Primary Targeted Muscle Reinnervation During Lower Extremity Amputation Is Safe in Medically Complex Patients: A Propensity Score-Matched Analysis

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INTRODUCTION

- Targeted muscle reinnervation (TMR) can reduce phantom limb and residual limb pain following below- (BKA) or above-knee amputation (AKA).
- Patients undergoing BKA or AKA are often medically complex, with high rates of diabetes, renal disease, peripheral vascular disease, and cardiovascular comorbidities
- Whether TMR performed at the time of amputation increases postoperative complication risk in this population remains unclear.

PURPOSE

To evaluate whether primary TMR during BKA or AKA amputation impacts surgical outcomes in a high-risk medically complex population.

METHODS

- Retrospective review of the National Inpatient Sample (NIS) database (2019-2022).
- Adult patients undergoing BKA or AKA with and without primary TMR were identified.
- A medically complex subgroup was created and defined as patients with diabetes, renal disease, or peripheral vascular disease.
- Propensity score matching using a k-nearest neighbors algorithm with a 1:4 (TMR: no TMR) ratio, adjusting for demographics, comorbidities, hospital characteristics, amputation level, and admission type. Covariate balance was assessed using standardized mean differences < 0.1
- Data collected included surgical complications, including superficial site infection, dehiscence, hematoma, and seroma, reoperation, and length of stay.

RESULTS

Overall cohort

- 278,205 BKA/AKA patients and 0.43% underwent primary TMR.
- After matching, 2,020 BKA/AKA patients (50% no TMR, 50% TMR) comprising 71.5% BKAs and 28.5% AKAs.
  - Overall, 68.8% male, median age 55 years (range, 18-90), 69.1% White, 22.8% Black, and 7.7% Hispanic
  - Groups were well matched across demographics and comorbidities except TMR patients had higher rates of congestive heart failure (11.9 vs. 8.4%), smoking (28.2 vs. 24.2%), and lower rates of controlled diabetes (45.0 vs. 49.5%) (all $p < 0.05$).
  - Postoperative outcomes for the overall matched cohort reported in **Table 1**.

Medically Complex Subgroup

- 24,355 BKA/AKA patients and 0.37% underwent primary TMR.
- After matching, 400 BKA/AKA patients (80% no TMR, 20% TMR) comprising 91.3% BKAs and 8.8% AKAs.
  - Overall, 67.5% male, median age 60.5 years (range, 32-87), 52.5% White, 42.5% Black, and 5.0% Hispanic.
  - Groups were well matched across all demographics and comorbidities between TMR groups
  - Postoperative outcomes for the medically complex matched cohort reported in **Table 2**.

TABLE 1. OVERALL MATCHED COHORT – POSTOPERATIVE OUTCOMES

	All patients N = 2,020	No TMR N = 1,010	TMR N = 1,010	p
Any surgical complication	195 (9.7)	95 (9.4)	100 (9.9)	0.706
Surgical site infection	120 (5.9)	60 (5.9)	60 (5.9)	>0.999
Dehiscence	95 (4.7)	45 (4.5)	50 (5.0)	0.599
Hematoma	0 (0)	0 (0)	0 (0)	
Seroma	5 (0.2)	5 (0.5)	0 (0.0)	0.062
Reoperation	50 (2.5)	40 (4.0)	10 (1.0)	**<0.001**
Length of stay (days)	8.5 (0.0 - 72.0)	8.0 (0.0 - 70.0)	9.0 (0.0 - 72.0)	0.225

Data reported as n (%) or median (range, minimum-maximum);TMR, targeted muscle reinnervation

TABLE 2. MEDICALLY COMPLEX MATCHED COHORT – POSTOPERATIVE OUTCOMES

	All medically complex patients N = 400	No TMR N = 320	TMR N = 80	p
Any surgical complication	40 (10.0)	30 (9.4)	10 (12.5)	0.405
Surgical site infection	25 (6.3)	20 (6.3)	5 (6.3)	>0.999
Dehiscence	20 (5.0)	15 (4.7)	5 (6.3)	0.568
Hematoma	0 (0)	0 (0)	0 (0)	
Seroma	0 (0)	0 (0)	0 (0)	
Reoperation	25 (6.3)	25 (7.8)	0 (0.0)	**0.010**
Length of stay (days)	13.0 (2.0 - 70.0)	13.0 (2.0 - 70.0)	13.5 (5.0 - 30.0)	0.203

Data reported as n (%) or median (range, minimum-maximum); TMR, targeted muscle reinnervation

CONCLUSIONS

- This is the largest study to data evaluating TMR at the time of lower extremity amputation
- Primary TMR did not increase surgical complications, reoperations, or length of stay, even in the medically complex patient cohort, supporting its safety and broader role in optimizing pain and functional outcomes.

REFERENCES

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