



Osteomyoplastic Amputation Reconstruction

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MEDICAL SCHOOL

UHS/Chicago Medical School

RESIDENCY

University of Illinois – MGH Internship Surgery

Creighton University – General Surgery

University of Illinois – General Surgery

CERTIFICATION

Board Certified, General Surgery

SPECIALTY TRAINING

Osteomyoplastic Amputation Preceptorship,

University of Oklahoma

Advanced Spine Preceptorship – Minimally Invasive Approach

Hyperbaric Medicine Team Training

MEMBERSHIP

American College of Surgeons

Amputee Coalition of America

American Academy of Wound Management

Medical Corps – United States Navy Reserve

“Amputee care is something more than just an operation about a bone-bridge, rather it has to be a team effort. My involvement with amputees began over 30 years ago starting with clerical responsibilities, reception, advocacy, and then assistant. As a physician, my role now also includes pre-operative assessment, surgery and long-term care issues.”

Osteomyoplastic Amputation Reconstruction

History

Amputation surgery has been documented for well over 3,000 years as a result of traumatic injury, judicial punishment, and disease. Although the concept, removal of a nonfunctional or potentially disease laden extremity has not changed much, the return to function has advanced greatly only in the last 100 years. Modern amputation surgery should be performed with the idea of returning a patient to as much function as possible based on their preoperative abilities.

The concept of Osteomyoplastic reconstruction developed as a result of thousands of World War I veterans who were only able to “exist” in a nonfunctional state, in an era when manpower was critically short. From a study of the

regenerative powers of the periosteum, initially applied to defects of the jaw, face and spine from trench warfare, developed the current technique. Subsequently, over 20,000 soldiers who survived the conflict, who were facing limb loss, with inadequate prosthetic and rehabilitation care, now had options available to them.

Therefore Professor Dr. Janos Ertl (1880–1951) was given the task and obligation to find a suitable way to reconstruct and revise these amputees giving them a functioning extremity once again. The principle is simple; through biological planning, the natural forces of the bodies’ regenerative





capabilities can be directed and guided to re-create a more functional extremity, which then can be fitted with any type of prosthetic device based on the patient's ability. In effect, "the surgeon's knife becomes an instrument of nature."

These observations were the results of the work by Ertl's predecessors and contemporaries who used the available technology at the time as well as laboratory experimentation to identify how bone and tissue heals itself (Bier, Roentgen).

Later investigators also re-created the clinical findings of Professor Ertl in laboratory situations thereby validating on a scientific and investigative level the theories of how well the Osteomyoplastic amputee can perform (Loon, Dederich).

Operative intervention is dependent on too many factors to adequately describe in this monograph. The ultimate decision for surgery requires a thorough physical examination, review of the patient's history (what was done, when, where, and why?); current imaging (X-ray, MRI), as well as a willingness to undergo the necessary care and refitting of the new stump. This involves the efforts of not only the patient, and patient's family, and the surgeon, but the prosthetist as well.

Procedure

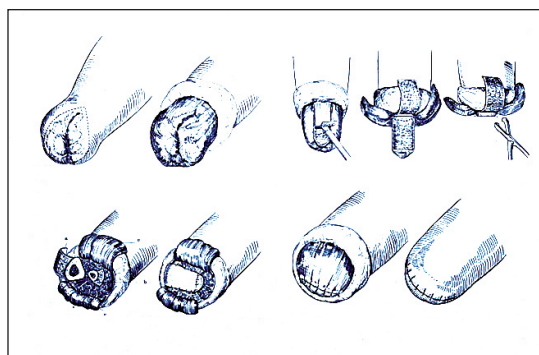
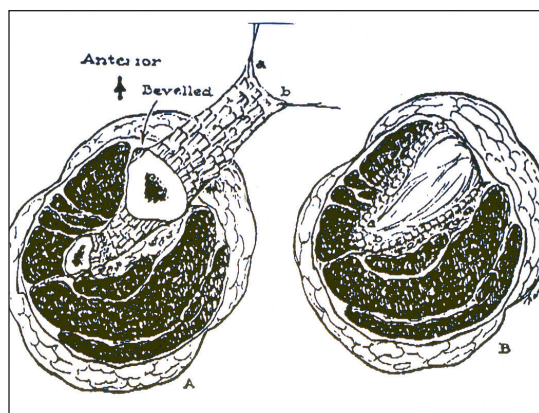
Initially, the old scar is removed and tissue planes are separated to identify the layers of muscle, blood vessels, and finally, bone.

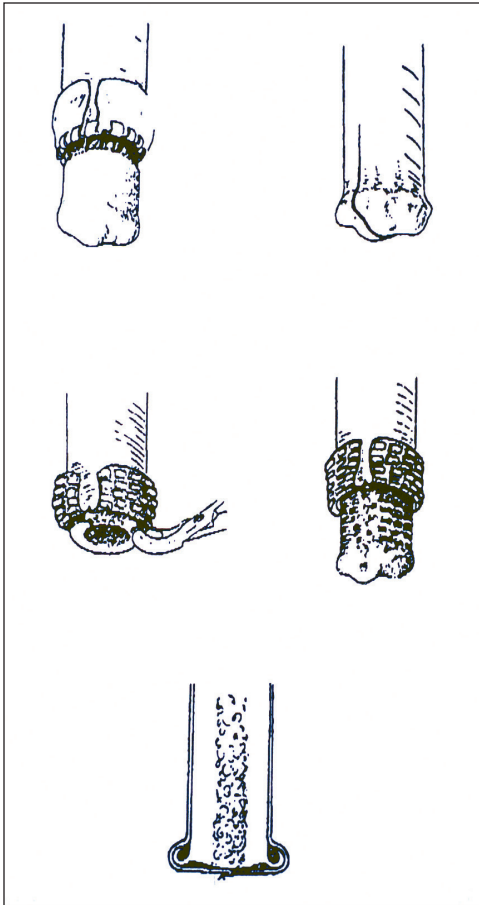
Next, a bone-bridge is created between the two lower extremity bones, the tibia and the fibula. By forming a *synostosis*, this provides a bony framework, recreating a heel-type structure with weight bearing capabilities.

This framework prevents the fibula from separating from its tibial relation and being pulled away by its tendinous attachments. Without this bony stabilization, the fibula may “wander” from the tibia with each step, causing unnecessary and non-physiological motion, irritating the soft tissues and nerves.

Also, the bony bridge prevents a rotational motion of the below-knee stump within its prosthesis, thereby creating additional stability in the rotational axis of the patient’s limb.

Another advantage is the recreation of a closed bone marrow cavity, which is also accomplished in the above-knee amputation by osteoperiosteal flaps. This is a principle in the





Osteomyoplastic amputation procedure that has been supported by biomedical experimentation. In conventional amputation techniques, the bones are transected exposing the medullary cavity. If the bone marrow cavity is allowed to remain open, abnormal vascular tissue will proliferate from the bone ends, called arterio-venous fistulas. These fistulas cause compromised circulation, pain and dysfunction, all contributing to an un-physiological mass at the bone end. In the **above-knee** amputations, osteoperiosteal closure of the bone marrow cavity also prevents crown sequestration (a 1.5–2.5cm. ring of necrotic bone at the amputation bone-end caused by endosteal and periosteal stripping).

With time, a full-contact prosthesis is used allowing full weight bearing. This is in contrast to the frequently used patellar

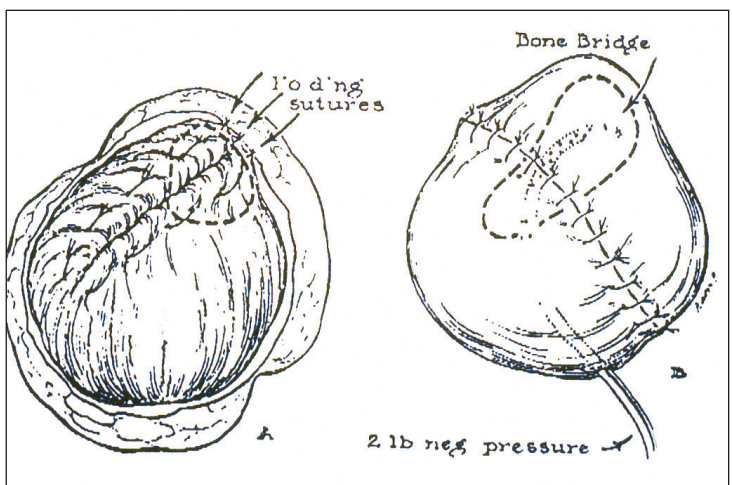
tendon bearing (PTB) prosthesis, which utilizes the knee-cap (patella) and femoral condyles for prosthesis suspension. Within this PTB prosthesis, the amputated stump becomes inactive, leading to disuse-atrophy and may become ulcerated from pressure irritation.

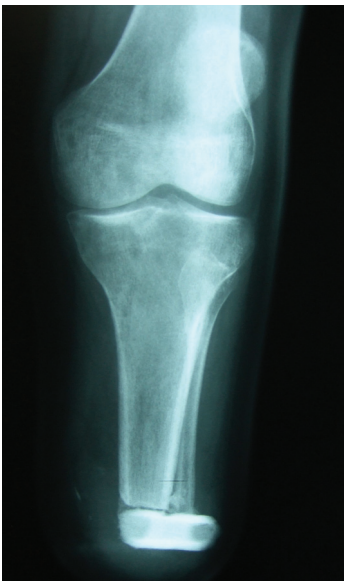
Following the creation of the bony architecture (foundation), the “motor” of the extremity, i.e. the muscles, are reconstructed. This step is accomplished by performing a *myoplasty*, which re-establishes a length-tension

relationship of opposing muscle groups. A second purpose of the myoplasty is to restore the pumping action of the “peripheral heart,” which refers to how contracting muscles in the lower limb aid the return of venous blood back to the central circulation and heart. This advantage cannot be over-emphasized as it helps cardiac output and improves the amputee’s walking ability.

Special attention is given to dissecting the extremity’s arteries, veins and nerves. In stump reconstruction, nerves are commonly found adherent to localized scar tissue as well as to the skin itself. This scarring restricts the normal gliding motion of the nerves and leads to pain from traction applied to the nerve while walking. For this reason among others, each structure is identified and isolated from its surrounding attachments as well as each other. The arteries and veins are separately ligated and allowed to retract to prevent communication between the two.

Finally, the skin is approached and flaps are contoured to the shape of the underlying muscle. A smooth surface is constructed to facilitate the fitting of a full-contact end-weight-bearing prosthesis.





In summary, this operation benefits the amputee in the following ways:

1. Prevention of excess fibular motion by bony bridge (synostosis) stabilization in below-knee amputations.
2. Reconstruction of the medullary canal and reestablishing intramedullary pressure and prevention of arterio-venous connections at the bone ends.
3. Prevention of crown sequestrations in above-knee amputations by medullary canal closure.
4. Improvement of the venous return to the heart by myoplasty, i.e. reconstruction of the pumping action of the muscles (peripheral heart).
5. Prevention of nerve adhesions and restoring the gliding properties of the nerve.
6. Improvement of the prosthesis fitting by the removal and prevention of unstable scars using reconstructive plasty.
7. Prevention of osteoporosis by providing end-bearing potential and reinstating physiological bone loading.

Recovery

Typically most patients spend enough time in the hospital to be comfortable with activities of daily living; such as, getting up and out of beds/chairs, going to the bathroom, etc. This can take anywhere from three to seven days and, if applicable, a short stay in a rehabilitation unit.

Therapy

After the initial surgical recovery, it will become important to begin the process of using your limb slowly and carefully.

For the first two weeks, only simple massage and wound/incision care are recommended; isometric exercises using the muscle groups above the amputation are acceptable.

After approximately two to four weeks, range of motion for the amputated limb can begin. Then isometric exercises are started slowly using all your muscle groups, at which point you will begin to flex and extend slowly, without any weights or pressure. This should start after the sutures are removed, the wound healed, and you are cleared to begin.

After approximately four to six weeks, towel pulls and scale exercises (not over 10–15 lbs.) can begin, in addition to the range of motion, isometrics, and massage.

After six weeks, advanced physical therapy can begin.

Please refer to the separate exercise sheets that we will provide for you.

Our office will prescribe a controlled medicine for management of post-operative pain and, while convalescing from surgery, we will reasonably manage your needs. However, patients must also be responsible for their own health, and the purpose of the medication is to increase your ability to function, although any prescription is unlikely to *eliminate* pain. The length and duration of surgical pain varies for each individual and can take weeks or months to resolve. Some forms of chronic pain can lead to dependence and, therefore, *some pain may not disappear completely* after surgery. It is also reasonable that after a period of months the Surgery Clinic may not be able to continue managing your pain needs, as we do not provide long-term/chronic therapy.

Transfemoral/Above Knee Amputee Exercise Program

It is very important that you take an active role in your own rehabilitation. After a transfemoral amputation, it is very important that you prevent your hips from staying in a bent or flexed position. To prevent this, you need to avoid the following:



- Do not sit in a chair for long periods of time. You need to frequently change the position of your hips.
- Do not place a pillow under your stomach when lying down.
- Do not place your residual limb on a pillow when lying down, unless told to do so by your physician.
- Do not place a pillow under your knees or hips. Do not place a pillow between your thighs.
- Do not place your residual limb over the side of the bed.

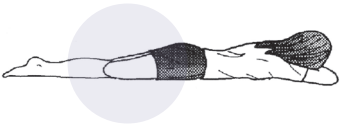
To desensitize your residual limb, promote healing and prevent swelling you will need to:

- Massage your residual limb from the hip down a minimum of 3 times a day.
- Elevate your residual limb as much as possible to prevent swelling.

Your exercise program begins at Level 1. You need to complete the exercises daily. You need to continue through the following levels at a rate that you are able to tolerate. Remember, when advancing to the next level you still need to perform the exercises from the previous level(s).

Do only the exercises checked by your physician or therapist.

Level 1: Do 3 sets of 30 repetitions of each exercise 3 times a day.



■ PRONE LYING

Lie on your stomach with your hips flat. Lay for at least 20 minutes on your stomach 3 times a day.

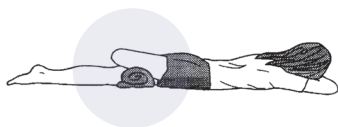


■ HIP EXTENSION

Lie on your back. Place a rolled towel under the end of your residual limb. Push down into the towel and hold for 5 seconds.

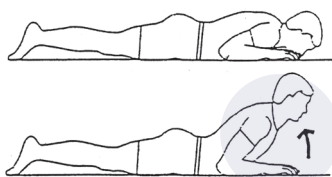
Transfemoral/Above Knee Amputee Exercise Program (continued)

Level 2: Do 3 sets of 30 repetitions of each exercise 3 times a day.



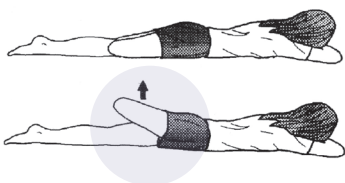
■ PRONE HIP FLEXION

Lie on your stomach. Place a rolled towel under your residual limb. Lie in this position for 20 minutes. As you stretch the hip muscle, you may increase the size of your towel roll.



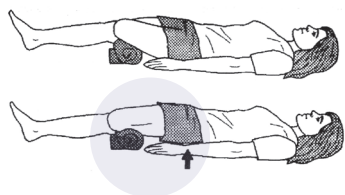
■ PRONE LYING (Elbow Press-Ups)

Lie on your stomach. Push up to your elbows keeping your hips on the bed. Return to the starting position and repeat.



■ PRONE HIP EXTENSION

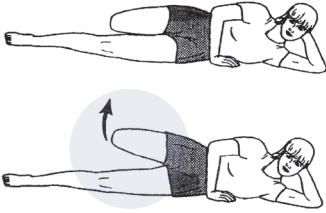
Lie on your stomach. Lift your residual limb off of the bed as high as tolerated. Return to your starting position and repeat.



Level 3: Do 3 sets of 30 repetitions of each exercise 3 times a day.

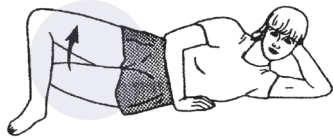
■ ADVANCED HIP EXTENSION

Lie on your back. Place a rolled towel under the end of your residual limb. Push down into the towel and lift your hips off of the floor. Return to the starting position and repeat.



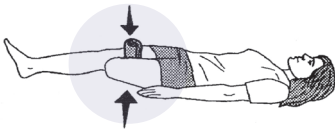
■ HIP ABDUCTION

Lie on your unaffected side and lift your residual limb toward the ceiling. Keep your knee pointed forward. Return to the starting position and repeat.



■ HIP ADDUCTION

Lie on your side. Bring your top leg forward and let your foot rest comfortably on the floor in front of you. Lift your residual limb towards the ceiling. Lower back slowly.



■ HIP ADDUCTION

Place a towel roll between your thighs. Gently squeeze towel roll between your thighs. Hold for 5 seconds.

NOTE: At approximately 2 weeks post operation, your surgeon may recommend a shrinker to assist with volume control. At approximately 4 weeks post operation, your surgeon may instruct you to begin towel pull and scale exercises. The instructions for those exercises will be provided at that time.

Further exercises will be set by your own goals and also by your own progress.

Transtibial/Below Knee Amputee Exercise Program

It is very important that you take an active role in your own rehabilitation. After a transtibial amputation, it is very important that you prevent your hips and knees from staying in a bent or flexed position. To prevent this, you need to avoid the following:



- Do not sit in a chair for long periods of time. You need to frequently change the position of your knees and hips.
- Do not place a pillow under your stomach when lying down.
- Do not place your residual limb on a pillow when lying down, unless told to do so by your physician.
- Do not place a pillow under your knees or hips. Do not place a pillow between your thighs.
- Do not place your residual limb over the side of the bed.



To desensitize your residual limb, promote healing, and prevent swelling you will need to:

- You need to massage your residual limb from the kneecap down a minimum of 3 times a day.
- Elevate your residual limb to prevent swelling as much as possible.

Your exercise program begins at Level 1. You need to complete the exercises daily. You need to continue through the following levels at a rate that you are able to tolerate. Remember, when advancing to the next level you still need to perform the exercises from the previous level(s).

Do only the exercises checked by your physician or therapist.

Level 1: Do 3 sets of 30 repetitions of each exercise 3 times a day.

■ **QUAD SETS**

Lie on your back. Tighten your knee muscles by pushing your knee into the bed. Hold for a count of 5 and release.



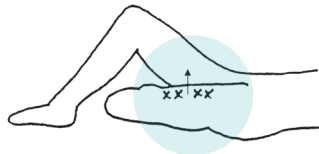
■ **KNEE BENDING**

Lie on your back and bend the knee of your residual limb to your chest. Bend it as far as possible and then straighten your knee completely. Return to the starting position.

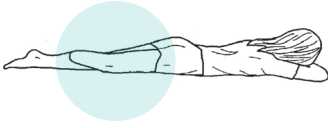


■ **STRAIGHT LEG RAISES**

Lie on your back and bend the unaffected leg so that the foot is flat on the bed. Tighten your knee muscles in your residual limb by pushing the knee into the bed and lift limb straight up. Lower limb slowly.

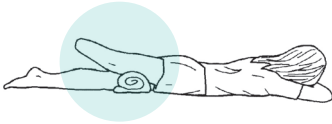


Transtibial/Below Knee Amputee Exercise Program (continued)



■ PRONE LYING

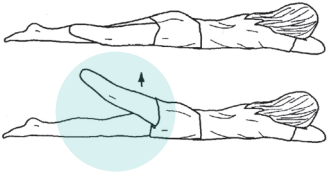
Lie on your stomach with your hips flat. Lay for at least 20 minutes on your stomach 3 times a day.



■ PRONE LYING ADVANCED

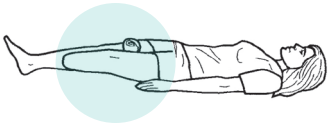
Lie on your stomach. Place a rolled towel under your residual limb. Lie in this position for 20 minutes. As you stretch your hip flexor muscle then you may increase the size of the towel roll.

Level 2: Do 3 sets of 30 repetitions of each exercise 3 times a day.



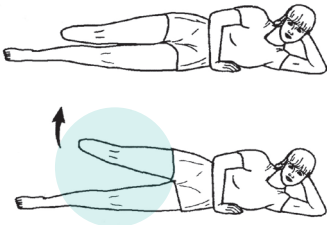
■ HIP EXTENSION

Lie on your stomach and lift your residual limb off of the bed towards the ceiling. Lower your leg slowly.



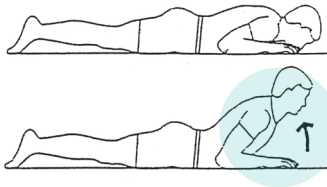
■ HIP ADDUCTION

Lie on your back with your legs straight. Place a towel roll between your legs. Turn your legs inward and press your legs into the towel roll. Hold for a count of 5 and release.



■ HIP ABDUCTION

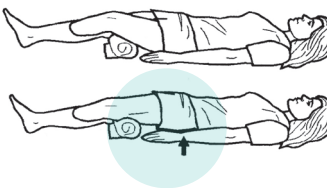
Lie on your unaffected side and lift your residual limb towards the ceiling. Keep your knee pointed forward. Lower your limb slowly.



■ PRONE LYING (Elbow Press-Ups)

Lie on your stomach. Push up to your elbows, keeping your hips on the floor. Return to the starting position and repeat.

Level 3: Do 3 sets of 30 repetitions of each exercise 3 times a day.



■ HIP EXTENSION

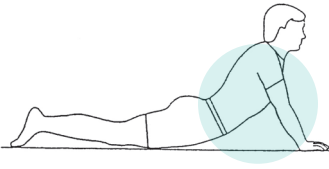
Lie on your back. Place a rolled towel under your residual limb. Push down into the towel and lift your hips off of the floor. Lower your hips slowly.



■ HIP ADDUCTION

Lie on your side. Bring your top leg forward and let your foot rest comfortable on the floor in front of you. Lift your residual limb towards the ceiling. Lower back slowly.

Transtibial/Below Knee Amputee Exercise Program (continued)



■ ELBOW PRESS-UPS

Lie on your stomach. Push up on your hands; straighten elbows, keeping your hips on the floor. Return to the starting position and repeat.

NOTE: At approximately 2 weeks post amputation, your surgeon may recommend a shrinker to assist with volume control. At approximately 4 weeks post amputation your surgeon may instruct you to begin towel pull and scale exercises. The instructions for those exercises will be provided at that time.

Towel Pulls and Scale Exercises

Typically these exercises begin after sutures are removed, the wound healed, and you are cleared to begin (after approximately 4–6 weeks).

Towel Pulls

Place a towel around the end of your residual limb. Pull back against the end of your residual limb, as tolerated, and hold for 5 to 10 seconds then release. That is one repetition. Complete 3 sets of 30 repetitions, 3 times a day.



Towel Pulls and Scale Exercises (continued)

Scale Exercises

Place the scale where you can comfortably get the end of your residual limb on the scale. Start with 5–10 pounds and hold for 5 seconds or as tolerated and try to increase the pressure by 2–3 pounds per week. ***Do not hurt yourself and stop immediately if you feel any sensation that is not pressure.*** Complete 3 sets of 10 repetitions, 3 times a day. Patients with a Transtibial amputation: place your limb on the scale with your knee bent. Patients with a Transfemoral amputation: you will need to stand with a balance aid, put a towel over the portion of your bathroom scale that the end of your residual limb will push on while still being able to see the weight measured by the scale, then use your hip muscles to push the end of your residual limb down on the scale. Patients with a Transfemoral amputation will need to shift their weight or bend their other knee to put pressure through the end of their residual limb.

More involved exercises can also be done pre-operatively to build up muscle strength. After surgery, only when cleared to do so, these can also be followed, typically in about 6–8 weeks.



Prosthetics

There are literally hundreds of choices of limbs, sockets, sleeves and socks. I could not possibly begin to tell you what you may or may not need. In general, a simple temporary socket will be the initial choice after the wounds have been healed (approximately six to eight weeks). Most amputees typically start with a locking-pin system; as strength and activities increase, sockets will be added or changed based on your needs. Emphasis is placed on establishing a full-contact, end-weight bearing socket. There is essentially no limit to what you can or cannot do, and modern prosthetics are broad in their scope. I encourage all amputees to meet with their Prosthetist before surgery to discuss any concerns and potential changes.



Frequently Asked Questions About Amputation

Q: What if I want a provider to be there for surgery?

A: Most hospitals do allow medical prosthetic providers to be present in some capacity as an observer only, unless they have credentials to treat in the institution. The typical and customary documentation is positive proof of name (ID), relationship to the patient, company and/or academic affiliation, and proof of immunizations. This varies based on the institution and includes, but is not limited to, Hepatitis A, Hepatitis B, Flu vaccine, etc. Arrangements must be made before the date of surgery, with the institution, by the individual.

Q: Will I have follow-up visits? How many, how often?

A: We prefer that all patients are seen over a regular and reasonable time frame, with allowances for those who come from a distance. Typically, visits are every two weeks, then on a monthly basis. Once the incisions are healed and you are undergoing fittings for your new prosthesis, then less frequent visits are required.

Q: Is amputation the best solution?

A: This question is best answered by how your life is being affected by your current level of function. Ask yourself, “Can I do all of my activities of daily living and still enjoy a reasonable level of function?” This decision is very personal and can really only be answered by you, but we encourage you to discuss your options and ask questions, so that you feel comfortable with your decision, and especially encourage Peer discussion (see resource section).

Q: How long will the surgery take?

A: The average surgery time is approximately 3–4 hours.

Q: What are the major risks of the surgery?

A: With any surgery there is a risk of bleeding and infection. Blood loss is minimized by the use of tourniquets. Infection is minimized by giving antibiotics preoperatively and sterile technique in the operating room. Other risks depend on your overall medical conditions.

Q: How long will I be in the hospital/rehabilitation after surgery?

A: The average hospital stay after surgery is approximately 3–7 days, depending on each individual’s medical and surgical needs. Discharge planning requires medical and surgical stability, as well as possibly a short-term rehabilitation stay.

Q: What kind of pain will I have after the surgery and for how long?

A: The initial postoperative pain is approximately 3–7 days. Phantom limb pain is unique to amputees and usually occurs within the first 3–6 months and can taper off, but “flare-ups” can occur even years later.

Q: How long will I have to remain in bed?

A: You will be up in a chair within a day of surgery and, soon after, you will be using a walker or crutches to get around.

Q: Will I have drains and/or stitches? If so, when will they be removed?

A: Most patients will have a drain, which will be removed prior to your discharge from the hospital; sutures are removed in 10–14 days.

Frequently Asked Questions About Amputation (continued)

Q: How long will you supervise my care after surgery?

A: While in the hospital you will be seen daily, unless other arrangements are necessary. (Please see section on follow-ups.)

Q: Will I be able to meet with a prosthetist before the surgery?

A: Pre-surgical evaluation with a Prosthetist is strongly encouraged so that a relationship can be established and goals discussed. This will help them in fitting and allow you to discuss prosthetic options.

Q: When will I be fitted with my prosthesis?

A: You will be fitted for a temporary prosthesis approximately 6–8 weeks after surgery, and a permanent prosthesis approximately 6–12 months after surgery.

Q: Who will notify my insurance company of my surgery?

A: Depending on your insurance carrier, our managed care department or the hospital will notify your insurance company of your upcoming surgery.

Insurance Questions

Q: Will my insurance pay?

A: In general, most procedures fall under typical medical guidelines, and go through a “routine” process, and all of the above is not required. Workmen’s compensation varies widely depending on the carrier, the intermediary, and also the state in which the incident occurred. Please have all your contact information, case (or file) number, and name of the individual with you so that we can remain in network and not violate any of your benefits.

These questions are designed to help you review your health insurance policy coverage and determine if your policy contains the benefit for Osteomyoplastic (or Amputation) reconstruction. *Completion of this form will not guarantee your approval for surgery. Also, completing this form does not guarantee the payment for your medical services rendered.* However, we are always willing to assist with the necessary documentation and forms.

Name of Insurance: _____

Policy Number: _____

Group Number: _____

Subscriber Name: _____

Subscriber Date of Birth: _____

Insurance Questions (continued)

Call the toll-free Customer Service number on your insurance card.

Ask the following questions to gather your necessary coverage information.

- 1) To whom am I speaking? _____
(Please note the date and time of your call) _____
- 2) What is the effective date of my policy? _____
- 3) When is the renewal date? _____
Is it by calendar year or fiscal year? _____
- 4) Do I have a pre-existing clause? Yes No
If yes, what is the end date of my pre-existing clause? _____
- 5) Does my plan require a referral to see a specialist? Yes No
- 6) What is my deductible per calendar year? " _____
- 7) How much have I met towards my deductible? _____
- 8) What is the maximum out-of-pocket per calendar year? _____
- 9) How much have I met towards my out-of-pocket? _____
- 10) Is the deductible applied to my maximum out-of-pocket? Yes No
- 11) Do I have benefits out of network? Yes No

Additionally, if you are self-employed, a contractor, or have a disability policy, call your company/carrier to see when it is effective. Also, please be sure that your payments and policies are up to date and that the policy has not terminated. Many policies are comprehensive but require regular certification to maintain benefits and also have time requirements before becoming effective. If there is an option for short-term disability, the same issues may apply, although the time requirement is less. Call your carrier first, and ask how long, what circumstances, and who. Do not forget the date and time.

Amputee Resources

www.oandp.com or www.oandp.com/barr

This is the orthotics and prosthetics website, which supports the industry.



www.wgbarrfoundation.org

They have several resources for amputees, including “Where Hope Meets Help,” which provides assistance to amputees most in need, as well as educational outreach to communities and legislators.

www.stumps.org

This website is dedicated to, from, and by amputees solely as a message board and resource for those who do not want a “technical” resource. You need a sense of humor to page through it.

www.amputee-coalition.org

This is a dedicated website that has many links and resources for amputees. They provide a lot of free literature, especially when dealing with family members who may not understand how to help, or why. Very supportive and they also provide local lists of amputees who can provide support directly or as a group, especially for Peer Counseling.

www.ertlreconstruction.com

An informational providing access to regional surgeons who specialize in Osteomyoplastic amputee care, for amputees and clinical providers.

Christian Ertl, MD, FACS

Western Michigan University School of Medicine

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269.337.6441 (fax)



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