

Faster Functioning

New techniques in postoperative and amputee management can speed up patients' return to functional status.

by Karl Barner, CPO

Limb amputation can be an emotional, physical, and financial burden. New techniques and materials in postoperative and amputee management can alleviate some of these burdens. Patient selection is essential and should include age, diagnosis, general health, compliance, and hygiene practices. Also, a multidisciplinary team of qualified physicians, prosthetists, therapists, nurses and other healthcare providers (including family) improves the chances of a successful postoperative outcome for the new amputee. These new techniques can influence early prosthetic usage, which may reduce time in rehabilitation and overall cost.

HISTORY OF POSTOPERATIVE AMPUTEE CARE

Goals for new amputees are: edema control in the residual limb, protection against accidental trauma, surgical site healing, and avoiding side effects (ie, joint contractures, muscle weakness, and skin breakdown).¹

When the goals of edema control and surgical site healing have been met, the patient is ready to be fit with a custom prosthesis. Over the next 3 to 12 months, the patient's residual limb will usually mature, which means that it has established edema control and shaping of soft tissues. At that point, a definitive prosthesis is made for maximum individual function. Following are the most common styles or care:

Postoperative sterile dressing and edema control. Some patients with new amputations are released from an acute care setting with a sterile dressing on the residual limb and/or an elastic compression wrap to assist in the control of swelling. The patient might be discharged from the hospital minimal therapy and asked to return 2 to 5 weeks later for suture removal. The prosthetist provides a compression shrinker to further reduce edema in the limb. Within the next 6-8 weeks, the patient will be fit with the first prosthesis.

The indications of the postoperative sterile dressing and edema control are: noncompliant patients, poor hygiene, and severe diabetes/peripheral vascular disease. The contra- indications are., young, active, compliant, traumatic, and healthy patients. The advantages are: initially inexpensive, easy to check healing limb, light weight, and easy to maintain hygiene. The disadvantages are: inconsistent pressure with each wrap, possibility of compression wrap limb constriction, wraps and shrinkers slip off with movement, encourages overall muscle weakness and possible contractures, lacks protection against further trauma, long-term high cost, for rehabilitation, and increased potential for friction/pressure sores. These findings have been corroborated (Malone JM, Pipinich L, Leal J, Hayden S, Simpson T, unpublished data, 1999).

Removable rigid dressings (RRD). Another alternative for post-amputation management is a removable rigid dressing (RRD). This is mainly designed for transtibial amputees. The RRD is a plaster or fiberglass cast that is applied to a patient's limb in the operating room or soon afterwards. The casting typically is applied up to the knee joint, but may have a posterior thigh extension to reduce the chance of developing knee flexion contractures. This cast is usually applied over two socks and with extra padding over bony areas.

One sock is for cast interface, and the other is used as a cushion to ease removal and reapplication of the cast on the residual limb. If the patient's edema reduces, the RRD may be removed and thicker socks can be applied to increase tension and possibly reduce more edema. This is an initially cost-effective treatment plan and allows easy checking of the surgical site. It also provides substantial protection for the residual limb against accidental trauma. However, this cast is not recommended for weight bearing.

The indications are; compliant, traumatic or disvascular conditions, edematous limbs, and non-weight bearing. The Contra- indications are: poor compliance, poor cognition, and poor hygiene habits. The advantages are, rapid residual limb shrinkage/prevention of edema, soft tissue immobilization to facilitate wound healing, reduction of skin breakdown, simple donning/doffing, easy to check residual limb healing, prevention of residual limb trauma, and reduction of wound pain. The disadvantages are; bulky, heavy weight, and initial moderate cost.

Immediate postoperative prosthesis (IPOP) approach. During the 1960s and '70s, a new style of treatment for amputees was established-the immediate postoperative prosthesis (IPOP). This consisted of the surgeon having the prosthetist apply a rigid plaster cast over a sterile dressing on the amputated limb while the patient was still in the operating room. The casting is similar to the removable rigid dressing with recommended padding.

The cast surrounds the anterior and posterior thigh, and usually needs to be removed with a cast saw. Attached to the cast are a suspension belt, an alignable pylon, and a prosthetic foot. The patient could initiate limited weight bearing the day after surgery with the assistance of a therapist and walking aid. The cast would be changed every 3 to 10 days to evaluate status of limb healing and to properly size it if there was a reduction in edema. Fiberglass casting wrap reduces the weight of the IPOP. This style of amputee management can be very successful when a qualified staff and proper patient education are available.

The indications are: compliant, young, healthy, and trauma patients. May be used on moderate diabetic/disvascular patients with closer follow-up and patient education. The contraindications are severe diabetes/disvascular, non-compliant, aggressive, and poorly cognitive patients. The advantages are: light, ambulation and limb conditioning, which prepares patients and residual limbs for prosthetic fitting earlier, encourages residual limb proprioception while standing; encourages limb healing and edema control; possible psychological benefits with prosthetic foot attached; discourages complete muscle atrophy and joint contractures; low long-term rehabilitation costs, and available to all lower extremity amputation lengths. The disadvantages are: initial higher cost in hospital, difficult to evaluate residual limb while in cast, heavy weight of cast, and as the edema reduces, the total contact pressure is lost and unadjustable until next cast change.

NEW APPROACHES

Recently, new techniques have been developed to meet post-amputation goals. Some of these devices are similar to conventional approaches, but differ with lighter weight, materials with increased comfort, easy application/removal, size adjustment for total contact

edema control, and better hygiene features. The following techniques are currently available options with initial scientific studies performed and presented here.

Prefabricated adjustable post-operative sockets. This design is similar to the RRD and IPOP, except that it uses a lighter weight, prefabricated plastic post-operative dressing.² These plastic dressings cover the same sterile and padded material that might be used in traditional RRDs or IPOPs, but they have the advantage of reduces weight, adjustability to control edema, easier to maintain hygiene, and easy checking of the surgical site. These plastic rigid dressings can also have prosthetic foot attachments added for early limited weight-bearing ambulation.

The indications and contraindications are the same as those for IPOP and RRD. The advantages are the same as IPOP, plus lighter weight, easy to check surgical site., easier to maintain hygiene, easier to adjust for- edema loss, no loud cast saw needed for removal, provides appropriate protection, and prevention resistance to knee flexion contractures. The disadvantages are: appropriate inventory needed for size availability and possibly less total contact on residual limb in comparison to cast.

Pneumatic prefabricated IPOP. The pneumatic prefabricated IPOP design is based on a conventional method of controlling limb edema.³ Instead of using a fabric shrinker, compression is achieved with a plastic air bladder. The patient's residual limb is introduced to the deflated air bladder. A distal to proximal measured pressurization occurs as the bladder is inflated with a pump. More air can be added if limb edema is reduced. This technique was advanced further with the application of a rigid structural socket around the pneumatic air bladder.

This system can be applied to prosthetic components for early weight bearing and limited ambulation. Initial results have indicated that this technique is effective and has a high level of patient satisfaction. The indications and contra-indications are the same as those for IPOP and RRD. The advantages are the same IPOP, plus lighter weight, easier to check surgical site, easier to maintain hygiene, ease in edema control, one size fits all, less inventory needed by the prosthetist, and it may be used after the initial amputation period for a shower or swim leg. The disadvantages are.: bulky, air bladder subject to possible punctures, initial higher cost, not available for above the knee amputees, and the need for an accessible pump to control air volume.

Silicone roll-on suspension sleeve post-op approach. Beginning in the late 1980s, the prosthetic profession has been revolutionized by different types of silicone prosthetic liners that provide suction suspension to the residual limb and give comfort.

Most of these silicone liners are inverted and rolled on the patient's residual limb. It is essential to properly size and don these liners without trapping air under them. After the liner has been applied to the patient's limb, a metal pin or a lanyard string attachment is screwed into the distal end of the silicone liner. The patient then dons the custom-made prosthetic socket over the liner and locks the residual limb into the socket via the pin lock or the lanyard jam cleat. This usually provides an adequate suspension of the prosthesis without the need of belts, straps, neoprene sleeves, etc.

More recently, prosthetists have used the silicone liner systems for postoperative amputee management. The silicone liner has been used alone for edema control or incorporated into all early postoperative prosthesis. The roll-on design of the liner appears to be less traumatic on the suture line than the fabric pull-on shrinker sock. The suction feature of the liner not only allows positive suspension with a prosthesis, but works well as a shrinker because it does not fall or roll off as do compression wraps or fabric shrinkers.

It is also recommended to gradually increase the use of the silicone liners with 2-hour increments daily up to approximately 8 hours per

day (the patient should be provided with an alternate style of management while out of the liner). It is very important to wash the liner and the patient's residual limb after usage to avoid bacterial buildup from the patient's perspiration. Close observation by the health care team is essential to assure tolerance by the skin on the residual limb.¹

Early post-amputation prosthetic fittings have also proven successful. These findings have been corroborated (Larsson G, Johannesson A, Holmquist A, Larsson Brita, unpublished data 1999). For many prosthetists, the time needed it to apply a sili- cone roll-on suspension sleeve with a prosthesis varies, according to their own success. One approach is to perform a more conventional-style method for the first the 5-7 days, then use the silicon liner for edema control and postoperative-style fittings of prostheses. The fitting of the first prosthesis and initial gait training are performed within 3 weeks post-operation, excluding any complications. The liner may be carefully donned on the patients limb with sutures/staple still intact. The indications are: young or old, traumatic or disvascular, compliant, and hygienic. The contra-indications are: non-healing wounds, silicone intolerance/allergy, poor hygiene habits, non-compliance, poor hand function (donning/doffing difficult), and conical bony limbs. The advantages are: limb compression for edema control, easy donning/doffing, positive suction suspension for shrinker or prosthesis, easy cleaning, reduces stress on suture line, and may be used on transtibial/transfemoral/knee disarticulation/Syme's amputees. The disadvantages are: high initial cost, perspiration, potential liner damage, and complications if inappropriately applied on residual limb.

CONCLUSION

Protection, edema control, and early limited ambulation of a newly amputated residual limb are essential to encourage patients to maximize function and reduce the changes of side effects. A recent study suggests that IPOP management can reduce total rehabilitation costs by up to \$8,000 for a unilateral transtibial amputee (Malone JM, Pipinich L, I,eal J, Hayden S, Simpson T, unpublished data, 1999).

With new techniques and materials, patients will be able to return to a functional status more quickly, therefore reducing overall rehabilitation costs. Many of the newer techniques; are currently backed only by initial scientific studies, but they are quickly becoming more popular. These current thehods are not limited to only lower extremity amputees, and they should be considered for application in upper extremity cases.

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REFERENCES

1. Moore WS, Hall AD, Wylie EJ. Below-knee amputation for vascular insufficiency-experience with immediate post-operative fitting of prosthesis. *Bulleting of Prosthetic Research*, 1969; 969:5-25.
2. *FLO-TECH*[®] (brochure) *Trumansburg, NY., *FLO-TECH*[®] O & P Systems, Inc. 1999.
3. Schon L, Rheinstein J, Kowalczyk G., et al. A universal immediate or early temporary prosthesis. Poster presented at: American Academy of Orthoepadic Surgeons meeting; March 1999, New Orleans,
4. Lake C, Supan TJ. The incidence or dermatological problems in the silicone suspension sleeve user. *Journal of Prosthetics and Orthotics* 1997; 9:97-06.

*Address correction provided by *FLO-TECH*[®] Feb. 21, 2001