Sport-Specific Limb Prostheses in Para Sport

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KEYWORDS

• Para sport • Prostheses • Amputation • Performance • Sport-Specific prostheses

KEY POINTS

- Prostheses are an integral part of life for most individuals with amputation.
- Modern technology has made the participation in sport significantly easier for individuals with amputation and has reduced some of the risks that may occur with the use of non sport-specific prostheses for sport.
- Sport-specific prostheses facilitate peak performance by aiming to satisfy the requirements of the sport.
- The influence of these technological advances are still not always understood.

INTRODUCTION

Prostheses have been used to facilitate participation in sport for individuals with amputation since 1976, when athletes with amputation took part in sprint events at the Paralympic Games for the first time.[1] In that edition of the Paralympic Games, athletes made use of nonsport-specific prostheses, which consisted of rigid keel prostheses with no flexion ability in the ankle joint. Since then, the prostheses used in sporting activities have changed significantly, to sport-specific prostheses designed and manufactured according to the specific requirements of the sport. To design the optimal prosthesis for an athlete, multiple factors must be considered. These factors include the anatomic limb amputated; the site of amputation; the requirements and regulations of the sport; medical factors relating to the cause of the amputation; and, most importantly, the comfort of the prosthesis during use. With regard to the characteristics of the prostheses, factors such as prosthesis length, stiffness, and attachment site should also be considered because these may have an impact not only on comfort but also on performance.

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Physical activity is an important factor in maintaining health and preventing noncommunicable disease for all individuals but especially those with impairment or disability.[2] However, lifestyle and behavioral factors often change with amputation, which lead to decreased participation in physical activity[3] despite that physical fitness is an integral part of the rehabilitation process. Thus, a better understanding of the factors associated with amputation, the prostheses used, and barriers and facilitators to sport and physical activity may be crucial in the endeavor to improve physical fitness and performance of individuals following amputation.

AMPUTATION

The International Paralympic Committee (IPC) defines an amputation as the partial or total absence of bones or joints as the result of congenital or acquired (traumatic or due to illness) medical conditions. A review of the literature relating to the incidence of lower limb amputation on a global scale found greater incidence of lower limb amputation in individuals with diabetes (46.1–9600 per 10^5 in the population) in comparison with individuals without diabetes (5.6–600 per 10^5 in the population).[4] This indicates a significantly greater occurrence of amputation due to vascular dysfunction and similar diseases related to inactivity.

Upper Limb Amputation

Upper limb amputations can take place at any of the following anatomic positions: transphalangeal, transmetacarpal, transcarpal, wrist, transradial, elbow, transhumeral, shoulder, or forequarter.[5] For participation in Para sport, there are minimum eligibility criteria with which the athlete needs to comply. For example, a minimum eligibility criterion is usually an amputation at least through the wrist (www.paralympic.org/classification).

Lower Limb Amputation

As with upper limb amputations, there is an array of amputation levels for individuals with lower limb amputation. These include partial toe, toe disarticulation, partial foot resection, transmetatarsal, Lisfranc, Chopart, Syme, transtibial (long and short), through-knee disarticulation, transfemoral (long and short), hip disarticulation, hemipelvectomy, and hemicorporectomy.[5] Similar to upper limb amputations, there is a minimum eligibility criterion for participation in classified Para sport, which, in the case of lower limb amputees, is specified as an ankle disarticulation (www.paralympic.org/classification).

CLASSIFICATION

In competitive sport for individuals with impairment, athletes are classified into smaller, more homogenous groups. This system has been adopted by the IPC to maintain fairness in the sport.[6] Each sport has its own classification system determined by medical and/or functional criteria. In the medical classification system, the athlete is classified according to the medical diagnosis, whereas a functional classification system is based on the impact that a specific impairment may have on performance of a sport.[6] In sports for athletes with amputations, the athletes are often classified according to medical classification; therefore, the level of amputation. In track and field (T/F), for example, athletes with unilateral or bilateral transfemoral (above-knee) amputations are classified into class T/F42, whereas bilateral (T/F43) and unilateral (T/F44) transtibial amputees are classed separately although they compete in a combined T/F44 class. Individuals with upper limb amputations will be classified as T/F45 to T/F47, depending on the extent of

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