average strength of pinch (finger to thumb) of the injured digit was seven kilograms compared with seven and one-half kilograms for the unaffected contralateral digits. Seventeen of the thirty-six digits had a mild decrease in strength of pinch, but this was moderate and of importance in only one patient who had the final examination four weeks after treatment of a subsequent complex open fracture in the ipsilateral wrist.

The little finger tended to lose more strength of pinch than did any of the other digits, and results were somewhat less favorable in the little finger than in the other digits. There were no infections, and all fractures united. Eight had minimum residual ridging of the nail and three had slight sensibility of the surgical scar. In one patient the scar was in the long finger on the dominant hand and the sensibility was of some significance because it interfered with writing.

Discussion

The method of open reduction and internal fixation that we describe requires the development of technical skill, and magnification using a loupe is essential. The anatomical reduction of the fracture to within a millimeter must be achieved. In eleven digits with a displaced fracture, Hamas et al. divided the extensor tendon to expose the fracture. However, we believe it is better to expose the fracture by dividing one collateral ligament, because the blood supply to a displaced fragment has been impaired, and dividing the extensor tendon may jeopardize further the viability of the small fragment. After dividing one collateral ligament, the surgeon has a clear view of the fracture and of the entire surface of the joint. This makes it much easier to reduce the fracture, to transfix the joint, and to drill the Kirschner wire or wires across the fracture gap. Niechajev reported that often he had to repeat the insertion of pullout wires because intraoperative radiographs showed an unsatisfactory reduction. Multiple passages of Kirschner wires are undesirable because they cause comminution and crumbling of the bone at the site of fracture. Repeated drilling can be avoided if there is good exposure, so that an exact reduction can be accomplished before the pinning.

Our results are in marked contrast to those of Wehbe and Schneider who compared the results in fifteen patients who were treated by splinting with those in six who were treated by operative fixation with a pullout wire. Because three of the six patients who were treated surgically had pain, they considered open reduction to be contraindicated. They also observed degenerative changes in one-half of the patients, and an average extensor lag of 15 degrees. In those who underwent an operation, the mean arc of motion was 58 degrees. Since the average extensor lag in our patients was only 2 degrees and the average arc of motion was 69

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**TABLE I**

<table>
<thead>
<tr>
<th>Finger</th>
<th>Total</th>
<th>Average Extensor Lag (Degrees)</th>
<th>Average Arc of Motion (Degrees)</th>
<th>Flexion That Was Achieved (Per cent)</th>
<th>Pinch Strength That Was Achieved (Per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>3</td>
<td>-2</td>
<td>83</td>
<td>98</td>
<td>82</td>
</tr>
<tr>
<td>Long</td>
<td>16</td>
<td>-2</td>
<td>72</td>
<td>86</td>
<td>89</td>
</tr>
<tr>
<td>Ring</td>
<td>10</td>
<td>-4</td>
<td>60</td>
<td>78</td>
<td>100</td>
</tr>
<tr>
<td>Little</td>
<td>5</td>
<td>-1</td>
<td>68</td>
<td>79</td>
<td>75</td>
</tr>
</tbody>
</table>

* Excluding data on two thumbs.

The findings at the follow-up roentgenographic examination showed an essentially normal appearance of the distal joint in about 70 per cent (twenty-six) of the digits. Minor roentgenographic abnormalities were present in the others, but a congruous and satisfactory joint space was present in all but one patient. This one patient first came for treatment two months after the time of fracture, and considerable callus had to be removed before the fracture could be reduced accurately.

The average loss of voluntary extension of the distal joint was 2 degrees, and the average arc of voluntary flexion was 71 degrees (Table I). All but two fingers could be flexed voluntarily to touch the distal palmar crease. One patient who underwent an operation three weeks after the time of fracture was unable to touch the fingertip to the distal palmar crease by nine millimeters. Another who had a comminuted...
Fig. 1-A: A displaced and rotated intra-articular fracture involves more than one-third of the articular surface. The distal phalanx is also subluxated volarily.

Fig. 1-B: The displacement of the fracture could not be corrected by splinting.

Fig. 1-C: Under direct vision, the joint was reduced and stabilized with a transarticular pin. The fragment was then repositioned and immobilized with two 0.028-millimeter Kirschner wires.

Fig. 1-D: Nine years later, the joint appeared normal on roentgenographic examination.
degrees, our results were better in this regard than those of Wehbé and Schneider. We believe that the stability provided by fixation of the fragment with Kirschner wires is more reliable than the stability provided by the technique using a pullout wire.

Other technical differences, such as the adequacy of exposure and the exactness of reduction that Wehbé and Schneider were able to achieve, were not clarified in their report. These issues might also explain some of the disparity between their results in six fractures as compared with ours in thirty-six fractures. On the other hand, Hamas et al. reported results that were similar to ours in eleven fractures that were treated by wide exposure of the joint and fixation of the fragment with Kirschner wires.

**Conclusions**

An intra-articular fracture of the dorsal aspect of the distal phalanx of a digit that involves one-third or more of the surface of the joint can be treated successfully by open reduction and internal fixation with Kirschner wires. By using the technique described, a congruous surface of the joint can be restored, and when this is accomplished the joint will be painless and will have less of a predilection to significant degenerative arthritis.

**References**