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Hand

The Psychological and Somatic Consequences of Digital Amputation

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Background: Major limb amputation is a devastating potential outcome of trauma, tumor, or disease. Much has been written about the physical, functional, economic, and psychological consequences of major limb loss. In contradistinction, considerably less has been written concerning the consequences of "minor" limb loss, specifically single partial digit amputations. Are minor limb (partial single digit) amputations associated with symptoms of psychological disorder similar to those reported for major limb amputations?

Methods: We conducted a clinical research study through interview and examination of 25 adult patients (average age: 45 years) who had suffered a single partial digit amputation to determine if symptoms of depression, anxiety, anger, or posttraumatic stress disorder newly occurred, and if such symptoms correlated with the surgical outcome. Questionnaires for Quick-DASH, Michigan Hand Score, and Diagnostic and Statistical Manual of Mental Disorders-5 Psychological Profile testing were completed.

Results: All but one of the patients suffered from psychological symptoms for a minimum of 3 months. Symptom resolution time averaged 6 months for seven of the 25 patients. For 18 of the 25 patients, both psychological disturbance and neuroma pain were ongoing. The Psychological Profile scores suggesting pathology were inversely related to the scores on the Quick-Dash and Michigan Hand (somatic) questionnaires indicating wellness ($P < 0.03$).

Conclusions: (1) Even minor partial amputations of single digits can trigger significant psychological disturbance; the study hypothesis is validated. (2) Psychological and somatic outcomes are directly correlative. (3) Mitigating neuroma pain and verbally offering psychological support services early in the postamputation period should improve the clinical outcome of digital amputations. *(Plast Reconstr Surg Glob Open 2022;10:e4387; doi: 10.1097/GOX.0000000000004387; Published online 20 June 2022.)*

INTRODUCTION

Increased attention has recently been focused on the mental health of surgical patients.[1–4] Perhaps in part provoked by the confessions of well-known contemporary athletes concerning mental health difficulties, the significant relationship between psychological and somatic well-being has become more acknowledged and better appreciated. Previous investigations have verified the proportionality of injury severity to psychological trauma.[5,6] More recent studies have focused on the patient's individual psychological profile and response to trauma as a major independent variable with respect to outcome.[7,8] Especially now, when patient-reported outcome measures are weighted equally to objective metrics of clinical result, the psychological status of the patient assumes added significance.[9]

In surgery of the upper limb, amputation is a devastating potential outcome of trauma, tumor, or disease. Much has been written about the physical, functional, and economic consequences of the loss of a limb.[10] Additional attention has recently been focused on the associated psychological ramifications of major limb amputation: depression, anxiety, anger, and particularly, posttraumatic stress disorder (PTSD).[11–15] In contradistinction and despite its frequency of occurrence, far less has been written about the psychological consequences of single digit amputation.[16]

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METHODS

The principal entrance criteria into the study were (1) a single digit partial amputation (bone and soft tissue) without associated trauma to the ipsilateral hand, or prior history of injury to or ailment of the effected digit; and (2) no history of psychiatric care at the time of amputation, a previous history of psychiatric or psychological counseling, or a prior history of a chronic pain syndrome.

Twenty-five consecutive adult patients were enrolled: 20 men, five women. Age range was 30–62 years, average = 45 (SD = 7). Participant enrollment was based upon a random presentation of patients to a university-affiliated private hand surgery practice, meeting the entrance criteria as established. Time interval from amputation to interview ranged from 12 to 60 months, average = 33 (SD = 16). Amputation etiology was 20 posttraumatic, four posttumor resection, and one postinfection. In total, 12 of the digits were from dominant hands; 13 were from nondominant hands. The ethno-racial background of the cohort was a mixture of White, Black, and Hispanic members. Without intent, there were no Asian patients. The patient pool from which participants were drawn consisted of individuals whose amputation was performed by the senior author (17/25); these patients represented a prospective cohort. The remaining participants (8/25) were consulted upon by the senior author after the digital amputation was performed elsewhere. These patients represented a retrospective cohort. No patients were lost to follow-up once enrolled.

Participation in this study was strictly voluntary with written informed consent. None of the invited patients declined to participate, thus creating a consecutive series. Institutional review board approval (2019P000645) was obtained before initiation of the study. The patients were directly interviewed and examined. Validated questionnaires for Quick-DASH (Disabilities of the Arm, Shoulder, and Hand), Michigan Hand Score, and DSM (Diagnostic and Statistical Manual of Mental Disorders)-V Psychological Profile Testing were completed by the subjects in a quiet setting, proctored by one of the authors who was not a member of the surgical team responsible for the digital amputation. The psychological questionnaires specifically addressed symptoms consistent with PTSD, depression, anxiety, and anger. The Quick-DASH and Michigan Hand scores addressed self-assessed hand function and pain. We estimated Spearman rank correlations between functional scores and psychological measures. We utilized the Wilcoxon rank-sum test to compare psychological measures between patients with and without current symptoms.[17] This method of statistical analysis was chosen because the data points were nonparametric—that is, they did not display a normal distribution.

RESULTS

All but one of the patients (24/25) admitted to having symptoms consistent with depression, anxiety, anger, or PTSD for a minimum of 3 months after their finger amputation. Of the seven patients whose somatic and psychological symptoms improved to a level of clinical inconsequence, resolution time ranged from 3 to 12 months, average = 6.0 (SD=3); five of seven were of nontraumatic origin. For the remaining 18 patients, both digital (principally neuroma) pain and psychological disturbance were ongoing; all were posttraumatic in origin.

No patient with residual neuroma pain achieved a psychological test score that was within normal limits. All patients without residual neuroma pain achieved a psychological test score that was within normal limits.

The scores on the Psychological Profile Testing questionnaire indicating ongoing psychological disturbance were inversely related to the scores on the Quick-DASH and Michigan Hand questionnaires indicating a satisfactory outcome; that is, the better the somatic outcome of the digital amputation, the shorter the duration of and less severe the psychological disturbance for all parameters measured ($P < 0.03$) (Table 1).

PTSD was the most prevalent psychological disturbance (17/25), followed by anxiety (16/25), depression (15/25), and anger (5/25). In total, 20 of 25 patients chose (when offered) to be fitted for and to wear ad-libitum, a cosmetic finger for improved appearance, psychological support, and as a pain protective thimble. All of the 18 patients continuing to experience psychological disturbance were receiving psychological support at the time of study, a conversion factor of 100% compared with their preamputation status of no perceptible need of psychological services. Of the seven patients whose psychological disturbance was temporary, five patients (71%) stated that they would have accepted psychological support if the service had been offered during their recovery. Of the 25 study patients, 23 (92%) were receiving or would have welcomed psychological counseling as a consequence of their partial digit amputation.

Takeaways

Question: Are partial digital amputations associated with psychological disorders similar to those reported for major limb amputations?

Findings: The results affirm the association between major and "minor" limb amputation with respect to their psychological effect.

Meaning: The threshold for psychological damage after amputation can be quite low. The duration and severity of psychological damage correlates with ongoing neuroma pain.

DISCUSSION

Potential psychological consequences of major limb amputations have included PTSD, depression, anger, and anxiety.[18] Potential somatic consequences of digital amputation have included a loss of motion, sensation, grip/pinch strength, and function.[19] Although the impact of mental health on recovery from major upper extremity trauma has previously been stated, the surgical hand and trauma literature reflect the conventional perspective that limb loss must be major or the extremity tissue mangled to be negatively impactful.[20,21] Little has been published regarding the psychological consequences of a single digit

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Table 1. Questionnaire Data Outcome

Current Symptoms	No.	Demographics	Quick-DASH Mean	SD	Mich. Hand Mean	SD	DSM-5 Mean	SD	Normal Values	Pre-Post Psychological Counseling
Yes	18	45 y 14 m 4 f 8 dp 6mp 4 pp	52 ± 24		48 ± 22		100 ± 47		Quick-DASH < 11 Michigan Hand > 89	0–18
No	7	50 y 6 m 1 f 3 dp 3mp 1pp	10 ± 5		87 ± 6		22 ± 2		DSM-5 < 38	0–0

amputation, specifically.[22] In the plastic surgery literature, the psychology of aesthetic reconstruction in relation to body dysmorphism has been discussed, but not in the context of digital amputation.[23]

In the preceding study, we collected data based upon interviews, examinations, and validated questionnaires, which included both objective somatic and subjective psychological metrics. The results demonstrate that even "minor" amputations can have major consequences regarding subjective, objective, and psychological outcomes. It is important to note that all of the digital amputations were only partial, consisting of a phalangeal segment. The remaining segments of the finger and the ipsilateral hand were functional. The surprising epiphany was that experiencing even partial finger loss of a single digit, however small, was sufficient to evoke significantly detrimental psychological trauma in individuals without a previous history of psychiatric illness. The residual length of the amputated digit did not correlate with either the incidence or prevalence of psychological disturbance. The common perception that major trauma or limb loss is the minimal provocative requirement, the excitatory threshold for triggering a psychological disturbance, is challenged by these findings. What constitutes major or significant with respect to the loss of a body part or alteration of body image is therefore idiosyncratically defined by the traumatized individual, not by an arbitrary universal standard.

In contrast to Socrates and later Descartes, who believed in mind–body distinction, the body–mind connection can be historically traced back to ancient India and the term *citta*, referring to both heart and mind.[24] In the modern era, psychologist William James and American philosopher William Poteat promulgated the concept of the interdependence and inseparability of mental and physical processes.[25,26] Southwick specifically translated PTSD into neurobiological terms by demonstrating that psychic trauma can chronically alter brain neurochemistry, the presumed basis for psychological disturbance.[27]

In the context of amputation, loss of function, persistent pain, and visible deformity with its effects on body image are directly correlated with a poor clinical outcome, as assessed by the patient.[28] Regarding upper extremity amputation, the additional loss of a means of social interaction and hand-related communication further vitiate the quality of the clinical result.[29–31] Consequently, upper extremity amputees experience psychological disturbances 50%–100% more often than lower extremity amputees.[32,33] Both groups have historically been shown to improve with psychological counseling and the use of a prosthesis.[34–37] We found that a nontraumatic cause of the amputation was a positive prognostic factor in resolving psychological disturbance. This observation, also documented by others, may reflect that advance planning for a loss of limb is an excellent proactive coping mechanism, superior to post hoc amputation strategies.[38] The apparent outcome superiority of the nontraumatic etiology may also reflect that violent amputation injures neural tissue far more extensively than carefully planned surgical amputation. We found that neuroma hypersensitivity, tenderness, and pain were the most significant factors in determining both a poor somatic and psychological outcome. Evidently, the daily reinforcement of unrelenting neuroma-related discomfort and visible body appendage loss (even a small segment of finger) continuously feeds into reliving the amputation experience and inhibits sublimation of the negative impulse.[39] In those seven of 25 patients who recovered, psychological and somatic symptom amelioration by 3 months after amputation as observed in this study is consistent with other published studies on amputation.[40,41]

Small sample size observational studies such as ours are subject to Type II statistical errors, which result in incorrectly accepting the study's null hypothesis of "no difference" between major and minor trauma regarding association with psychological disturbance. Furthermore, the very small cohort of recovered patients (7/25) precludes any meaningful subgroup statistical analysis. When comparing the two groups of patients with and without residual psychological and somatic disturbance, both groups were of similar age, mixed gender, and equivalent levels of digital amputation. The distinguishing features between the groups consisted of the persistence of digital neuroma pain, ongoing psychological complaints, and the etiology of amputation. The striking consistency of these observations as measured by validated questionnaires strongly implies direct correlation but does not definitively prove causation. The wide range of follow-up

time reflects the presence or absence of ongoing symptoms at the time of presentation. The unintentional absence of Asian patient participants circumvented the potential for a cultural confounding variable regarding the loss of a finger.[42]

The data from this study suggest that patients who endure even minor amputations of single digits may have transient or permanent symptoms consistent with depression, anxiety, anger, or PTSD; the study hypothesis is validated. Patients who achieve a satisfactory somatic outcome (absence of neuroma pain) seem to have an excellent prognosis with respect to resolution of the psychological disturbance of digital amputation. Patients who achieve an unsatisfactory somatic outcome (persistent neuroma pain) are at high risk for unresolved, ongoing psychological disturbance. The study results imply that the probability of persistent psychological disturbance after digital amputation seems to be higher in the setting of a traumatic rather than that of a nontraumatic etiology. Clinical relevance of the study includes findings suggesting that maximizing both somatic and psychological outcomes are necessary for a successful result. Improvements in surgical technique regarding the creation of or treatment for painful neuromas, including re-excision, capping, wrapping, translocation, implantation, and both auto- or allo-nerve graft anastomosis, are likely to positively influence the duration and intensity of somatic complaints.[43] Unfortunately, these surgical techniques are not universally successful, with unsatisfactory outcomes in 10%–50% of cases.[44] Even when successful, neuroma pain resolution may require up to twelve months and may only be partial. Therefore, as a supplemental intervention, simultaneous psychological support services should be verbally offered to patients early in the postamputation period, as the majority of the patients would favorably receive and benefit from such assistance. Regrettably, many contemporary university and community hand service practices do not include psychological support as a routine component of postoperative care unless the patient develops a recognized posttraumatic neuropathy such as complex regional pain syndrome, or unless the patient or family member requests such assistance.[45] More often, patients are reticent to ask for help with psychological difficulties, and either do without such support, or seek psychological/psychiatric assistance independent of their hand service physicians. Additionally, surgical training does not always prepare us to recognize our patients' distress in these circumstances. A more proactive, comprehensive approach would clearly be in the patient's best interest.[46] Recent literature has suggested the use of psychological questionnaires in addition to Quick DASH scores in assessing the patients' posttraumatic outcomes.[47] This is certainly an excellent recommendation but does not replace direct surgeon-to-patient verbal dialogue regarding both their physical and mental health during the postamputation rehabilitation period.

Regarding the utility of a digital prosthesis, the misperception that the device is purely a cosmetic enhancement is contradicted by the study's findings, with widespread acceptance of the prosthetic finger by the study's participants, irrespective of age, gender, amputation etiology, or outcome, as a protective covering of the amputation stump, and a restorer of body image. This observation has also been reported in the published literature on amputation.[48]

CONCLUSIONS

The study observations strongly insinuate that psychological trauma from the somatic insult of digital amputation has a low threshold for occurrence; even minor limb loss can behave as a provocative psychological trigger. Once provoked, persistence and severity of psychological distress seem directly correlated with ongoing digital neuroma pain combined with altered body image. Mitigating digital neuroma pain and early involvement of psychological services in the postamputation period would likely assuage psychological distress and improve patient-reported outcome measures as well.

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