



Plantations of Major Upper Extremities: Long-term Outcomes

Achilleas Thoma*

Division of Plastic Surgery, McMaster University, Hamilton, Ontario

*Corresponding author: Thoma A, Division of Plastic Surgery, McMaster University, Hamilton, Ontario. E-mail: athoma@81mcmaster.ac

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Abstract

Background: The long-term results of significant upper-extremity replants are rarely recorded. Replantation is thought to be appropriate for all levels of amputation in children and all distal amputations in adults. Adult replantation of arm or proximal forearm amputations is debatable.

Objective: To assess the outcomes of significant upper extremity replantation's performed through the wrist, forearm, elbow, or arm, which is classified as those that are trans metacarpal.

Methods: From 2002 to 2012, a review of various types of replantation performed at the authors' institution was conducted. The strength, range of motion, and two-point discrimination of the patients were also evaluated. The Disabilities of the Arm, Shoulder, and Hand (DASH), the Michigan Hand Questionnaire (MHQ), and the Hospital Anxiety and Depression Scale were all completed by the patients (HADS).

Results: Seventeen individuals had substantial replantation surgery on their upper extremities. The bulk of the patients in the study were men. Reoperations were required in 13(76.5%) of the 17 patients. On the MHQ, the average score for afflicted hand function was 16%, compared to 84% for unaffected hand function. On the HADS, patients generally showed at least mild levels of anxiety and depression.

Discussion: The findings indicate that catastrophic upper extremity injuries and replantation have a considerable impact on patients' long-term hand function, as well as anxiety and depressed symptoms.

Keywords: Functional outcomes; Microsurgery; Quality of life; Replantation; Upper extremity

Introduction

Upper extremity replantation, initially performed by Dr. Ronald Malt in Boston in 1962, is now commonly utilised to treat patients who have amputations of the thumb, multiple digits, hand, wrist, and forearm that are sharp, guillotine-type, and little polluted [1,2].

The most common criterion used to assess the success or failure of this operation is the survival of the transplanted extremity. It's been estimated to be between 80% and 94% [3]. This outcome measure, on the other hand, merely indicates if the replanted limb is functional at the follow-up appointment. More helpful outcome metrics are those that examine the surgical functional outcome, such as chen's criteria, the ability to return to work, range of motion in comparison to normal, sensibility, and power [4]. Assessments that cover both patient-reported quality of life and functional outcomes are ideal. These provide a more accurate indication of replantation success or failure.

Even though there is a risk of bias, clinician-measured physiological outcomes provide useful information about patient recovery status. For example, a surgeon may consider a viable replanted limb a success; yet, if the patient is unable to do the majority of his or her Activities of Daily Living (ADL) and requires social help, the treatment may be regarded a failure.

It's surprising that these outcomes have never been assessed using patient-reported outcome measures, given that major upper extremity replantation have been conducted and documented for more than three decades [5,6].

Amputation is a disfiguring procedure [7] that causes the patient significant psychological, social, vocational, and financial distress. As a result, it's critical to keep the patient at the centre of the replantation surgical outcome evaluation. Patients' experiences with disease and disability are increasingly being assessed using patient-reported outcome measures [8]. They represent the patient's perceived advantage or loss following surgery and are useful for preoperative and postoperative patient counselling. They are also used to determine the allocation of health-care resources and as standards for treatment efficacy.

The goal of this study was to use both objective and patient-reported outcome measures to examine the long-term effects of major upper extremity replantation. Amputations of the metacarpal, wrist, forearm, elbow, or arm are considered major upper extremity amputations [9]. The findings of this study, we feel, add to the substantial upper extremity replantation literature and highlight the benefits of using patient-reported outcome measures to assess surgical outcomes.

From 2002 to 2012, a retrospective chart study of all major upper extremity replantation performed at three McMaster University affiliated hospital sites in Hamilton, Ontario (Hamilton General Hospital, St Joseph's Healthcare Hamilton, and McMaster University Medical Centre) was conducted. All patients who had metacarpal, wrist, forearm, elbow, or arm amputations and underwent replantation surgery were included. Patients who had digital replantation were not included in the study.

Patient age, occupation, hand dominance, mode of injury, medical history, concurrent injuries, in-hospital services required, additional surgeries, complications, and the most recent follow-up appointment were all noted.

The research investigator (WN) or medical administrative assistants from each surgeon's office made at least three efforts to reach the included patients *via* phone. The study's goals were communicated to the patients, and they gave their informed consent. The Hamilton Integrated Research Ethics Board in Hamilton, Ontario, gave its

approval to the project. These patients were invited back to the clinic for a follow-up visit.

Objective Measures

The study investigator took grip and strength measurements with a JAMAR dynamometer (Sammons Preston, USA) and a key pinch device during this follow-up session (WN). A two-arm goniometer was used to measure active range of motion. A padgett two-point discriminator was used to measure dynamic two-point discrimination in millimeters. All assessments were done twice (on both the afflicted and non-affected extremities), with the best effort from the two trials being recorded for analysis. The initial author carried out all of these measurements (WN).

Patient-reported outcome measures

The patients filled out a battery of three self-report questionnaires during their follow-up visits: The Disabilities of the Arm, Shoulder, and Hand (DASH) [10,11], the Michigan Hand Questionnaire (MHQ) [12-16], and the Hospital Anxiety and Depression Scale (HADS) [17-20]. Because the DASH and MHQ are the most commonly used patient-reported outcome measures in hand surgery, they were chosen. Meanwhile, a 30-item scale linked to upper extremity function is included in the DASH questionnaire. It is graded on a percentage scale (0 indicates no problems). These scales have been proven to be accurate in assessing impairments, activity limitations, and participation restrictions in everyday activities. The MHQ is made up of 37 hand-specific items that are grouped into five domains: Overall hand function, ADL, pain, work performance, aesthetics, and patient satisfaction with hand function.

Because it provides a psychological viewpoint on patients' well-being, the HADS was chosen. It's thought to be a useful screening tool for detecting concomitant anxiety and depression in people with musculoskeletal problems. The HADS is a self-administered questionnaire that is used to screen for depression and anxiety. The HADS was created to offer therapists with a practical measure for diagnosing and quantifying depression and anxiety that was acceptable, reliable, valid, and easy to use. The HADS scale cannot be used to make clinical diagnosis; however raw scores of 8 to 10 indicate mild instances, 11 to 15 moderate cases, and 16 severe cases.

Patient Characteristics

Between 2002 and 2012, 17 patients at the hospital centres (Hamilton General Hospital, St Joseph's Healthcare Hamilton, and McMaster University Medical Centre) underwent major upper extremity replantation surgery. All patients were replanted under general anesthesia with tourniquet control where possible, following a typical replantation procedure that began with bone stabilization and ended with graft placement. In none of these cases, arterial shunting was used.

The bulk of the patients in the study (16 of 17 (94.1%)) were men. Ten of the 17 patients (50.8%) worked as manual laborers in factories or construction sites, two (11.8 %) were students, one (5.9%) was a truck driver, and the remaining four (23.5%) did not describe their occupation. The patients' mean (SD) age at the time of injury was 45.5(13.0) years (range 14 years to 68 years). Eight patients (47.1%) had their metacarpals amputated, 6(35.3%) had their wrists amputated, and three had their forearms amputated (17.7%). Over a four-year

follow-up period, 13(76.5%) of the 17 patients required reoperations, including five revision amputations (range 1 year to 10 years).

Replantation and Revascularizations

Previous investigations detailing upper extremity replantation and revascularizations found that functional results in using replanted upper extremities were reasonably consistent (between 88% and 94%) as subjectively stated by patients and through no standardized monitoring. However, the assessment and inclusion criteria in these studies varied, and the follow-up period was brief. The majority of studies that looked at the results of upper extremity replants employed objective or surgeon-reported criteria such as Chen's criteria, range of motion, grip strength, and sensitivity. These metrics, however, only provide a limited picture of the patient's functional status. We report on the long-term results of upper extremity replantation in this study, utilizing both objective and patient-reported (*i.e.* DASH, MHQ and HADS) assessments. Furthermore, we chose to concentrate on major replantation rather than digital replantation because the latter is more common and extensively reported. Finally, no long-term significant replantation outcomes have been documented in any Canadian study to date.

Patients continued to have significant reductions in range of motion (reduced by 59.4% for the mean total active range of motion for the best digits in the replanted extremity compared to the no affected extremity) and grip strength even after a four-year follow-up (range 1 year to 10 years) (reduced by 87.4% compared with the no affected extremity). The best digital dynamic two-point discrimination was good, it should be mentioned (mean 7 mm, range 5 mm to 9 mm). The individuals were found to have mild depression and anxiety symptoms, as measured by the HADS. We were unable to collect the baseline status (*i.e.* immediate postoperative) of the included patients due to the nature of the study design.

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