

A Light Weight Model of the Becker "Boomerang" (A Self-Help Device To Facilitate Locking and Unlocking of Long-Leg Braces)

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Introduction

It is extremely difficult for a patient wearing long-leg braces to comfortably extend the braces to the lock-knee position while seated. This difficulty is even greater where there is any degree of spasticity in flexion such as may be seen in paraplegia and hemiplegia. Bending forward at the hips in any effort to extend the knees greatly increases the difficulty by putting mechanical stress on the hamstring muscles.

The Becker "Boomerang"⁽¹⁾ leg-brace extension device employs a principle which enables a patient to lock and unlock his long-leg braces with ease and without assistance from others. Using the "Boomerang" in any case where the knee is mechanically capable of full extension, knee lock-

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ing in extension can be readily accomplished by patients in whom this act is normally very difficult without assistance from another person, or without sitting precariously on the edge of the wheelchair or bed with the heel resting on a point of counterpressure such as the floor. It is possible with this device to produce knee extension while also extending the hip rather than bending forward to support the leg or to apply downward pressure. The savings in man hours made possible by the "Boomerang" amounts to at least one-half man hour daily per patient. This device has a secondary use in permitting patients with short and long leg braces to perform active assistive exercises of a weak lower extremity.

The original model of the Becker "Boomerang" has been in general use since 1955. This report presents the newer, lightweight model that has been tested with success over a three-year period in our rehabilitation cen-

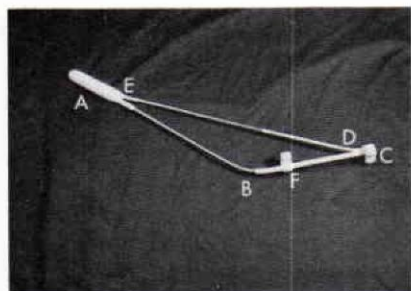


FIGURE 1

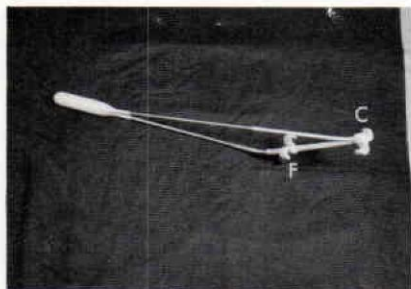


FIGURE 2



FIGURE 3



FIGURE 4



FIGURE 5

ter. Stainless steel tubing has been used because it is lightweight, strong, rust free and cosmetically acceptable.

Specifications

The main bar of the "Boomerang" leg extension device is made of $\frac{3}{8}$ inch (outside diameter) stainless steel tubing, 27 inches in length. The proximal arm, A-B, is 17 inches in length, including the grip. The distal arm of the "Boomerang," B-C, is 10 inches in length. To this arm, double hooks formed from $\frac{1}{8}$ inch x $\frac{5}{8}$ inch x 5 inches stainless steel are welded solidly to the "Boomerang" at points F and C. Distance from B to F is 2 inches. Double hook at C is flush with the end of the "Boomerang." All hook gaps must be $\frac{1}{2}$ inch in width. The sides of the hook are $\frac{3}{4}$ inch deep on the inside and $\frac{1}{2}$ inch deep on the outside. The strut to support the "Boomerang" angle against spreading is of $\frac{3}{16}$ inch stainless steel rod 20 inches in length and firmly welded at points E and D. Hooks at F have the gaps facing down; those at C have the gaps facing upward. The device can be applied to any side of either leg brace, which is most helpful where some degree of upper extremity disability may be present.

The handpiece or grip has an additional piece of stainless steel tubing or aluminum $\frac{1}{2}$ inch (outside diameter) x 5 inches in length slipped over the end, A-E, to increase the diameter of the grip. The handgrip is then dipped several times in Plastisol to build up a thick protective and comfortable covering. The hook end, B-C, is dipped enough to allow minimal coating which eliminates scratching of the brace uprights. Plastisol is used because it has the advantages of 1) a comfortable grip, 2) an easily cleaned surface, and 3) its durability against long and continued use. The weight and cost of the "Boomerang" have been kept at a minimum by using lightweight materials (approximately $1\frac{1}{2}$ pounds) that should not exceed ten dollars.

A leather case (holster) or straps can be attached to the wheel-chair to hold the device for convenience at hand.

Discussion

Figure 3 illustrates the starting position for obtaining knee extension. Note that the "Boomerang" feature of this device permits the greatest component of pull in the long axis of the femur practically throughout the entire extension phase. Figure 4 shows the leg not quite fully extended. It is within these last few degrees of full extension that devices heretofore proposed have fallen short in that there has not been sufficient offset provided for pull rather than downward push. The angle at B should be 130 to 140 degrees for optimum mechanical advantage. Figure 5 shows the leg brace fully extended and locked. It can be seen that while comfortably and safely seated the patient still has plenty of room. Without the "Boom-

erang" feature (e.g., straight bar) the patient would have to move forward in the seat and would have to apply all pressure in a downward direction, or push, at this phase of the procedure. Torque, spring, and tissue yield, would add to the difficulty where a straight lever is employed in the last few degrees of extension. Torque is a negligible factor in the use of this device.

Conclusion

The Becker "Boomerang" has proven itself not only as a time saver, but as a device that has made possible a patient being able to extend his long-leg braces to the knee-lock position without human aid. This lightweight model is relatively new and has been tested only at the Spain Rehabilitation Center. These tests, however, have proven its advantages already mentioned — it is lightweight, rust-free, strong, cosmetically acceptable, has a comfortable grip, and the easily cleaned Plastisol surfaces are durable even with continued use.

Since the modified device weighs less than 1½ pounds and is quite easily handled by the average patient having paralyzed or weakened lower extremities, the weight-strength relationship need not be changed to accommodate individual patients. Lighter materials such as tempered aluminum and magnesium may be used providing this results in no significant reduction in strength. The "Boomerang," as described, is extremely rugged and repairs are seldom necessary even after years of continuous use.

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