Assessing and Improving Prosthetic Referral Rates in Unilateral Lower Limb Amputations

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Abstract

Lower limb amputation significantly impacts quality of life, mobility, and mortality, making timely referral for prosthetic services integral to optimizing patient outcomes. However, referral practices vary widely across institutions and patient populations. This quality improvement project aimed to determine the baseline prosthetic referral rate for patients who received a unilateral lower limb amputation within the orthopedic trauma department of a large, metropolitan, academic medical center. A retrospective chart review was conducted on a one-year time frame using EPIC electronic medical records data extraction and applying strict inclusion criteria. Only six patients met criteria for analysis, highlighting the challenge of capturing a sample size sufficient for statistically meaningful conclusions. While the results revealed a referral rate lower than that reported in the available literature, the small sample size limited the analysis to descriptive statistics. The project also examined contextual factors such as patient age, comorbidities, length of stay, insurance type, and amputation level that may influence referral likelihood. The findings highlight variability in referral practices, suggesting that these factors may influence referral rates. The low referral rate observed suggests the need for improvement in referral practices to better support patient outcomes. Future efforts should focus on expanding the sample size and exploring targeted interventions to improve referral rates for this population.

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Problem Description

In the United States more than 150,000 lower limb amputations are performed annually (Molina & Faulk, 2022), and as many as 95% of patients will use a prosthetic (Raichle et al., 2008). Referral to prosthetics consultation during the perioperative phase of unilateral lower limb amputations, defined as prior to hospital discharge, is associated with numerous benefits. These benefits include improved psychological acceptance of the prosthetic (Choo et al., 2022), decreased rates of postoperative complications (Day et al., 2023), and reduced all-cause mortality even when patient characteristics and comorbidities are taken into account (Shutze et al., 2021). Although retrospective cohort studies have examined the rates of prosthetics or orthotics referral for lower limb amputees in various settings, these studies are complicated by the lack of consensus on the benefits of perioperative referral. At the chosen quality improvement project site in the orthopedic trauma department, there was no data available on the rate of perioperative prosthetic referral for unilateral lower limb amputations.

Available Knowledge

Guidelines for prosthetic consultation and referral in the perioperative unilateral lower limb amputation patient are not well established and often rely on clinician judgement of wound healing, patient comorbidities, and patient ability to use a prosthesis (Day et al., 2023; Houdek et al., 2014). Evidence supports that prosthetic referral and fitting made before hospital discharge correlates with improved wound healing, decreased incidence of muscular deconditioning and flexion contractures, and improved patient satisfaction with the prosthesis (Balduzzi et al., 2023; Choo, 2022; Day et al., 2023). Prosthetic fitting is also correlated with a decrease in all-cause mortality in patients who received either a unilateral transtibial or transfemoral amputation

(Shutze et al., 2021). This decrease is evident even when comorbidities such as cardiovascular disease, anxiety and depression, and diabetes are corrected for, which excludes the possibility of prosthetic fitting selection bias (Singh & Prasad, 2016).

The fact that this improvement cannot be easily explained by quantitative measures informs qualitative studies of the psychological impact of prosthetics. Consultation with prosthetics experts improves patients' expectations of their future abilities suggesting that more emphasis should be placed on "talking, rather than just walking" (Ostler et al., 2014). Data shows that consultation and prosthetic fitting may not be correlated with overall acceptance or rejection of the prosthetic, but patient expectation of prosthetic function is correlated with future satisfaction regardless of prosthetic use (Baun et al., 2018; Biddiss & Chau 2007). Additionally, consultation in the immediate perioperative phase provides information at a critical juncture when demand is high, and delivery is often lacking (Biddiss & Chau, 2007).

A lack of clinical practice awareness of the benefits of prosthetic referral complicates the reporting of rates of referral in the perioperative phase in the literature. Illustrating this, a retrospective cohort analysis from a single practice in North America found that of 293 patients who received unilateral below-knee-amputations, only 42% received referral in the perioperative setting. Given that this study and others have found increased survival benefits not attributable to patient characteristics or comorbid factors (Shutze et al., 2021), it is evident that prosthetic referral practices could be improved. Furthermore, a retrospective study of Veteran's Administration hospital patients found that of 9,994 patients who received lower limb amputations, 1-year prescription rates for prosthetics ranged from 38% to 93% with affecting variables including patient race, geographical location, and level of amputation (Resnik & Borgia, 2015). Similarly, source data show typical 1-year rates of prosthetic referral or

prescription between 49% and 93% for transtibial amputations and between 14% and 57% for transfemoral amputations (Remes et al., 2009; Resnik & Borgia, 2015; Shutze et al., 2021; Webster et al., 2012). In addition, a study from the United Kingdom's National Health Service examined the time to final prosthetic fitting in 107 patients when using a temporary prosthetic adjunct. Although this study found an average of 19.4 days between amputation and referral, it did not track the rate of referrals (Lee et al., 2023). Given the evidence supporting prosthetic referral and the variability in current practice guidelines, significant potential exists to improve referral rates and ultimately patient outcomes.

Rationale

This project relies on retrospective chart review used the Johns Hopkins Evidence-Based Practice Model (EBP) with the Practice question, Evidence, and Translation (PET) (see appendix A) (Dang et al., 2022) framework to assess the current state of prosthetic referral rates for unilateral lower limb amputations in an orthopedic trauma department. The focus of this project was to quantify current referral rates and understand how various contextual factors influence these rates with the aim of informing future practice change recommendations.

Specific Aims

1) Primary Aim: To determine the rate of prosthetic referrals for unilateral lower limb amputations in the perioperative phase in a selected orthopedic trauma department and evaluate the existence and scope of referral deficiency to inform practice improvements.

2) Secondary Aim: To examine how contextual factors, including patient demographics, length of hospitalization, comorbidities, and amputation site correlate with the prosthetic referral rate. This analysis aimed to identify opportunities for practice improvement to benefit patient outcomes.

Context

This project was undertaken at an orthopedic trauma department of a large metropolitan hospital, which serves a diverse patient population. Contextual factors included the availability of prosthetic services, which include the prosthetics team and prosthetic clinic partner. Other factors include the clinical practices of individual referring surgeons, existing protocols for postoperative care, and understandings about the benefits of prosthetic referral prior to hospital discharge for unilateral lower limb amputees. Understanding these factors was instrumental in the study and act phases of the project as it guided data interpretation and presentation to be relevant to the department.

Interventions

The intervention consisted of a retrospective chart review, identifying patients admitted to the orthopedic trauma department, as well as those admitted to other services who received unilateral lower limb amputations performed by the orthopedic trauma department. The chart review identified instances of prosthetic referrals in patients who have new occurrences of the list of ICD-10 codes related to unilateral lower limb amputation (see Appendix B). The data collection involved extracting relevant patient records from the EPIC system, including patient demographics, comorbidities, the site of amputation, patient outcomes and the rate of prosthetic referrals. This detailed data extraction ensured a full understanding of the referral patterns.

The team involved in this project consisted solely of the data extractor who performed all aspects of chart review, data extraction, recording, and analysis. Consultation assistance was also provided as needed by the Department of Nursing Practice (DNP) faculty, orthopedic trauma practitioners, statisticians through the School of Nursing, and research department staff. The project's reliance on a single data extractor allowed consistency and control over the data

collection and analysis, which aimed to identify trends and gaps in the prosthetic referral process to inform potential practice improvements.

Study of the Interventions

The impact of the interventions was a thorough analysis of the data quantitatively to identify trends in prosthetic referrals for unilateral lower limb amputations. Actual rates of referrals were measured against expected rates comprised of those found in the literature. The analysis assisted in determining the presence or scope of the referral deficiency and help inform practice improvement recommendations.

Measures

The primary measure analyzed was the rate of prosthetic referrals for unilateral lower limb amputation. Additional measures included patient demographics, comorbidities, amputation site, timing of referrals, and outcomes. These measures provided a comprehensive understanding of the current state of referrals and their impact. The data's reliability and validity were ensured through standardized data extraction methods and cross-checked referencing of patient records. The focus was on identifying the rate of prosthetic referrals during the hospital stay for unilateral lower limb amputations. Practice improvement recommendations are focused on identifying context factors that contributed to the rate of referrals and identifying potential sources of improvement.

Analysis

Quantitative methods analyzed referral rates using descriptive statistics for an overview and chi-square tests to compare observed referral rates against expected referral rates from the literature. The prosthetic referral rate was measured as the proportion of patients who received a referral to prosthetic services, calculated against the total number of patients who underwent unilateral lower limb amputation within the inclusion timeframe. The project's inclusion time

frame was a one-year period of hospital admissions from January 1st of 2023 through December 31st of 2023.

Due to the small sample size, multivariate regression was not performed. Instead, descriptive analysis was used to explore potential patterns in referral rates in relation to patient variables (see Appendix C). This approach provides context which may inform future practice change recommendations regarding prosthetic referral practices.

Ethical Considerations

The project was submitted to an Institutional Review Board (IRB) prior to commencement to ensure compliance with ethical standards and patient confidentiality. All data collected was anonymized to protect patient privacy. All patient-identifying information remained on site department servers and will not be extracted. Only de-identified data was extracted and stored on a password-protected personal computer with encryption and regular backups ensuring data security and confidentiality. There were no potential conflicts of interest as the project is solely intended to inform clinical practices at the chosen project site.

Results

A total of 187 patients were initially identified using the ICD-10 codes related to amputations (Appendix B). However, after applying inclusion criteria, only six patients met eligibility for analysis. Common reasons for exclusion included amputations present on admission, upper limb amputations, procedures performed by non-orthopedic services, and bilateral procedures. Of the six patients ultimately included, only two received a referral for prosthetic evaluation, while four did not.

Due to the small sample size, statistical significance could not be determined, and findings are presented descriptively. The mean age was slightly lower in the referred group (55.0 years, SD 17.0) compared to the non-referred group (64.8 years, SD 12.8). Both referred patients underwent transfemoral operations, whereas the non-referred group was evenly split between transfemoral and transtibial operations. Both referred patients were white and had Medicare-managed care. In contrast the non-referred group included both black and white patients and had a mixture of Medicaid and traditional Medicare. All patients had at least one identified comorbid condition. Neither group included patients with type I diabetes. Type II diabetes was documented in half of the non-referred group and absent in the referred group. Hypertension was present in all non-referred patients and absent in both referred patients. Patient length of stay (LOS) was substantially longer in the non-referred group (40.3 days, SD 23.2) compared to the referred group (8.5 days, SD 10.6).

Summary

This quality improvement project examined prosthetic referral rates for unilateral lower limb amputations in an orthopedic trauma unit. Through retrospective chart review, using the Johns Hopkins Evidence-Based Practice Model, referral rates were analyzed against contextual factors including patient demographics, length of hospitalization, comorbidities, and amputation site. The primary goal was to establish a baseline referral rate and describe contextual factors correlating to prosthetic referral rates. The observed referral rate of 33.3% was lower than rates reported in the literature, where perioperative referral rates range from 42% to over 90% depending on setting and amputation level (Shutze et. al., 2021; Resnik & Borgia, 2015; Webster et. al., 2012).

Interpretation

While the statistical significance of the findings of this project is limited by the small sample size, the findings do offer insights into prosthetic referral practices within the orthopedic trauma department. The observed referral rate of 33.3% is below even the lowest rates found in the available literature, and descriptive trends suggest potential differences in referral patterns based on amputation level, age, and length of stay, comorbidities, and race. However, no definitive conclusions can be drawn from the limited data set.

The project was not designed or intended to be statistically powered for hypothesis testing. Had the goal been to evaluate contextual factors for correlation or influence with statistical significance it would have required a substantially larger sample size. This would have been considered with different methodological considerations during the project design. Instead, this project served as served as an initial step to identify potential disparities, inform future QI efforts, and highlight the feasibility of gathering data in this setting.

Limitations

This project had several limitations which impacted the sample size and statistical significance of this project's findings. First, the retrospective chart review was limited to a one-year time frame, which constrained the number of eligible cases. Second, the project focused specifically on patients with unilateral lower limb amputations, excluding those with bilateral, upper, and combination limb amputations, further narrowing the sample. Third, the project was confined to patients managed specifically and primarily by the orthopedic trauma service, which omitted amputations performed by other departments such as vascular surgery –a specialty which more commonly manage amputations related to conditions like diabetes. Fourth, inclusion criteria excluded patients who had their amputations performed at outside hospitals and were then transferred to the orthopedic trauma department. Fifth, the project excluded patients who

were evaluated for amputation but ultimately managed with limb salvage, further reducing the potential sample size.

Additionally, limitations inherent to the project design may have contributed to missed cases. The chart review relied on identifying patients managed by a specific subset of orthopedic trauma department attending physicians, and one attending had not yet joined the practice during the inclusion period. It is also possible that some trauma related amputations were performed by providers outside the orthopedic trauma department and were not captured using the defined inclusion criteria, leading to underrepresentation in the final sample.

Conclusions

While this project's statistical power is limited by a small sample size, it provides valuable descriptive preliminary insights into the referral patterns within an orthopedic trauma department. The finding reinforces the need for a large, more adequately powered analysis to examine referral rates in in post amputation care. Expanding the inclusion timeframe and refining inclusion strategies to capture a broader base may enhance future data collection efforts. Additional research is needed to identify trends over time and explore potential areas for improvement in the referral process to ensure eligible patients receive appropriate, evidence based, prosthetic care.

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Appendix A

Practice, Evidence, and Translation (PET) Framework for this Project.

1) Practice Question: What is the current rate of prosthetic referrals for unilateral lower limb amputations in the orthopedic trauma department and how are these rates influenced by patient demographics, comorbidities, amputation site, and patient outcomes?
2) Evidence: A thorough review of available literature was conducted to understand the comparable standards for prosthetic referral and the impact on patient outcomes. Evidence shows that timely prosthetic referral is associated with improved wound healing, reduced complications, and reduced mortality (Choo et al., 2022; Day et al., 2023; Shutze et al., 2021). This literature review provides a gauge against which current referral practices can be compared.
3) Translation: The project extracted data using a detailed retrospective chart review using the EPIC charting system. This project gathered data on referral rates and identified contextual factors to assess current practices. Analysis of this data has allowed the project to identify and describe trends and gaps in referral practices and can provide a descriptive analysis on how different factors affect the referral rate. The results are used to understand the current state of referral practices and identify potential areas for future improvement recommendations.

Appendix B

ICD-10 Codes Used to Identify Included Patients.

ICD-10 Codes for Acquired Absence:

- Z89.511: Acquired absence of right leg below knee
- Z89.512: Acquired absence of left leg below knee
- Z89.519: Acquired absence of unspecified leg below knee
- Z89.611: Acquired absence of right leg above knee
- Z89.612: Acquired absence of left leg above knee

ICD-10 Codes for Traumatic Amputation:

- S88: Traumatic amputation of lower leg
- S88.1: Traumatic amputation at level between knee and ankle
- S88.11: Complete traumatic amputation at level between knee and ankle
- S88.12: Partial traumatic amputation at level between knee and ankle
- S88.9: Traumatic amputation of lower leg, level unspecified
- S88.91 Complete traumatic amputation of lower leg, level unspecified

Appendix C

Patient Variables Measured as Correlates to Referral Rate.

- Patient demographics: including age (exclusive to adult patients greater than 18 years old), race/ethnicity, Insurance type (Medicaid, Medicare, Private).
- Comorbidities: Type I Diabetes Mellitus, Type II Diabetes Mellitus, Hypertension, Peripheral Arterial Disease, Chronic Kidney Disease, Obesity, Dyslipidemia, Osteoarthritis, Rheumatoid Arthritis, Stroke, Dementia, Anxiety, Depression, Tobacco Use.
- Amputation site: Transtibial, Transfemoral, Through Knee (knee disarticulation), Transmetatarsal
- Outcomes: Mortality at 30 days and 1 year, in hospital postoperative infection occurrence, length of hospital stay, reoperation rate, readmission rate.