

The use of a hands-free crutch in patients with musculoskeletal injuries: randomized control trial

Rohit Rambani^a, Muhammad Saleem Shahid^b and Surinder Goyal^c

Unilateral musculoskeletal below-knee injuries occur with great frequency. Patients who cannot bear weight on an injured limb usually mobilize themselves with standard crutches. When the patient also has an upper limb injury, however, mobilization might be impossible, and can result in a lengthy in-patient stay. A randomized control trial was conducted on 80 patients to share our experience with the innovative 'hands-free crutch', and to discuss the potential of this device for more frequent use in orthopaedic surgery. We present its value in facilitating early discharge in patients with both upper and lower limb injuries. We show the cost benefit of the decreased in-patient stay that the hands-free crutch provides. *International Journal of*

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^aDepartment of Computer Sciences and Orthopaedics, University of Hull and Hull Royal Infirmary, Hull, ^bDepartment of Orthopaedics and ^cWhipps Cross University Hospital, Leytonstone, London, UK

Correspondence to Dr Rohit Rambani, MS (ortho), MRCS (Eng), 158 Priory Road, Hull HU5 5RX, UK
Tel: +44 7832444888; e-mail: R.Rambani@hull.ac.uk

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Introduction

Injuries or surgeries to the lower extremity often result in a non-weight bearing (NWB) or partial weight bearing (PWB) status for an individual. This restriction in weight bearing might be required for several days, weeks, or even months, depending on the nature and severity of the condition. To solve this, crutches are used to eliminate weight bearing by the affected extremity, while still allowing ambulation. Crutches have been in use for centuries. The use of crutches has been depicted in Egyptian tombs to as far back as in 2830 BC (Ebstein, 1972). Throughout history, various crutch apparatuses have been studied, introduced, and used for patients with restricted weight bearing (LeBlanc *et al.*, 1993; Andrews *et al.*, 1994). The standard axillary crutch (SAC) is still widely used all over the world, perhaps owing to the fact that it is economical. An alternative has not yet demonstrated superiority over the standard crutch.

Patients with both upper and lower limb injuries cannot to use their elbows or axillary crutches and this makes them bed-bound or wheel chair-bound for a long period, until their injuries heal sufficiently to allow them to subject the injured extremity to weight bearing (McCormack, 2000). In the United Kingdom, the use of axillary crutches was replaced by the use of elbow crutches owing to the potential complications arising as a result of using the former (McCormack, 2000).

Different modalities have been used to expedite the discharge of these patients and to make them independent as soon as possible after the operation. This not only benefits early mobilization, but also decreases the

amount of expenditure in patients' stay in hospital. In cases in which NWB or PWB requirements exist, the individual must rely on some type of assistive device, such as standard elbow crutches. Although elbow crutches provide a safe mode of unilateral NWB ambulation, they require the use of both upper limbs for gait (Goh *et al.*, 1986). Therefore, standard elbow crutches are not of help to individuals who are unable to use both upper limbs because of recent injury.

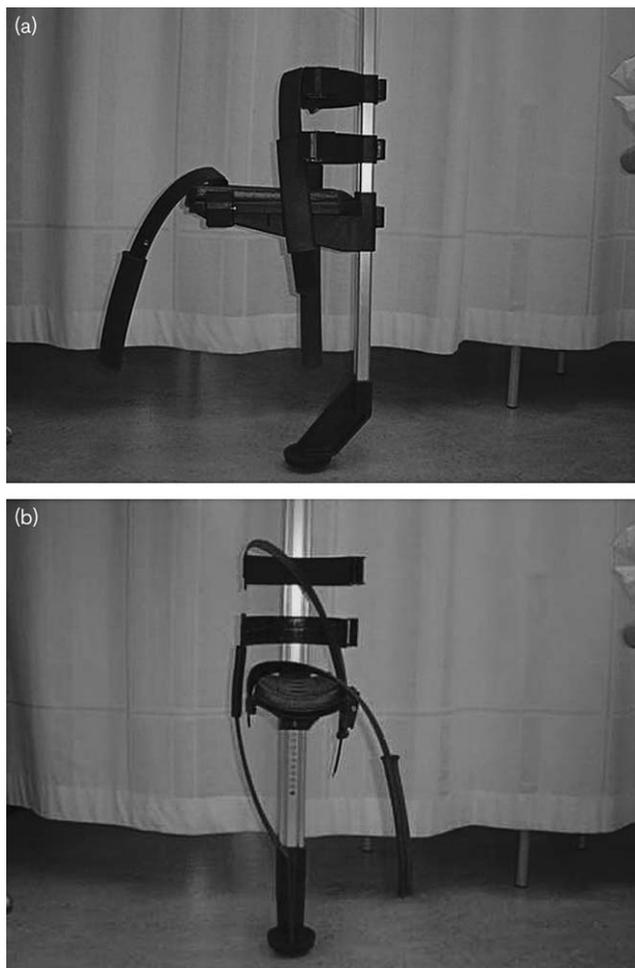
We used a hands-free crutch (HFC) in 40 patients with both upper and lower limb injuries, and discuss the advantages of this crutch both in terms of early mobilization and early discharge from the hospital (Fig. 1).

Materials and methods

The purpose of the study was to evaluate the usefulness of the HFC in patients with multiple injuries. The main objective of this study was to use the HFC in patients with both upper and lower limb injuries, so that they can directly support their weight with the femur using this crutch.

The crutch is made up of lightweight carbon fibre material. A platform supports the leg, and the weight is transmitted from the knee to the crutch. The thigh of the patient is attached to the crutch using Velcro straps, which are easily adjustable and convenient to use. The learning curve for using the crutch is relatively small and is comparable with that of the conventional crutch (Fig. 1a and b).

Fig. 1



(a, b) Photographs of the hands-free crutch.

Eligibility criteria to use this crutch included patients with upper and lower limb injuries who were unable to use the elbow crutches, and who had no head injury or other injuries that could cause vertigo. Written informed consent was taken from all the patients included in the study. All the patients included in the study were randomly divided into two groups, using computer software: one group using HFC and the other using standard protocols. We used the HFC for 40 patients in whom the use of a standard axillary/elbow crutch was not possible. A physiotherapist was especially trained for the safe use of the HFC. Function was measured in both the groups with the help of the musculoskeletal functional assessment and SF-36 questionnaires after 6 weeks (Fig. 2).

Results

Patients in the age group of 18–54 years (average age 37.4 years) were included in the study. Forty-eight men and 32

Fig. 2



Photograph of the patient using the hands-free crutch with non-weight bearing below-knee plaster on the left leg.

Table 1 Patients using the hands-free crutch

Diagnosis	Number of patients
Fracture clavicle with bi-malleolar fracture	24
Fracture of the neck of the humerus and of the ankle	17
Fracture of the olecranon with ankle fracture	11
Fracture dislocation of shoulder with fracture of the metatarsals of the foot	8
Fracture of the shaft of humerus with fracture of the ankle	7
Supracondylar fracture of the humerus with bi-malleolar fracture	7

women were included in the study group. All 80 patients included in the study had sustained injuries to both lower as well as upper limbs, which made it impossible for them to use axillary/elbow crutches. Table 1 shows the different diagnoses included in the study.

The HFC was used for an average period of 3.5 weeks (range 3–6 weeks) until the patients were either full weight bearing or able to use elbow crutches. All patients found the HFC easy to learn and to use.

The average stay of the patients using HFC was 2.3 days, with a range of 1–5 days. This was much shorter compared with the stay for patients who had similar injuries and had decided not use this crutch: 4–14 days (average, 6.7 days). This difference was statistically significant ($P = 0.05$).

The HFC was associated with a better overall musculoskeletal functional assessment score ($P < 0.05$), better coping, a trend towards better lower extremity function, and with performing activities around the house. The HFC was well accepted, safe, and easy to use. A clear trend for better function with the HFC was seen. SF-36 physical function tended to be better with the HFC ($P < 0.05$).

Five patients reported problems with the use of HFC. Knee pain was reported in three patients, but none of the patients developed pressure sores or patellar bursitis after using HFC. Two patients complained of backache, which subsided without any intervention.

Discussion

Numerous injuries, surgeries, or infections can lead to an individual being NWB or PWB for prolonged periods of time. In most cases, individuals rely on axillary crutches to maintain their limited weight bearing status (McCormack, 2000). One problem with the use of axillary crutches is the inability of the patients to use their upper extremities while in an upright standing position, especially while walking. This problem can be compounded in the situations in which the patients have associated upper limb injuries. Owing to this major limiting factor, the HFC was designed to overcome the problem of restricted use of the upper extremities, while also allowing individuals to maintain their weight bearing status, by bearing weight through the femur (Jackson, 2001).

The SAC during ambulation produces a seven-fold increase in the force that runs through the axilla (Wagstaff, 1984). Indeed, this increased force through the axilla can lead to bilateral brachial plexus compressive neuropathy (crutch palsy) (Raikin and Froimson, 1997), axillary artery aneurysms (Tripp and Cook, 1998), acne mechanica (Raikin and Froimson, 1997), and suprascapular neuropathy (Kang *et al.*, 1999). Additional complications can arise from prolonged SAC use, such as shoulder joint degeneration (Shabas and Scheiber, 1996) and carpal tunnel syndrome (Johnson *et al.*, 1962; Gellman *et al.*,

1988). The use of HFC in patients in whom the SAC cannot be used presented a better alternative for the early mobilization of these patients, and made them more functional immediately after the operation.

Conclusion

The HFC has been useful in all the patients, helping them to have an early discharge. This not only helps in decreasing the burden on the hospital in terms of the expenses of hospital stay, but also helps the patient to be independent quickly, after an injury. The HFC is a viable alternative for patients required to be NWB during ambulation. This study delineates the usefulness of this crutch in patients who cannot use the SAC because of associated injuries. Further research is, nevertheless, needed to delineate the range of injuries for which this crutch might be appropriate, and to study the effects of long-term use on knee extension, swelling, and other soft tissue problems. Energy expenditure and gait analysis while using the HFC are other areas that have to be studied.

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