Effect of Amputation Type on Functional Status in Peripheral Arterial Disease: An Educational Review

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Purpose

Amputations at different levels in peripheral arterial disease (PAD) may be considered when patients develop critical limb ischemia, non-healing wounds with superimposed infection, or refractory ischemia revascularization. Despite continued therapeutic advancement, there remains significant morbidity and mortality postamputation. Furthermore, this patient impact varies considerably by class of amputation and postoperative care. Therefore, endovascular specialists should possess a detailed understanding of lower extremity amputations. Here, we present an educational review of different types amputations for patients with PAD and unique considerations for maximizing patients' functional status and quality of life (QOL).

Learning Objectives

- **Understand the natural history of peripheral arterial disease and lower extremity amputations as pertinent to interventional physicians.**
- **Understand the multifaceted management requirements for TMA, BKA, and AKA.**

Methods

- A review of literature and current American Heart Association guidelines for PAD was utilized to construct an educational exhibit over lower extremity amputations.
- Specific considerations for each lower extremity amputation type were consolidated from literature review, including functional implications, complication rates, and post-operative optimization.
- Post-amputation care guides were constructed from available evidence related to immediate post-amputation care and mobility promotion.

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Lower Extremity Amputation Care

Specific Amputations

Transmetatarsal Amputation (TMA)

Functional Implications: Increased difficulty with normal walking speed and climbing stairs
Complications: Majority have some complications within 3 years (Adams, 2018). 14.5-27% progress to BKA, 15.7-34%% require revision (Tokarski, 2022; Kempe 2017).
Post-operative optimization: Total contact shoe-inserts and rigid rocker bottom shoes enhance function and reduce pressure in the plantar region (McCallum et al., 2012), where foot-ankle orthosis and short shoe were ineffective and poorly tolerated.

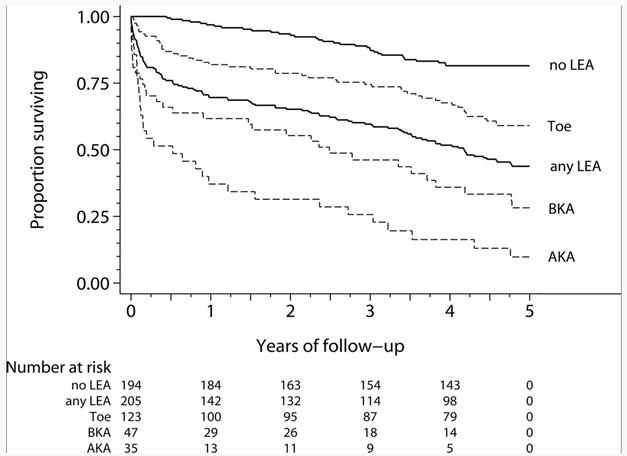
Below-knee Amputation (BKA)

Functional Implications: Maintains joint mechanics, with moderate energy expenditure and decreased ambulation rate relative to TMA.
Complications: Wound occurrences present in 10-30% of below-knee amputations. 19.7-34% of BKA undergo re-amputation.
Post-operative optimization: In addition to all components of stump optimization, rigid dressings should be favored over soft knee immobilizers to promote stump recovery.

Above-knee Amputation (AKA)

Functional Implications: Highest energy expenditure and lowest ambulation rates.
Complications: Current evidence suggests 7-30% of above-knee amputations develop wound occurrences, and approximately 12% of AKA undergo re-amputation.
Post-operative optimization: Follow general stump management

Non-Traumatic Lower Extremity Amputation Mortality



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Ambulation rates of BKA vs. AKA

Follow-up	Amputation	Total (*N*)	Ambulatory status		
			Baseline	6 months	1 year
6 months	AKA	107	44.9% (48)	25.2% (27)	
	BKA	226	83.2% (188)	58.0% (131)	
1 year	AKA	110	46.4% (51)		29.1% (32)
	BKA	283	86.9% (246)		64.3% (182)
6 months and 1 year	AKA	53	50.9% (27)	35.8% (19)	34.0% (18)
	BKA	122	86.9% (106)	65.6% (80)	65.6% (80)

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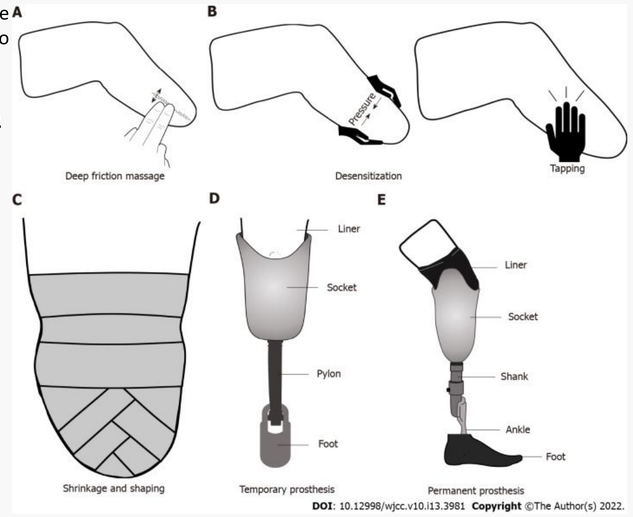

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General Amputation Management

Desensitization

All amputation stumps are highly sensitive after surgery, requiring massage, light tapping, pressure, vibration, and various fabrics 2-3 times every day for at least 5 minutes to decrease response to stimulus (Choo et al., 2022).

Shrink and Shape

As the most important step towards future prosthesis and proper healing/circulation, shrinking and shaping with rigid dressings or immediate postoperative prosthesis (IPOP) demonstrates superior stump recovery and lower postsurgical complications compared to soft dressings. (Choo et al., 2022).

Range of Motion and Exercise

To improve blood flow, build strength, and prevent various contractures unique to each amputation type, postoperative patients should engage in regular mobility training. This includes 3-minute isometric exercises beginning 1 week after surgery and elastic resistance band work beginning 3 weeks after surgery (Choo et al., 2022).

Skin Care

In addition to proper hygiene, controlling stump edema is a priority to prevent ulceration. Edema management techniques include stretching, compression, cooling, lymph node massage, and high-voltage pulsed current.

Phantom Limb Pain

Mirror therapy and transcranial direct current stimulation (tDCS) are the two most effective treatments for phantom limb pain, with tDCS with and without mirror therapy demonstrating better pain reduction than mirror therapy alone (Gunduz et al., 2021; Segal et al., 2021).

Discussion

Morbidity and mortality have been repeatedly demonstrated to increase with more proximal lower extremity amputations. However, rates of reamputation increase with more distal amputations. Transmetatarsal amputation can salvage limbs in the setting of forefoot gangrene or infection, and confers a favorable functional outcome over major amputation due to preservation of a weight-bearing surface. Maintaining joint mechanics in BKA results in higher likelihood of ambulation; however both major amputations (BKA and AKA) require diligent, coordinated follow up and devices such as stump shrinkers, limb protectors, and in the case of BKA, rigid knee immobilizers. Ambulation has a significant impact on decreasing mortality rates. Therefore, interventional physicians should be familiar with stump maintenance and the subsequent steps to increase mobility support.

In addition to stump optimization, controlling cardiovascular risk factors is critical at all levels of lower extremity amputation. This includes high-intensity statins, anti-hypertensive therapy, antiplatelet therapy, smoking cessation, and physical activity. Tight glycemic control in amputation patients with diabetes has demonstrated increased ambulation likelihood. Endovascular specialists should confirm limb salvage patients have appropriate social care upon discharge as decreased initial mobility elevates the risk of postoperative complications. As risk of recurrent disease and insult is high in amputation patients, lifelong follow up is recommended. Finally, counseling patients on functional expectations and individualized goals leads to higher subjective QOL in patients with amputations.

References