

Exploring risk factors associated with ulcerations after first ray amputations.

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Research

Statement of Purpose

The goal of this study is to gain a better understanding of factors which predispose diabetic patients to lesser toe ulcerations after first ray amputations. If these factors can be determined prior to the initial amputation, then prophylactic measures can be taken to prevent recurrent ulcerations after first ray amputations.

Study Relevance

Ulcerations are one of the most common complications associated with diabetes and can become a significant impairment to a person's quality of life. Data has shown that ulcerations are becoming a huge drain on healthcare resources, contributing to the increasing cost burden on hospitals. Many factors contribute to ulcerations, but one of the most important risk factors is the history of amputation. In some studies, annual recurrence of ulcerations in this population is up to 50%. Given these statistics, it is vitally important to be able to identify any factors that could potentially put a diabetic patient at risk for further ulceration after foot amputations. In this study, we aim to explore these factors, specifically looking at the biomechanical characteristics of diabetic patients who develop transfer lesions after undergoing first ray amputations. Thus far, minimal research has been done to address this topic. The most relevant literature to address this question was conducted nearly thirty years ago (Lavery 1995, Quedeaux 1996). Their studies were limited because they only focused on the location of the ulcerations and the pressure redistribution pattern leading to the lesions. Our study expands on the issue by looking at the biomechanical characteristics that directly contribute to the pressure redistribution, and ultimately, ulceration.

Methodology & Procedures

This a retrospective observational cohort study. The observational time period is from 2010 to 2016. Using retrospective chart review, patients who have had a partial hallux amputation, complete hallux amputation, or partial 1st ray amputation were isolated using ICD 9 coding. Patients who had prior lesser toe ulcerations, prior lesser toe amputation, or a non healing hallux amputation were excluded from the study population.

We used the patient's chart to gather data including, age, gender, BMI, Charlson index score, race/ethnicity, smoking status, alcohol abuse or dependence diagnoses, level of peripheral neuropathy, vascular status, compliance with appointments, shape of metatarsal parabola, and lesser toe contractures. We then examined the prevalence of lesser toe ulcerations among our population, using the cox proportional hazard model to estimate the incidence of lesser toe ulceration in relation to each of the variables listed above.

Results

Table 1: Demographics

N=42	N (%)
Age (years)	
Mean	62
Range	35-79
Gender	
Male	30 (71.4)
Female	12 (28.6)
Race	
White	18 (42.9)
Hispanic	15 (35.7)
African- American	3 (7.1)
Other	6 (14.2)
Follow up (mo)	
Mean	14.2
Range	0.2-65.9
BMI	
18.5-24.9	12 (28.6)
25-29.9	8 (19.0)
30-39.9	22 (52.4)
+tobacco use	23 (54.8)
+alcohol use	8 (19.0)
PVD	20 (47.6)
Neuropathy	41 (97.6)
Charlson Index Score	
<5	24 (57.1)
>5	18 (42.9)

Table 2: Subsequent Lesser Toe Amputations

N=42	N (%)
2 nd toe	17 (40.5)
3 rd toe	6 (14.3)
4 th toe	1 (2.4)
5 th toe	1 (2.4)
TMA	6 (14.3)
Multiple toes	5 (11.9)
No amputation	6 (14.3)

Table 3: Biomechanical Factors

	N (%)
Metatarsal Protrusion Distance >2mm	30 (71.4)
Lesser toe contractures	28 (66.7)

Level of Evidence

Level II – Retrospective Study

The data collected showed:

- 71.4% of the population was male
- 52.4% of patients had a BMI greater than 30
- 97.6% had peripheral neuropathy
- 54.8% had a history of smoking
- 71.4% had a metatarsal protrusion distance greater than 2mm
- 66.7% had lesser toe contractures prior to the first ray amputation
- 85.7% of patients had a subsequent lesser toe amputation

No statistical significance was found amongst the variables



Figure 1: Example of a 2nd toe ulceration after a 1st partial ray amputation

Conclusion

The most common complication after a partial hallux amputation, complete hallux amputation or first ray amputation is the development of lesser toe ulcerations. These ulceration can often lead to subsequent lesser toe amputations. This is seen in our data, where 86% of the study population went on to some form of lesser toe amputation, with the second digit being most common. This correlates to Lavery's finding that peak pressures are increased at the digits after great toe amputation. The presence of lesser toe amputations increased peak pressures at the distal tip of the digits. Additionally, 71.4% of patients had an increased 2nd metatarsal protrusion distance. This, associated with the presence of lesser toe contractures could explain why the 2nd digit was the most commonly affected. Overall analysis of the variables shows that males, patients with a BMI greater than 30, a metatarsal protrusion distance of greater than 2 mm, and lesser toe contractures are more likely to develop lesser toe ulcerations after first ray amputations. In conclusion, we hope that these results will motivate physicians to consider prophylactically addressing these risk factors to prevent development of lesser toe ulcerations after a first ray amputation.

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