Review of Secondary Physical Conditions Associated with Lower-Limb Amputation and Long-Term Prosthesis Use

Robert Gailey, PhD, PT; Kerry Allen, DPT; Julie Castles, DPT; Jennifer Kucharik, DPT; Mariah Roeder, DPT

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Background: The majority of service-connected amputations occur before the third decade of life. Losing a lower limb at such a young age is life-altering in many ways. The use of prosthetic or assistive devices must be incorporated into all daily activities and may influence body image, vocation, and other socialization issues. Conservatively, an estimated 20 percent of people with amputation in the civilian or veteran population underwent amputation early in life and have had to negotiate a prosthetic and/or assistive device. As a result, altered gait, reduced activity, and other adaptations additionally stress and strain their entire bodies. However, the concern is that having an amputation for a long period of time is associated with secondary physical conditions, including osteoarthritis, osteoporosis, back pain, and other musculoskeletal problems. These conditions are believed to result from increased forces on the intact limb and altered body mechanics that occur secondary to limb loss and/or prosthesis use.
Objectives: We review the literature on secondary complications among people with lower-limb loss who are long-term prosthesis wearers.

Criteria for selecting studies for this review:
Types of studies: All the studies were retrospective.
Types of participants: Ages ranged from 14-73 years. Patients studied had TFA, TTA, dyvascular amputation, nondysvascular amputation, knee disarticulation.
Types of interventions: Factors reviewed included: Prostheses, osteoarthritis in hip & knee (table 1), osteopenia & osteoporosis (table 2), back pain, socket fit and prosthetic alignment, posture and step-length discrepancy, general deconditioning
Types of outcome measures: Table 1 & 2

Search strategy for identification of studies: MEDLINE, OVID, and EMBASE were searched and publications from 1970 to May 2006 were included.

Conclusion: Musculoskeletal pathologies often develop as secondary complications in people with amputation, which may affect their mobility and quality of life. An alteration of biomechanics occurs with the use of one or more prostheses. Individuals with amputation tend to favor their intact limb and stress it more during mobility and daily activities. This tendency can cause degenerative changes of the intact limb, such as osteoarthritis of the knee and/ or hip joints. Since people with amputation spend less time on their residual limb, osteopenia and subsequent osteoporosis often occur secondary to insufficient loading of the bones. Prosthetic fit and alignment can influence posture and comfort, which may promote greater equal force distribution across the intact and prosthetic sides during gait and tentatively decrease the susceptibility to osteoarthritis. Moreover, back pain that is bothersome and influences activity is a common complaint among individuals with amputation. Back pain has been linked to poor socket fit and alignment, postural changes, leg-length discrepancy, amputation level, and general deconditioning. Knowledge of the possible secondary complications of amputation can help rehabilitation practitioners provide high-quality, prophylactic care for their patients with lower-limb amputation.

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Table 1.
Literature summary: Hip and knee osteoarthritis by amputation level, age, and limb in people with traumatic amputation.

Study	Level	*n*	Mean Age at Study	Mean Yr Since Amputation	Mean Age at Amputation	Study Results (%)	
Hungerford & Cockin, 1975 [1]						**Knee OA: Amp Limb, Radiograph**	**Knee OA: Nonamp Limb, Radiograph**
	TTA	63	—	—	—	NR	41
	TFA	54	—	—	—	NR	63
	Total	117	NR	NR	NR	—	—
	Control	NR	—	—	—	NR	22
Burke et al., 1978 [2]						**Knee OA: Amp vs Nonamp Side, Radiograph**	**Hip OA: Amp vs Nonamp Side, Radiograph**
	TTA	22	—	—	—	NR	NR
	TFA	19	—	—	—	NR	NR
	Other	1	—	—	—	NR	NR
	Total	42	48.4	24.6	23.8	0 vs 17	5 vs 12
Mussman et al., 1983 [3]						**Knee pain: Self-Report, Symptomatic**	**Hip pain: Self-Report, Symptomatic**
	TTA	28	—	—	—	46	29
	TFA	16	—	—	—	75	19
	Other	3	—	—	—	—	—
	Total	56	51.1	24.4	26.0	55	23
Lemaire & Fisher, 1994 [4]						**Knee OA: Amp Side, Radiograph**	**Knee OA: Nonamp Side, Radiograph**
	TTA	12	71.8	46.2	25.6	NR	83
	Control	12	69.8	—	—	—	50
Kulkarni et al., 1998 [5]						**Hip OA: Amp Side, Radiograph**	**Hip OA: Nonamp Side, Radiograph**
	TTA	29	—	—	—	45	NR
	TFA	15	—	—	—	73	NR
	Total	44	73.0	47.0	26.0	55	18

1. Hungerford DS, Cockin J. Fate of the retained lower limb joints in Second World War amputees. Proceedings and Reports of Universities, Colleges, Councils and Associations. 1975;57(B1):111.
2. Burke MJ, Roman V, Wright V. Bone and joint changes in lower limb amputees. Ann Rheum Dis. 1978;37(3):252–54. [PMID: 150823]
3. Mussman M, Altwerger W, Eisenstein J, Turturro A, Glockenberg A, Bubbers L. Contralateral lower extremity evaluation with a lower limb prosthesis. J Am Podiatry Assoc. 1983;73(7):344–46. [PMID: 6875169]
4. Lemaire ED, Fisher RF. Osteoarthritis and elderly amputee gait. Arch Phys Med Rehabil. 1994;75(10):1094–99. [PMID: 7944914]
5. Kulkarni J, Adams J, Thomas E, Silman A. Association between amputation, arthritis and osteopenia in British male war veterans with major lower limb amputations. Clin Rehabil. 1998;12(4):348–53. [PMID: 9744670]

Amp = amputated, Control = nondisabled control, Nonamp = nonamputated, NR = not reported, OA = osteoarthritis, TFA = transfemoral amputation, TTA = transtibial amputation.

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Table 2.
Summary of postamputation fractures by cause and level of amputation, fracture site, interval between amputation and fracture, and cause of fracture.

Study	Subjects (*n*)	Fracture Location*	Mean Age at Amputation (yr)	Mean Interval Amputation to Fracture (yr)	Fracture Cause (No.)	
					Trauma	Fall
Gonzalez et al., 1980 [1]	8 (DV: 5, NDV: 3)	TFA: 5 hip; TTA: 3 femur	DV: 67.6; NDV: 14.7	DV: 3.2; NDV: 38.5	DV/NDV: 0	DV TTA: 5; NDV TTA: 2; NDV TFA: 1
Denton & McClelland, 1985 [2]	23 (DV: 15, NDV: 8)	TTA: 7 hip, 8 femur; TFA: 5 hip, 3 femur	DV: 62.6; NDV: 39.8	DV: 1.7; NDV: 12.8	NR	NR
Lewallen & Johnson, 1981 [3]	14 (DV: 5, NDV: 9)	TTA: 9 hip, 4 femur, 1 tibia; KD: 2 femur	DV: 68.4; NDV: 21.4	DV: 4.0; NDV: 19.3	DV: 0; NDV TTA: 4	DV TTA: 4; NDV TTA: 5; NDV KD: 2
Bowker et al., 1985 [4]	85 (DV/NDV: NR)	TTA: 19 hip, 27 femur, 7 tibia; TFA: 35 femur	NR	NR	TTA: 9; TFA 1	TTA: 35; TFA: 27; Other: 3

1. Gonzalez EG, Matthews MM. Femoral fractures in patients with lower extremity amputation. Arch Phys Med Rehabil. 1980;61(6):276–80. [PMID: 7377956]
2. Denton JR, McClelland SJ. Stump fractures in lower extremity amputees. J Trauma. 1985;25(11):1074–78. [PMID: 4057296]
3. Lewallen RP, Johnson EW Jr. Fractures in amputation stumps: Review of treatment in 16 fractures. Mayo Clin Proc. 1981;56(1):22–26. [PMID: 7453246]
4. Bowker JH, Rills BM, Ledbetter CA, Hunter GA, Holliday P. Fractures in lower limbs with prior amputation. A study of ninety cases. J Bone Joint Surg Am. 1981;63(6):915–20. [PMID: 7240332]

*Hip fractures include femoral neck, intertrochanteric, and subtrochanteric fractures.

DV = dysvascular, KD = knee disarticulation, NDV = nondysvascular, NR = not reported, TFA = transfemoral amputation, TTA = transtibial amputation.