The purpose of this prospective study was to evaluate the results of primary treatment of flexor tendon laceration in zone II according to Verdan’s zone system. Special emphasis was given to the postoperative rehabilitation program. Nineteen patients (23 fingers) with laceration of the flexor tendons in zone II were treated operatively. Twelve males and seven females were included in the study. Their mean age was 28 years (range, 16 to 50 years). In 12 cases a concomitant laceration of the digital nerve was present. In all cases primary repair of all injured tendons and nerves was performed and a dorsal splint was applied. On the third to fifth postoperative day an exercise program commenced involving passive flexion-active extension of the injured fingers. Eighteen (22 fingers) of 19 patients completed the follow-up. The results were evaluated according to Strickland’s original classification system. The result was excellent in 15 cases, good in five and fair in two.

After primary repair of injured flexor tendons, a program of close follow-up, early protected motion and unrestricted motion of the interphalangeal joints offers the best chance of restoring optimal function to the hand.

INTRODUCTION

During the past 25 years, reestablishing satisfactory function after primary repair of lacerated flexor tendons in Verdan’s zone II has been an insoluble problem. Flexor lacerations in the finger were found to show poor performance after primary repair and the digital sheath was referred to as ‘no man’s land’ (17). Much investigation has been conducted in recent years into the appreciation of tendon structure, nutrition, function, biomechanical properties, and the biological response to injury and repair (5). As a result improved methods of tendon repair, flexor sheath restoration, and early motion stress have been applied (10).

The purpose of this prospective study was to estimate the functional results of primary repair of flexor tendons in zone II. Special emphasis has been given to the postoperative rehabilitation program.

MATERIAL AND METHODS

From January 1997 to June 2000, 19 consecutive patients (23 fingers) with traumatic flexor tendon laceration...
ration in zone II were treated operatively in our depart-
ment (table I). There were 12 males and seven females.
The mean age of the study group was 28 years (range, 16
to 50 years). The sources of injury included knife cuts
(seven cases) and broken glass cuts (16 cases). In
12 cases a concomitant laceration of a digital nerve was
present (table I).

The flexor digitorum superficialis, the flexor digito-
rum profundus, and the associated digital nerve lacera-
tion were primarily repaired in all cases. All patients
received general anesthesia or an axillary block. A non-
sterile tourniquet was applied above the elbow, and a
second-generation cephalosporin was administered
before inflation. Operating loupes (x 4 magnification)
were used for all tendon repairs. A palmar Brunner’s
zig-zag incision based on the original skin laceration
was made. Pulleys were preserved where possible.
Tendon suturing was performed through an appropriate-
ly designed L-shaped tendon sheath window created in
its membranous portions (12). The sheath window was
left unrepaired to avoid tendon constriction. Both pro-
fundus and superficialis flexor tendons were repaired in
all cases using a 2-strand core stitch (modified Kessler)
repair core suture of 4-0 nylon to reapproximate the ten-
don ends, while a 6-0 circumferential whip stitch of
monofilament nylon was used to smooth out any jagged
tendon ends. Associated digital nerve repair was per-
formed finally by end-to-end coaptation, using 9-0 nylon
suture, after tendon repair. Before wound closure, the
tourniquet was deflated, and haemostasis was achieved
with bipolar cautery. The skin was closed with 4-0 nylon
vertical mattress sutures. A bulky compressive dressing
and a dorsal splint extending from the tip of the fingers
to the elbow, allowing full, unrestricted extension of the
proximal interphalangeal (PIP) and distal interphalange-
al (DIP) joints was applied, with the wrist in 30° of pal-
mar flexion, and the metacarpophalangeal (MCP) joints
in 70°-90° of flexion (fig 1).

Postoperative rehabilitation was taught to the
patients, which they carried out alone. Passive
flexion–active unrestricted extension of the operated fin-
ger was initiated on the third to fifth postoperative day.
The DIP joint was flexed first, followed by the PIP joint,
and lastly the MCP joint (fig 2). Special emphasis was
given to full interphalangeal joint extension using a dor-
sal elevation between the splint and the PIP joint cre-
ating sufficient room for full finger extension (fig 1).
This exercise program was performed for 60-90 minutes
daily. Digital nerve repair did not affect the time or type
of postoperative rehabilitation.

The importance of passive flexion and full active
extension was explained to the patients. At four and
seven days after initiating rehabilitation, instruction
application was checked. Six weeks postoperatively the
splint was removed, and active flexion and extension
exercises were permitted to each finger-joint separately,
with simultaneous blocking of other hand joints (1). The
patient was told to use the operated hand for exercise
and general functions. Where stiffness of the proximal
IP joint was present, a dynamic extension splint was
applied between exercise periods and during the night.

Table I. — Distribution of flexor tendon and digital nerve laceration per digit

<table>
<thead>
<tr>
<th>Fingers</th>
<th>Index</th>
<th>Median</th>
<th>Ring</th>
<th>Small</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Tendons</td>
<td>Nerve</td>
<td>Tendons</td>
<td>Nerve</td>
</tr>
<tr>
<td>of cases</td>
<td>7</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>Tendons</td>
<td>23</td>
<td>Nerves</td>
<td>12</td>
</tr>
</tbody>
</table>

Fig. 1. — Dorsal elevation between the splint and the PIP joint permits full unrestricted extension.
until full extension was achieved. Eight weeks after suturing limited activity was permitted. Full, unlimited activity depended on the patient’s job, but it was usually permitted at 10 to 12 weeks together with strengthening exercises.

Functional evaluation of all digits was performed taking into account the range of motion in flexion as well as the extension lag in the PIP and DIP joint. Results were classified according to Strickland’s original grading system (16, 18) (table II).

### RESULTS

The follow-up period was 20 weeks (range, 12 to 35 weeks). Range of motion of the injured finger was evaluated in all cases at 12 weeks postoperatively (table III). Fifteen of the 22 cases with zone II flexor tendon laceration were classified as excellent, five cases as good, and two as fair (one had become infected). Sixteen out of 19 patients (20 fingers) classified as excellent or good were absolutely satisfied with the final result. All patients returned to their employment between the tenth and twelfth week postoperatively depending on their job.

Complications were observed in two of the 19 patients. There was one rupture of a tendon repair two weeks postoperatively, which was reoperated; however the patient did not appear for follow-up and was excluded from the study. In one case the result was fair because wound infection resulted in interphalangeal flexion decrease as well as extension lag of both DIP and PIP joints. The two patients with a fair result denied any further operation to improve their range of motion, and they considered the result as adequate for their everyday demands.

### DISCUSSION

The issue of recovery of satisfactory digital motion after flexor tendon repair has long challenged hand surgeons. Flexor tendon lacerations in zone II particularly require a full understanding of the local anatomy and atraumatic repair. Adhesion formation of the surrounding tissues during the healing process of the flexor tendons would lead to

<table>
<thead>
<tr>
<th>Rating</th>
<th>PIP+DIP return</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>85-100</td>
<td>(150° +)</td>
</tr>
<tr>
<td>Good</td>
<td>70-84</td>
<td>(125°-149°)</td>
</tr>
<tr>
<td>Fair</td>
<td>50-69</td>
<td>(90°-124°)</td>
</tr>
<tr>
<td>Poor</td>
<td>&lt; 50</td>
<td>(&lt; 90°)</td>
</tr>
</tbody>
</table>

\[
\text{Rating} = \frac{(\text{PIP} + \text{DIP}) \text{ flexion} - (\text{PIP} + \text{DIP}) \text{ extension deficit} \times 100}{175} \%
\]
In the current study, with the use of classic methods of tendon repair and rehabilitation satisfactory results were achieved. This study confirms the results of previous studies (7, 14). The dorsal splint application at the beginning of rehabilitation, which permits full unrestricted extension in the PIP and DIP joint, is of great importance, because it lessens the possibility of extension stiffness. A modified Duran and Hauser protocol (11) was used, because passive flexion using the uninjured hand encourages the patient to be more cooperative and permits improved movement of the DIP joint and better gliding of the flexor digitorum profundus, which is extremely important in rehabilitation (20). However the patient was not permitted active flexion of the finger.

Ideal operating conditions (satisfactory general anesthesia, tourniquet, and operative loupe magnification), and atraumatic operative technique are also of great importance in the successful rehabilitation of a flexor tendon laceration in zone II. The restoration of function to a digit following flexor tendon interruption and repair is long and arduous. A strong relationship must develop between the surgeon, the patient, and the therapist. The surgeon needs to spend considerable time explaining the inherent problems to the patient, the likelihood of achieving success, the importance of the rehabilitation protocol to avoid adhesion formation, the diminished danger of tendon suturing rupture, and tendon strengthening.

REFERENCES


