Impact of Lower Extremity Amputation on Spinal Health: A Comparative Analysis of Back Pathologies in Transfemoral and Transtibial Amputees

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INTRODUCTION: Lower extremity amputation is a serious and life-altering procedure in which numerous patients undergo it due to both traumatic and non-traumatic causes. Each year in the United States, between 115,000 and 150,000 people undergo lower extremity amputation. Amputation significantly impacts the quality of life for individuals, often leading to a range of complications, including altered biomechanics and increased incidence of low back pain. This study sought to investigate the connection between lower extremity amputation and the development of spinal pathologies, specifically among patients undergoing transtibial amputation (TTA) and transfemoral amputation (TFA).

METHODS: Utilizing the PearlDiver database, which includes data from approximately 165 million patients, we conducted a retrospective analysis comparing the prevalence of back pathologies and the frequency of spinal surgeries of TTA and TFA amputees and matched able-bodied control subjects which was based on age, gender, and the Elixhauser Co-morbidities Index (ECI). The patient cohorts for this analysis were precisely defined using ICD-10 diagnosis codes and CPT procedural codes, ensuring a thorough and accurate identification of both diagnostic categories and management strategies employed. Odds ratios and p-values were calculated to assess the associations between amputation status and the incidence of back pathologies and spine surgeries.

RESULTS: In both the TFA and control groups, 23,079 patients were analyzed while 16,350 patients were analyzed in both the TTA and control group. Matched patient groups resulted in a sample size of 2,457 TFA matched controls and 1,642 TTA matched controls. The findings of this study reveal a markedly higher prevalence of spinal conditions, including low back pain, radiculopathy, sciatica, anterior and posterior lumbar pathologies in amputee populations. Both TFA and TTA patients had higher odds of developing back pathologies compared to controls (Table 1). Both TFA and TTA patients were found to have increased odds of undergoing posterolateral fusions, lumbar decompressions, and lumbar fusions (Tables 2 & 3). There was no difference between the prevalence of back pathologies when comparing TFA and TTA patients directly, while TFA patients had greater odds of undergoing lumbar decompressions and fusions.

DISCUSSION: Our finding that lower extremity amputees have an increased prevalence of low back pain compared to the general population agrees with the previously published literature. We found increased odds of undergoing spinal decompression and fusion among amputees, which agrees with the findings of studies where it was found that lower extremity amputees were predisposed to developing intervertebral disc degeneration and facet arthropathy. There is strong evidence to suggest that altered walking biomechanics in lower extremity amputees can lead to accelerated degeneration of the spine, specifically the lumbar spine. Alterations to gait, seen in amputees, has been shown to increase the loading forces experienced by the spine, especially to facet joints. While we believe the findings of this investigation to be valuable, we acknowledge certain limitations within our study. clinical database studies, such as this one, have inherent limitations. Administrative clinical databases may contain inaccuracies within the diagnosis and procedure codes used for individual patients, and the accuracy of coding may differ between the sources that compose the database. The use of ICD codes for diagnosis alongside CPT codes for procedures performed can mitigate database coding inaccuracies and this method was utilized within our study.

SIGNFIGANCE: Our findings underline the critical need for proactive clinical measures, including early and regular monitoring of spine health in amputees. Additionally, tailored physical therapy programs aimed at strengthening the core and enhancing spinal stability could play a vital role in preventing spine deterioration among this population and integrating these practices into patient care protocols could significantly improve the overall quality of life for amputees and mitigate the long-term consequences associated with back pathologies.

IMAGES AND TABLES:

Table 1. Comparison of back pathologies between TFA, TTA patients and controls (TFA-C, TTA-C).

	Non-matched				Matched			
Outcome	**TFA-C (N, %)**	**TFA (N, %)**	**Odds ratio**	**p-value**	**TFA-C (N, %) N=2457**	**TFA (N, %)**	**Odds ratio**	**p-value**
Anterior lumbar pathologies	2010 (8.7%)	3197 (13.9%)	1.69 (1.59-1.79)	**p < 0.001**	214 (8.7%)	183 (7.4%)	0.84 (0.69-1.4)	p = 0.12
Posterior lumbar pathologies	1807 (7.8%)	3012 (13.1%)	1.77 (1.66-1.88)	**p < 0.001**	218 (8.9%)	156 (6.3%)	0.70 (0.56-0.63)	**p < 0.001**
Radiculopathy	1506 (6.5%)	2401 (10.4%)	1.66 (1.56-1.78)	**p < 0.001**	184 (7.5%)	142 (5.8%)	0.76 (0.60-0.95)	**p = 0.02**
Low back pain	4717 (20.4%)	6784 (29.4%)	1.62 (1.55-1.69)	**p < 0.001**	547 (22.3%)	408 (16.6%)	0.70 (0.60-0.80)	**p < 0.001**
Sciatica	1276 (5.5%)	1630 (7.1%)	1.30 (1.20-1.40)	**p < 0.001**	135 (5.5%)	97 (3.9%)	0.71 (0.54-0.92)	**p = 0.01**
Outcome	**TTA-C (N, %)**	**TTA (N, %)**	**Odds ratio**	**p-value**	**TTA-C (N, %) N=1642**	**TTA (N, %)**	**Odds ratio**	**p-value**
Anterior lumbar pathologies	1428 (8.7%)	2217 (13.6%)	1.64 (1.53-1.76)	**p < 0.001**	136 (8.3%)	113 (6.9%)	0.82 (0.63-1.06)	p = 0.15
Posterior lumbar pathologies	1268 (7.8%)	2089 (12.8%)	1.74 (1.62-1.88)	**p < 0.001**	118 (7.2%)	92 (5.6%)	0.77 (0.58-1.02)	p = 0.07
Radiculopathy	1098 (6.7%)	1688 (11.5%)	1.60 (1.48-1.73)	**p < 0.001**	100 (6.1%)	79 (4.8%)	0.78 (0.58-1.05)	p = 0.12
Low back pain	3337 (20.4%)	4750 (29.1%)	1.68 (1.52-1.68)	**p < 0.001**	349 (21.3%)	261 (15.9%)	0.70 (0.59-0.84)	**p < 0.001**
Sciatica	886 (5.4%)	1111 (6.8%)	1.27 (1.16-1.39)	**p < 0.001**	89 (5.4%)	61 (3.7%)	0.67 (0.48-0.94)	**p = 0.02**

Table 2. Comparison of all fusions and decompressions between controls and patients with transfemoral amputations (TFA) and controls (TFA-C).

	Non-matched				Matched			
Outcome	**TFA-C (N, %)**	**TFA (N, %)**	**Odds ratio**	**p-value**	**TFA-C (N, %)**	**TFA (N, %)**	**Odds ratio**	**p-value**
Anterior Lumbar Interfusion All	3 (0.01%)	5 (0.02%)	1.67 (0.40-6.98)	p = 0.72	0	0	NA	NA
Transforaminal Lumbar Interfusion All	5 (0.02%)	4 (0.02%)	0.80 (0.21-2.98)	p = 1.00	1 (0.04%)	0	NA	p = 1
Posterolateral Fusion All	46 (0.20%)	85 (0.37%)	1.85 (1.29-2.66)	**p < 0.005**	7 (0.28%)	3 (0.12%)	0.43 (0.11-1.66)	p = 0.34
360 ALIF PL All	3 (0.01%)	3 (0.01%)	1.00 (0.20-4.96)	p = 1.00	3 (0.01%)	3 (0.01%)	1.00 (0.20-4.96)	P = 1.00
360 PLF TLIF All	10 (0.04%)	12 (0.05%)	1.48 (0.52-2.78)	p = 0.83	10 (0.04%)	12 (0.05%)	1.48 (0.52-2.78)	p = 0.83
Lumbar Decompression	209 (0.91%)	352 (1.53%)	1.69 (1.43-2.01)	**p < 0.05**	209 (0.91%)	352 (1.53%)	1.69 (1.43-2.01)	**p < 0.05**
Lumbar Decompression Revision	18 (0.078%)	25 (0.11%)	1.39 (0.76-2.55)	p = 0.36	18 (0.078%)	25 (0.11%)	1.39 (0.76-2.55)	p = 0.36
Lumbar Fusion	152 (0.66%)	290 (1.26%)	1.92 (1.58-2.34)	**p < 0.05**	152 (0.66%)	290 (1.26%)	1.92 (1.58-2.34)	**p < 0.05**

Table 3. Comparison of all fusions and decompressions between controls and patients with transtibial amputations (TTA) and controls (TTA-C).

	Non-matched				Matched			
Outcome	**TTA-C (N, %)**	**TTA (N, %)**	**Odds ratio**	**p-value**	**TTA-C (N, %)**	**TTA (N, %)**	**Odds ratio**	**p-value**
Anterior Lumbar Interfusion All	3 (0.02%)	4 (0.02%)	1.33 (0.30-5.96)	p = 1.00	0	0	NA	NA
Transforaminal Lumbar Interfusion All	2 (0.01%)	4 (0.02%)	2.00 (0.37-10.92)	p = 0.68	0	0	NA	NA
Posterolateral Fusion All	41 (0.25%)	62 (0.38%)	1.51 (1.02-2.25)	**p < 0.005**	2 (0.12%)	3 (0.18%)	1.50 (0.25-8.99)	p = 1.00
360 ALIF PL All	6 (0.04%)	3 (0.02%)	0.50 (0.13-1.99)	P = 0.50	0	0	NA	NA
360 PLF TLIF All	8 (0.05%)	11 (0.07%)	0.73 (0.29-1.81)	p = 0.64	2 (0.12%)	1 (0.06%)	0.50 (0.05-5.52)	p = 1.00
Lumbar Decompression	201 (1.2%)	260 (1.6%)	1.30 (1.08-1.56)	**p < 0.05**	20 (1.2%)	15 (0.91%)	0.75 (0.38-1.47)	p = 0.50
Lumbar Decompression Revision	12 (0.07%)	20 (0.12%)	1.67 (0.81-3.41)	p = 0.22	1 (0.06%)	1 (0.06%)	1.00 (0.06-16.0)	p = 1.00
Lumbar Fusion	125 (0.76%)	206 (1.26%)	1.66 (1.32-2.07)	**p < 0.05**	11 (0.70%)	10 (0.61%)	0.91 (0.38-2.15)	p = 1.00