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Trans-tibial prosthesis fitting and prosthesis satisfaction

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Chapter 2a

A patient with donning-related stump wounds: a case report

Baars ECT, Geertzen JHB

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Abstract

A patient, suffering from diabetes and a trans-tibial amputation is presented with stump wounds caused by improper donning of the liner. His diminished hand function resulted in improper donning with air trapping between the liner and stump. This caused blisters on the skin after loading the prosthesis.

Key words: stump wounds, liner, donning, hand function

Introduction

A 62-year-old male patient with insulin dependent diabetes and a trans-tibial amputation on the left side, as a result of necrotizing fasciitis after a burn injury seven years ago, was seen in the outpatient clinic because of large blisters on the stump. A few weeks earlier the patient was seen because of shrinking of the stump volume and the sinking of the stump in the socket. The stump skin was in good condition with no wounds. The patient had a gradual deterioration of the hand function, with diminished grip strength and sensation, during the years due to the diabetes, but claimed to have no difficulties in donning or doffing the prosthesis. He mentioned that he could not walk at all and only makes transfers with his current prosthesis because of the poor fit, but wanted to start walking again. He also mentioned that walking was unsure and only possible in the home with the aid of his wife, after a left hip fracture a few years ago and because of his right diabetic foot. Initially the patient had a conventional type prosthesis with thigh corset, but since six and a half years he used a KBM type prosthesis with silicon liner. He never complained of stump wounds prior to now. A new socket and tighter fitting liner of the same type was prescribed. A week after the new socket and liner was delivered the patient was seen with 4 large open blisters on the distal part of the stump (Fig. 1). The patient had had no trauma of the stump and only mentioned that, directly after delivery and donning the prosthesis and walking a short distance in the home, he noticed the blisters on his stump at the end of the day after doffing the prosthesis. We checked the donning technique of the patient and saw that he did not flatten the distal portion of the liner during application, but applied it with a cup form with air trapping between the liner and stump. The skin sensitivity of the stump, checked by brushing the skin lightly, was clearly diminished. The wounds were treated and healed a week later after which the stump was formed with a “compression liner”. A thicker, more loosely fitting and more soft liner was applied for use in the prosthesis. The patient could turn the liner inside out and flatten the distal portion of the liner against the stump adequately and was given

instructions to do so every time he donned the prosthesis. No air trapping was seen and he could function adequately afterwards. No wounds were seen during the subsequent consultations.

Discussion

This case report shows that adequate donning of a silicon liner is essential and improper donning with air trapping distally can easily cause large blisters on the distal stump skin. With this patient the donning technique was not evaluated before a new socket and liner were prescribed. Also, the patient did not mention having trouble with donning. In our experience this is often the case with patients that have a (gradual) deterioration of hand function and the patient should be asked explicitly if donning presents a problem. Also, a demonstration of the donning technique by the patient can be very informative. We assume that the old liner, which did not have a good fit, let the trapped air escape proximally during loading of the prosthesis. The tighter new liner caused trapping of the air that could not escape and during loading response of the prosthesis this air heated and caused the skin temperature to rise (bike pump phenomenon). The pattern of blister formation, forming a circle on the distal end of the stump, shows that friction on the skin also plays an important role. Because of the air trapping distally the liner loses contact with the skin in a circular pattern. This results in sheering forces as a result of the loosening of the liner contact with the skin. This effect in combination with the elevated skin temperature causes blisters. Blisters can form quickly especially when the sheering forces are combined with elevated skin temperature (*Levine 1982, Zhang et al. 1994*). Also, the fact that the patient could not walk with his old prosthesis protected him from developing these blisters, because the prosthesis was not loaded and thus the trapped air not heated and friction forces remained minimal.

The new liner we prescribed was softer, more pliable and could be handled more easily and had a looser fit so trapped air could escape. The patient could resume walking short distances in his home with two crutches, but did not reach his old level of walking because of the long period of inactivity in combination with the progression of the diabetes.

The literature pays little attention to the donning and doffing of the lower limb prostheses. There are only a few studies that mention donning in relation to a larger study objective. For example, in comparing the function of a KBM prosthesis with the liner prosthesis, mention is made of the donning ease of the different fitting systems (*Cluitmans et al. 1994, Datta et al. 1996, Yigiter et al. 2002*). Gauthier-Gagnon states that the donning of a prosthesis is an enabling factor for use of the prosthesis and that more than 8% of the trans-tibial patients have problems while

more than 3% need help (*Gauthier-Gagnon et al. 1999*). Difficulties in donning can be caused by deficiencies in the upper limb, either in strength or dexterity and impaired vision (*Cochrane et al. 2001*). Also diminished sensation in the fingers and hemiplegia can cause problems (*Hachisuka et al. 1998*). In prior research we found that impaired hand function poses an increased risk for skin problems in the stump (*Baars et al.*). To facilitate donning different solutions have been developed in the form of a special prosthesis suspension table or donning apparatus (*Figuroa et al. 1980, Tamir et al. 2003*). In light of these studies and our case report it is odd to note that experts in the field of amputation and prosthesis in the Netherlands do not seem to regard donning and doffing as a primary influence on prosthetic prescription (*vd Linde et al. 2004*).

In our opinion donning of the prosthesis is an essential prerequisite for safe use and this should be considered during the prescription of the prosthesis. Not only is optimal function of the prosthesis dependent on an adequate donning technique, but also stump skin integrity can be dependent on this. Blisters can form quickly, especially when the skin temperature is elevated (*Levine 1982*). The large blisters shown in this case report appeared quickly as the result of one-time improper donning.

Conclusion

The lesson to be learned in this case report is that an improper donning technique can result in a serious stump skin complication. It is important to take time and observe the donning and doffing of the prosthesis by the patient, especially if the hand function is compromised. If proper instruction does not lead to an adequate result the prosthetic prescription must be adapted to allow a safe donning. In the case of a liner, one can think of using a softer more pliable liner to facilitate the flattening of the distal cup of the liner so that a proper application to the stump can be achieved and the risk of air trapping can be eliminated.

Figure 1.



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