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Components of Prosthetic Lower Limbs for Transfemoral and Transtibial Amputations: General Prescription Recommendations and Literature Review

Jean-Claude Fernandes
Marta Silva
Rui Santos
Central Lisbon Hospital Centre

Abstract

The most common levels of amputation are transfemoral and transtibial. Although there are a variety of prosthetic components, prescription criteria are based on subjective experience of physiatrists. Professionals who work outside of large medical centres with less experience in the prescription of prosthetic limbs have difficulty in the choice of components which depend, in many cases, exclusively on the recommendations of manufacturers of the components.

The aims of this article are to evaluate current evidence on the characteristics of lower limb prosthetic components (i.e. socket, liner, suspension mechanism, knee and feet) that could influence prescription for adult transfemoral and transtibial amputations and describe the authors principles of prescription.

This search strategy found 1401 articles which were reviewed by independently by two different researchers, and 37 articles were included. The authors found who although there are well developed studies on the technological development of prosthetic components, clinical research is scarce. Clinical decisions on component prescription cannot be supported by evidence-based studies and depends upon clinical experience.

Introduction

Lower limb amputation is a traumatic event for both the patient and those close to him. The annual incidence of lower limb amputation is around 20 per 100, 000 (Geertzen et al., 2014). The most common levels of amputation are transfemoral and transtibial. Although a variety of prosthetic components exist, the criteria for prescription are based on subjective experience of the prescriber. The lack of impartial recommendations on prescription motivated the elaboration of these recommendations aimed at helping physiatrists with less experience with the responsibility of prosthetic prescription.

Methods

The authors searched for guidelines on the National Guidelines Clearinghouse, National Institute for Health and Care Excellence (NICE) and Canadian Medical Association (CMA) InfoBase using the key words: *prosthesis, limb loss, amputation, amputee, transfemoral and transtibial*. This search included all systematic revisions, meta-analyses, clinical trials, cohort studies, case series, case reports, validation studies and technical reports on Cochrane Collaboration and PubMed (Medline) up to 2017 using the MeSH words: *amputee, artificial limb and limb loss*. The articles were reviewed independently by two researchers.

As inclusion criteria the authors used: publications in English with information that could influence the prescription of a prosthesis in an adult amputee (transfemoral or transtibial); articles that were not entirely dedicated to prosthetics for running or amputations due to burns. They further went on to integrate the opinions of the experience of physiatrists from the Porto Hospital Center and Central Lisbon Hospital Center with vast experience in this area.

Results

The search terms identified 1401 results. After screening titles and abstracts the authors identified 86 articles after deleting three duplicates (Figure 1). Ultimately, 37 articles met the inclusion criteria: two guidelines; one non-systematic review; 12 systematic revisions; 20 case series; two cohort studies.

General overview of prescription

The first decision to make is whether a prescription is in the best interest of the patient. There are no absolute contraindications; relative contraindications are listed in Table 1. A key point is to not only considering the amputation itself but the overall state of the patient, as co-morbidities are an important factor in the rehabilitation process(Passero, 2014).

Table 1: Relative contraindications for the prescription of transfemoral or transtibial prosthesis.

Relative contraindications

- Severe cognitive disability that interferes with learning and the notion of danger
- Low motivation
- Severe cardiovascular disease (Ejection fraction ≤ 20%)
- Moderate to intense pain of the stump aggravated or caused by contact with the prosthesis

- Neurological disease with compromised equilibrium, coordination, vision and muscle force
- Active alcohol or narcotic abuse that interferes with learning and safety
- Chronic or recurring sores on the stump, especially if associated with infection.
- Flexion contracture > 30º of the hip and/or knee refractive to techniques that increase joint range of motion.
- Economic restraint

The reason behind the amputation should be considered since the most common motive is vascular disease in which case the increased effort necessary to walk with the prosthesis may cause excessive stress on the cardiovascular system. This is particularly true in the case of transfemoral amputation and even more so in the case of bilateral amputees. In one study from a center in São Paulo with 195 patients with peripheral arterial disease only 70% were able to use a prosthetic leg at the end of the rehabilitation program (Chamlian, 2014). Most cases of amputations due to trauma or congenital malformations require prosthetic limbs. Amputations due to tumors generally follow similar reasoning as malformations in pediatric patients whereas the health status of the adult is more complex requiring closer assessment on the cardiovascular function, hematological repercussions, evidence of metastatic disease, need for radiotherapy and/or chemotherapy.

An ethical question of economical restriction is inherent to the prescription. Understanding what the patient needs not only helps choose the appropriate components, but also evaluate the price-benefit relation. Other issues that should be addressed include the cognitive capacity to learn to use a prosthesis; motivation; psychiatric factors that could put the patient´s safety in jeopardy; severe motor or sensorial deficits; conditions of the stump such as neuropathic pain and sores; and severe joint contracture.

Generally, patients who are accustomed to their prosthetic leg do not appreciate changes to their components. With the development in prosthetic technology, it would be logical to substitute prosthetic components for more modern designs with more advantageous properties, however, patients generally feel uncomfortable with the change. Therefore, it is recommended that when a component needs to be substituted because of wear and tear that the same models be used.

Prostheses substitute a part of the body, thus understanding what the amputee needs the prosthesis for is the basis for the prescription. If feasible, evaluating the performance of an amputee in physiotherapy will give a clearer indication of the prosthetic components to choose. Commonly used scales for evaluating activity levels for amputee patients are the Medicare Functional Classification Level (better known as K-level scale) and the Special Interest Group in Amputee Medicine (SIGAM) scale which often are used as the criteria for prosthetic component selection (Tables 2 and 3). Further detail on this point is given in the sections below on each component.

Table 2: Medicare Functional Classification Level (MFCL) also known as the K-Level

Level	**Description**
K0	This patient does not have the ability or potential to ambulate or transfer safely with or without assistance and a prosthesis does not enhance their quality of life or mobility.
K1	This patient has the ability or potential to use a prosthesis for transfers or ambulation on level surfaces at fixed cadence - a typical limited or unlimited household ambulator.
K2	This patient has the ability or potential for ambulation with the ability to traverse low-level environmental barriers such as curbs, stairs, or uneven surfaces - a typical community ambulator.
K3	The patient has the ability or potential for ambulation with variable cadence - a typical community ambulator with the ability to traverse most environmental barriers and may have vocational, therapeutic, or exercise activity that demands prosthetic use beyond simple locomotion.
K4	The patient has the ability or potential for prosthetic ambulation that exceeds basic ambulation skills, exhibiting high impact, stress, or energy levels - typical of the prosthetic demands of the child, active adult, or athlete.

Table 3: SIGAM level of activity classification for amputee patients

SIGAM	**Description**
A.	Limb wearing or use of cosmetic limb only
B.	Therapeutic wearer wears the prosthesis only for transfers, to assist nursing, walking with the physical aid of another during therapy.
C.	Walks on level ground only Walks on level ground only and in good weather, less than 50 meters, with or without the use of walking aids: a = frame, b = crutches/sticks, c=crutch/stick
D.	Walks on level ground only and in good weather, more than 50 meters, with or without the use of walking aids: a = frame, b = crutches/sticks, c=crutch/stick
E.	Walks more than 50 meters. Independent walking aids except occasionally for confidence or to improve confidence in adverse terrain or weather.
F.	Normal or near normal gait.

Frame

The frame of a prosthesis can be endoskeletal or exoskeletal. In the former, the frame consists of pipes known as pylons that connect the different components whereas in the latter the frame is a hard shell with filler inside. Most modern prosthesis prescribed are endoskeletal. The main disadvantages of exoskeletal prostheses are their heavy weight and compatibility with knee and foot components. Some patients benefit from exoskeletal prosthesis, the most typical example is the amputee with arduous agricultural activity that requires a low maintenance, simple but robust prosthesis. Pylons made of steel are heavier, while carbon and titanium pylons are lighter. Carbon pylons theoretically can also provide more energy return during gait.

Suspensions

There are five main mechanisms of prosthesis suspension: direct contact using anatomical contours; liners with a pin-locking mechanism; suction (passive removal or air from socket); vacuum (active removal of air from socket) and the use of sleeves. More than one mechanism may be used.

Transfemoral.

No clinical evidence is available to suggest any single transfemoral suspension system as a standard system for all amputees (Gholizadeh, Lemaire, & Eshraghi, 2016; Hossein Gholizadeh, Osman, Eshraghi, & Ali, 2014b) The suspension mechanism of liners are becoming the standard. These mechanisms include the pin lock and vacuum. Specialists from the Curry Cabral Hospital (CCH) in Lisbon prefer the liner pin lock mechanism provided that the stump is not too long that it would cause asymmetry with the contralateral knee due to that fact that even with variation of stump volume the prosthesis does not fall off. A variant of the pin mechanism is the lanyard strap which uses a strap at the end of the liner which is the fastened on the exterior of the socket; however, this requires a certain amount of dexterity. The suction mechanism has traditionally worked through direct contact but has been enhanced by new liners on the market, some of which actively pump air out of the socket (also known as vacuum). Suction mechanisms require distal contact to prevent skin problems related to constant negative pressure on the stump. Direct contact suspension mechanisms are generally reserved for amputee patients who are already accustomed to them and do not tolerate the liner or the liner proves insufficient alone. Silesian bandage, pelvic belt and, tes belt can provide an important additional suspension mechanism.

Transtibial.

As with the transfemoral suspension mechanisms, liners can provide the suspension either through pin lock or through vacuum. Studies show vacuum-assisted suction socket seem to improve gait symmetry, control residual limb volume fluctuations, and affect residual limb health positively compared with other socket designs (Board, Street, & Caspers, 2001; Gerschutz, Denune, Colvin, & Schober, 2010; Goswami, Lynn, Street, & Harlander, 2003; Hoskins, Sutton, Kinor, Schaeffer, & Fatone, 2014; Samitier, Guirao, Costea, Camos, & Pleguezuelos, 2016). As locking liner suspensions concentrate the suspension force at the distal end of the socket, they may create a milking effect on the distal residual limb in people with lower limb amputations (Kistenberg, 2014), nonetheless, it is the preferred mechanism at the CCH and the study by Gholizadeh (Gholizadeh, Osman, Eshraghi, & Ali, 2014a) demonstrated that patient satisfaction is greater with the pin lock to suction mechanism due to easier donning and doffing.

External suspension mechanisms include the use of supracondylar cuff, thigh corset and sleeves. Supracondylar and suprapatelar extensions also provide a suspension. A patella Tendon Bearing (PTB) socket with sleeve suspension (Safari & Meier, 2015) provides the least suspension.

Sockets

The socket is the most personalized component of the prosthesis and the most important for comfort and successful use. A few general principles can be defined to guide prescription, but individual adjustments are inherent in most cases, even more so in transfemoral amputees. The mutual interaction between the socket and the residual limb makes biometrical parameters studied in the design of sockets very complex to apply in a clinical setting. There is still no solution discomfort felt after wearing the prosthesis over long periods of time (Pirouzi et al., 2014). To reduce sweating and skin maceration, there is a prototype using a helical cooling system (Webber & Davis, 2015).

The suspension system is intrinsically associated with the type of socket used. In general, a prosthesis is prescribed with liners with either a pin lock or suction suspension mechanism. However, patients amputated over a decade ago and already accustomed to direct contact of the skin with the socket often reject liners (see liners).

Transfemoral amputation.

There are three types of transfemoral sockets: Ischial containment; quadrilateral; subischial.

Ischiatic contention sockets, aka CAT-CAM (contour adducted trochanteric - controlled alignment method) sockets are the preferred choice in most cases as far as the shape of the socket. Also frequently seen is the quadrilateral socket, which is plausible for longer firm residual stumps with intact adductor musculature and also useful if canes or walkers are needed to assist in ambulation (Schuch & Pritham, 1999). This shape is however falling into disuse with the advent of CAT-CAM. A popular innovation to the CAT-CAM system is the Marlo anatomic socket, in which the posterior border of the socket is lowered allowing the exteriorization of the gluteus maximus (which gives a more natural look) and greater ischial-pubic containment.

The subischial socket distributes the weight over the thigh musculature and is usually associated with a suction suspension mechanism. This type of socket requires more maintenance.

Flexible sockets, the most well-known of which is the ISNY (Islandic-Scandanavian-New-York) can have either an ischiatic contention or quadrilateral shape. They are more comfortable, increase sensorial feedback and have a transparent window. They are more expensive and less resistant to wear and tear. They are a good choice for stumps with substantial volume fluctuation.

Transtibial amputation.

Total surface bearing (TSB) sockets are the mainstay for most patients since theoretically it allows for a uniform distribution of pressure throughout the stump. Donning this type of socket may be difficult in patients with visual, sensory, and motor deficits (Hachisuka et al., 1998). This type of socket is not a good choice if there are frequent changes in stump circumference from edema or gradual decreases in stump diameter with progressive stump maturity (Hachisuka et al., 1998). Negative issues associated include distal stump pain, discomfort during knee flexion, and excessive perspiration inside the socket (Hachisuka et al., 1998). This type of socket provides greater activity level and prosthesis satisfaction than patella tendon bearing (PTB) sockets for active users, those with a traumatic cause of amputation, and younger users (Safari & Meier, 2015).

Patella Tendon Bearing (PTB) distributes weight on areas of greater tolerance. Not all patients tolerate this design due to excessive pressure on the patellar tendon knee flexion may be limited, and adventitial bursa, skin abrasions and dermatitis can develop (Ahmed, Bayol, & Ha, 1994; Hirai, Tokuhiro, & Takechi, 1993; Moo, et al., 2009). There is less perspiration and sweating compared to the TSB socket (Safari & Meier, 2015).

Modified versions of PTB sockets include the PTB-supracondylar (PTB-SC) and PTB-supracondylar suprapatelar (PTB-SCSP) sockets. PTB-SC socket provides improved mediolateral stability by virtue of the high sidewalls. PTB-SCSP, on the other hand, extends further proximally and encloses the patella. PTB-SCSP socket limits the hyperextension of the knee during stance by applying force above the patella, which provides some sensory feedback (Chitragari, Mahler, Sumpio, Blume, & Sumpio, 2014).

Liners

In certain situations, the stump does not fit standardized liners in which case custom-made liners are an option. As mentioned in the section on sockets and suspensions, Pin-lock mechanism is the preferred suspension method at the Curry Cabral Hospital. Therefore, unless the stump is too long for the pin lock mechanism due to asymmetry with the contralateral leg, this should be the first choice.

The shape of the stump also determines the type of liner, particularly in transfemoral amputations. A cylindrical shape is where the proximal and distal diameters do not vary substantially, whereas a conic shape the proximal diameter is much greater than the distal diameter. A bony stump, as the name suggests, is one in which bony projections are superficial. The level of activity of the amputee, fragile skin, phantom pain and area of pain caused by pressure on the stump are other factors that influence prescription.

The materials most commonly seen in our clinical practice are silicone, urethane, neoprene, gel liners and pelite. There are many other types of materials, which have been tested in the laboratory. Laboratory tests show silicone most appropriate for cushioning bony prominences (Sanders et al., 2004). Both silicone and urethane are advantageous for residual limbs with excessive soft tissue, since the liners would not add any more deformation on top of the tissue and prevent the limb from sliding into the socket (Sanders et al., 2004). Urethane had the highest coefficient of friction suggesting that it would adhere well to weak skin sites and protect them from breakdown (Sanders et al., 2004). Pelite have deformation properties that could allow a better adaptation to the stump sensitive and are best for bony or scarred residual limbs (Sanders et al., 2004). Silicone has recovers from stress and therefore more suited for situations where retaining thickness and volume is necessary such as the pin-locking mechanism (Sanders et al., 2004). A clinical study did not show patient preference of pelite to silicone (Boonstra, van Duin, & Eisma, 1996). Some manufacturers recommend silicone for low to moderately active amputees, urethane for very active amputees and copolymer for inactive amputees. There are liners that are designed to reduce phantom pain. The approach to liner selection is shown in Figure 2.

Knee

The knee is an important component of prosthesis in transfemoral amputations, its prescription requires a compromise between safety and adequate function. They can be classified in different ways: according to their axis of rotation/ kinematics in monocentric and polycentric; according to the control mechanism in mechanical, pneumatic and hydraulic; according to control during stance phase in load activated and locked in extension with manual unlocking.

In monocentric knees the movement is done around one axis of rotation, they are more often prescribed than polycentric knees, especially amongst patients with a low level of activity. The gait allowed with this type of knee is slow with a constant speed and requires higher energy consumption, however, they are relatively safe, simple, inexpensive and require little maintenance, thus indicated for patients with limited access to health services. For the same reasons explained above, they are not indicated for more active patients who require walking on irregular terrain. For moderate levels of activity, in patients with a variable walking speed, the polycentric knee (mobile centre of rotation, with multiple rotation axes) is more adequate than the monocentric knee; they allow for walking speed variation, are more aesthetically more appealing for patients with longer stumps, improve posture and facilitate knee flexion at the beginning of the swing phase (Tang et al., 2008).

Pneumatic and hydraulic knees are reserved for more active patients as they allow for greater walking speed and longer distances than the mechanical knees. The pneumatic knees allow for low to moderate speed, therefore, very active patients (greater than K3) can "surpass" the prosthesis. The hydraulic knee is indicated for patients with a high level of activity (K3/K4), with good muscle strength, coordination and reflexes, facilitating a better performing gait and descending inclines and stairs. The lighter models are adequate for children and shorter adults (low to moderate walking speed) whilst the heavier and more potent models are better for taller and more active adults, especially if they practice competitive sport (Tang et al., 2008).

The knees with microprocessor are indicated for patients moderate activity levels which is in agreement with recent guidelines proposed in the United Kingdom (Sedki & Fisher, 2015); the C-leg has level B recommendation for improvement balance sensation and reducing risk of fall compared with other prosthetic knees (Highsmith et al., 2010)). The disadvantages include higher cost and weight.

Relative to control during stance phase, weight-activated knee locking is indicated for patients with low levels of activity (K1/K2) and high risk of fall, since they allow for stability during stance phase by inhibiting flexion. The locking mechanism in extension and manual unlocking guarantees complete extension and total stability in stance phase; it is indicated for levels of activity K1/K2 with limited equilibrium, bi-amputated patients, weak patients and patients with difficulty with hip flexion; as well as elderly patients with heart disease because it allows for faster walk with less cardiovascular effort. The knees with a manual lock should be prescribed for patients with a low level of activity who desire a stable gait.

Feet

An important concept to retain is coherency in component prescription. In this sense, if a sophisticated knee is chosen that allows for high level of activity, then the foot needs to be equally adapted for that level of activity.

Choosing the right foot depends above all on the level of activity of the amputee. Traditionally the K-Levels are used (Table 2). This system is simple, however, in a clinical setting the classification of a patient into one of these categories is not linear and there is a discrepancy amongst clinicians as to what group to place them. We adapted the SIGAM classification (Table 3) for these recommendations to create the algorithm demonstrated Figure 3. Most feet are not specific to the level of amputation however the height of the foot should be considered in distal transtibial amputations.

Feet can be classified from the simplest fixed feet such as SACH (Solid Ankle Cushion Heel) which allow for shock absorption; articulated feet which allows for dorsal and plantar flexion (mono-axial) or may even allow inversion, eversion and rotation (multi-axial); dynamic feet which allows energy to be saved and returned impelling the stride as well as often having physical properties which adapt to irregular surfaces with similar efficiency as multi-axial feet

For a patient with no functional use for a prosthetic leg, there are cosmetic feet available. Some cosmetic feet also allow for transfer if the patient weighs less than 65 pounds (75Kg) If the patient needs the prosthesis to facilitate transfers, the SACH foot provided is the most appropriate option. Solid ankle cushion heel feet are available for women and these offer a higher heel but no functional advantage. The prescription should consider weight, as different models support different maximum weights.

A patient with limited mobility who uses the prosthesis for short distances [<164 ft (50 m)] in a domestic or similar environment, is also a candidate for a SACH foot although a single axis-foot is also a viable option. Some single axis feet are designed for lightweight patients and there is also the possibility of prescribing with or without toes and by gender. Other solid feet have a softer heel strike, foot flat and mid-stance and claim to be more suited for these situations. However, we have little experience to support these claims and find SACH still to be the most practical solution. The flex-foot balance, which has some studies that show its advantages in relation to SACH feet (Versluys, et al., 2009). However, the advantages demonstrated in these studies would benefit more active patients, we feel a dynamic foot brings little advantage to this situation.

A patient who walks > 164 ft (50 m) with the help of walking aids is at a similar functional level as the patient described in the last paragraph unless they can surpass barriers such as stairs and ramps. A SACH foot is usually prescribed, however, a foot with a softer heel strike, foot flat and mid-stance should be considered. It should be noted that the type of walking aid gives a clearer notion of gait stability, in this sense, a walking stick requires a more stable gait than crutches which in turn or need a more stable gait than a walking frame. Patients with a more stable gait would benefit from an articulated foot. Single-axial, multi-axial and dynamic feet are required for ramps. Multi-axial and dynamic feet are needed for stairs, however single-axis foot does not meet the requirements. One study that compared postural stability amongst 10 transtibial amputees in a laboratory setting between SACH, single-axis and dynamic feet showed no significant difference among them (Arifin, Abu Osman, Ali, & Wan Abas, 2014). However, the participants of the study were of different activity levels and cause of amputation

A patient who walks > 164 ft (50 m) on regular surfaces without the help of walking aids but cannot surpass ramps or stairs should be considered as K1 or SIGAM C and we recommend a dynamic foot designed for this respective activity level. On the other hand, if the patient can walk >

164 ft (50 m) on regular surfaces without walking aids and surpass ramps and stairs, then this patient is a candidate for a dynamic foot that has slightly less energy return than those for a patient who walks on irregular surfaces. Attention should be payed to the length of the residual limb as many models of energy return dynamic feet in this group may be too tall, in these cases, a low-profile model should be selected.

Powered ankle prostheses can be considered for moderately active patients. Despite being very expensive they have several advantages for transtibial amputees. They use microprocessor technology to recognize gait phase reducing demand on the intact limb by providing active plantar flexion (Rabago et al., 2016; Struchkov & Buckley, 2016) and variable cadence (D'Andrea, Wilhelm, Silverman, & Grabowski, 2014; Kahle & Highsmith, 2013; Shultz, Lawson, & Goldfarb, 2016). There are designs in development for running (Grimmer et al., 2016; Shultz, Lawson, & Goldfarb, 2015) and for bilateral amputations (Lawson, Ruhe, Shultz, & Goldfarb, 2015). Studies are promising, but limited to protocols and small number of participants (Windrich, Grimmer, Christ, Rinderknecht, & Beckerle, 2016).

Patients who walk > 164 ft (50 m) on irregular surfaces, surpass ramps and stairs, but occasionally need walking aids (on irregular surfaces or in bad weather) should be considered K3 or SIGAM E and follow the orientation given in the last paragraph. For the active amputee who walks > 164 ft (50 m) on irregular surfaces, surpasses ramps and stairs and does not require walking aids, a robust dynamic foot should be chosen. Some feet are more robust than others. Again, the length of the residual limb is important for transtibial amputations, using low-profile models for distal amputations.

Activity prostheses

Lower limb prosthetic components for specialized activity is out of the scope to be explored in detail in this article. These components are mainly aimed at highly active amputees. We recommend that the patient to be referred to a center with experience for prescription these prosthetic components as the decision can be complex. Often, the amputee has more than one prosthetic leg or easily substitutable components which allows the amputee to change from the day to day prosthesis for walking and the prosthesis for specialized activity.

For patients who want to go swimming, the most common practice is to remove the prosthetic leg before going into water. If the amputee wishes to use a prosthetic leg for bathing for cosmetic purposes, then the components should be adapted to water exposure including non-corrosive material, a suspension mechanism that does not require vacuum pump, liners that dry easily, a system to channel water out of the socket pylon and feet and an anti-slip plantar surface cosmetic covering. An exoskeletal prosthesis is a possibility for going to the beach and lowers the complication of sand in the different components. There are specially designed prosthetic legs with a shorter pylon and fins designed for swimming.

Running prosthetic legs require above all a specially designed running energy return blades. The can be in a J shape for sprinting or a C shape for jogging. The stiffness of the blades depends on the weight of the amputee.

For riding a bicycle, there are specially designed prosthesis with lighter weight pylons and feet to better adapt to the pedals, however, they are not compulsory to be able to ride a bike. When it comes to bike riding, the bike itself needs to be adapted to the amputee including the pedals and lower seat height (especially for above knee amputees). Either the prosthesis or shoes can be fitted a magnetic system to allow easier fixation to the pedals.

Similarly, there are feet design for rock climbing, which are difficult to balance on and inappropriate for walking. Prosthetic feet for ballet lock the foot in maximum plantar flexion and can be a choice for unilateral amputation.

Future Research

The authors found that although there are well developed studies on the technological development of prosthetic components, clinical research is scarce. Clinical decision on component prescription cannot be supported by evidence-based studies and depends on clinical experience.

There is a need to develop European committees to create guidelines based on consensus amongst specialists in the area. An important issue to tackle is the review of the various models for different components of the prosthetic leg. It would be useful to create a European database in which the components prescribed could be cross-referenced with patient characteristics such as activity level, amputation level, residual limb characteristics, gender, age and comorbidities. Online feedback questionnaires for doctors, prosthetists and patients should be developed to allow for follow-up satisfaction to be analysed. This could be done by attributing a code for each prescription. Large scale studies of this nature could then allow the development of impartial online selection tools such as an App, in which the best prosthetic component could be selected according to the patient´s unique situation.

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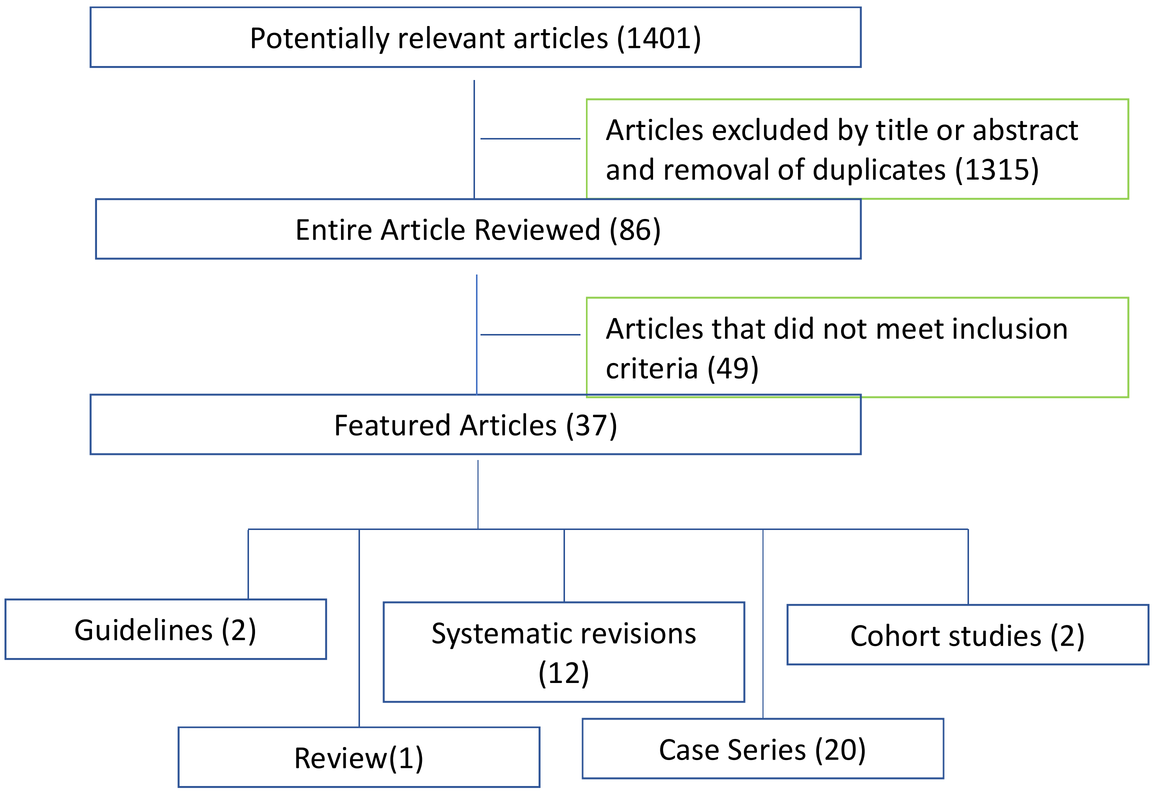

Inclusion criteria:

1. publications in English
2. with information that could influence the prescription of prosthesis in an adult amputee (transfemoral or transtibial);
3. articles that were not entirely dedicated to prosthesis for running or amputations due to burns.

Figure 1. Flow diagram of included studies

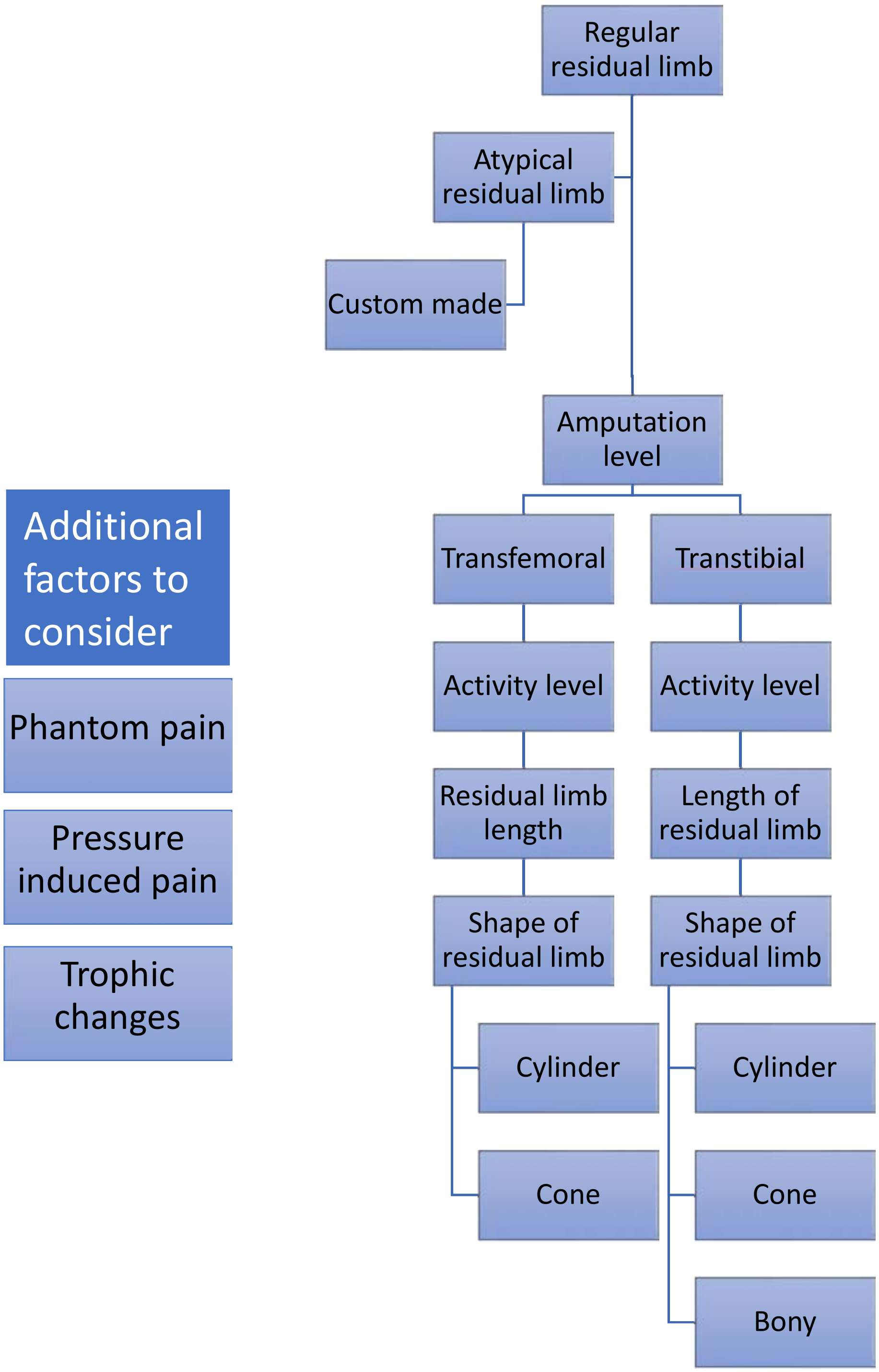

Figure 2 – Algorithm to classify residual limb characteristics for choice of adequate liner

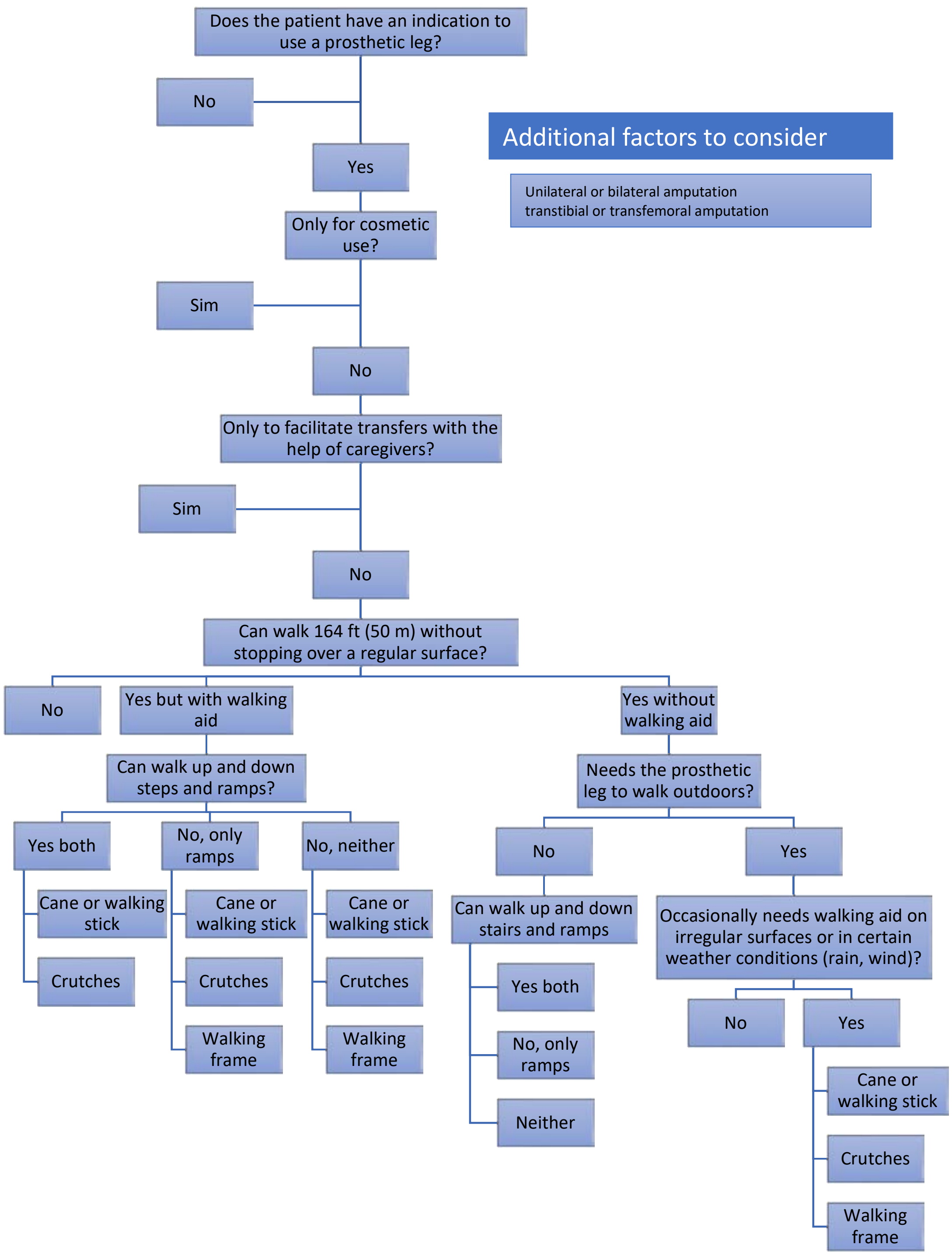

Figure 3: Algorithm to classify amputee activity level for choice of adequate foot component of prosthetic leg