

Rehabilitation after successful finger replantation

Meric Ugurlar,¹ Fatih Kabakas,² Husrev Purisa,² Ilker Sezer,²
Pinar Celikdelen,² Ismail Bulent Ozcelik²

¹Department of Orthopedics and Traumatology, Sişli Hamidiye Etfal Education and Research Hospital, Istanbul, Turkey

²IST-EL Hand Surgery, Microsurgery and Rehabilitation Group, Istanbul, Turkey

ABSTRACT

OBJECTIVE: The aim of the present study was to assess results of rehabilitation of patients after finger replantation.

METHODS: The study examined 160 fingers amputated and replanted at various levels between 2000 and 2013 at the clinic. Mean patient age was 29.4 years. Mean follow-up time was 23 months. Rehabilitation of fingers began between postoperative fourth and eighth week and continued until the 24th week. Range of motion of affected hand, return to daily activities, aesthetic appearance, and patient satisfaction were assessed according to Tamai criteria.

RESULTS: Functional results according to Tamai criteria were perfect in 36 patients, good in 54 patients, average in 27 patients, and poor in 18 patients.

CONCLUSION: Post-operative rehabilitation of replanted fingers should begin as soon as possible. During the rehabilitation period, physiotherapist, surgeon, and patient must work in close cooperation. Functional results of patients who adjust to the rehabilitation program, home practice, and splint usage are better.

Keywords: Finger; rehabilitation; replantation.

Finger amputations cause emotional and social trauma to patients in addition to physical trauma. Although there are individual differences, the primary goal for most patients is to regain use of their fingers and return to their lives [1]. Finger replantation requires a difficult and complex rehabilitation program, but results are highly satisfactory in the long term.

This study assessed rehabilitation results of 160 fingers replanted at different levels on 135 patients.

MATERIALS AND METHODS

Between 2000 and 2013, 135 patients had a total of 160 fingers that had been amputated at different levels successfully replanted at the clinic. The study

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Correspondence: Dr. Meric UGURLAR. Sisli Hamidiye Etfal Egitim ve Arastirma Hastanesi, Halaskargazi Cad. Etfal Sok., Istanbul, Turkey.

Tel: +90 216 373 50 00 e-mail: mugurlar@yahoo.com

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group consisted of 95 male patients and 40 female patients. Mean age of patients was 29.4 (range: 6-57) years. The injuries occurred in the right hand of 84 patients (62.2%) and the left hand of 51 patients (37.8%). Replantation was performed on 17 thumbs (12.6%), 32 index fingers (23.7%), 42 middle fingers (31.1%), 30 ring fingers (22.2%), and 14 little fingers (10.4%) (Table 1).

More than one finger was replanted in 11 patients (2 fingers amputated at the same level in 5 patients, and 3 fingers amputated at the same level in 6 patients). Replantation levels were grouped according to Tamai classification [1]. A total of 45 reattachments were categorized as being in zone I, 32 in zone II, 37 in zone III, 31 in zone IV, and 15 in zone V (Table 1). Rehabilitation began in the postoperative fourth to eighth week and continued until the 24th week. All patients used splints supporting the wrist in the neutral position, metacarpophalangeal joints in 60-degree flexion, and interphalangeal joints in extension. Internal bone fixators were removed after sixth week and mobilization was initiated according to status of bone fusion. Rehabilitation of all patients began was started in first postoperative week with edema control and by splinting wrist and fingers in functional position. For patients' comfort, and because of the advantage of controlling flexion contractures that might develop in the fingers, generally volar splints were preferred.

To avoid possible complications such as pseudoarthrosis, exercise programs for replanted fingers were not initiated during early postoperative period. However, physical therapy support is necessary in this process to position the hand, control edema, and maintain range of motion (ROM) of unaffected

fingers. Massage was used before exercise to soften scar tissue at surgical area and to control edema in the fingers during rehabilitation process.

Exercise programs arranged as block exercises targeting active, active-assistive, passive, isolated interphalangeal joint motions; strengthening exercises; and light functional activities, such as writing and holding small objects, were initiated after eighth week. Number and level of difficulty of the activities was increased according to patient tolerance in the succeeding weeks. Muscle stimulators were used in order to preserve ROM obtained after exercise and to increase tendon strength.

Rehabilitation program of patients differed after 10th to 12th week according to the level of replantation. Active rehabilitation program of patients was completed at 10 to 12 weeks for replantations of distal interphalangeal joint and fingertips located more distally. Active rehabilitation process was longer for digital replantations located at proximal part of distal interphalangeal joint. Follow-up of patients continued intermittently until postoperative sixth month and secondary surgical interventions were planned according to functional gains. Secondary reconstruction was performed in two patients and tenolysis was performed in one patient who had undergone finger replantation at medium level of proximal phalanx.

Results were evaluated according to Tamai criteria, including assessment of joint ROM, sensation assessment, subjective assessments, aesthetic appearance, and satisfaction of the patient, and were scored on a 100-point scale [1].

In the assessment of joint ROM, total active ROM of the fingers was measured using standard

TABLE 1. Affected fingers and zones

Affected finger	Thumb	Index	Middle finger	Ring finger	Little finger
	17	32	42	30	14
Affected zone	Zone I	Zone II	Zone III	Zone IV	Zone V
	15	32	37	31	15

goniometric measurements defined by American Association of Orthopaedic Surgeons (AAOS) [2]. Measurements of joint ROM correspond to a value of 20 points in the calculation of functional level according to Tamai criteria, and each replanted finger was assessed separately. In thumb replantations, patient success in opposition motion, percentage of total active motion loss in the thumb, and degree of total active joint motion in the other fingers were evaluated.

Twenty different daily life activities were assessed on a 20-point scale.

The last step in the evaluation was the satisfaction of the patient. They were asked about their professional status and if they were obliged to change jobs, in addition to how happy they were with their replanted fingers.

During evaluation of subjective symptoms, complaints such as pain and cold intolerance were evaluated where present. Deformities such as atrophy, scarring, color change, angulation, mallet finger, etc. were assessed with regard to aesthetic appearance. If present, the severity of these problems and how they limited functional use of the finger was considered in the scoring [3].

Postoperative sensation was evaluated using Semmes-Weinstein monofilament (SWM) and two-point discrimination (2-PD) tests. SWM test values used for interpretation were: green filament, size 2.83 (normal); blue filament, size 3.61 (diminished light touch); purple filament, size 4.31 (diminished protective sensation); red filament, size 6.65 (loss of protective sensation)[4]. A 2-PD score of 6 mm or less was excellent, 7-15 mm was good, and 16 mm or greater was defined as poor [5]. Superficial touch-deep pressure perception in fingers was evaluated using monofilament test and the fine tactile discrimination sensation important in daily life activities was evaluated using static and dynamic 2-PD tests.

Sensory rehabilitation was initiated after postoperative sixth week. Treatment modalities such as whirlpool, paraffin, ultrasound, electrotherapy, and various dynamic and static splints were also used in addition to therapeutic exercises. Patients were also

informed regarding keeping the hand elevated, protecting it from cold, and avoiding substances such as nicotine and caffeine that could disturb replanted finger blood circulation [6].

RESULTS

Mean follow-up time of patients was 23 (range: 12-62) months. During treatment, goniometric, dynamometric, sensory, and functional assessments were performed at periodic intervals and treatment programs were designed according to test results. Additionally, it was observed that assessments performed during treatment contributed significantly to increased patient motivation and participation.

SWM test results were green in 52 fingers (32.5%), blue in 59 fingers (36.9%), purple in 38 fingers (23.7%), and red in 11 fingers (6.8%). Mean static 2-PD test of patients was determined to be 6.9 (range: 3-11) mm and mean dynamic 2-PD test result was 4.5 (range: 3-6) mm.

At the end of the follow-up period, there was chronic pain complaint in 3 patients. Although cold intolerance was seen almost in all patients in the postoperative first year, it was observed that in all but 5 patients the cold intolerance complaint regressed in subsequent years.

There was atrophy in 8 patients, and significant atrophy affecting aesthetic appearance was present in 3. Two patients had scar tissue that led to proximal interphalangeal joint contracture. Three patients had mallet finger formation.

During assessment of patient satisfaction, it was observed that the most important factor affecting patient expectations and results was the occupation of the patient. Patients in occupational groups such as laborer and farmer stated that they were very happy with the result, while patients from occupational groups such as jeweler, musician, and others using fine motor skills stated that they were less happy with the result. However, generally the satisfaction level of patients was greater than expected. All patients stated that they were happy with their replanted fingers.

Functional results according to Tamai criteria

[1] were excellent in 36 (26.7%) patients, good in 54 (40%) patients, average in 27 (20%) patients, and poor in 18 (13.3%) patients.

It was observed that sensation, motion, and function results in distal finger replantations were better than those at the level of middle phalanx and proximal phalanx. Although level and type of injury are important factors affecting functional results, patient continuation of rehabilitation and participation in treatment is the most important factor [7].

DISCUSSION

Finger amputation is an emotionally and physically traumatic injury. Typically, regaining use of their fingers and returning to their lives is the patient's greatest concern [8].

There are several alternatives available for treatment of distal amputations. Following procedures such as primary stump repair, local flap, free flap, neurovascular island flap, skin graft, etc., problems like pain, hypersensitivity, numbness, and cold sensitivity can occur, in addition to impaired aesthetic appearance. Most importantly, though the affected area is small in size, disturbance of body wholeness affects patients negatively. While the technique is difficult for surgeons, replantation is the preferred treatment modality for patients with zone I and zone II amputations. Replantation is also targeted in amputations of fingers in zones III, IV, and V; however, insufficient flexion in the replantation and flexion contracture in distal interphalangeal (DIP) joint are frequently encountered problems. To increase functional use of the hand in cases that cannot be controlled with early rehabilitation and splinting, secondary reconstructions like flexor tenolysis, and DIP joint arthrodesis may be recommended. Secondary reconstructions were performed as part of the current study and it was observed that recovery of finger and functional use of the hand increased in both patients. The study also determined that functional levels of replanted fingers were very similar in patients with multiple finger replantation. Long-term results are very satisfactory, even for patients for whom sufficient joint motion cannot be provided after finger replantation and rehabilitation.

Rehabilitation should be initiated as soon as possible after surgery and the patient, physician, and physiotherapist should work in collaboration [9]. It should be noted that exercises performed in early postoperative period without sufficient bone healing can cause undesired results like pseudoarthrosis. However, the difficulty of controlling problems like tendon cohesion and joint contracture in patients initiating a physical therapy program later must also be taken into consideration. It was observed that secondary reconstructions were not required in the long term for patients kept stable and given limited physical therapy treatment beginning from the postoperative first week and initiating further physical therapy after the start of bone healing. Secondary reconstruction was required in only 7 of 135 patients in the present study. The importance of exercises performed, physical therapy modalities used and splints applied during the rehabilitation process should be explained in detail to patients and they should be asked to actively participate in therapy. It was observed that patients who initiated rehabilitation quickly and who had good participation in treatment found relief from the period of depression experienced after the accident and surgery.

In finger replantations, if a deliberate and serious rehabilitation program is not undertaken, it is difficult to achieve the desired functional level despite surgical success. Physical, psychological, and social conditions, such as age and mental status of the patient, should be considered when establishing the rehabilitation program and determining the best follow-up program the patient can maintain given these conditions. As in all rehabilitation programs, the aim in finger rehabilitation is to increase quality of life of the patient in daily life and in work life [10].

Although finger replantations require a difficult and complex rehabilitation program due to anatomical structure, the results can be highly satisfactory in the long term. In the present study it was observed that patients with good treatment compliance, who performed home exercise program regularly, and used splint correctly and with appropriate frequency, had better functional outcomes [11].

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