Mid-palm replantation

Long-term results

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16 patients with complete mid-palm amputations underwent replantation between 1987 and 1991. 14 were successful. Young patients with guillotine type mid-palm amputations who could be treated with end-to-end suturing of the tendons and nerves, presented with the highest degree of function when evaluated both objectively and subjectively. In contrast, less return of function was noted in patients with high energy or avulsion type injuries of the nerves.

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The initial enthusiasm produced by Komatsu and Tamai's first successful thumb replantation in 1968 has now been followed by efforts aimed at maximizing function. In regard to function, replantation of transmetacarpal amputations of the hand is a demanding and time consuming procedure. Restoration of the hand by stable osteosynthesis and the successful repair of the tendons and nerves using microsurgical technique appears crucial (Lendvay 1973). This study examines the functional results obtained following replantation of mid-palm amputations in 16 patients.

Patients and methods

16 mid-palm amputations were treated between 1987 and 1991 by the Microsurgical team of K.A.T. Hospital. 5 additional patients who had been admitted for replantation procedures were rejected on the grounds of age, degree of injury or other associated problems. All amputations were complete and all patients were men. The average age of the patients was 31 (21–60) years. The amount of associated soft tissue trauma was graded at the time of admission as guillotine typed in 9 patients, crush in 5 patients and avulsion in 2. In 9 cases the injury was caused by high-powered saws, in 6 cases by presses and in 1 case by an agricultural machine. The total time of ischemia varied between 5 and 12 hours with an average of 10 hours. Total surgery time ranged from 12 to 22 hours, mean 14 hours.

The most common complication was infection which occurred in varying degrees in 4 cases and which included the one failure. Successful cases underwent a total of 24 secondary operations, the most frequent being tenolysis (9), bone graft procedures (2), nerve graft procedures (7) and tendon transfers (6).

All patients were available for evaluation. Evaluation of function was based on the degree of sensibility on both sides of each finger, range of motion and flexion (Gelberman et al. 1978). The TRM system (total range of motion) developed by the American Society for Surgery of the Hand was used to grade digital motion. Power grasp and lateral pinch were measured in kg using a jamar dynamometer.

Results

Out of the 16 cases, 14 were successfully replanted. All 9 of the guillotine type of amputations were successful (Figure 1), 4 out of 5 crush type amputations survived and 1 of the 2 avulsion type injuries also survived (Table 1). The two failures in this series was one unsuccessful replantation of an avulsion type amputation injury due to the no-reflow phenomenon and crush injury which was lost to infection in the immediate postoperative period. Follow-up of the patients averaged 41 (32–58) months after injury (Table 2).

Intrinsic muscle function was absent or weak in all patients (Gelberman et al. 1978). During the procedure no patient had intrinsic muscle repair. In all patients abduction or adduction of the fingers was impossible. The best return of digital sensibility

Figure 1. Guillotine type of transmetacarpal amputation. Satisfactory flexion and extension 2 years post-operatively.

Table 1. Relation of the survival rate with type of injury

Type of injury	No. patients	No. survival
Guillotine	9	9
Crush	5	4
Avulsion	2	1
Total	16	14

occurred in a 28 year old patient (case 8) whose nerves could be immediately repaired without tension. In 7 cases (including cases no 13 and 14), the common digital nerves could not be approximated in the first operation. Secondary reconstructive nerve grafting procedures with the sural nerve as a graft were performed within 6 months of the initial injury. The least satisfactory return of sensibility was

Table 2. Results after replantation of complete transmetacarpal amputation in 14 patients

	Grasp	Pinch	Intrinsic	Fingers Total Range of Motion				Sensibility
	(kg)	(kg)	Function	Index	Long	Ring	Small	(mm)
1	15	3	absent	35	40	20	20	30
2	16	3	absent	55	60	60	35	30
3	23	5	weak	90	100	120	55	35
4	18	4	weak	100	100	100	95	25
5	17	2	weak	90	80	85	90	20
6	10	4	absent	20	80	85	90	20
7	12	3	absent	35	30	25	30	35
8	21	2	weak	85	80	70	80	20
9	22	3	weak	70	95	95	95	15
10	26	2	weak	85	110	110	80	18
11	17	2	absent	40	50	50	40	25
12	19	2	absent	35	40	35	40	27
13	7	1	absent	50	50	75	80	np
14	9	1	absent	30	40	45	35	np

np not protective

observed in the one case each of crush and avulsion injuries. Out of the 14 patients, 3 returned to their previous occupation, 7 to lighter occupation and 4 retired after injury. None of the patients reported cold intolerance.

Subjective patient evaluation: Patients were out of work for an average of 16.5 months. All, with the exception of patients 13 and 14, were satisfied with results of the operation, even when hand movement and function was relatively poor. However, all patients including those unsatisfied with function, were pleased with the appearance of their hand.

Discussion

Advances in microsurgical techniques has enable surgeons to replant amputated parts with a high rate of success. The decision of whether or not to proceed with an attempt at replantation depends, in part, upon the viability of the amputated part which can determined only under the operating microscope. Diffuse tissue destruction, usually from avulsion type injuries, systemic diseases such as diabetes, or warm ischemia of more than 7 hours contraindicated replantation attempts. In regard to the latter, McNeil and Wilson (1970) demonstrated that muscles under warm ischemia for more than 6 hours do not become viable after revascularization. Thus, we did not attempt to replant any amputated part which had been under ischemia for longer than 12 hours or under warm ischemia for more than 7 hours. In addition, by following the recommendation of Lendvay (1973) and re-establishing arterial circulation first, the period of warm ischemia was reduced.

The aim of replantation following mid-palm amputations is the restoration of hand function and an acceptable appearance of the distal part of the upper extremity. It is clear that the cosmetic appearance achieved following replantation is usually superior to any prosthesis. However, the return of hand intrinsics was poor. Therefore, future functional use was dependent upon restoration of all the extrinsic muscle as a lack of both the intrinsic and superficialis muscles results in a hand which is unable to handle small objects. The best return in sensibility was observed in a young patients in whom the nerves could be approximated without tension and following guillotine type of amputations where all structures could be repaired in the initial procedure.

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