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Original Article

Epidemiology of digital amputation and replantation in Taiwan: A population-based study

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Abstract

Background: Publications on digital amputation and replantation have been mostly derived from case series in high-volume hand surgery practices, and epidemiological studies are few. This study used a population-based dataset to illustrate the incidence of digital amputation, patient and hospital characteristics, and their relationships with replantation.
Methods: A claim for reimbursement dataset (2008) was provided as a research database by the Bureau of National Health Insurance, Taiwan. Patients with ICD-9-CM coded as digital amputation (885 and 886) were included. These were cross-referenced with procedure codes for replantation procedures (84.21 and 84.22). We defined the patients who underwent thumb replantation (84.21) and thumb amputation (84.01) during a single hospitalization as replantation failure. Patient and hospital characteristics were studied with statistical analysis.
Results: In total, 2358 patients with digital amputation were admitted (1859 male, 499 female), mean age 39.2 ± 15.5 years. The incidence was 10.2/100,000 person−years. The highest incidence was 14.7/100,000 person−years in the age group 45−54 years. Machinery and powered hand tools caused 68.8% of digital amputations. Thumb amputation [odds ratio (OR): 1.35, $p = 0.01$], private hospital (OR: 1.40, $p = 0.01$), medical center (OR: 2.38, $p < 0.001$), regional hospital (OR: 2.41, $p < 0.001$) and hospitals with an annual volume >20 digital amputations (OR: 4.23, $p < 0.001$) were associated with higher attempt rates for replantation. Elderly patients (age >65 years) had higher risk of thumb replantation failure (OR: 32.30, $p = 0.045$), while hospitals with >20 annual replantations had lower risk (OR: 0.11, $p = 0.02$).
Conclusion: Our study of the National Health Insurance database characterized the epidemiology of digital amputation patients undergoing replantation and the facilities in Taiwan where these procedures are performed. The hospitals treating more digital amputation patients had higher attempt rates and lower thumb failure rates.

Keywords: amputation; digit; epidemiology; finger; replantation

1. Introduction

Hand and digital injuries account for >4.8 million visits/y to emergency departments in the USA.[1] Because digits are particularly vulnerable to injury, it is not surprising that digital amputation is the most common type of amputation injury in the upper extremities; it commonly occurs in the work setting in predominantly unskilled manual laborers.[2] Such injury is associated with disfigurement and disability, bringing functional, psychosocial, and financial consequences.

Replantation is the process of reattaching the digit or limb by repairing the broken bones and cut nerves, arteries, veins, and tendons. Replantation of the amputated part requires specialized equipment and well-trained staff and surgeons. As

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with advances in microsurgical techniques, replantation is now more widely performed.[3]

The publications on digital amputation and replantation have been derived from case series in high-volume hand surgery practices.[4,5] Although these series have provided important demographic and clinical data, the information from these highly selected samples may not reflect the national experience. However, only a few epidemiological studies have been undertaken.[1,6–16]

Because replantation is complicated and costly, requiring prolonged operation time, long recovery periods, and multiple procedures, facilities offering adequate treatment are limited. Previous studies have shown that age, treatment location, and primary payer status are related to the rate of replantation.[6,7]

The purpose of this study was to use a large nationwide database to characterize the epidemiology of digital amputation and replantation in Taiwan, with particular emphasis on the characteristics of the patients and the procedures they received, as well as the types of facilities where those patients received treatments.

2. Methods

2.1. Data source

Taiwan launched a single-payer national health care program, National Health Insurance (NHI), in 1995; this program covered >99% of the 23 million population of Taiwan at the end of 2008. To respond to current and emerging health issues rapidly and effectively, the National Health Research Institute, cooperating with the NHI Bureau, established an NHI research database.

This population-based retrospective study used consecutive secondary data abstracted from the annual inpatient expenses database of the NHI Bureau from January 1, 2008 to December 31, 2008.

2.2. Selection of patients

Annual inpatient claim files with diagnostic ICD9 codes, as 885 (traumatic amputation of thumb) or 886 [traumatic amputation of other finger(s)], defined as digital amputation, were included in this study. These were then cross-referenced with ICD9 procedure codes for replantation procedures: 84.21 (thumb reattachment) and 84.22 (finger reattachment). Multiple finger or thumb amputations were counted as one event, and multiple digit replantations were also taken as one event, and we used these data to calculate the attempt rate for replantation (i.e., the number of patients who underwent replantation/number of patients who had digital amputation).

2.3. Failure of replantation

To obtain the failure rate of digital replantation from this population-based study, we followed Shale et al's study[8] and assumed that patients who underwent replantation and amputation during single hospitalization were replantation failures. However, patients with multidigit amputations may have undergone replantation of one finger and amputation of another, which was unclear from the database. Thus, we only included thumb replantation (84.21 thumb reattachment) and amputation (84.01 thumb amputation) as our study group. Patients having these two procedure codes were defined as replantation failures.

2.4. Demographics and covariables

We reviewed patient and injury characteristics, including age, sex, injury location (thumb or fingers), location of residency (urban, suburban, or rural), mechanism of injury, chronic comorbidity, associated injuries, length of stay, and total charges.

Mechanism of injury was analyzed from external cause-of-injury codes (E-codes). E-codes were classified into broader categories to allow for meaningful comparison with previous studies. Chronic comorbidity and associated injuries were inferred from the ICD-9-CM codes declared in the same admission data file. Diabetes, hypertension, and other cardiovascular diseases, head injury, chest injury, abdominal injury, and limb fracture were grouped as variables.

In addition, we reviewed the characteristics of the treating hospitals, including ownership (private or public), annual volume of amputation and replantation, and level of hospital. Hospitals in Taiwan were classified into three levels: medical centers (MC), regional (RH), and local hospitals. According to Taiwan's definition (in 2008), an MC needs to have >700 beds and an RH needs to have >250 beds. RHs are required to provide medical services covering fourteen subspecialties, and MCs are expected to provide services covering 19 subspecialties. A common criterion for RHs is the ability to perform operations of neurosurgery for acute brain injury. MCs are expected to maintain cardiovascular surgery service with the ability to perform open-heart surgery on a regular day-to-day basis.

2.5. Statistical analysis

Descriptive statistics about the distribution of age, sex, weekday of admission, length of stay (LOS), and inpatient cost were analyzed. Two-sample *t*-test was used for statistical analysis of continuous variables.

Categorical variables were analyzed using contingency (cross-tabulation) tables and the χ^2 test on amputation and replantation rates. Multiple variables were analyzed using logistic regression to determine patient and facility characteristics that were associated with a higher likelihood of replantation and failure rates. For the purposes of this study, $p < 0.05$ was considered significant.

3. Results

We identified 2358 patients as having digital amputation in 2008. Of these, 1859 were male, and 499 female. Mean age was 39.2 ± 15.5 years. There were 405 patients diagnosed