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I. Introduction

The goals of prosthetic rehabilitation are to improve the new amputee's functional capability and to successfully reintegrate the patient into their community. Function can affect more than just mobility; in a study of 25 transtibial and transfemoral amputees, Deans et al. found that there was a significant relationship between amputees' functional ability and their physical, psychological and social well-being[1]. While there are many advanced technologies that claim to improve patient function, often the research is inadequate in terms of experimental design and ecological validity [2]. In fact, a national meeting to assess the research needs in prosthetics and orthotics cited outcomes research as the highest ranked area of need [3]. To combat this lack of knowledge, a prosthetist or physical therapist can perform qualitative functional assessments to gauge the effectiveness of various interventions and components with an individual patient. A previous case report has outlined this procedure to quantify the impact of prosthetic knee choice on balance confidence [4]. This type of assessment protocol allows the prosthetist to see which components have the greatest positive impact on the patient's function, making it instrumental to the patient's successful reintegration into the community and overall quality of life.

However, very little has been studied about functional development after major limb amputation. Munin et al. studied the predictive factors for early ambulation among lower-limb amputees but ended data collection after the patients were discharged from inpatient rehabilitation[5]. This showed that early prosthetic training can be beneficial in the short term, but did not consider the long term effects. Another study assessed the functional abilities of transtibial amputees one year after amputation, and those results were used to show that longer residual limbs can be associated with improved mobility [6]. While valuable for comparison, a cross-sectional study like this one does not consider the way in which the patients reached independence, nor does it include the components used by each patient. More valuable to a prosthetist would be a study showing how a group of similar patients progresses functionally through the prosthetic process. Furthermore, where research on patient function following amputation does exist, the outcome measures used are standard gait protocols with limited ecological validity to assess community mobility [2]. Therefore, valid, quantitative research is needed to illustrate how a patient progresses through the recovery process.

With regard to amputee rehabilitation, each phase has distinct challenges, goals and outcomes (Table 1). This case report shows the functional development of one patient from prosthetic training to follow-up, assessing his functional status at intervals.

Table 1. Phases of amputee rehabilitation[7]

Phase	Hallmark
Preoperative	Assess body condition, patient education , surgical level discussion, prosthe
Amputation Surgery & Rehospitalization	Length, myoplastic closure, soft tissue coverage, nerve, handling, rigid dres
Acute Post Surgical	Wound healing, pain control, proximal body motion, emotional support
Pre-prosthetic	Shaping, shrinking, increase muscle strength, restore patient locus of contro
Prosthetic Prescription	Team consensus on prosthetic prescription and fabrication
Prosthetic Training	Increase prosthetic wearing and functional utilization
Community Integration	Resumption of roles in family and community activities, emotional equilibriu
Vocational Rehabilitation	Assess and plan vocational activities for future, many need further training c
Follow-up	Lifelong prosthetic, functional, medical assessment and emotional support

II. Case Presentation

The patient is a 74 year old male. He is 6 feet tall and weighs 143 pounds. He was non-diabetic. After a post-operative blood clot led to gangrene in January 2010, the patient underwent amputation of his right leg at the transtibial level. No other vascular symptoms have been reported. He is osteoporotic. Also of note, the patient had a total knee replacement on his left knee in 1999 and right knee in 2001. He smokes three small cigars daily and does not drink alcohol. He was retired and lived in a two story home with his wife but did not use stairs daily. Prior to the amputation, he required no assistive devices to ambulate independently and enjoyed camping and yard work.

The patient works with a prosthetist and physical therapist at Dayton Artificial Limb in Dayton, Ohio. He received a patella tendon bearing (PTB) socket in March 2010, but experienced sharp pain at distal patella and distal tibial prominence accompanied by persistent redness at those areas. The prosthetist added dense pads to the patellar region and distal end of the socket, but little improvement was seen. The clinician and physical therapist agreed that the patient was a good candidate for a vacuum prosthesis, because it could relieve the areas of high pressure on the patient's limb by evenly distributing forces over a total surface weight bearing socket[7]. He began wearing the vacuum system prosthesis (Fig. 1) in May 2010, and the clinician evaluated

his functional status at the two month, three month and 15 month landmarks in the training and community integration stages of his rehabilitation process with the vacuum system.

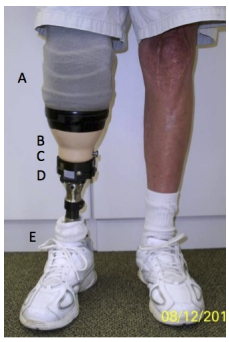

Figure 1. Patient's vacuum system prosthesis: silicone liner (not visible), sealing sleeve (A), thermop

III. Assessment

An attempt was made to implement the most reliable and ecologically valid instruments for the patient's functional assessment (Appendix ii-iii). First, the patient self-reported his functional capabilities with the Locomotor Capabilities Index 5 (LCI5), a measure of a lower limb amputee's perceived capabilities with a prosthesis. It was originally developed as part of the Prosthetic Profile of the Amputee questionnaire and consists of 14 basic and advanced activities on a five-point ordinal scale. Analyses show that it demonstrates good internal consistency, test-retest reliability, and construct validity when used with adults with lower limb amputation[9-11]. It has been shown to be able to detect changes in functional limitations throughout rehabilitation [6,11], making it appropriate for this report.

The second assessment was the Instrumental Activities of Daily Living (IADL) index, which is a tool used to measure functional independence in a wide range of patient groups[12]. While not a measure of locomotor ability, it does yield information about a patient's general ability to perform daily tasks. It is especially useful for this patient, because the researcher hoped to compare his performance to non-amputees in his age group and age-matched norms are well established for IADL. Both assessments were given in an interview so that the researcher could clarify any questions the patient had about the measures.

IV. Outcome

On the patient's first visit since agreeing to participate in the case study, two months after receiving the vacuum prosthesis, he was administered the LCI5 and IADL assessments (Table 2). While considering his vacuum prosthesis and using a cane, he scored 24 points in general

activities and 16 points in advanced tasks. His IADL score reflects an inability to do light housekeeping tasks.

Table 2. Patient's Functional Assessment Results

Duration of EV Use	LCI5 Score (56 possible)	IADL Score (8 possible)
2 months	38	6
3 months	36	8
15 months	41	8

After three months of wearing the prosthesis, the patient came into the clinic for a routine check of his prosthesis and functional evaluation. He walked using a cane and expected to remain doing so. He reported that sometimes he doffs the prosthesis if it begins to ache within the first twenty minutes of donning, but usually re-dons it after his residuum "calms down" and from that point wears it for 4-6 hours without pain. The redness he experienced with the PTB socket had largely disappeared, and his limb appeared healthy, even showing hair re-growth at the distal end (Fig. 2). Again, the clinician administered the LCI5 and IADL assessments. His LCI5 score decreased for advanced two tasks: going up a few stairs without a handrail and walking while carrying an object. He indicated that he would only perform those tasks if someone was nearby. His IADL score improved because he felt more confident performing light household work like putting away dishes. No major component changes were initiated because the patient's progress seemed to be adequate with current components.

Figure 2. Three month follow-up. Medial view of patient's residual limb immediately after wearing pro

Figure 3. 15 month follow-up. Anterior view of residual limb immediately after wearing the prosthesis f

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