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Post-amputation rehabilitation in an emergency crisis: from preoperative to the community

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Abstract
Purpose Losing a limb (or a part of a limb) usually leads to loss of functionality and subsequent disability. This paper aims at pointing out the importance of comprehensive and multidisciplinary care that includes early, direct or indirect, involvement of rehabilitation service providers even in an emergency context.
Methods We underline the links between amputation and disability as well as the milestones and main purposes of the rehabilitation process following amputation. We then emphasise the influence that the level of amputation has on functional outcomes.
Results In order for functional outcomes to balance purely medical factors when identifying the best site for amputation in emergency settings where preoperative involvement of a rehabilitation professional is difficult due to limited resources, we enunciate five general rules to be used as guidelines by the medical team in the absence of a rehabilitation service provider. These five rules, remaining general enough to apply to most contexts and patients, still need to be balanced against contextual and personal factors that can only be identified at the time of the amputation.
Conclusions The main expectations of people who undergo surgery are, usually, to remain actors in the society and regain functional abilities. Therefore, surgical outcomes are closely related to functional outcomes. In order for the functional and personal factors to be taken into account, we recommend, even in an emergency context, preoperative involvement of rehabilitation care providers.

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Introduction

Patients who have undergone amputation, whether upper or lower limb amputation, will face difficulties and obstacles due to the amputation. Indeed, the loss of a limb (or even just a part of it) usually leads to limitation of activity or ability. In addition to the impairment and the ability limitation created, external factors (personal and environmental factors) will lead to social participation restrictions, generally called "disability" [1].

In order to prevent or reduce the level of disability the patient will face when returning home (and, therefore, improve the surgical outcome), rehabilitation (in its broadest sense [2]) should take place, from an early stage [3] prior to returning home and social inclusion. The rehabilitation process secondary to amputation usually includes:

- Medical rehabilitation services mainly aiming at preventing secondary and disabling complications, encouraging healing and preparing for prosthetic fitting
- Psychosocial support aiming at facilitating acceptance of and adaptation to the new condition and overcoming traumatic and psychological difficulties
- Functional rehabilitation aiming at recovering functional abilities and autonomy in daily life activities, usually through the provision of assistive device(s) and training for proper use of those device(s)
- Social reintegration tackling broader issues such as livelihood, education, family and social inclusion, accessibility, rights, empowerment, gender and community's attitude changes

The starting point for rehabilitation is often considered to be the amputation (the surgical act) itself and its cornerstone the fitting of a device. Providing a prosthetic device is indeed a key stage of the rehabilitation process as, if successful, it will

greatly influence the level of functional recovery and therefore social participation. As for the starting point of rehabilitation, when considering the influence that the surgical act (its quality [4] and the level of amputation [4–6]) has on rehabilitation outcomes, it clearly appears that it should precede the amputation itself.

Choosing the proper site for amputation is primarily guided by pathological, anatomical and surgical factors (e.g. cause of amputation, viable tissues, blood supply). Nonetheless, other personal and contextual factors that may influence expected outcomes should also be taken into account. In order for these to be appropriately considered when identifying the proper site for amputation, input from a rehabilitation professional might be required before the amputation is done.

Comprehensive and multidisciplinary approaches, including rehabilitation services providers in the medical team, have long been advocated [7]. Nowadays, in developed countries and in some developing countries where the situation is stable, early rehabilitation and early involvement of the rehabilitation team is, if not systematic, very common. Nonetheless, this is far from being the case when it comes to an emergency context, such as post-earthquake situations. Even though the importance of postoperative rehabilitation for trauma-related injury during a humanitarian crisis is now being advised as a minimum standard in humanitarian response [8], it is not yet systematic in the field. Not to mention preoperative involvement of rehab professionals, which is, following an emergency crisis, nearly nonexistent. Indeed, in emergency contexts, where needs are very high and resources to answer them are limited, priorities are legitimately put on life-saving procedures. It is, therefore, quite understandable that involvement of the rehabilitation providers is delayed.

It would, therefore, appear relevant to try to enunciate general rules that could be taken into account by the surgical team when identifying the best site for an amputation in order to balance the medical factors against more functional factors. Due to the complexity and variability of personal and contextual factors that might influence such a decision, it appears difficult to issue guidelines that would apply to all patients and contexts. Nonetheless, considering emergency situations, such general rules might already be a good starting point. Therefore, based on existing, but limited, relevant literature and professional expertise, we would recommend, from a purely functional standpoint, the following rules to be considered:

Rule 1: Sites of election for amputation [9, 10] are, in preferential order: foot level (save all possible); ankle Syme's/through ankle joint amputation (only if surgical expertise exists and prosthetic technology is available); tibial amputation (below knee amputation, BKA); through knee amputation (TKA); and femoral amputation (above knee amputation, AKA).

Rule 2: More specifically, for AKA and BKA (most common types of amputation), the appropriate residual limb length is: for an AKA, between the middle and distal one third of the thigh (at least 5.5 in. below the upper border of the tibia and not lower than the musculotendinous junction of the calf muscle [7]); for aBKA, between the distal one third and proximal one third of the leg (10–12 in. below the tip of the greater trochanter and at least 4.5–5 in. above the knee axis). Longer stumps are not appropriate, as they may lead to fitting, and therefore, gait difficulties.

Rule 3: As long as rule 2 can be respected, BKA is better than AKA (preservation of joint level).

Rule 4: Even if rule 2 applies, TKA is better than AKA end-bearing stump.

Rule 5: If rule 2 cannot be respected for BKA (very short residual limb), AKA might be preferable (indeed, a very short stump makes it difficult to control the device, increases energy requirement and consequent tiredness [10], and requires stump/knee flexion for fitting—which impacts on muscle shortening, weight-bearing and alignment as well as cosmetics).

The above five general rules, which remain very general, should yet be balanced against external personal and contextual factors:

- Availability of technology
- Expected functional recovery (which is influenced by age, sex, cause of amputation, premorbid functions and existence of comorbidities, as well as local context [4, 6])
- Cosmetic considerations
- And, last but not least, patient's expectations [4]

In practise means that, for example, counter to the fourth rule presented above, AKA might be preferable to TKA if satisfactory through knee prostheses are not available while above knee amputations are, or for patient with lower expected functional recovery (elderly with comorbidities) or for whom cosmetic result is more of a concern than functional recovery.

At the end of the day, without undermining the life-saving aspects of amputation, in case of amputation, surgical outcomes are very much linked to rehabilitation outcomes—saving a life is paramount; making sure that the life that was saved is satisfying for the patient is also very important and gives even more sense to the surgical act. When considering patients who have undergone amputation, their main expectations are usually to recover as much function as possible and remain active in society. This goes through the rehabilitation process and rehabilitation outcomes will be greatly influenced by the quality of surgery, the level of amputation and the early start of rehabilitation care. It is, therefore, important, even in an emergency context, to support early

involvement of rehabilitation care providers in order for these factors to be taken into account [11].

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