Secondary repair of ulnar nerve injury

44 cases followed for 2 years

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A series of 44 patients with complete section of the ulnar nerve was reviewed on average 2 years after secondary repair. The procedures applied were fascicular grafting in 33 cases, epineural suture in 7, and fascicular suture in 4. Useful ulnar motor function was restored in 22 cases of fascicular grafting, in all 4 of fascicular suture and in 3 of epineural suture. Sensibility recovered in 23 patients operated on by fascicular grafts and in 10 of 11 treated by epineural or fascicular suture. Cases with unsatisfactory results had other associated severe lesions, i.e., median nerve section, vascular damage or tendon injuries. Early repair of clean-cut nerve sections by fascicular or epineural suture gives a good chance for recovery. Grafting should be performed within 3 months and no later than 1 year after the injury.

The ulnar nerve is the most frequent nerve trunk damaged (Seddon 1975). In ulnar nerve lesions, functional recovery of the intrinsic muscles of the hand is more important than sensory restoration (Sunderland 1978). Appropriate matching of nerve fascicles at surgery, particularly fascicular motor group arrangement, is crucial for obtaining satisfactory function (Millesi 1980, 1981, Chow et al. 1986).

We report our experience of secondary repair of 44 ulnar nerve injuries with complete trunk section.

Table 1. Surgical technique and level of injury. Patients not followed are given in parentheses

		Surgical technique		
Injury level	n	FG	ES	FS
Upper arm	2	2	–	–
Elbow-proximal forearm	24	21 (4)	1 (1)	2
Distal forearm-wrist	17	12 (2)	4	1
Hand	8	4	3	1
Total	51	39 (6)	8 (1)	4

FG fascicular graft, ES epineural suture, FS fascicular suture.

Patients and methods

A total of 150 ulnar nerve lesions were treated at our department between 1970 and 1985. Out of these, 51 were complete nerve sections with 2 in the upper arm, 24 at the elbow or proximal third of the forearm, 17 at the distal forearm or wrist, and 8 at the hand level (Table 1).

Forty-four patients with a mean age of 29 (6–69) years were reviewed at least 6 months after secondary nerve repair (Table 2). The series consisted of 33 fascicular grafts, 7 epineural sutures, and 4 fascicular sutures; the follow-up time was 2 (0.5–10) years.

Other associated lesions were present in 19 cases. The median nerve was sectioned in 10 cases, the radial nerve in 3, and the flexor tendons of the fingers in 4. There was severe vascular damage in 7 cases and extensive soft tissue laceration in 5.

The initial functional loss and the postoperative sensory and motor recovery were assessed according to the score (Table 3) introduced by the Nerve Com-

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Table 2. Observations in 44 patients with secondary repaired ulnar nerve injury

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	1	50	5	4	1	2	2	1+	0	4	3	7	0
2	2	14	5	1	1	2	4	1+	0	4	4	23	0
3	1	25	5	6	1	3	3	2+	2	5	4	18	0
4	1	51	5	7	1	3	3	1+	0	3	3	12	0
5	1	28	4	9	1	2	8	0	0	1+	2+	17	1
6	1	15	4	1	1	3	3	1+	0	5	4	24	0
7	1	47	4	13	1	1	5	1+	0	1+	2	13	1
8	1	21	4	5	1	3	3	1+	0	2	3+	25	0
9	1	21	4	5	1	4	4	1+	0	2	3+	6	0
10	2	35	4	6	1	3	4	0	0	1+	2	44	0
11	1	24	4	9	1	3	2	2	1	2+	2+	11	3
12	1	21	4	4	1	4	5	1+	0	2	3+	25	0
13	2	9	4	8	1	3	3	1+	0	3	2+	12	1–2
14	1	38	3	9	1	4	5	1	0	1	0	14	1
15	2	6	3	2	1	3	5	1+	0	4	3	15	0
16	1	38	3	5	1	4	4	1	1	3	3	15	0
17	2	48	3	8	1	3	4	1+	0	2+	2	120	1–2
18	2	6	3	1	1	3	3	1+	0	3	4	17	1
19	1	38	3	3	1	3	10	0	0	2	0	10	2
20	1	19	3	10	1	4	4	1+	1	4	4	55	0
21	1	28	3	12	1	3	6	1	0	2+	2	29	1
22	1	30	3	11	1	4	4	2	1	2+	2+	100	3
23	1	48	3	5	1	3	5	1	0	1	1	13	1
24	1	12	3	1	1	3	3	2	0	3	2	19	0
25	1	23	3	3	1	2	5	2	0	2+	3	17	0
26	1	12	3	23	1	3	3	2	1	2	1	14	0
27	2	6	3	3	1	3	2	1+	0	4	4	21	1
28	1	31	3	5	1	4	2	1+	0	4	4	13	2
29	1	62	3	5	1	3	3	2	2	4	3	3	0
30	1	30	3	3 *	1	4	3	1	0	3	3	47	0
31	2	8	1	1	1	4	3	0	0	4	3	34	0
32	1	69	1	4	1	2	3	0	0	1+	1	16	1–2
33	1	48	4	6	1	4	6	2+	2	3	3	16	0
34	1	21	3	1	2	0	0	1	0	1	3	31	1
35	2	16	3	3	2	0	0	1+	0	3	3+	15	0
36	2	51	4	1 *	2	0	0	0	0	4	3+	7	1
37	1	50	4	1 *	2	0	0	0	0	1+	0	16	1–3
38	1	24	5	1	2	0	0	2+	0	5	4	12	0
39	1	36	5	1 *	2	0	0	5	0	5	4	2	0
40	1	20	5	6	2	0	0	5	0	5	3	13	0
41	1	12	3	3	3	0	0	1	1	4	3+	15	1–2
42	1	60	2	9	3	0	0	0	0	3	3+	14	0
43	1	32	4	4	3	0	0	1+	0	3	3	6	2–3
44	1	24	5	5	3	0	0	1+	2	5	4	9	0

A Sex: 1 male, 2 female.
B Age.
C Level of injury: 1 upper arm, 2 elbow, 3 distal forearm, 4 wrist, 5 hand.
D Period between injury and surgery in months (* days).
E 1 fascicular graft, 2 fascicular suture, 3 epineural suture.
F Number of grafts.
G Length of grafts (cm).
H Motor function, preoperatively.
I Sensory function, preoperatively.
J Motor function, at last follow-up.
K Sensory function, at last follow-up.
L Follow-up time, months.
M Associated lesions: 1 neural, 2 vascular, 3 tendinous.

mittee of the British Medical Research Council (Seddon 1954).

The Student's *t*-test was used to analyze differences between parametric variables, and the chi-square test and Fisher's exact test were used for nonparametric variables. *P*-values < 0.05 were considered significant.

Results

Grafting (33 cases)

Fascicular grafting restored motor function to useful levels (2+ or better) in 22 cases. In 10, the intrinsic muscles recovered the ability to contract against resistance (4 or 5). As to sensory function, return of

Table 3. Scoring system for assessment of ulnar nerve function proposed by the Nerve Committee of the British Medical Research Council (Seddon 1954)

Motor function (M)	
0	No contraction
1	Perceptible contraction of the forearm muscles
1+	Forearm muscles contract against gravity, but ulnar intrinsic muscles are paralyzed
2	Same as M1+ but there is also some power in the hypothenar muscles, but little or none in the interossei
2+	Forearm and hand muscles are all active, but first dorsal interosseous does not contract against resistance
3	Forearm, hypothenar, and first dorsal interosseous muscles all contract against resistance
4	All muscles contract against resistance with some independent lateral movement of the fingers
5	Full recovery in all muscles
Sensory function (S)	
0	Absence of sensibility
1	Deep cutaneous pain sensation in the autonomous zone
2	Some degree of superficial pain sensation and tactile sensibility
2+	Tactile sensibility and pain sensation throughout the autonomous zone with persistent overreaction
3	Same as S2+ without overreaction
3+	Good localization of stimuli and some return of two-point discrimination
4	Complete recovery

Table 4. Functional recovery in relation to the length of grafts

		Motor recovery			Sensory recovery		
Length (cm)	n	> 3	2+	< 2	> 3	2+	< 2
< 5	23	15	3	5	14	4	5
5–10	10	2	2	6	4	1	5

Table 5. Motor function score in relation to the presence of associated lesions and surgical timing

	n	< 2+	2+	> 2+
Associated lesions				
No	19	5	1	13
Yes	14	6	4	4
Delay of surgery				
< 3 months	12	2	0	10
> 3 months	21	9	5	7

two-point discrimination (3+ or 4) was reached in 11 patients; 3 in 7 and 2+ in 5. Hence, 23 of 33 patients who underwent fascicular grafting gained restored useful sensory function.

Motor recovery was better when the graft was less than 5 cm ($P < 0.05$; Table 4). However, this did not apply to sensory recovery.

Better results were noted for those without concomitant neural, vascular or tendinous injury ($P < 0.01$; Table 5). Functional recovery was not related to injury level or patient age.

Regarding the time interval between injury and surgery (Table 5), motor recovery was better in those who had undergone repair within 3 months ($P < 0.05$).

Epineural suture (7 cases)

In 6 cases, the sensory function 3 or higher was reached, even though one was operated on 6 months after injury. Useful motor function was obtained in 3 cases. Only 1 had poor functional recovery, although the nerve was repaired the day of injury. Three cases had complete section of the median nerve. Only 1 of these achieved excellent ulnar motor and sensory function.

Fascicular suture (4 cases)

The surgical delay ranged from 3 to 9 months. Anterior transposition of the nerve at the elbow was performed in 2 cases. Although 2 of the cases had associated injuries, all reached good or excellent motor and sensory function. Palliative opponent plasty of the thumb by tendon transfer was necessary in 1 case with a median nerve injury.

Discussion

We found a high rate of functional recovery after repair of completely sectioned ulnar nerves. Our results confirm those reported by Millesi et al. (1976).

Several factors—such as, patient age, level of injury, length of nerve defect, associated lesions, surgical procedure and timing—have been claimed to influence the prognosis of nerve recovery (Seddon 1975, Sunderland 1978, Omer 1983). In our study associated lesions and the time interval between injury and surgery proved to be the most critical factors for restoration of nerve function.

As to length of grafts, our results basically confirm the findings reported by Nicholson and Seddon (1957) concerning median nerve repair. However, in our series, graft length was more critical for motor than sensory recovery; transplants longer than 5 cm yielded poor motor function, but in approximately half of the cases good sensory function.

Associated lesions comprised the most important factors related to poor recovery of ulnar function, despite repair of these concomitant lesions. The reason is unclear, but may be attributed to insufficient blood supply for nerve regeneration and also impaired function of the surrounding soft tissues, not permitting adequate rehabilitation.

In accordance with Birch (1986), we found that the time interval between nerve injury and repair was one of the crucial factors for regaining useful nerve function. Different critical time limits for return of motor and sensory function have been proposed (Zachary 1954, Seddon 1975), mainly dependent on the level of injury. In our experience, almost all the cases operated on within the first 3 months regained satisfactory motor and sensory function. Only one fourth of the patients regained useful motor function when the nerve repair was performed after 6 months, and no motor recovery occurred if repair was attempted after 1 year or later. We believe that an appropriate tendon transfer is more likely to improve motor function than nerve grafting performed after 1 year of the injury.

The age of patients did not influence the outcome after nerve grafting. This accords with our previous results in a series of radial nerve injuries also treated by grafting (Ayala et al. 1983).

As to surgical technique, the high rate of motor recovery in our series, regardless of whether fascicular suture or grafting was performed, indicates that the arrangement of fascicular groups mostly was accurate. This has been claimed to be more important for motor recovery than for sensory recovery, because the ulnar nerve in the distal half of the forearm only contains one motor fascicle but two main sensory fascicles (Chow et al. 1986). We believe that superior sensory recovery can be obtained by identifying and adapting fascicular subgroups.

So far, microsurgical techniques for nerve repair have met with limited enthusiasm among orthopedic surgeons. Nevertheless, the techniques are not very difficult to acquire, entail few complications, and provide a good chance for recovery of nerve function.

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