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Outcome measures used in lower extremity amputation: Review of clinical use and psychometric properties

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Abstract

Decreased mobility and negative effects of poor functional status (FS) significantly reduce the quality of life in individuals with lower extremity amputation (LEA). These parameters should be evaluated in detail, and FS should be revealed. Measuring the results is important in terms of enabling clinicians to evaluate the quality of care and the effectiveness of treatment. The fact that the measurements are not purposeful makes the obtained results (evidence) and consecutively treatments unreliable. To obtain valid and reliable results, it is important to use measurement tools that are valid and reliable. Considering all these, the current FS should be evaluated using valid and reliable outcome measures (OMs). Numerous OMs are used to evaluate the FS of individuals with LEA. The multiplicity of available criteria, when coupled with the concept of multidimensional FS, complicates the selection of appropriate OMs for use with this population. Resources providing information about OMs used in the domain of LEA are limited in the literature. Many of the commonly used OMs are not included in the available sources. This review is designed to provide up-to-date information on clinical suitability and psychometric properties of OMs used in individuals with LEA. We believe that this study will help healthcare professionals serving in the field of LEA and prosthetics to learn about and choose the appropriate OMs.

Keywords: Amputation, Lower extremity, Outcome assessment, Health care, Psychometrics

Introduction

With the increased prevalence of vascular disease and increased life expectancy, lower extremity amputation (LEA) has become a prominent issue. In Australia, 3.400 LEAs are performed every year due to diabetes mellitus, which amounts to 12 amputations per 100,000 people [1]. If the increases in vascular disease and obesity continue, this rate is expected to increase further. Vascular dysfunction is responsible for 80-90% of LEAs in developed countries. Other causes of amputation include trauma, cancer, and congenital anomalies [2]. The need to evaluate the results of rehabilitation in LEA has become critical in healthcare centers. However, the use of outcome measures (OMs) by clinicians is limited due to insufficient knowledge of valid and reliable OMs. Clinicians not only determine the effectiveness of their interventions using the OMs but also show the positive effects of the intervention to the patient and third parties [3].

Since the decrease in mobility and negative effects of poor functional status (FS) in individuals with LEA will significantly affect the quality of life of the individual, these parameters should be evaluated in detail and FS should be revealed. Given all this, the current FS needs to be evaluated using valid and reliable measures. There are many OMs to evaluate the FS of individuals with LEA. The abundance of existing measures complicates the selection of appropriate OMs used in this population [4].

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In the literature, the sources that provide information about the OMs used in the LEA field are limited, and many of the commonly used OMs are not included in the available sources. However, it is worth noting the need for a study that provides up-to-date and detailed information on the clinical usefulness and psychometric properties of these OMs. This review was designed to provide up-to-date information on clinical use suitability and psychometric properties of OMs used in LEA. The reviewed OMs in this study indicate the most common clinical measures that can be used for assessing the functional abilities and the quality of life in individuals with LEA during the treatment process. This study also describes OMs that are simple to administer and require restricted resources, and, for this reason, could be easily applied in a clinic. This study will help healthcare professionals serving in the field of LEA and prosthetics to learn about and choose the appropriate OMs.

Functional status

Health professions have become responsible not only for the treatment of acute diseases but also for the management of chronic diseases and disability. The World Health Organization (WHO) has developed classification systems to ensure the integrity of concepts and standardize measurement within the healthcare profession following this paradigm shift. The International Classification of Functioning, Disability and Health (ICF) was approved by WHO member states in 2001. In ICF, there are concepts of capacity, ability and performance. FS covers a range of functional areas including individual's thoughts, feelings and overall health-related quality of life, including physical functions such as step activities and walking, the ability to work and maintain a job, psychosocial and emotional functions [5]. Evaluation of FS is important in clinical and scientific research. The clinician records his practices, decides on the choice of treatment and prepares a report on the effects of the selected treatments. The need to record changes in the FS when combined with the complexity and diversity of the FS has led to the development of numerous OMs [6].

Outcome measure types

The way the result measure is applied determines the type of information obtained. The capacity, capability, and performance parameters existing in ICF provide important information about the FS of the individual. Self-report measures such as surveys evaluate capacity, while performance-based measures evaluate also real-world performance along with capacity. Ease of application and the low cost is effective in the widespread use of self-report measures in the clinic. Self-reporting measures include surveys and interviews and do not require extensive additional training for practitioners. The weaknesses of the self-report measures are that they are subjective. Patients may show their capacity more or less than they are. Therefore, the data obtained from the self-report measures may not be a true reflection of the FS. Factors such as culture, language, educational background, cognitive impairment, and depression affect the person's responses to self-report measures [7]. Performance-based measures enable more objective data to be obtained and have the potential to provide quantitative data that enable quantitative analysis as well as evaluating the change in FS [8].

Psychometric properties of outcome measures

Psychometric properties should be taken into account when choosing the outcome measure [9]. The scales and assessment methods used in clinical and academic studies must be valid and reliable to obtain accurate results. Reliability, defined as the consistency of repetitive measurements, is the feature of obtaining similar results from repeated measurements in the same sample. High reliability means that the standard error is low. Reliability types are test-retest, parallel forms, split half, intra-rater and inter-rater reliability, and Cronbach alpha. Evaluation in intra-rater reliability is done by looking at the intraclass correlation coefficient (ICC) if the measurement values are numeric, and by looking at the kappa coefficient of Cohen if the measurement values are categorical. The ICC value ranges from 0 (no consistency) to 1 (full consistency). In inter-rater reliability, the measurement values are evaluated by looking at the ICC if they are numerical, while in categorical terms, the alignment between the evaluators' measurements is expressed as a percentage. Evaluation in test-retest reliability is done by looking at the ICC. Validity is whether the measurement tool can measure the variable to be measured, and if it measures, to what extent it measures the structure it is designed to measure. Validity types are content validity, construct validity, predictive/criterion validity, face validity, and concurrent validity [10].

Outcome measures used in lower extremity amputation

1. Self-report outcome measures

Activities-specific balance confidence scale (ABC)

ABC is a 16-item scale that measures the ability to perform various daily life activities without falling. During the 16 increasingly difficult functional activities, the individual is asked to score the level of confidence felt between 0-100. The scale score is calculated by dividing the total score otained by 16. A higher score indicates a higher balance of confidence. It has been found reliable in individuals with transtibial and transfemoral LEA (ICC for test-retest reliability: 0.91, Cronbach alpha for internal consistency: 0.95). Convergent validity of the scale was supported by 2-Minute Walk Test (2MWT) (r: 0.72) and Timed Up and Go Test (TUG) (r: 0.70). It has been reported to be valid in evaluating balance confidence in individuals with LEA and its use has been proposed [11-13]. The scale, which has high test-retest reliability, internal consistency, and validity, has been reported as suitable for clinical use [14].

Amputee body image scale (ABIS)

ABIS evaluates the situations and experiences that the individual with amputation feels and perceives about her body and consists of 20 items. In the scale, in which the items are scored between 1 and 5 points, the total score varies between 20 and 100, and a high score indicates that body image distortion is high. It is valid and reliable in evaluating body image in individuals with LEA [15]. The internal consistency (Cronbach alfa: 0.834-0.842) and test-retest reliability (ICC: 0.94) of the scale were excellent [16].

Hospital anxiety and depression scale (HADS)

HADS evaluates symptoms of anxiety and depression. It consists of two separate sections that measure the cognitive and emotional aspects of depression (HADS-D) and anxiety (HADS-

A). It has a four-point (0-3 points) Likert scoring scale. High scores from the sections indicate that the risk is high in terms of depression and anxiety. It has been reported that its internal consistency is high (Cronbach alfa; HADS-D: 0.67-0.90, HADS-A: 0.68-0.93), its validity is supported by other scales, and it has sufficient sensitivity and specificity [17]. Its usage is available in individuals with LEA [18].

Socket comfort score (SCS)

It has been reported that 50% of transfemoral amputees and 70% of transtibial amputees use their prosthesis at least seven hours a day. Considering this, it is important to evaluate the comfort with the prosthesis. SCS evaluates the perceived comfort within the prosthetic socket between 0 (uncomfortable) and 10 (most comfortable) point. The use of SCS is suggested because it is easy and simple [11].

Special interest group for amputee medicine (SIGAM)

It is a scale consisting of 21 items used to evaluate mobility level in individuals with LEA. Mobility level is determined by six functional levels (A, B, C, D, E, F). Progress from A to F indicates that the mobility level has increased. It has been reported that internal consistency (Cronbach alfa: 0.67) and test-retest reliability (ICC: 0.82) are high, and external construct validity, convergent and discriminant validity are supported by other scales. It is valid and reliable for use in individuals with LEA [19].

Prothesis evaluation questionnaire-mobility scale (PEQ-MS)

Mobility Scale (PEQ-MS) is a combination of PEQ's ambulation and transfer subscales. It consists of thirteen items with an 11-level numeric rating scale. It evaluates the capacity including transfer and ambulation with a prosthesis for the past four weeks. A high score indicates that the individual has high mobility with the prosthesis. Internal consistency (Cronbach alpha: 0.95) and test-retest reliability (ICC: 0.77) were high in individuals with LEA. Validity based on correlations between PEQ-MS and TUG (r: 0.50), 2MWT (r: 0.50) and ABC Scale (r: 0.85) was confirmed. It has been reported to have excellent reliability and validity for use in individuals with LEA [14, 20-22].

Houghton score (HS)

It evaluates the use of prosthesis and mobility with the prosthesis in individuals with LEA. It consists of four items with a 4-level numeric rating scale. The maximum scale score is 12, and the high score indicates that mobility level and confidence are high. According to the scale score, gait ability is classified into three categories. The test-retest reliability, concurrent validity and internal consistency of the scale were high. The predictive validity of the scale was examined and found to have a high correlation with PEQ-MS (r: 0.73), ABC (r: 0.76), TUG (r: 0.67) and 2MWT (r: 0.73) [14].

Locomotor capability index (LCI)

It evaluates locomotor skills and level of independence in individuals with LEA. Items are scored between 0-3 points on the scale consisting of fourteen items. The highest score is 42, and the higher score indicates higher locomotor capacity and independence [9]. It has a version using a five-point rating scale (LCI-5). It has been reported that both LCI and LCI-5 exhibit sufficient internal consistency, test-retest reliability and construct validity [23]. In different studies, ICC and Croncbach alpha values of the scale were found between 0.95-0.96. Its validity and reliability have been confirmed and it is stated to be correlated with HS [9, 24].

Trinity amputation and prosthesis experiences scales (TAPES)

It is used to determine the level of prosthesis compatibility and evaluate the functional level. In the two-part scale, the first part consists of psychosocial accordance, activity limitation and satisfaction with the prosthesis. The second part consists of eight items that evaluate daily prosthesis use time, general health, physical capacity, phantom limb pain, and residual limb pain [25]. It has been reported that the scale has minimum floor and ceiling effect, high internal consistency (Cronbach alpha: 0.72-0.86), high reliability and validity [9, 25, 26].

Orthotics prosthetics users survey (OPUS)

OPUS consists of four components. The lower extremity FS component is assessed with 20 substances with a five-point rating, while the quality-of-life component is assessed with 23 substances with a five-point rating. The prosthetic satisfaction and prosthetic service satisfaction components are evaluated with 10 and 11 items, respectively, with a four-point rating [27]. The scale can distinguish between different levels of FS, quality of life and level of satisfaction. The test-retest reliability (ICC: 0.50-0.85) and internal consistency (Cronbach alpha: 0.78-0.98) scale is suitable for use in individuals with LEA [9].

Satisfaction with the prosthesis questionnaire (SATPRO)

SATPRO consists of 15 items with triple Likert scale that evaluate the satisfaction of the individuals with the prosthesis. The scores of the 6th, 12th and 14th items, which are asked negatively, are reversed. While calculating the survey score, the total score obtained is divided by the highest score that can be taken from the marked questions, and the result obtained is multiplied by 100. The highest score (45 points) that can be obtained in the survey shows 100% satisfaction and the lowest score (0 points) shows the minimum satisfaction [28]. Internal consistency (Cronbach alpha: 0.90), test-retest reliability (ICC: 0.97) are reported to be high, valid and reliable [28, 29].

Mobility questionnaire for lower extremity prosthesis users (PLUS-M)

PLUS-M is a 44-item mobility scale developed for individuals with LEA and using prosthesis. Each item on the scale which evaluates mobility with prosthesis has a five-point rating. High score gaining from the scale indicates better mobility. The activities on the scale are linked to the two main forms of movement. The first form reports repetitive or continuous movements and the second form shows postural transitions such as moving from one activity or position to another activity or position. The items in the scale evaluate the achievement degree of activity and strain rather than the performance of the person during the activity. There is also a twelve-item short form. In the study where the construct validity of the short form was examined, there was a strong correlation between PLUS-M and PEQ-MS score (r: 0.81); a medium correlation was found between AMP scores (r: 0.54) and TUG time (r: 0.56). PLUS-M has been reported to be structurally valid and suitable for clinical use [30].

2. Performance-based outcome measures

Amputee mobility predictor (AMP)

The scale, which evaluates the ambulatory potential of individuals with AEA, is available in two versions, with a prosthesis (AMP-Pro) and prosthesis-free (AMP-noPRO) use. However, published psychometric studies are only available for AMP-Pro. AMP-Pro consist of 21 items that evaluate transfers, sitting, standing balance and walking skills. Items in the scale are scored between 0-2 points, and the total scale score is 42. Higher scores indicate better functional ability. AMP-Pro has been reported to have excellent inter-rater (ICC: 0.99) and intra-rater (ICC: 0.96-0.98) reliability [31]. The scale, which has high construct validity and concurrent validity with the 6-Minute Walk Test (6MWT), has been reported as valid and reliable for the evaluation of functional ambulation in individuals with LEA. Taking into account the AMP-pro score, at which K group level the individual is determined according to Medicare Functional Classification Levels [9, 31]. K group levels range from K0 (the lowest) to K4 (the highest) and are used to identify the potential for functional mobility in individuals with AEA [31].

Comprehensive high activity mobility predictor (CHAMP)

CHAMP is a performance-based outcome measure improved for evaluating high-level mobility capacity. It consists of One-Leg Stand Test, Edgren Side Step Test, T-test, and Illinois Agility Test, which measure physical performance parameters such as balance, postural stability, coordination, strength, speed, and agility. Each of these four tests score between 0-10 points. The scores achieved from the four tests are collected and a scale score ranging from 0-40 is obtained. Higher scores indicate higher mobility capacities. In the study in which construct validity was examined, it was found that it had a strong correlation with 6MWT (r: 0.80) and AMP score (r: 0.87). It has been reported that inter-rater reliability (ICC: 1.0) and test-retest reliability (ICC: 0.97) are excellent [32]. It has been reported to be safe, valid and reliable in assessing high-level mobility in individuals with LEA [32, 33].

Berg balance scale

It consists of 14 tests that measure different positions, postural changes and the ability to maintain balance during movement. On the scale, the ability to perform each test independently at a specific time or distance is measured. Fourteen tests involve daily activities that include sitting, standing, lying down, and balance along with transfers, turning and taking an object off the ground. Each test is rated between 0 (the lowest function level) and 4 (the highest function level) points. The total score is between 0 (dependent) and 56 (independent), and higher scores indicate a better balance. 0-20 points indicate balance impairment (high risk of falling), 21-40 points indicate acceptable balance presence (moderate risk of falling) and 41-56 points indicate good balance. Inter-rater reliability (ICC: 0.94) and internal consistency (Cronbach Alpha: 0.82) were high in individuals with LEA. The scale has high convergent validity with the ABC scale (r: 0.63), PEQ-MS scale (r: 0.58), 2MWT (r: 0.68) and L Functional Mobility Test (L Test) (r: -0.80). [34]. It has been reported that the scale has high validity and reliability in evaluating balance in individuals with LEA [14, 34].

3. Evaluation of cardiovascular functions

Cardiovascular capacity is classified as aerobic and anaerobic capacity. Energy consumption during walking can be measured as oxygen consumption per minute. The amount of oxygen consumed per minute per kilo during maximum exertion is called maximum oxygen consumption capacity (VO2max). VO2max is considered the best outcome measure in the measurement of aerobic capacity. The tests used to evaluate aerobic capacity are divided into indirect and direct tests. Direct tests include maximal tests such as the Treadmill Test, Arm Ergometer Test, and Single-Leg Bicycle Ergometer Test. As indirect tests, submaximal field tests such as the Harvard Step Test, 12-minute Run-Walk Test, and 6MWT are used. Anaerobic capacity is assessed by the Wingate Test and The Vertical Jump Test, which includes submaximal loading [35]. In the evaluation of exercise capacity in individuals with AEA, Single-Leg Bicycle Ergometer Test, Arm Ergometer Test, Combined Arm and Leg Ergometer Test and Treadmill Test are used. Single-Leg Bicycle Ergometer Test and Treadmill Test are the most common laboratory tests used to measure VO2max. VO2max measured in these tests is expressed in milliliters/kilograms/minute (ml/kg/min) [36]. Laboratory tests that require expensive equipment and special training are time-consuming and difficult to implement. However, it has been reported that functional walking tests may be advantageous in assessing cardiovascular capacity [37].

Functional walking tests evaluate gait and exercise performance at a given time or distance. These tests that don't require expensive equipment and are easy to implement are divided into two as time-based tests (2MWT, 6MWT, 12-Minute Walk Test-12MWT) and distance-based tests (10-Meter Walking Test-10MWT). Time-based tests, in which energy expenditure can be assessed during walking, provide a submaximal measurement of functional capacity. Energy expenditure is determined by measuring oxygen consumption and its cost during gait. A strong correlation between time-based tests and VO2max was found in individuals with LEA. Measuring oxygen consumption with laboratory tests is time-consuming, difficult and costly, which is effective in carrying out the measurement together with walking tests [38]. 2MWT is suitable for clinical use with the advantages of short application time, less fatiguing, high reliability (ICC: 0.90-0.96) [39] and sensitive to changes [21]. 6MWT has been defined as a reliable measure of functional capacity [37] and indicator of energy expenditure [38] in individuals with LEA. 6MWT has been reported to have high reliability (ICC: 0.97) [21] and a strong correlation with 2MWT (r: 0.89) and 12MWT (r: 0.95) [40]. With advances in technology, portable tools such as pulse oximeter, which measures blood pressure, heart rate and oxygen saturation, and telemetry electrocardiography, which monitors heart rhythms, can be used during walking tests. Thus, it is possible to measure the basic OMs such as heart rate, oxygen consumption and oxygen cost, which are used to evaluate energy expenditure [37, 38].

4. Evaluation of gait

In the case of amputation, part of both the sensory and motor system is lost. With the loss of receptors that provide proprioceptive information from joints and other structures, the amount of proprioceptive input that provides information about the movement and position of the prosthetic limb in space decreases. Loss of motor control of the extremity occurs, and balance strategies are negatively affected. The musculoskeletal system performs more activity to maintain balance. This increases energy consumption and causes fatigue [41,42]. The ability of the individual to gait is adversely affected if he is unable to adequately perceive the position of his prosthesis in space. As a result of abnormal gait, functional capacity decreases and energy consumption increases. However, the economy of the gait declines. Assessment of gait is of great importance in the determination of deviations from normal walking, planning and implementation of appropriate treatment approaches and determining the effectiveness of treatment [42]. Different tests and measurements such as observational gait analysis, footprint method, kinematic and kinetic analysis, electromyographic analysis (dynamic EMG), 2MWT, 6MWT, 10MWT, TUG and L Test are used to evaluate gait in individuals with LEA. With the data obtained from these evaluations, information about the spatiotemporal parameters of gait (stance phase symmetry, single/double stride length, stride width) and functional gait performance (gait velocity, cadence, maximum gait velocity) is obtained [43].

Observational gait analysis

Gait is observed from the front, back and side with a specific sequence. Deviations and compensations from normal gait are noted. It is widely used in the clinic with the advantages of its application in a short time, no need for expensive equipment and specialized laboratories. However, the subjective side (depend on the evaluator's experience), the inability to quantify the results, the difficulty in identifying the primary causes of gait disorder are the weaknesses of this method. In observational analyses, the analysis can be done in conjunction with video recording, as it is difficult to simultaneously study moving body segments during gait. During gait, short video recordings are obtained from the front, back and both sides with the video camera placed at the height of the pelvis. The differences between evaluations can be examined by repeating video recordings. Joint angles can also be measured using special software [44].

Gait analysis by footprint method

In this analysis, the participant is asked to walk at his or her walking speed on a flat 10-meter tracer ground to determine the time-distance characteristics of gait. The two-meter section at the start and end is removed. The analysis is conducted through step marks in the six-meter area in the middle. With this method, step length, stride length, support surface, step width and foot angle can be determined on the amputee and non-amputee extremity. It is widely used in the clinic with the advantages of its application in a short time, its low cost, and not requiring private laboratories and training [41, 43].

Kinematic and kinetic analysis

The inability of the human eye to detect movements taking place within milliseconds has been instrumental in the development of computer-aided analysis methods that provide objective and numerical information. Using these methods, the components of gait (joint angle, strength, moment) that cannot be perceived with the eye can be recorded, converted to numerical data, and the resulting data can be compared in repeated evaluations. In the kinematic analysis, which examines the movements of the body in space, the joint angles, angular, linear velocity and acceleration of the body, pelvis, legs, and feet in three planes are measured and the results are recorded as numerical data. Thus, changes in joint angle, speed and acceleration can be calculated in addition to temporal and spatial characteristics during gait. In the kinetic analysis, the ground reaction force, moment, and force parameters affecting the joint are evaluated using special force platforms [44]. When force platforms are used together with kinematic analysis, moment and forces acting on the hip, knee, and ankle in three planes can be calculated. The use of these analysis methods is available for individuals with LEA [45].

Electromyographic analysis (Dynamic EMG)

The muscle activity that occurs during gait is recorded through surface electrodes. In dynamic EMG, EMG signals from electrodes are transmitted to the computer via wired or wireless systems. These signals are processed with special software and converted into numerical data that provide information about the timing and duration of contraction of muscles. In gait analysis, when dynamic EMG is used in conjunction with kinematic data, it can be determined which muscles show how much activity in which phase of the gait cycle. In this way, the pathological activity can be distinguished from compensatory activity. When used in conjunction with kinetic data, it can be determined which muscle has how much activity in the force and moments acting on joints by muscles [43, 44].

Timed up and go test (TUG)

The TUG test is a numerical measure of the maneuvers required for basic mobility, such as walking, balance, transfers and turning while walking. It is easy to use and interpret in the clinic, where the many maneuvers and gait capacity required for mobility can be measured numerically in individuals with unilateral LEA. The time to complete the test is recorded in seconds. Shorter completion time indicates higher capacity. The decrease in completion time can be interpreted as an improvement in basic mobility [22,46]. It has been reported to have high intra-rater (r: 93) and inter-rater (r: 96) reliability and convergent and divergent validity in individuals with LEA [22]. It is a valid and reliable test in assessing physical mobility in individuals with LEA [46].

L functional mobility test (L Test)

The L test, which assesses basic mobility skills in individuals with a unilateral LEA, is a modified version of the TUG. It is designed to reduce the TUG's ceiling effect. The distance covered in the test, which includes two transfers and four turns, is 20 meters. Completion time is recorded in seconds, and the decrease in completion time indicates an improvement in basic mobility. The distance covered in the L Test is longer than 10MWT and TUG, making the sensitivity of the test higher than these tests. It is more suitable for individuals with high activity levels of LEA. It is reported to have high inter-rater (r: 0.96) and intra-rater (r: 0.97) reliability. It was found to have a high correlation with TUG (r: 0.93), 2MWT (r: 0.86) and 10MWT (r: 0.97), whose concurrent validity was examined [47].

Conclusions

Amputation is a permanent state of incapacity that restricts an individual's daily life activities and participation. The main goal of health professionals involved in the treatment and rehabilitation of amputees is to minimize the negative effects of inadequacy caused by amputation through appropriate prosthetic design and treatment methods. Thus, the quality of life of the individual can be improved. To achieve this goal effectively, the results of treatment, rehabilitation and prosthetic applications must be measured with appropriate methods. The need to measure treatment and rehabilitation outcomes has become critical in the current health environment. Measuring the outcomes is important in terms of enabling clinicians to evaluate the quality of care and the effectiveness of treatment. It is of great importance to use valid and reliable result criteria with which the necessary adaptations have been made to accurately measure the results. Clinicians not only determine the effectiveness of their interventions using the reliable and valid OMs, but they can also determine the cause of the problem, provide ideas on therapeutic interventions and potential solutions and show the positive effects of the intervention to the patient and third parties. By utilizing the suitable OMs, clinicians may obtain an overall idea of the health outcomes in individuals with LEA, increase satisfaction and prosthetic performance and reduce the cost of treatment. When clinicians incorporate OMs in daily practice, they may be able to evaluate various aspects of clinical care such as socket comfort, functional level, level of confidence with the prosthesis and quality of life with the prosthesis.

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