ADDING EXTERNAL POWER TO YOUR PROSTHETIC PRACTICE

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The purpose of this presentation is to give the prosthettist a better understanding of the requirements needed to establish an external power prosthetic practice. Patient census, equipment, personnel, components, education/training, communication, and finances will all be discussed. An adequate number of arm amputees on an annual basis are necessary to maintain your proficiency. A substantial financial outlay is needed for staff education, evaluation and trouble-shooting equipment, and components. But what makes the whole thing work is enthusiasm and patience on the part of all the members of the amputation rehabilitation team.

With my background as a research prosthetist at Northwestern University, I had developed a good understanding of what an externally powered prosthesis can do. I firmly believe that a myoelectric prosthesis for the unilateral below elbow amputee is even more functional than a cable prosthesis. It certainly is more cosmetic and comfortable. With the pediatric case, you’re dealing with something which makes the condition more acceptable to the parents, to the siblings, and to the other children.

If you are not seeing, on an average, nine new or return arm amputees on an annual basis you probably don’t have the patient volume to warrant the expense of getting into upper extremity powered prosthetics. With fewer patients you would be doing a disservice. You may not have the components available for them or repair parts available for them.

The acceptance rate of upper limb amputees is reduced much more than it is for lower extremity amputees. This is do in part because of not having enough follow through, carry over and dependability of the prosthetic components. When the nuisance factor exceeds the benefit of wearing a prosthesis, the patient is going to discontinue using it.

Training is probably the next area that you have to consider for your involvement. First off, you need to have training in basic electronics: how to solder wires together, how to trace circuits, how to evaluate whether there is a short circuit or not.

Second you want to get involved with myoelectric theory. Probably the best place to learn that is in a very intensive process with the University of New Brunswick Myoelectric Course (1) that runs every Fall. It deals with myoelectric training. I highly recommend it not only for the prosthetist, but also for the therapy staff.

Prosthetic fabrication training is also necessary, and this is probably achieved by dealing with the manufacturers. A prosthetist knows how to fabricate a prosthesis, but it’s the idiosyncrasies of each individual component from the different manufacturers that makes the special training necessary. The decision I made is that I had to invest in training for my staff. Otto Bock (2) probably has the best course for an overall approach for technical training for your staff.

If your organization does not have the backup of allied health personnel (OT/PT), you won’t be
able to provide patient training for both upper extremity prosthetics and myoelectric controls. You are going to have to hire the staff or convince the director of the local hospital’s department to send their staff for training.

Equipment is probably the second major investment that you are going to have to make when you decide to go into upper extremity prosthetics. I divide that equipment up into two areas; evaluation equipment and laboratory equipment.

Evaluation equipment is used to determine whether or not the person has the potential to use a myoelectric prosthesis. All of the manufacturers have a piece of equipment they either manufacture or that they recommend. Some of them have to be used in order to get their prosthetic components to work. An example of that would be the UNB Universal Myo Trainer (3) and the Boston Elbow System Evaluation Trainer (4). Both of these pieces of equipment have to be used in order to calibrate the components that’s eventually going to be going into the prosthesis.

The Hosmer Myo Tester (5) and the Motion Control Myolab II (6) are two small evaluation units. The Hosmer unit cannot register as low a potential as the Motion Control. The Motion Control unit can register down to one-tenth of a micro volt of electricity, one-tenth of a millionth of a volt. The Otto Bock Tester (7) and the Hosmer Tester, both test on a range of approximately 20 micro volts above the baseline. Although the electronics has gotten more sensitive, the Otto Bock and Hosmer components require stronger EMG signals. That will make it easier for you. If a person can operate an Otto Bock System, then you know they’re going to be able to operate any of the others.

You will need typical prosthetic equipment in order to fabricate the prosthesis: grinders, sanders, plaster equipment, vacuum forming, laminating equipment. A clean room for equipment that is used for the myoelectric or the electronics is recommended. Nonstandard tools are low wattage soldering irons, low temperature heat guns, volt/ohm meters, small screwdrivers, cutters, wrenches. These are used to do the wiring and to assemble the components.

Otto Bock has an excellent kit (8) which includes a lot of the small equipment that is useful not only for their components specifically (to be able to disassemble hands, etc.) but also to be able to do the normal wiring.

You’re going to have to have the evaluation equipment to be able to test whether the component is working. Some of the testers that I recommended earlier do part of that. In the case of Otto Bock (9), their system is set up so that they have a separate system test unit which evaluates their components. You have to have battery testers for the different types of batteries you’re going using with different test units. Liberty Mutual has a universal tester (10). We have over 30 different types of test cables that are used to be able to connect to the different types of components used in our laboratory.

Inventory is the major investment that you need to make. With overnight delivery you may want to use in-time delivery and allow the manufacturers to maintain the inventory for you. This does compromise the care that you do provide.

Prosthetic hands are the second most expensive piece of equipment that is available. There are seven different sizes from Otto Bock; five different sizes from Steeper (11) (with different control setups); and three sizes from Variety Ability Systems (12).

All of the hands require a cosmetic glove that goes over the top of it. The color glove that you really need for that patient is not the one that you have (a large inventory, again). You need to keep replacement gloves in stock in case of a tear or a hole in it. Getting moisture in the mechanical or the electrical parts of the electric hands is a concern.

Hosmer has three different types of other terminal devices that can be used instead of hands; Otto Bock has the Greifer; and Steeper has their myo hook.

When dealing with electric elbows, there are four manufacturers in North America. Hosmer Dorrance
has two sizes of elbows that were designed at NYU and then modified by Hosmer. Liberty Mutual and Motion Control both have one size elbow for adults (both of these are very expensive). Finally, Variety Ability Systems has four different sizes of elbows that are available.

Electric wrist units are only available from Otto Bock, but controllers are available from the other manufacturers.

The manufacturers that we talked about previously, as well as, Universal Artificial Limbs (13) work on different types of EMG control units to be able to control the prosthesis. You are dealing with a multitude of components. If you have the component out on a patient, I’m a firm believer that you need to have a back up in stock.

Steeper, Otto Bock, Universal Limb, Hosmer, and Variety Ability Systems all have different type of switch units as well. There are push switches, pull switches, rocker switches, and servo control switches. Servo control allow better and finer control of the hand or elbow. There area multitude of arrangements that can be used, but you need to follow the manufacturers recommendations on use.

At the present time almost everybody is using nickel cadmium batteries on their prostheses. Some are 12-volt, some are 9-volt, some are 6-volt, some are 4.3-volt, and if you have a battery out, you’re going to have to have a charger for that particular type of battery unit.

Motion Control has modified the Otto Bock battery housing so that it can accommodate either lithium or the alkaline 9 volt batteries, but they are just used with the Pro-controller from Motion Control at this point.

Hopefully, with the smaller telephone systems and pagers, battery technology will finally catch up so we will have smaller, lightweight batteries that will give us more time duration and power in the myoelectric prostheses.

As your practice expands you will start to combine different manufacturer’s components. Having cables and connectors, et cetera, and being able to put them together becomes more necessary. The Otto Bock flat wire system with different types of connectors on some of their components is more difficult to adapt to some of the other equipment that is used.

Again, invariably the part that you don’t have is the part that breaks. I’m a firm believer that if I’m going to be committed to providing this type of prosthetic care, I’ve got to have components available to be able to replace that person’s prosthesis, or have access to be able to get it to them in a fairly reasonable time. What that tells me is if I have one out, I have to have one in my facility to cover it. When you are dealing with a Utah arm or a Liberty elbow, that means you are going to have a fairly expensive inventory.

Support is probably the one thing that makes an upper extremity practice like this gratifying. Support from the patient and their families. The small children who are fitted with the prosthesis and their family are aglow; the patient who first gets their myoelectric prosthesis and starts using it; and acceptance of the people around them probably is what gives us the best reasoning for getting involved with this.

However, if your physician is not in support of upper extremity electric prostheses, then you are going to have “a long row to hoe”. You are going to have to fight every step of the way to get them to order the components and may not get the backup support that is necessary in order to have the very expensive devices paid for.

You need therapists that are trained. In my fourteen year career at S.I.U., I’ve gone through training nine occupational and physical therapists that have been involved with upper extremity prosthetics.

Clerical support is necessary in the States because of the amount of paperwork that is necessary in order to be able to provide this kind of service. Letters of Necessity, documentation, letters going to insurance carriers, funding agencies, et cetera.

There’s an extreme amount of support available out there from the manufacturers for our benefit.
The technical support staff at Otto Bock, Liberty Mutual, Hosmer, Motion Control, Universal, and Variety will work with you and help you solve the problems that you are going to experience.

You do have to have electricity and you do have to have a telephone. The patients must have the ability to charge the batteries before you can provide electric prostheses. You don’t have to live in Southern Mexico to not have electricity. Sixty miles from Springfield is a large Amish community that does not believe in having electricity in their homes or in their buildings. Therefore, when an Amish patient has a traumatic amputation, I cannot provide him with an electric prosthesis. We also have to be able to communicate with the patients; we have to be able to communicate with the manufacturers. Poor phone service will diminish your ability to provide good care.

If you don’t have your own financial support to be able to make the large investment (at S.I.U. our large practice has over $150,000 worth of components that is just sitting there waiting for patients to come in because we have to have all of that backup support in components) then talk to the manufacturers about the loaning of equipment. Some of them will loan or rent myotesters and components for patient evaluations. They will work with you to be able to provide the components that you will need. It’s in their best interest for you to be able to provide the prosthesis to the patient.

Limb banking is another alternative. At S.I.U. we have a limb bank that was established through the Children’s Miracle Network Telethon (14) which is sponsored by the Osmond Foundation each Spring. Variety Clubs International (15) is involved with limb banking support in both the United States and Canada. The Shriner’s Hospitals for Children (16) are getting more involved with the externally powered prosthetics.

Finally, use your enthusiasm to take the initiative to get involved with it. The rewards are going to be returned. But have patience! It’s never going to work the way you want it to the first time. If it does the first time, I guarantee it won’t be that way a second time.

Look at your potential practice. Determine that you do have the number of patients that it takes and that you do have the support of the physicians, the families, and the therapists. You do have the electricity and the telephones to be able to communicate with the manufacturers, and you have a plan to solve the problem of the financial burden that’s going to be caused by establishing the upper extremity practice. Now, make the decision that “yes” you want to add external power to your prosthetic practice.

You now have to make the investment, to get the training, to buy the equipment to do the evaluations, and to invest in the inventory. Put your enthusiasm to work and if you have enough patience, you will eventually develop an excellent upper extremity practice.

References

1. Institute of Biomedical Engineering, University of New Brunswick, Fredericton, New Brunswick, Canada.
2. Otto Bock Orthopedic Ind. Inc., Minneapolis, MN.
3. Part #T101, Institute of Biomedical Engineering, University of New Brunswick, Fredericton, New Brunswick, Canada.
4. Part #BES115, Liberty Technology Prosthetic & Orthotic Group, Hopkinton, MA.
5. Part #57304, Hosmer Dorrance Corp., Campbell, CA.
6. Part #5033-0-01, Motion Control - A Division of IOMED Inc., Salt Lake City, UT.
7. Part #757M5, Otto Bock Orthopedic Ind. Inc., Minneapolis, MN.
8. Part #W8E7-2, Otto Bock Orthopedic Ind. Inc., Minneapolis, MN.
9. Part #757T1, Otto Bock Orthopedic Ind. Inc., Minneapolis, MN.
10. Part #BC21, Liberty Technology Prosthetic & Orthotic Group, Hopkinton, MA.
11. U.S. distributor, Liberty Technology Prosthetic & Orthotic Group, Hopkinton, MA.
12. U.S. distributor, Liberty Technology Prosthetic & Orthotic Group, Hopkinton, MA.
13. Universal Artificial Limb Co., Silver Springs, MD.
16. Shriners’ Hospitals for Crippled Children, P.O. Box 31356, Tampa, FL, 33631-3356.