



RETROSPECTIVE CHART REVIEW OF DATA ON BODY AND PROSTHESIS MASS OF PEOPLE WITH TRANS-TIBIAL AMPUTATION

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INTRODUCTION

Following a trans-tibial amputation (TTA) only part of the original limb musculature remains. The amount of musculature lost below the knee could affect the user's control over the trans-tibial prosthesis (TTP). To ensure that the user has a good control over the TTP, an ideal prescription would need to take into account many important factors, one of which is the mass of the TTP. Currently however, there is lack of evidence on optimal mass configurations of TTP to guide clinical practice. One key aspect towards finding optimal mass configurations of TTP is to understand the relationship between the user's body and TTP mass. Knowledge of this relationship may help in standardizing future recommendations for clinical practice. Hence, the purpose of this study is to find the relationship between TTP mass and different body segment masses/lengths.

METHOD

Subjects: Data on 13 individuals with unilateral TTA. Mean height and body mass of 1.71m and 83.3kg.

Procedures: This is a retrospective study; all retrieved data was de-identified before analysis. Body mass was measured without the TTP. TTP mass was measured with the suspension system and shoe. Residual limb length (RLL) was measured from the patella tendon to the distal end of limb.

Data Analysis: Descriptive statistics were used to derive relationships between TTP mass, body mass, and contralateral side mass. The contralateral side mass was calculated two ways 1) as 6.18%¹ of the user's body mass, representing complete shank and foot (CM) and 2) as 3.26%² of user's body mass, representing estimated mass of the lost limb segment (MLL). Body mass index (BMI) was computed and subsequently data was analyzed by BMI categories: normal, overweight and obese. To determine if differences exist among the BMI categories independent t-tests were performed with significance at $\alpha = 0.1$. Further, a Pearson Product Moment Correlation analysis was done for TTP mass and RLL.

RESULTS

Overall, the mass of a TTP is **2.6kg** which can be expressed as **3.2%** of body mass, **9.4%** of BMI, **51.6%** of CM and **97.6%** of MLL (Table 1). The TTP mass as a % of body mass ($p=0.06$), BMI ($p=0.04$), CM ($p=0.06$) and MLL ($p=0.06$) was significantly greater between the normal BMI group, and the obese BMI group. RLL and TTP mass have a negative relationship, $r = -0.25$.

Table 1. Prosthesis mass (PM) as a % of body mass (BM), BMI, CM and MLL by BMI categories

	PM (kg)	BM (kg)	PM as % of BM	BMI (kg/m ²)	PM as % of BMI	CM (kg)	PM as % of CM	PM as % of MLL
Normal (18.5 to 24.9kg/m ²), n = 4								
Mean	2.3	65.9	3.5% *	21.6	10.7%*	3.4	56.8% *	107.7% *
Range	1.8-2.7	60.6-78.1	2.3-4.3%	18.5-24.0	7.6-13.5%	2.3-3.9	37.6-69.8%	71.3-132.4%
Overweight (25 to 29.9kg/m ²), n = 4								
Mean	2.9	82.6	3.5%	28.3	10.3%	5.1	56.5%	107.2%
Range	2.0-4.1	75.1-95.3	2.7-5.4%	25.4-29.3	7.0-16.1%	4.6-5.9	44.0-87.2%	83.4-165.3%
Obese (>30kg/m ²), n = 4								
Mean	2.5	101.1	2.5%	35.4	7.0%	6.2	39.9%	75.7%
Range	1.8-3.2	77.1-129.8	2.4-2.7%	30.1-42.3	6.0-7.5%	4.8-8.0	38.1-43.3%	72.2-82.1%
All groups combined, n = 12								
Mean	2.6	83.3	3.2%	28.4	9.4%	5.1	51.6%	97.6%

* - Normal BMI group significantly different than Obese BMI group, $p < 0.1$

DISCUSSION

There is a lack of evidence on the relationship between a user's body and TTP mass. This preliminary investigation has yielded ranges for relationships between TTP mass, body mass, BMI, CM and MLL of users (Table 1). The values found here for TTP mass as % of body mass are larger than past reports^{3,4}, which could be because TTP mass in this study was taken with the suspension system and shoe. An analysis of the sample by BMI revealed that all TTP mass and user relationships change across the 3 categories, with significant difference between the normal and obese BMI groups. Interestingly, TTP mass was similar for the 3 BMI categories, but on analyzing TTP mass as a % of all other variables (Table 1) it was found that individuals with normal BMI have a relatively heavier TTP, compared to those with obese BMI. Further, the TTP mass was found to be 75.7 to 107.7% of MLL. RLL was inversely related to TTP mass; the longer the TTP the less it weighs. Future studies should review data on a larger sample size and utilize a variety of clinics & clinicians to gain a better insight into TTP mass and user relationship.

CONCLUSION

The TTP mass and user relationship is different for each BMI group. Knowledge of this difference may make it more convenient for clinicians when deciding on the initial TTP mass.

CLINICAL APPLICATIONS

Clinicians should aim to keep their patient's TTP mass around 3.2% of the body mass. This, however, may change based on the patient's BMI.

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