



Original Research—CME

Predictors of Receiving a Prosthesis for Adults With Above-Knee Amputations in a Well-Defined Population

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Abstract

Background: Prior studies have identified age as a factor in determining an individual's likelihood of receiving a prosthesis following a lower limb amputation. These studies are limited to specific subsets of the general population and are unable to account for preamputation characteristics within their study populations. Our study seeks to determine the effect of preamputation characteristics on the probability of receiving a prosthesis for the general population in the United States.

Objective: To identify preamputation characteristics that predict of the likelihood of receiving a prosthesis following an above-knee amputation.

Design: A retrospective, population-based cohort study.

Setting: Olmsted County, Minnesota (2010 population: 144,248).

Participants: Individuals ($n = 93$) over the age of 18 years who underwent an above-knee amputation, that is, knee disarticulation or transfemoral amputation, while residing in Olmsted County, MN, between 1987 and 2013.

Methods: Characteristics affecting the receipt of a prosthesis were analyzed using a logistic regression and a random forest algorithm for classification trees. Preamputation characteristics included age, gender, amputation etiology, year of amputation, mobility, cognitive ability, comorbidities, and time between surgery and the prosthesis decision.

Main Outcome Measures: The association of preamputation characteristics with the receipt of a prosthesis following an above-knee amputation.

Results: Twenty-four of the participants received a prosthesis. The odds of receiving a prosthesis were almost 30 times higher in those able to walk independently prior to an amputation relative to those who could not walk independently. A 10-year increase in age was associated with a 53.8% decrease in the likelihood of being fit for a prosthesis (odds ratio = 0.462, $P = .030$). Time elapsed between surgery and the prosthesis decision was associated with a rise in probability of receiving a prosthesis for the first 3 months in the random forest algorithm. No other observed characteristics were associated with receipt of a prosthesis.

Conclusions: The association of preamputation mobility and age with the likelihood of being fit for a prosthesis is well understood. The effect of age, after controlling for confounders, still persists and is associated with the likelihood of being fit for a prosthesis.

Introduction

Above-knee amputations can result from the progression of dysvascular conditions (eg, diabetes or peripheral vascular disease) or a nonvascular event (eg, trauma or cancer). Following an above-knee amputation, an individual's suitability for a prosthesis is typically determined using postamputation assessments based on mobility and balance measures of the individual without a prosthesis [1]. The nature of these assessments does not allow these evaluations to be reliably administered prior to the amputation. In

addition, amputation etiology, age at amputation, and comorbidities are often correlated with one another, and therefore it is necessary to control for each of these factors in analysis looking at preamputation characteristics and their effects on the probability of receiving a prosthesis.

Individuals with amputations who had more comorbidities are less likely to receive a high Medicare Functional Classification Level, which is directly related to an individual's eligibility for a prosthesis and prosthesis type [1]. Age, often associated with more comorbidities, has been previously shown to affect an individual's

likelihood of receiving a prosthesis. Within the elderly U.S. military veteran population, being 75 years old or younger increased a veteran's likelihood of receiving a prosthesis within the first year following a lower-limb amputation by almost 5 times compared to those veterans over the age of 85 years [2]. In addition, veterans with peripheral vascular disease are less likely to receive a prosthetic prescription. Outcomes following lower limb amputations for the entire population of the Marshall Islands offer more generalizable results as compared to looking only at outcomes within the U.S. veteran population. In the Marshall Islands, where all of the amputations in a single year were of dysvascular etiology, one-third of patients received a prosthesis, although none of the patients with transfemoral amputations used their prosthesis for ambulation after being discharged from rehabilitation [3].

Following an amputation, an individual's mobility and function are reduced, but receiving a prosthesis can be an important factor in improving mobility and overall quality of life [4]. Physical activity is important in the maintenance of overall health; increased physical activity is linked with reduced risks for early death, diabetes mellitus, coronary heart disease, high blood pressure, strokes, and depression, along with other negative health factors [5]. Individuals with lower-limb amputations are at higher risk for developing coronary artery disease, although this varies by amputation etiology, with dysvascular individuals having a greater risk [6]. Mortality rates among individuals with dysvascular amputations are linked to coronary artery disease, diabetes, and renal failure, with coronary artery disease increasing the risk of mortality by more than 3 times [7].

Identifying characteristics associated with the likelihood of receiving a prosthesis could be used in a preamputation assessment to determine an individual's likelihood of receiving a prosthesis following an amputation. It is also important that the predictors of prosthetic prescription match the factors used in a clinical assessment to determine an individual's eligibility for a prosthesis. We sought to identify preamputation characteristics that are predictive of the probability of receiving a prosthesis following an above-knee amputation, that is, transfemoral amputation or knee-disarticulation, and to compare these predictors with those commonly used by clinicians. It is likely that older individuals, those with amputations of dysvascular etiology, and those with reduced mobility prior to the amputation have a lower probability of receiving a prosthesis.

Methods

Data Source and Study Population

Individuals with above-knee amputations residing in Olmsted County, MN, were identified using the resources

available through the Rochester Epidemiology Project (REP; NIH AG034676). The REP was designed to take advantage of the unique circumstances within Olmsted County: being relatively isolated from other urban areas and having only a few health care providers (including Mayo Clinic, Olmsted Medical Center, and their affiliated hospitals) that all agreed to share medical records and administrative data [8].

It should be noted that the Olmsted County population is quite similar to the Upper Midwest population but is less diverse, wealthier, and more educated than the general U.S. population; yet results from other studies using this population are applicable to populations outside the Upper Midwest [9].

Using the resources of the REP, we identified individuals who underwent an above-knee amputation procedure as a resident of Olmsted County from 1987 to 2013 ($n = 93$). These individuals were initially identified using the ICD-9-CM procedure code of 84.17. Medical records for these individuals were reviewed to confirm their amputation status and level. Also recorded were demographic, amputation etiology, year of amputation, preamputation mobility level, cognitive ability (limited to the presence or absence of dementia, Alzheimer disease, or psychiatric disorders), preamputation comorbidities, and receipt of a prosthesis following the above-knee amputation were also recorded. Patients who had denied research authorization for use of their medical records in research were excluded. This study was approved by both the Mayo Clinic and Olmsted Medical Center Institutional Review Boards.

Outcomes Measured

A review of the individual's medical record was used to determine the following: (1) the etiology of the amputation (unknown, diabetes mellitus type 1 or type 2, peripheral vascular disease, trauma, or cancer); (2) the side of the limb amputated; (3) whether the individual had a bilateral amputation; (4) the preamputation mobility level (wheelchair dependent, walking with an assistive device, or walking independently); (5) preamputation living situation (residing in a nursing home or in the community, to include assisted-living facilities); and (6) preamputation cognitive ability (presence or absence of dementia, Alzheimer disease, or psychiatric disorders). with full cognitive ability defined as the absence of a diagnosis of dementia, Alzheimer disease, or a psychiatric disorder in the medical records. The level of amputation, that is, knee disarticulation or transfemoral amputation, was verified by surgical reports from the amputation procedure. All individuals with a verified above-knee amputation were included; the ability to view the entire medical records ensured that all preamputation characteristics were recorded for each individual. Individuals were also classified as unilateral or bilateral amputees. The

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