

Clinical note

Quadriceps muscle injury in trans-femoral amputees

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Abstract

Two male trans-femoral amputees using modular trans-femoral prostheses lost control and fell to the ground when their prosthetic knees gave way. The semi-automatic knee lock malfunctioned in the first case while the free knee stabilising mechanics gave way in the second case. This resulted in a high tensile force acting on the contralateral quadriceps muscle causing it to rupture. As there are a significant number of patients with both kinds of prostheses it is important to be aware of this possibility so that necessary actions can be taken to minimise its occurrence. Even with the currently available weight activated stance phase control, the prosthetic knee will give way if the knee is flexed more than 20° on weight bearing. Good power and control of hip extensors on the amputation side is needed to control the prosthetic knee joint, especially in the early stage of the walking cycle, i.e., from heel strike to mid-stance. Quadriceps muscle injury in amputees, as far as the authors are aware, has not been reported previously.

Introduction

In the elderly careful evaluation regarding balance and the ability of the stump to control a free knee should be made before prescription. It may be safer to prescribe a semiautomatic knee lock in spite of the disadvantages of a less cosmetic gait and possible increased energy consumption, in patients with poor balance, poor co-ordination or with weak muscles.

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Patients and methods

Case one

A 56 year old male patient underwent a left trans-femoral amputation 3 years earlier due to gangrene, resulting from peripheral vascular disease. In the post-amputation rehabilitation period he progressed from an automatically locked prosthetic knee joint to a weight activated "stabilised knee" stance phase control and a pneumatic swing phase control in a Blatchford endoskeletal modular Endolite prosthesis. This "free" knee joint also incorporated a manual knee lock allowing the patient to lock the knee joint if he felt unsafe to walk with the "free" knee especially outdoors, on uneven or slippery grounds. He gave a history of losing his balance because of the prosthetic knee joint giving way when he was about to start walking after getting out of his car. He reported that he had applied the knee lock, when he stood up after getting out of the car, but as he was just about to walk off with weight bearing on the prosthetic limb, the prosthetic knee joint gave way unexpectedly. This happened during the double support phase of the gait cycle when his natural right foot was still on the ground. The patient felt a very sharp pain on the anterior aspect of his lower right thigh and fell to the ground. A swelling quickly developed in the anterior aspect of his right thigh about 8 to 10 cm proximal to the upper margin of the patella. He was seen by his general practitioner who diagnosed a partial tear of the right quadriceps muscle and was treated with analgesics. An ultrasound examination 2 months later confirmed the clinical diagnosis of partial tear of the right quadriceps muscle. Clinically at this time a palpable gap in the muscle belly was still easily felt. Examination of the mechanics of the prosthetic limb revealed the

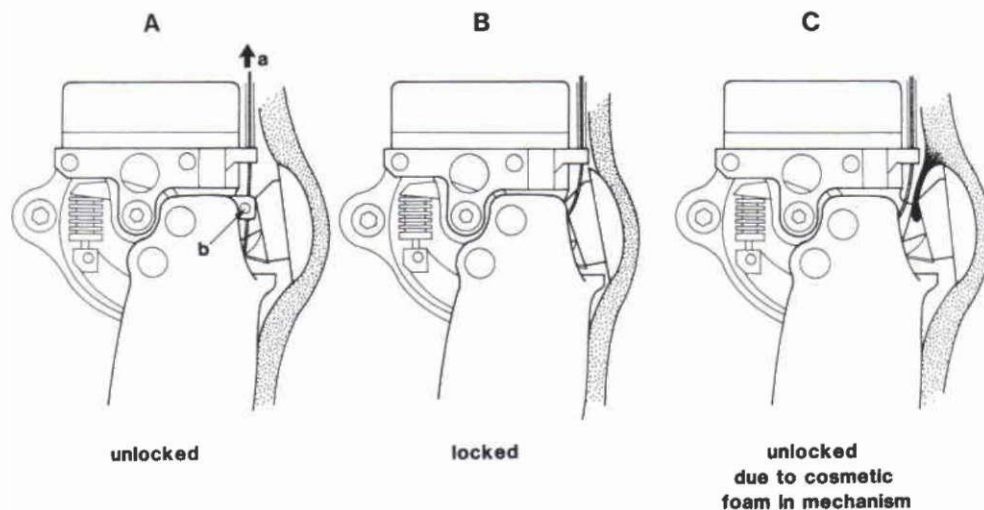


Fig. 1. The prosthetic knee in (a) unlocked (b) locked position. In (c) loose cosmetic foam is interfering with the locking mechanism of the knee lock.

cause of the malfunctioning of the manual knee lock. There was a torn piece of foam interposed in the locking mechanism, preventing the knee lock from being engaged (Fig. 1).

The patient was reviewed 6 months later, the pain and tenderness had completely resolved. Clinically he had no appreciable quadriceps weakness or extensor lag, but the patient reported that he has developed difficulty in getting up from a squatting position. Reinforcement of the foam overlying the knee joint mechanism was carried out to reduce the risks of foam tearing and thereby interfering with the knee lock mechanism. The patient was also advised that he must check properly every time he locks his knee joint that the locking has been effective. He was also strongly advised to watch out for any damage to the foam covering the prosthetic knee joint and to have it replaced or repaired regularly to reduce future risk of falls.

Case two

A 78 year old male with a left trans-femoral amputation performed 2 years previously due to critical ischaemia, fell in the physiotherapy room. When he was attending for review clinic appointment he was wearing a trans-femoral prosthesis with Blatchford Stanceflex knee with pneumatic swing phase control. While walking on level surface the prosthetic knee unexpectedly collapsed forcing him to fall to the

ground. He also complained of considerable pain in the lower anterior aspect of his right thigh. On examination, there was a palpable tender gap in the quadriceps felt at about 5 cm proximal to the superior pole of the patella. The passive range of movement of his knee joint was full, but he demonstrated an extension lag of 20° while attempting active extension. A clinical diagnosis of partial rupture of the quadriceps muscle was made, and was treated by a plaster of Paris back slab for about 3 weeks followed by a knee brace for 3 months, a programme of physiotherapy was also given. Though not performed initially, an ultrasound scan carried out 7 months after injury confirmed the clinical diagnosis of partial tear of quadriceps muscle. On enquiry, this patient gave history of two previous falls during gait training in the week prior to this fall in the physiotherapy department. As it was clear that this patient was having difficulties in controlling the "free" knee joint, his prosthesis was changed to one with a semi-automatic knee lock which meant that he could only walk with a locked knee gait, but unlocked to sit down. This gave this patient confidence to walk again and prevented further falls.

Discussion

It has been reported by some authors that quadriceps muscle or tendon can be ruptured or damaged secondary to an underlying disease

such as rheumatoid arthritis, systemic lupus erythematosus, gout, chronic renal failure, secondary hyper parathyroidism, diabetes mellitus and peripheral vascular disease (Harries *et al.*, 1995). It may occur spontaneously or secondary to injury involving a uniformly indirect force, i.e., force flexion of knee against maximum quadriceps contraction, during unexpected falls (Mann *et al.*, 1995; Brashear and Rany, 1986; Harries *et al.*, 1995; Robert *et al.*, 1970). In both patients reported here, the unexpected falls were the problem, neither suffered from diabetes or poor circulation. The first patient fell due to unexpected flexion of the prosthetic knee. The way the foam interfered with the knee locking mechanism is illustrated in Figure 1. In the authors' experience cosmetic foam getting trapped within the manual locking mechanism of this type of prosthesis has been reported by a number of patients. In the second case the inability to control the prosthetic knee due to age related lack of reflex control mechanism in the residual limb as well as general weakness of hip extensors caused the unexpected fall. In the elderly careful evaluation regarding balance and the ability of the stump to control a free knee should be made before prescription. It may be safer to prescribe a semi-automatic knee lock in spite of disadvantages of less cosmetic gait and possible increased energy consumption, in patients with poor balance, poor co-ordination or with weak muscles.

Quadriceps muscle injury in trans-femoral amputees should be suspected if an amputee patient who has fallen and complained of pain in the contralateral leg over the anterior aspect of

the thigh and present with a swelling in the muscle belly. The clinical diagnosis can be confirmed by ultrasound scanning if necessary. Treatment of quadriceps rupture is dependent on the extent of the rupture, symptoms and the level of ensuing disability. Partial ruptures are usually satisfactorily treated with analgesics, appropriate support and rest and may also need an orthosis to hold the knee in extension. Complete tears may require surgical repair (Brashear and Rany, 1986). Regular review of elderly patients is advisable, since deteriorating muscle strength compounded by poor balance may dictate change of prosthetic prescription. Clinical finding of palpable gap, local tenderness and varying degree of interference with active extension of the knee are diagnostic features.

Acknowledgement

The authors thank the Medical Illustration Department at the Northern General Hospital and Dr S. Vaidya for his helpful contribution.

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