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Utilizing the Amputee Mobility Predictor for Determination of Functional Level Following a Unilateral Transtibial Amputation: A Case Study

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Abstract

Background: In 1995, Medicare developed the Medicare Functional Classification Level (MFCL) system to classify lower extremity amputees into different categories to guide prosthetic reimbursement based on their potential level of ambulation. Very few clinical tests exist to accurately assist clinicians in determining an amputee's mobility potential. The purpose of this case study is to demonstrate the use of the AMP in order to provide an objective and appropriate determination of an amputee's mobility following a unilateral transtibial amputation. **Case Description:** The patient was a 61 year old male status post left transtibial amputation following a bimalleolar ankle fracture which healed in valgus deformity with nonunion. The AMP was administered three weeks after his amputation. The patient scored at a K3 level and he was subsequently fitted for his prosthesis. **Intervention:** The patient was seen in physical therapy for 5 visits for lower extremity strengthening, gait training, and various balance training tasks beginning 9 weeks after his amputation. **Outcome Measures:** Outcome measures used were 10 meter walk test (10 MWT) and the Timed Up and Go (TUG) test. The subject's gait speed at his initial evaluation was 0.89 m/s and his TUG time was 15.2 seconds. At his final visit his gait speed improved to 1.3 m/s and his TUG time improved to 11.5 seconds. **Discussion:** This case describes the use of the AMP to determine an amputee's functional classification level in order to maximize mobility and quality of life after a transtibial amputation. This case also demonstrates that the AMP is a quick and simple way for clinicians to use objective data to determine an amputee's potential for ambulation.

Background

Each year there are approximately 185,000 amputations that occur in the United States leading to an estimated 1.6 million people living with the loss of either an upper or lower extremity. 86% of amputees are lower extremity amputees equating to an estimated 1.3 million individuals living with the loss of at least on leg.[1-3]

In 1995, Medicare developed a way to classify amputees into different levels (K0, K1, K2, K3, and K4) based on their predicted ability to ambulate with a prosthetic leg and their rehabilitation potential. This system is called the Medicare Functional Classification Level (MFCL) system. The purpose of this classification system is for clinicians to determine a predicted level of mobility that an amputee will be able to achieve in order to determine the level of prosthesis and prosthetic components that insurance will pay for. One major limitation with this system at its implementation, however, was that there was very little objective information for physicians, physical therapists and prosthetists to use when determining a mobility level. This left the practitioners to rely on subjective information, prior level of function, current condition and the patient's desire to ambulate when determining a K level.[3] This method is problematic because K level determination can be influenced by factors such as experience with amputees, personal opinions and potential biases of the practitioner making the decision for the amputee, making it variable and unreliable. Thus, an individual may be assigned a K level lesser than their functional capability, thereby making optimal prosthesis components unavailable. Conversely, a practitioner may incorrectly classify an individual with too high of a K level. This leaves the amputee at a disadvantage because they do not have the ability to operate the prosthesis appropriately. This error in classification may lead to the patient not being able to maximize their function and mobility leading to poorer patient satisfaction and quality of life.[4]

Many clinical tests and measures are utilized in clinics today to aid in the determination of predicted mobility, however, most ambulation assessments are not specific to amputees and therefore lack the efficacy needed in order to ensure that an accurate prognosis is being made. Some of these tests include the 6-minute walk test (6 MWT), Tinneti's Performance-Oriented Assessment of Mobility Problems (POMA), Duke Mobility Skills Profile (DMSP), the Timed Up and Go (TUG) and more.[3,5] The fault in relying on these measures is not that they are poor tests, but rather they do not encompass all of the functional tasks required to assess an amputee's mobility potential. For this reason, Robert Gailey, et al developed the Amputee Mobility Predictor (AMP) as a way to objectively measure an amputee's functional performance and predict their potential to utilize various levels of prostheses.[3]

The AMP is a clinical test consisting of 20 tasks that are given a score of 0, 1, or 2 based on the amputee's performance. There is an item 21 where a score is given ranging from 0 to 5. The score for item 21 is determined based on the assistive device used during the test. Certain test items require the amputee to stand on their prosthesis (for testing to advance mobility levels after an initial prosthesis has been issued). Therefore, when the AMP is being used for an initial prosthesis a score of 0 is assigned for each of these tasks. Thus, the highest score an individual can achieve on the AMP without their prosthesis is 43. Each component of the AMP is designed to test the ability of the amputee to perform a task required for the differing functional levels. For example, test items one through seven differentiate between the K0 and K1 levels. These items test the amputee's sitting balance, ability to transfer from chair to chair, perform a sit to stand transfer, and their standing balance. Test Items 15 through 20 are designed to test the amputee's ability to perform higher level mobility tasks that would be required of a K4 ambulator. These items test the individual's ability to perform single limb stance, hopping, stepping over a 10 centimeter tall object, varying gait speed, and their ability to ascend and descend stairs. The AMP is the only clinical test that is specifically designed to differentiate mobility levels for the determination of an amputee's K-level.

While the AMP has been available for over 15 years, it is not universally used and may be unknown to providers who do not treat many amputees. This causes practitioners to continue to use other non-objective measures and mobility assessments that are not specific to predicting the mobility of an amputee. The purpose of this case study is to demonstrate the use of the AMP in order to provide an objective and appropriate determination of an amputee's mobility following a unilateral transtibial amputation.

Case Description

History

A 61 year old male presented to physical therapy three weeks after undergoing a left transtibial amputation. He was walking outside during the winter one year prior and experienced a slip and fall which resulted in a bimalleolar fracture of his left ankle. Prior to his ankle injury he was independent with gait and all ADL's. He is a retired bus driver who likes to hunt, fish, and work on motorcycles. The fracture was treated non-operatively. He continued to have high levels of pain in his ankle one year after the fracture occurred and was having a lot of difficulty walking leaving him mostly non-ambulatory. Prior to his amputation he had a visit with his orthopedist and imaging revealed that the fracture went on to heal with a valgus deformity and malunion. Imaging also showed severe joint degeneration of the talocrural joint space. The patient had tried multiple methods of bracing and orthotic boots over the previous year, all which were unsuccessful at alleviating his pain. The orthopedic surgeon discussed the options of an ankle fusion or transtibial amputation as his two surgical options. Due to history of poor healing and the poor functionality he would have with a fused ankle, the patient elected to pursue the amputation.

His past surgical history included a transmetatarsal amputation of his left foot due to an accident he was involved in when he was seven years old. The patient's past medical history includes hypertension, obstructive sleep apnea, hyperlipidemia, thyroid disorder, and diabetes.

The patient lives in a one story ranch style house with his wife. They have two stairs to enter the home. There is no hand rail on their stairs, however, the patient is able to hold on to the door frame to stabilize himself when ascending and descending the steps.

AMP Testing

3 weeks following his amputation, the patient presented to physical therapy in order to perform the AMP assessment (see Gailey et al for example of the instrument[3]) to determine his predicted level of mobility. This was needed in order to guide his prosthetist in the prescription of his prosthesis. The purpose of the testing was explained to the patient and he acknowledged his understanding. After completing a patient history we began his AMP testing. It is important to note that there is an overlap of testing items among the different K-levels in which they are intended to test. The reason for the overlap is that each K level requires a combination of abilities consisting of balance, strength, ambulation. No single test item is intended to specify a K level independently. The examiner should look at the test as a whole when determining the final score.

Tasks 1-7 of the AMP are intended to test the amputee's ability to perform tasks that would be appropriate of a K0 mobility level. An individual at the K0 mobility level does not have the ability or the potential to ambulate or transfer safely with or without a prosthesis. Thus, a prosthesis would not enhance the individual's mobility or quality of life.[6] Tasks 1-7 are therefore aimed at determining an individual's ability to transfer safely, their ability to sit without support, and their stability with static stance. Our patient was able to perform all of the tasks in this portion of the AMP, however, he did require assistance from his arms due to poor stability with single limb stance and weakness of his right (uninvolved) leg when attempting to perform a sit to stand transfer.

Test items 4, 6, 7, 8, 9, 10, 11, 13, and 14 are intended to determine the amputee's ability to perform tasks appropriate of a K1 mobility level. At the K1 mobility level, the amputee would have the potential to use a prosthesis for transfers and ambulation on level surfaces at a fixed cadence. Typically, a K1 level ambulator is an individual who walks only in their home.[6] These tasks assess the patient's ability to stand on one leg, reach outside of their base of support while standing, ability to maintain standing balance when a perturbation is introduced to their upper body, ability to maintain single leg balance with closed eyes, ability to sit from standing in a safe and controlled manner, and their ability to initiate gait without hesitancy. Once again, our patient demonstrated the ability to perform each of these tasks, though he once again required the use of his arms for the balance tasks.

AMP items 7, 9, 10, 15, 16, and 17 are intended to assess whether an amputee can perform tasks typical of a K2 ambulator. An individual at the K2 level has been determined to have the ability to ambulate outside of their home and can traverse low level barriers such as curbs or uneven surfaces.[6] Items 15, 16, and 17 test the patient's ability to hop on their non-prosthetic limb for 8 meters and their ability to turn 180 degrees to sit in a chair. These items are scored based on the amputee's ability to get foot clearance while hopping as well as obtain at least 30 centimeters of foot advancement with each hop. Item 16 observes continuity during the hopping task and the 180 degree turn (item 17) is scored based on the number of hops it takes to perform the full turn. Our patient was able to perform each of these tasks without difficulty resulting in maximum scores on each test item.

Tasks 9, 10, 12, 15, 16, 17, 19, and 20 are aimed at determining an amputee's ability to perform at the K3 level. Individuals at this mobility level have the potential to ambulate with variable cadence as well as traverse most environmental barriers. They may have vocational, therapeutic or recreational demands that extend beyond simple locomotion.[6] Item 12 assesses the amputee's ability to pick an object up off of the floor while standing. Our patient was able to complete this task, however, he required the use of his arms for support and assistance with returning to standing from a stooped position. The use of his arms in this item resulted in the deduction of 1 point. Items 19 and 20 test the individual's ability to hop over a 10 cm high obstacle as well as ascend and descend 2 stairs. With the use of his crutches, our patient was able to ambulate over the 10 cm obstacle without any change in his stride and no unsteadiness was noted. Our patient also demonstrated the ability to ascend and descend stairs. To do so safely, however, he required the use of his crutches. In order to score the maximum score on this test item, you must ascend and descend 2 stairs without the use of an assistive device or handrail. Therefore, our patient was penalized 1 point in both components of stair navigation.

Finally, test items 9, 15, 16, 18, 19, and 20 assess the amputee's ability to perform tasks at the K4 level. A K4 level ambulator exceeds the needs of basic ambulation. They require a prosthesis that will allow them to partake in high impact activities. This level is typical of children and athletes.[6] Item 18 is the only test item unique to this subset of tests and its purpose is to test the amputee's ability to perform variable cadence. The amputee begins ambulating at their self-selected gait speed. They are then instructed to walk fast, followed by the instruction to walk slowly. The examiner looks for the amputee's ability to perform the task with a clear and smooth change in gait speed without hesitation. Our patient demonstrated the ability to change his gait speed without asymmetry and demonstrated good balance throughout this test.

Finally, to score item 21, our patient used crutches for the entirety of this test which gave him a score of 3 out of a possible 5. Our patient's final score was determined at the completion of his AMP testing. He scored a 31 out of a possible 43 points which placed him at the K3 mobility level (See Gailey et al, 2002[3]).

Initial Evaluation
Examination and Evaluation

Six weeks later, the patient had received his prosthesis. He presented to the physical therapy clinic wearing his prosthesis immediately following his appointment with the prosthetist. His prosthetist fit him with a dynamic vacuum socket (Ottobock DVS) and an Agilix foot from Freedom Innovations.

At the start of the examination, the patient's prosthesis was removed and his skin was assessed. His incision appeared to be healing well with no signs of active drainage or infection. He also had no areas of excessive redness indicating pressure from his socket.

The patient's hip and knee strength and mobility were assessed using goniometric measurements and manual muscle testing (MMT). MMT revealed that the patient had weakness in his left hip with flexion, abduction, extension, and adduction with scores of 4/5. Knee flexion and extension were tested both with and without his prosthesis. With his prosthesis off he demonstrated excellent knee flexion and extension strength achieving scores of 5/5. When we tested these motions with his prosthesis on he scored 4/5 for both knee flexion and knee extension. The patient had knee active range of motion to 130 degrees and active hip extension to 15 degrees.

Special testing was not indicated for this patient, therefore, no special tests were performed. Personal factors for this patient included that he was married and had support from his spouse at home. There were no psychological factors or learning barriers identified. We observed the patient during ambulation and noted that he demonstrated a significant lateral lean to his right during gait. He was not shifting his weight over his prosthetic side and was spending decreased time in stance on his left side. This same observation was made during static stance. When asked to perform single limb balance he was unable to stand unsupported on his prosthetic side. The patient was primarily using crutches for ambulation but was able to walk short distances without the use of an assistive device, though he demonstrated unsteadiness of gait.

Diagnosis and Prognosis

After evaluating the examination findings along with the tasks completed in the AMP, it was determined that the patient's primary limitations were due to standing balance impairments. The patient had difficulty standing on his sound limb without using an assistive device. He also had difficulty with tasks that required him to move outside of his base of support without the use of his crutches.

This patient demonstrated adequate hip and knee range of motion required in order to successfully use a prosthesis. He also demonstrated good static strength, however, we observed during gait that the patient demonstrates an excessive lateral lean to his right (non-prosthetic) side. We determined that this excessive lateral trunk motion could be due to a combination of factors including:

1. Good strength statically which is not demonstrated when performing a dynamic task such as walking.
2. Poor motor program due to abnormal gait since childhood transmetatarsal amputation.
3. Lack of trust for prosthesis, therefore, avoiding placing all of his weight through the prosthetic limb.
4. Poor proprioceptive awareness on his left side making him avoid time spent on his prosthetic leg.

When formulating our plan of care, we attempted to address each of these possible contributing factors.

His AMP score was 31/43 which placed him at the K3 MFCL. This patient is predicted to have the ability to ambulate with variable cadence which is required of a typical community ambulator. He is likely to have the ability to traverse most environmental barriers and he may have demands due to hobbies and a desired level of function that requires prosthetic use beyond simple locomotion. Based on our evaluation findings we felt that the K3 mobility level was appropriate for this patient. We anticipated that with 4 additional visits of physical therapy over the course of 5 weeks for balance and gait training, this patient would achieve the ability to ambulate independently and safely at home and in the community. We utilized his deficits that were identified by his AMP testing to guide our treatment goals, as well as tasks that would be necessary in order to be a safe community ambulator. To help return the patient to his prior level of function and enable him to perform all of his desired activities, the 5 week goals for this patient included:

1. Ambulate 500 feet independently without the use of an assistive device.
2. Ascend and descend a full flight of stairs with a reciprocal step pattern.
3. Ambulate on uneven surfaces without loss of balance.
4. Be independent with his home exercise program for continued lower extremity strengthening.

The patient's prognosis for meeting goals was excellent.

Intervention

The patient underwent 5 total physical therapy visits consisting of his initial evaluation and 4 subsequent visits. As predicted at his initial evaluation, this patient was able to achieve each of his physical therapy goals after 5 weeks of treatment. Treatment was aimed at normalizing his gait by ensuring he is able to achieve each stage of the gait cycle. We also included many interventions that were intended to challenge his balance as this was determined to be one of the most difficult tasks from his AMP testing.

During the 5 weeks of physical therapy treatment, normalization of gait was his biggest struggle. He had the most difficulty achieving heel strike at the initial stance phase of gait and he also demonstrated poor toe off in terminal stance on his prosthetic side. We determined that the reason for this was because he was taking a shortened stride and spending less time with his left leg in stance phase. To attempt to correct this we included interventions that got him comfortable bearing weight through his prosthesis. We then progressed to interventions that forced him to slow down and exaggerate each step such as marching and stepping over small hurdles. We cued him to focus on hip extension and taking larger steps. By the final physical therapy visit he demonstrated the ability to ambulate with symmetrical step lengths and he was achieving both heel strike and toe off.

We also included interventions that challenged his balance and tested his ability to walk on uneven surfaces as expected of a K3 ambulator. He had difficulty with this early in his treatments, however, after 5 weeks he demonstrated the ability to ambulate on various surfaces without an assistive device and no loss of balance. He also reported that prior to his final physical therapy visit he was able to rake his yard. He reported no loss of balance with walking on the grass.

This patient did experience complications that limited how much activity he was able to perform throughout each session. At his second treatment session he experienced cramping in his calf. This would occur when he stood after sitting for extended periods of time. On his third treatment session he presented to the clinic with blistering on his skin where the edge of his liner sat around his mid-thigh. The patient had noticed the blisters forming one day prior to his third treatment session. We contacted his prosthetist and he was given liner liners to wear in order to prevent direct contact between his liner and his skin. When the patient returned for his fourth treatment session the blisters had healed.

By the end of his fifth visit all goals were met and he was ambulating at home and in the community safely and without any assistive device. He had no further needs for outpatient physical therapy and we determined that it was appropriate to end his episode of care at that time.

Outcomes

The patient was seen for 5 visits over 5 weeks following the issuance of his prosthesis. His AMP was completed prior to his initial evaluation and he was issued a K3 level prosthesis. To measure the patient's progress throughout his episode of care we utilized the 10 meter walk test to monitor changes in his gait speed and the TUG test to monitor his fall risk. These tests were performed during his first and last sessions and were performed using standard testing procedures.

With the 10 MW test at his first visit, his preferred gait speed was 0.89 m/s. At his final visit, his calculated preferred gait speed was 1.3 m/s. Clinically important differences and minimal detectable change have not yet been determined for the amputee population, however, this gait speed did place him in the average range for healthy community dwelling adults in his age group of 60-69 years old.[7]

We decided to utilize the TUG test because it incorporated many aspects of balance that individuals face frequently when at home and in the community including a sit to stand transfer, ambulating forwards, turning, and performing a stand to sit transfer. At his initial visit, his TUG time was 15.2 seconds which placed him at an increased risk of falling. On his final visit his TUG time had improved to 11.5 seconds. This change of 3.7 seconds exceeds the minimal detectable change for the amputee population and was clinically significant. Based on his final TUG score he was not at an increased fall risk as the cut-off score for community dwelling adults is 13.5 seconds.[8,9]

Other outcomes used to determine appropriate discharge from physical therapy services was monitoring the patient's progress towards meeting his physical therapy goals. As mentioned above, by the fifth visit this patient had met each of his goals that were determined at his initial evaluation.

Discussion

The purpose of this case study was to demonstrate the use of the AMP in order to provide an objective and appropriate determination of an amputee's mobility following a unilateral transtibial amputation. This case provides an example of an instance when the AMP was accurate in assigning a predicted mobility level to effectively set the patient up for a successful return to their prior level of function. The AMP was completed and was used to determine what prosthesis this patient would need. He then underwent normal physical therapy for transtibial amputees at this institution. Interventions were aimed at learning to use his prosthesis, learning a new gait pattern, and practicing new balance techniques.

A lower extremity amputation is a medical event that has obvious implications on mobility.[4,10,11] Mobility and function have been linked to patient's quality of life following amputation and should therefore be treated as one of the most important goals in post-amputation rehabilitation.[4] In a study by Suckow, et al, 26 lower extremity amputees were interviewed in which 65% of them reported that poor mobility had a negative impact on their quality of life.[12] A systematic review by Davie-Smith, et al evaluated influences on quality of life in patients who had undergone an amputation due to peripheral arterial occlusive disease. In this review, the authors identified multiple factors that influenced quality of life following an amputation including the ability to walk with a prosthesis, gender, age, presence of comorbidities, and family support. However, the ability to successfully utilize a prosthesis for ambulation had the greatest impact on quality of life over any other factor.[4,13] Thus, physical therapy interventions should prioritize ambulation and normalizing gait mechanics following prosthetic fitting.

Clinicians today use many methods of determining predicted mobility levels and it is important to take into consideration all of the factors that may affect a patient's ability to ambulate. However, a 2016 study by Borrenpohl, et al found that only 38% of its respondents who are involved in prosthetic prescription actually used outcome measures. This same study found that 67.8% of respondents are not confident in the current K-level system for determining mobility potential.[5] When practitioners are uncertain in the decisions that they are making for their patients, we risk lowering the quality of care resulting in poorer patient outcomes. For example, a study by Gailey, et al found that 30% of amputees received an ankle/foot that was intended for a lower functional category than the amputee's were capable of functioning. For this reason, outcome measures should be used in order to make evidence based clinical decisions on prosthetic prescription and determination of rehabilitation potential. We also need to ensure that the outcomes we are using are validated for the purpose we are intending to use them, in this case, determining predicted mobility levels for amputees.

Restoring mobility and independence should be of utmost importance in physical therapy interventions following a lower extremity amputation in order to improve the quality of life and overall function of amputees. We need to ensure that we as healthcare professionals are setting our patients up for success and maximizing their potential to achieve their personal goals and return to their desired level of function by utilizing appropriate outcome measures to determine mobility potential. The AMP is a tool that has been demonstrated to be effective at determining an accurate prognosis for amputees and can guide clinicians to getting the patient the proper equipment that will allow them to maximize the use of their prosthesis. This clinical test should be used along with other factors such as age, need for mobility, and presence of comorbidities that may affect ambulation when determining an appropriate prosthesis for an amputee.

Conclusion

This case report described how the AMP was utilized in the outpatient physical therapy clinic setting to determine the MFCL (K-level) of an individual with a unilateral transtibial amputation. The outcomes showed significant improvement in patient safety and mobility in a short period of time with physical therapy consisting of lower extremity strengthening, balance training, and gait training. Despite several challenges this patient experienced, this case demonstrates that the AMP was accurate in assigning a predicted mobility level for our patient and is clinically feasible. Along with determining mobility levels, the AMP is a way for clinicians to identify functional impairments and guide treatment interventions to improve mobility. Future research should focus on comparison of AMP determined mobility levels with other predictive measures used in amputee clinics today. Future studies should also look at the most effective ways to maximize mobility in order to improve patient satisfaction and quality of life.

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