

The Stat Limb: A Prosthesis for Immediate Postoperative Fitting of AK and BK Amputations

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INTRODUCTION

Postoperative care of amputation wounds varies significantly ranging from simple daily dressings to rigid immobilization. These variations make it difficult for the occasional surgeon to judge the virtues of each method from available literature. A basic prefabricated plastic supportive structure is described here to simplify the use of an immediate postoperative prosthesis (Figure 1).

Although immediate post surgical fittings (IPSF) were in common use 20 years ago, they are used only in isolated areas today. The reasons for the decline of IPSF were both educational and logistical. Most amputations today are done by general and vascular surgeons who are not trained in IPSF principles or rehabilitation, and who do not have a working relationship with a prosthetist. Secondly, to use the conventional IPSF technique as taught by Weiss and Burgess, a prosthetist needs to be available at surgery with a number of special socks, attachment plates, tubes, padding materials and the associated tools needed to apply the prosthesis. Scheduling the prosthetist caused logistical problems, so physicians began to simply apply a rigid dressing in surgery and call the prosthetist in a week or so later to apply a shrinker. A preparatory prosthesis is not usually prescribed until three to four weeks post-surgery.

ADVANTAGES OF EARLY MOBILIZATION

The postoperative disease problems of the amputee are typical of any long term illness en-

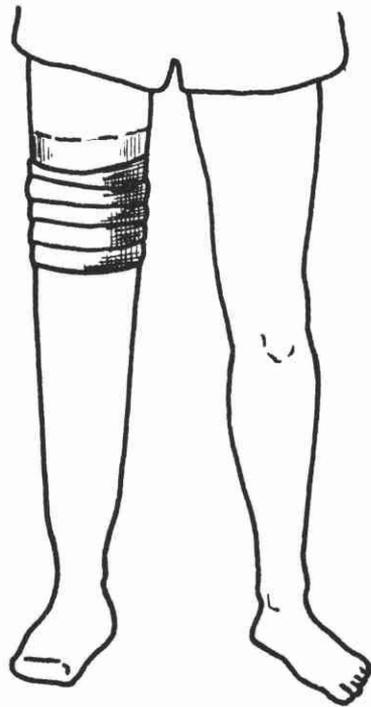


Figure 1. The Stat Limb is a prefabricated high density polyethylene shell that can be applied in less than ten minutes in the operating room.

countered in medical practice. Thinking solely of the amputated limb is a grave mistake, not only for the mental health of the patient, but also for the surgical wound itself.

Early mobilization after surgery is a necessity in preventing bowel, bladder and cardiopulmonary complications. The post-amputated patient is usually a high risk patient. Often, severe diabetes with restricted cardiopulmonary reserve is a common associated medical problem. Small pulmonary emboli cause major cardiac changes, and bladder/bowel stasis of recumbency may lead to recurrent septicemias. Each day of postoperative immobilization adds a significant risk to ultimate survival. First or second day mobilization into the standing position is a necessity to reduce basilar atelectasis, reduce the residual urine volume in the bladder, and allow feces to move into the rectum for evacuation.

Even without the psychological and balance effect of a second limb, the process of getting a weak postoperative patient to stand on the unaffected leg alone is next to impossible. However, a rigid locked knee above a "weightless" prosthesis gives the patient more stability than when they had a painful necrotic leg before surgery. It is possible to mobilize a patient within 24 hours post-surgically or to at least have the patient stand and transfer to a commode or wheelchair using a limb, even though they have been bedridden entirely for many weeks preoperatively. Minimal ambulation in therapy from the second day onwards is important. The wound risk involved with minimal weight bearing and the brief stance phase on the amputated leg is outweighed by all the general advantages to the patient for ultimate survival.

The Stat Limb was designed to allow even the surgeon doing an occasional amputation to apply an immediate postoperative prosthesis himself following surgery. The Stat Limb comes in one size that fits both right and left legs, eliminating the requirement for inventory. The patient receives all the advantages of a rigid dressing, with the added advantages of early weight bearing. The psychological boost given to a patient who wakes up following surgery with two feet under the covers cannot be easily measured, but is definitely a positive factor. In addition, the medical team working with the patient (physician, nurse, therapist,

etc.) automatically become rehabilitation oriented. The patient is no longer laying in bed week after week waiting for his new leg. Early ambulation is safe and is encouraged as early as one day postoperatively. The lack of knee flexion in the prosthesis poses no particular problem to the patient during walking, and the extremely light prosthesis allows the patient to move the leg around easily in the sitting and supine positions.

Patients who have worn the Stat Limb make the transfer to a preparatory prosthesis very easily; they already know how to walk and are not afraid to place weight on the residual limb.

APPLICATION PROCEDURE

The major advantages of the Stat Limb immediate postoperative fitting are as follows:

1. a rigid dressing,
2. the knee fixed in hyperextension,
3. rapid application of the prosthesis while the patient is under anesthesia,
4. light weight due to the structural strength at the periphery of the prosthesis, and
5. modification of the limb as rehabilitation continues.

Rigid Dressing

The application of a rigid protective dressing is important to the survival of a poorly perfused limb. By surrounding the limb in a soft, heat-insulated environment, free of shearing forces, the limb is maintained at near 37 degrees centigrade, which is optimal for almost all physiological functions of wound healing, tissue resistance, and arteriolar dilation, and gives the surgery its best chance of success. Daily opening of the wound by tearing off adherent, coagulated dressings is not only painful, but rarely indicated unless for observation of unexplained pyrexias or blood loss.

The dressing is nothing other than a gauze dressing over the wound site, to allow for any drainage which might occur, followed by multiple layers of cotton, giving a total of about two centimeters of thickness of cotton from groin to the distal end. A thin layer of fiberglass casting material is then applied to provide a rigid outer layer, preventing knee flexion and maintaining the residual limb shape, and protecting the wound (Figures 2 and 3). If plaster

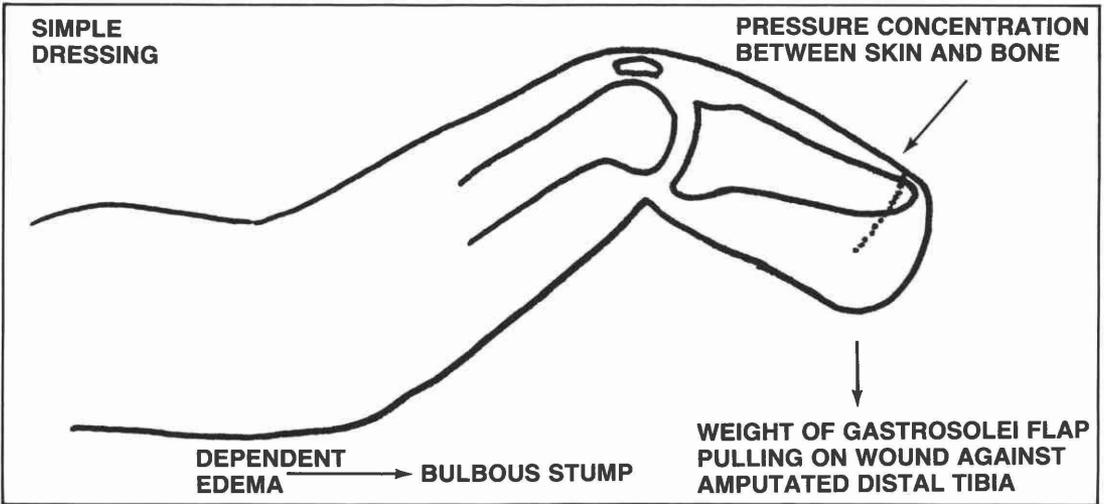


Figure 2. A simple dressing creates pressure between the skin and bone and forces the weight of the gastrosolei flap to pull on the wound against the amputated distal tibia.

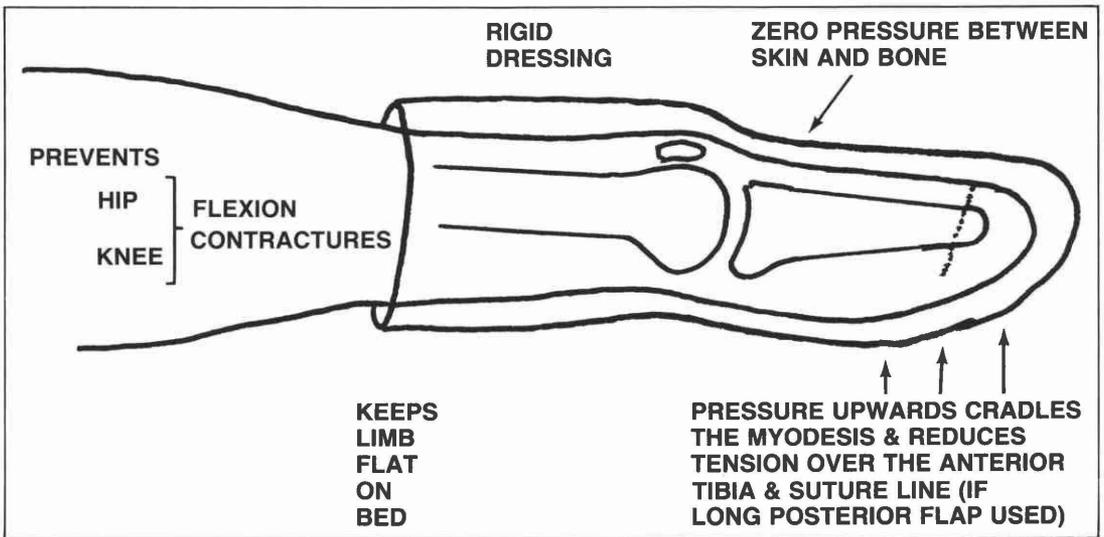


Figure 3. The rigid dressing maintains the knee in extension.

is used for the rigid dressing, it must be allowed to dry 24 hours before the Stat Limb is applied. At no stage is compression ever applied in the application of the rigid dressing. The speed of limb application is important in the critically ill, and with prior experience of one or two applications, it should be successfully applied in less than eight minutes (Figure 4).

Stat Limb Application

Following the application of the rigid dressing, the Stat Limb is applied. The Stat Limb is designed to fit both left and right legs and can be cut to fit around the rigid dressing in nearly all cases.

The desired length of the Stat Limb is approximated by either measuring the sound side,

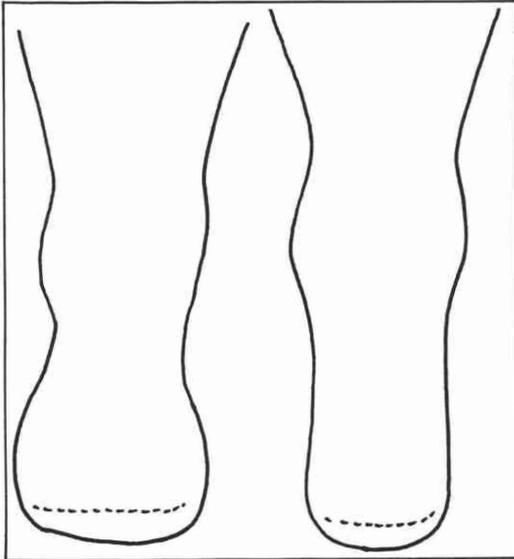


Figure 4. Left, a bulbous residual limb after compression wrap. Right, a cylindrical residual limb after rigid dressing.

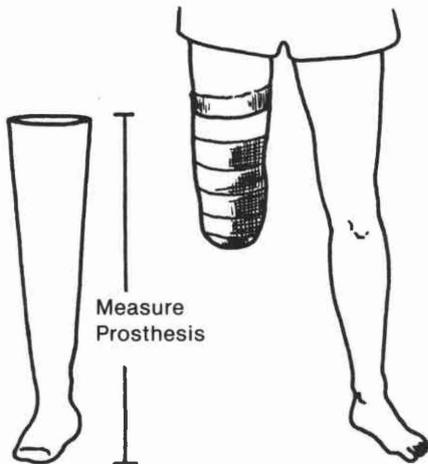


Figure 5. The rigid dressing consists of a gauze bandage over the wound, about two centimeters thickness of cast padding, and two layers of fiberglass casting tape to mid-thigh. The Stat Limb should be one centimeter shorter than the sound side, and the knee cast in extension.

or by laying the Stat Limb next to the patient and marking the section to be cut off. The top edge of the Stat Limb should be trimmed a few inches short of the top of the rigid dressing (Figure 5).

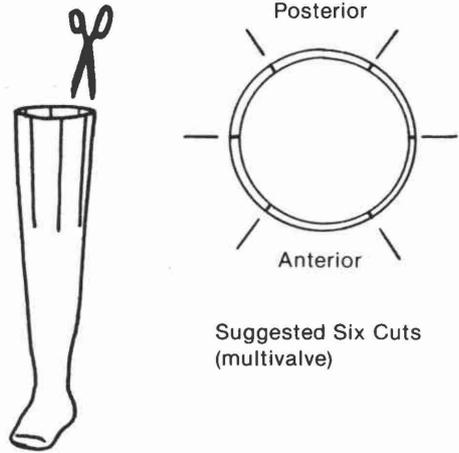


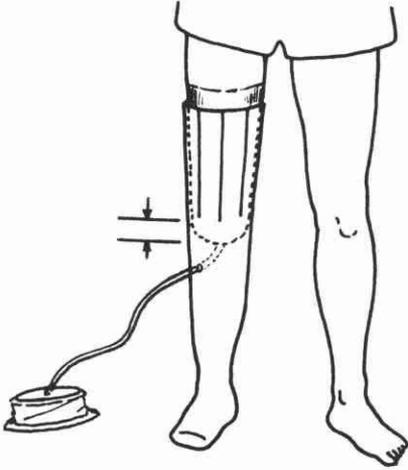
Figure 6. A scissors or cast saw is used to cut off excess length and multivalve the Stat Limb. Six longitudinal cuts are recommended. The cuts may have to extend past the end of the rigid dressing if a bulbous end is present.

Six vertical cuts are then made in the Stat Limb to allow it to form around the rigid dressing (Figure 6). Alignment is approximated while wrapping the Stat Limb onto the rigid dressing. The Stat Limb should be about a half inch shorter than the sound limb to allow toe clearance with an extended knee (Figure 7). Toe out, foot in-set and out-set, and the anterior-posterior positioning of the foot should be held in a normal position as the casting material sets (Figure 8).

Knee in Extension

Keeping the knee in extension, or locking it in about two degrees of hyperextension, makes the knee stable at the tibiofemoral joint. Subsequently, the quadriceps, hamstrings, and gastrocnemius are reflexly relaxed. Pain and associated spasms are reduced. The reduction of spasm of the gastrocnemius reduces the stress placed upon the distal myodesis and, indirectly, on the wound itself.

With the knee in extension, the distal residual limb can be molded to prevent posterior migration of the long posterior flap. In extension, limb application is easier and it is easier to judge valgus, varus, rotation, and length of the limb. Application under anesthesia is justifiable because the patient is relaxed and this



Multivalve the prosthesis to about 5cm (2 inches) above the distal end.

Figure 7. For most applications, the vertical cuts can stop two centimeters from the distal end of the rigid dressing, and the proximal edge of the Stat Limb should be a few centimeters distal to the rigid dressings upper edge. A drain hole can be punctured through the Stat Limb, allowing removal in 24-48 hours.

avoids fighting with a flexed knee joint four days later.

Lightweight Due to Exoskeletal Construction

Using the mechanical principles of the square area of inertia, the prosthetic material and the intended forces acting through the prosthesis are distributed to the periphery. This allows the use of a minimum amount of material while gaining the maximum strength to the prosthesis. A semi-pliable thermoplastic of high density polyethylene is used to give toughness to the prosthesis, to reduce the chance of any brittle failures, and to allow for cold forming of the prosthesis around the rigid dressing.

MODIFICATION AS REHABILITATION CONTINUES

As the patient's healing improves and rehabilitation continues, the thigh length rigid dress-

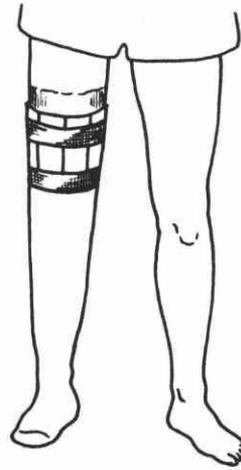


Figure 8. A double layer of fiberglass material is used to fasten the Stat Limb to the rigid dressing. All of the vertical slits should be covered. For heavy duty users, reinforce the ankle area with casting material as well. Normal toe-out and foot positioning should be maintained while the casting material sets.

ing is changed for a padded P.T.B. socket, also made of fiberglass cast material and attached to the limb. Depending on the strength of the quadriceps and hamstrings, the suspension is either a supracondylar strap or a simple single axis hinge from a knee orthosis; this usually occurs at the end of the second week. At the end of the seventh week, the residual limb is usually mature enough for a standard P.T.B. prosthesis. In a similar manner, the prefabricated limb can be used with less complexity for an above-knee prosthesis.

A non slip sole material should always be worn when a patient is using the Stat Limb, as the plastic foot section is very slippery. A hospital slipper can be used as can elastoplast adhesive tape.

On some occasions, buckling of the plastic at the ankle has occurred. This is usually a sign that the patient has become either very active or is wearing the prosthesis for a longer time than for which it was designed. Reinforce the ankle and foot with fiberglass tape during the original application process if it is felt that the patient will be a heavy user.

The same Stat Limb module can be used for cast changes. However, it is important to cut off the cast carefully to prevent damage to the Stat Limb. It is not recommended to reuse the

Stat Limb on other patients since it is designed for limited use.

The earlier a prosthesis is applied, the more successful and pain free is the final fitting. The problems encountered in the use of any system have to be recognized, but it is difficult to scientifically explain why a minimally weighted limb can impede wound healing. If the prosthesis is not applied to the patient for a few days, we note the rate of progress is retarded. This is detrimental to the functional recovery of wound healing and the entire patient.

CASE HISTORY

Although over 1,000 Stat Limbs have been used to date, one case history will be presented to illustrate the benefits of the Stat Limb in a community hospital setting.

Patient A.B. is an 80 year old woman who had a right below-knee amputation, secondary to diabetic gangrene, two years ago. She was fit with a Stat Limb immediately and began weight bearing in physical therapy two days later. A cast change was made 12 days postoperatively when the stitches were removed. The Stat Limb was reapplied and the patient was discharged home with a walker and wheelchair. Two weeks later, a second cast change was made and measurements were also taken for a preparatory prosthesis. The following week, the Stat Limb was removed and the patient was fitted with her prosthesis. She walked six full lengths of the parallel bars without hesitation.

One year later, the same patient lost her left leg below the knee and was immediately fit with a Stat Limb. Within two weeks she was home with a walker using a definitive right below-

knee prosthesis and her Stat Limb. Without the availability of the Stat Limb in this case, this patient would have been wheelchair bound for weeks, the time needed for physical therapy would be lengthened, and many activities of daily living would have required assistance.

SUMMARY

With the decline in use of immediate post-surgical fitting of prostheses, most amputees do not walk for several weeks post-surgically. The Stat Limb is designed for easy application by even the occasional surgeon and allows weight bearing within days following surgery.

The Stat Limb does not provide the answer to every amputation. Each patient is entirely different from another in any series, and many other factors must be taken into account, including the initial pathology, age, cooperation of the patient, availability of nursing and physical therapy care, and other associated problems.

The Stat Limb does remove most of the logistical and educational problems that are associated with IPSF, and should allow many new amputees to benefit from early weight bearing and walking.

AUTHORS

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