

Keys to Building a Successful Pediatric Limb Reconstruction Program

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Introduction

Over the past 20 years, pediatric orthopaedics has gradually become increasingly sub-specialized. The rapid advancement of pediatric orthopaedic knowledge and surgical techniques has made it more difficult to remain proficient in all areas of the field. Surgeons have also started to identify and concentrate on personal areas of special interest within pediatric orthopaedics. As a result, specific disciplines within pediatric orthopaedics, such as spine, sports, hip, and hand, are now recognized as distinct sub-specialties.

Pediatric limb reconstruction, however, is not universally recognized as a separate sub-specialty. For example, it was not listed as one of the choices of primary clinical interest in the 2017 POSNA member needs assessment. The AAOS also does not provide limb lengthening and limb reconstruction as a separate designation for instructional course lectures or scientific presentations. These omissions may be explained by the fact that limb reconstruction appears to overlap with so many different aspects of orthopaedics. Nevertheless, developing a distinct limb reconstruction program as part of your institution's orthopaedic strategy should be encouraged. The existence of such programs has been shown to have multiple benefits to the entire orthopaedic department.¹

The purpose of this article is to outline the components necessary to build an ideal limb reconstruction practice including the surgeon(s), the clinic team, the operating room team, and practice recommendations (Figure 1). While it may not be possible to have every piece in place from the beginning, this guide will provide a fundamental structure that each surgeon should work towards creating at his/her institution.

The Surgeon

The keystone of any limb reconstruction practice is the surgeon. As the supervisor of the entire program, the surgeon must perform many roles. Besides the expected clinical duties involving patients in the clinic and the operating room, the surgeon must organize and manage a large multidisciplinary team of providers that support the daily activities of the program. In addition to this

clinical team, the surgeon may desire to develop and coordinate a research team and a marketing team. These management and promotional concepts are skills that are not usually taught as part of the formal medical school or residency education process. It is this combination of clinical, surgical, research, leadership and interpersonal skills that make the limb reconstruction surgeon's job description unique.

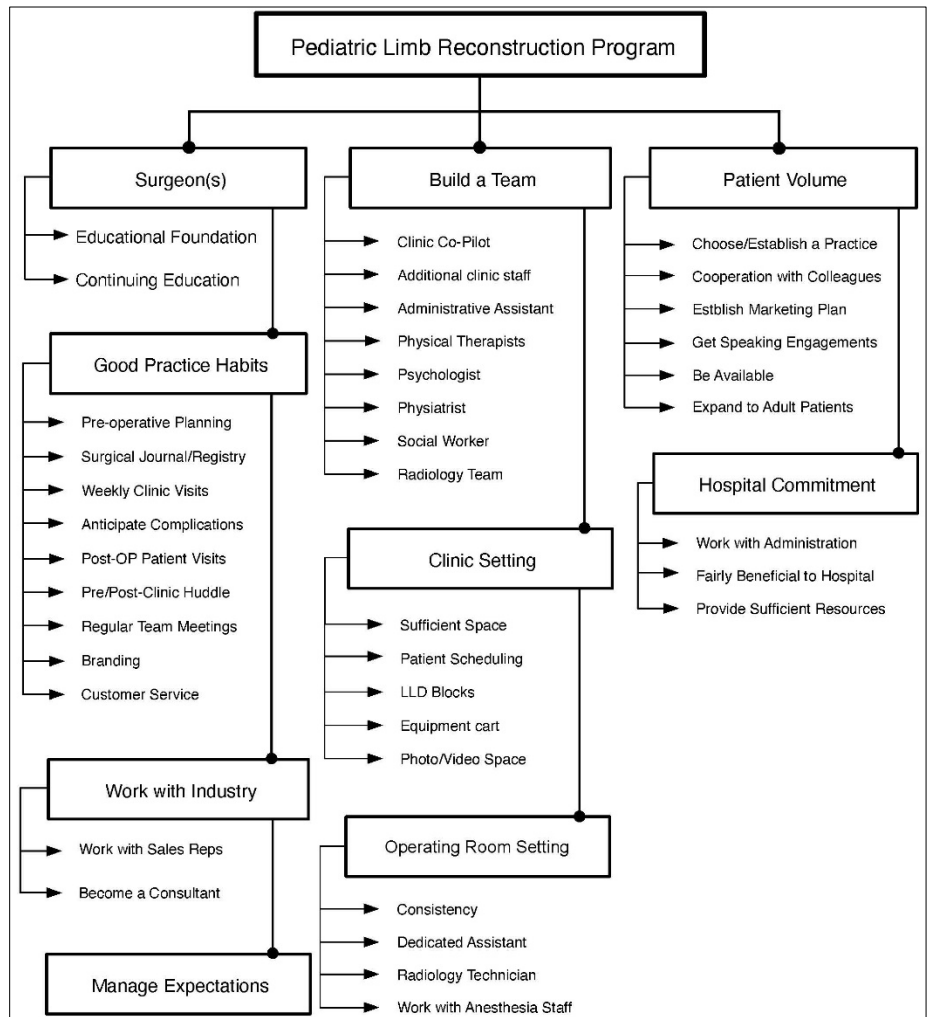
Figure 1. Diagram of the organizational chart for building a limb reconstruction program. This can be utilized as a quick summary reference of the key points in the article.

Pediatric limb reconstruction is a challenging profession both mentally and physically. Not only does it require surgical dexterity, but it demands fastidious attention to detail and the ability to effectively analyze and design solutions to complex problems that evolve over time. If possible, it is highly recommended that the surgeon fully dedicate himself/herself to the field. The following are suggested items to help prepare the surgeon who may be interested in limb reconstruction:

1) Educational Foundation

Before requesting to manage limb reconstruction patients, the surgeon first needs to develop a solid knowledge base. This foundation is ideally formed by supervised training either through a fellowship(s) or by working with an experienced colleague. The following options provide directed training in limb reconstruction:

- a) Pediatric orthopaedic or orthopaedic trauma fellowship
Traditional fellowship programs at institutions that also contain a well-established limb reconstruction program provide an opportunity for training. Although the limb reconstruction experience is limited by the time required in the other disciplines of the fellowship specialty, the fellow can still build a strong base if he/she can spend at least three to six months with the limb reconstruction team.



- b) Limb reconstruction fellowship
There are several centers in the United States (and internationally) that offer dedicated limb lengthening and reconstruction fellowships. These reconstruction fellowships often incorporate a mixture of pediatric and adult deformity patients and provide an excellent foundation for a career in limb reconstruction.
- c) Traveling fellowship
The Limb Lengthening and Reconstruction Society (LLRS) offers a one month traveling fellowship that sends participants to four different limb reconstruction centers each for a week at a time.

This intensive learning experience is designed for young surgeons to enhance their prior training and gain exposure to current limb reconstruction techniques.

2) Continuing Education

Once the fellowship training is over, the real learning begins. As your limb reconstruction experience begins to grow, you will realize that your knowledge base continuously needs to be augmented and expanded. There are several methods to continue the education process:

a) Educational courses

Educational courses, both CME and non-CME events, provide an avenue for learning either broad topics (limb deformity analysis) or more specific surgical techniques. Not only is it recommended to attend these courses, but it is often beneficial to repeat them. Courses also provide an opportunity for networking with fellow attendees and faculty members. Connecting with colleagues and mentors who will become resources for advice is crucial to a young surgeon's development. This networking is also a useful way to develop research partnerships.

b) Visiting limb reconstruction surgeons

Arrange short private visits to experienced limb reconstruction surgeons. Multiple visits to several different surgeons are recommended because they provide the opportunity to compare and contrast different styles and select the components from each practice that are the most beneficial to you. Repeat visits to the same surgeon provide the opportunity to pick up nuances that you may have missed the first time and strengthens the professional rapport between you and your host.

c) Find a mentor

Because pediatric limb reconstruction encompasses a wide array of patient types and surgical procedures, finding a mentor (or mentors) to guide you is extremely important. Joining a group that already

has an established limb deformity specialist is the ideal situation for a young surgeon. Working side by side with an experienced surgeon who can provide daily guidance provides the best framework for success. Unfortunately, many pediatric orthopaedic departments don't have a dedicated limb deformity specialist on staff. Therefore, young surgeons need to find a trusted and willing mentor. Fortunately, email and video chats allow cases to be discussed almost instantaneously with virtually any colleague around the world. Despite these virtual opportunities to interface with an experienced surgeon, finding a local mentor, i.e., someone within easy driving distance, provides an opportunity to conveniently observe or assist on cases which will increase your knowledge base.

d) Reading list

Appendix A provides a suggested core reading list for limb reconstruction surgeons.

e) Limb reconstruction societies

Most countries have a national limb reconstruction society. In North America, the Limb Lengthening and Reconstruction Society (LLRS) hosts an annual scientific meeting. These meetings provide an opportunity to see the latest research and surgical techniques being performed by colleagues around the world. There are usually educational workshops or courses attached to the meeting where you can learn new skills or enhance existing ones. Volunteering your time on society committees keeps you informed of policies and discussions that may be affecting the field and allows you to contribute to the decision making. It also provides an opportunity to develop relationships with other surgeons within the field.

f) Teaching

Inviting trainees to the clinic/OR provides an opportunity to teach. Instead of focusing on how they may slow you down, consider these two points:

1) There is no better way to develop mastery of a subject than having to teach it to another person. By teaching others, you will benefit by improving your own skills.

2) Create an environment where the students/residents/fellows are encouraged to be curious and ask questions. Answering their questions will keep you intellectually stimulated, and the subsequent discussions may generate a research idea or concept that may not have been apparent to you.

g) Share your experience

Presenting your work at society meetings and conferences is another valuable method to increase your experience and knowledge base. Direct feedback from colleagues can help to identify strengths and weaknesses in your development.

Develop a Limb Reconstruction Team

While the surgeon may be considered the main element of a limb reconstruction practice, he/she represents just one piece of a much larger interconnected network of care providers. Like other high-performance units such as Navy SEALs, airline flight crews, or auto racing pit crews, an effective limb reconstruction program requires a cohesive team of people working toward a common goal.³

1) Clinic Coordinator (Co-pilot)

After the surgeon, the most indispensable limb reconstruction team member is the designated provider responsible for running the clinic. In many ways this person is more important than the surgeon since he/she will be interacting with the patients on the front lines every day. The medical background of this team member may vary at different centers (nurse, nurse practitioner, physician assistant, nonoperative physician) but their role is the same. He/she is the person(s) responsible for knowing the details of every patient and how to manage their care in coordination with the

surgeon. Depending on how busy the program is, this may be one person or multiple people, but their role is to function as the surgeon's most trusted assistant. This person must be proficient in many vital (and time consuming) patient care areas such as educating pin site care, educating limb lengthening protocols, changing dressings, managing pin site infections, performing frame adjustments, and trouble-shooting limb lengthening devices. While it requires a substantial investment of time to prepare the "co-pilot" to be comfortable and competent to independently manage the nuances of limb reconstruction patients, the development of this provider is essential to the success of the program. In addition to training the co-pilot yourself, consider sending him/her to educational courses to complement and boost their knowledge base. This provider must be dedicated solely to the limb reconstruction program on a full-time basis and should be the first person the surgeon adds to the team.

2) Additional Clinic Staff

For a clinic to run efficiently, each team should have at a minimum a medical assistant, a nurse, and a mid-level provider (physician assistant or nurse practitioner). Residents and fellows will come and go but these providers should be assigned to work with the surgeon on a full-time, daily basis. Because the management of limb reconstruction patients has so many unique components, the effectiveness of the care suffers when there are multiple different, rotating providers rather than the same team at each clinic. In addition to regular clinic duties, this core team will be responsible for handling the daily patient phone calls, emails, paperwork, and unscheduled visits especially when the surgeon is in the operating room or out of the office.

3) Limb Reconstruction Program

Administrative Assistant

A person dedicated to the scheduling of limb reconstruction patient clinic visits and surgeries is another necessary team member. Many patients will have frequent visits to clinic and/or physical therapy that

need to be organized and monitored. The coordinator will be responsible for arranging this process and alerting the team when patients miss scheduled visits.

4) Physical Therapists

Physical therapists specifically trained in limb reconstruction rehabilitation are crucial to the success of any program and provide a central role in the surgical outcomes. Often the therapist will be the first to recognize subtle changes in the range of motion, weight-bearing status or pain levels in your patients and can alert you to potential trouble. Ideally, the therapist should be on-site to allow direct, real-time communication about each patient. Having a therapist who is dedicated to your clinic is essential for two reasons:

- a) A therapist assigned to your patients full-time allows the therapist to rapidly develop his/her expertise in limb reconstruction patient rehabilitation. These patients have their own unique therapy needs and an experienced therapist can often make the difference between a mediocre and a good outcome. The designated therapist will also be a resource for communicating with and educating therapists who will provide ongoing care and guidance within the patient's home community. This is especially important in more rural settings where exposure to limb lengthening and reconstruction will be rare.
- b) A dedicated therapist(s) allows the surgeon to obtain near instantaneous feedback on the patient's progress and make appropriate decisions based on this information. Offsite therapists can communicate with the surgeon by phone or email, but it is usually hours or days after the session took place when it is too late to make meaningful changes.

Once you have identified your primary therapist or team of therapists, send them to visit established limb lengthening centers. Visiting other centers to exchange ideas and learn new skills is just as important for the therapist as it is for the surgeon.

5) Psychologist

Pediatric limb reconstruction patients often undergo prolonged, sometimes repeated treatment regimens over the course of their lifetime. Having a psychologist to help them and their families through these stressful situations is valuable on multiple levels.

- a) The psychologist can screen preoperative patients for warning signs that may indicate the patient or family may not be a good candidate for a limb reconstruction procedure at that time. There are often many co-existing medical, family, or social stressors that the surgeon may not recognize (or have time to recognize) that could negatively influence the postoperative course.
- b) The psychologist can help them navigate the anxiety and depression that are often associated with the reconstruction journey.
- c) They can also teach pain management strategies to help decrease the need for prescription pain medicine and muscle relaxants.

6) Physiatrist

Limb reconstruction patients will often have orthotic and prosthetic needs. Partnering with a physiatrist who has expertise in managing limb deficiency patients can be very helpful. If possible, try to schedule the physiatrist's clinic concurrently with yours so patients can see each of you in the same setting.

7) Social Worker

An evaluation of the patient and their family's home/social situation prior to surgery is important and will minimize any post-surgical logistical problems that may jeopardize the patient's outcome. The social worker can determine the family's transportation, medical equipment, and additional support needs. Reliable transportation is essential for frequent clinic and therapy visits.

8) Radiology Team

Obtaining accurate, high-quality pre- and postoperative radiographs on a consistent basis is crucial for patient's success. Invest time teaching the technicians who work in your clinic how to correctly position the patient and what pitfalls to avoid. Most importantly, do not hesitate to go with the patient to the X-ray suite and assist the technician with the radiograph. Obtaining the radiographs can be a stressful and painful experience for the patient and their family. Having the same technician allows him/her to establish a relationship with the patients that they radiograph each week and learn what makes the process more comfortable for them.

Although most of the immediate radiographic interpretation will be done by the surgeon in clinic, having a trusted musculoskeletal radiologist is essential. Rare or unusual cases will benefit from having an additional perspective from the radiologist. In addition, discussing the need for advanced imaging on certain patients and the subsequent interpretation of the obtained studies will be enhanced by an experienced orthopaedic radiologist.

Limb Reconstruction Clinic Setting

In order to maximize the quality and efficiency of the limb reconstruction clinic, the following elements are recommended:

a) Space

The clinic area needs to be big enough to accommodate patients in wheelchairs, multiple family members, and your team. In addition, there needs to be an unobstructed area where the patient can walk and run a sufficient distance to observe the gait pattern.

b) Clinic patient scheduling

It is recommended to have a dedicated limb reconstruction clinic where all limb reconstruction patients are seen at the same time. This arrangement will utilize your team resources most efficiently,

especially in the early stages when your practice is just starting to grow. It also provides an opportunity for patients with similar conditions to meet each other and share experiences. Finally, some patient visits can be lengthy, whether it is discussing the treatment options for leg length discrepancy with a new patient or making frame modifications on a postoperative patient. Plan adequate time for each patient visit into the clinic schedule. A very busy limb reconstruction clinic may only see 20-25 patients in an entire day.

c) Blocks

Have multiple sets of labelled blocks available to evaluate leg length discrepancy in the clinic area (Figure 2). The radiology suite should also have a set of blocks to use for your standing radiographs.



Figure 2. A collection of wooden blocks is used for measuring leg length discrepancy in clinic.

d) Equipment room/Equipment cart

Patients with external fixators will often require frame maintenance during clinic. Create an organized collection of fixation elements, struts, wrenches, ring sizing templates, pin caps, pin clips, etc., and store them in a safe, convenient place in the

clinic. Depending on the size of your collection and the available space in your clinic, this equipment can be housed in an entirely separate room or in a large rolling cart (Figure 3 and Figure 4). In addition, to save time, try to have several, smaller portable containers filled with the essential items needed for frame maintenance that can be easily transported into the patient room (Figure 5).

e) Photo/video space

Documenting your patient's preoperative condition and the postoperative change is important in limb reconstruction. Create a designated space for taking high-quality photographs and gait videos (Figure 6). Invest in a high-quality digital camera that can be used to store patient images securely. Identify a designated clinic photographer to improve the quality and consistency of your images.

Operating Room (OR) Setting

Consistency is the key to running an efficient operating room. Utilizing the same circulating nurse, scrub technician, and radiology technician (C-arm) every day will maximize the productivity of the surgeon and can make the difference between a smooth surgery and a stressful surgery. Limb reconstruction cases often involve a lot of equipment trays, often from multiple



Figure 3. Examples of equipment carts in clinic. These carts allow organized storage and rapid access to external fixator components in clinic.



Figure 4. Plastic templates are used for measuring patient ring sizes in clinic.

companies, which can be overwhelming for a scrub technician that is not familiar with the process. When the same scrub technician is present every day, he/she will not only know the equipment but also be able to anticipate each step of the procedure and have the appropriate instruments ready for the surgeon. In addition, having the same OR staff allows a relationship with the industry representatives to develop which helps everyone anticipate equipment needs and troubleshoot potential equipment problems for the surgeon.

If you are in a program that has residents and fellows, then you will most likely have their assistance in the operating room. Because their positions are constantly rotating, they may not be familiar with you or your cases. To increase efficiency, consider having a

dedicated assistant in the operating room for each case. This person will know your preferences and can provide meaningful assistance with all aspects of the case. In addition, he/she can keep things moving while you stop to teach the residents/fellows.

Using the same radiology technician or core group of technicians to operate the fluoroscopy machine (C-arm) in every case is another factor that can make a huge difference in the level of stress in the operating room. A technician that is familiar with your cases and understands the required views to complete the surgery is invaluable. Having a laser pointer attached to the C-arm helps to eliminate some of the erroneous images.

While it may not be possible to have the same anesthesia staff every day, it is advisable to communicate your antibiotic, regional anesthesia, and muscle relaxation requirements to them before each case. Establishing a consistent routine and promoting open communication with your anesthesia colleagues will also help them to perform more efficiently during your cases.

Building Patient Volume

Once the care team is in place, the next component to building a successful limb reconstruction program is developing a large, consistent patient volume. Many limb reconstruction patients have relatively rare conditions and gaining management experience requires adequate exposure to them. Obtaining true expertise requires repetition.³ Applying one or two hexapod frames or inserting one or two limb lengthening nails per year will not provide the necessary feedback to improve or even maintain the minimum surgical skills. Moreover, gaining the experience to properly manage these patients through the extended and sometimes complicated postoperative period is arguably an even more critical skill to acquire.

There are multiple factors that contribute to establishing patient volume:



Figure 5. Examples of portable carrying cases for essential equipment to make frame adjustments in clinic.

1) Joining a Department with an Already Existing Limb Reconstruction Program and Surgeon(s)

Having a well-established patient referral base is the easiest way to ensure being busy from the outset. Unfortunately, these positions and opportunities are relatively rare.

2) Joining a Department Without an Established Limb Reconstruction Program

It is far more common that the surgeon will need to build a program de novo or expand a partially developed one. In these situations, choosing to practice in a heavily populated geographic area is important. Pediatric limb reconstruction cases are not as common as other pediatric conditions such as sports medicine injuries and require a large population of patients to achieve a critical mass of cases. Imagine a catchment area that encompasses a population of potential patients within a

reasonable driving distance (two to three hours) from your institution. If less than a million people fit within that imaginary circle, it may be hard to develop a robust limb reconstruction practice.

3) Cooperation from Colleagues

Your primary referral source will be patients seen initially by an orthopaedic surgeon in your department or the surrounding orthopaedic community. These colleagues need to be willing to refer desired patients to you rather than keeping them for themselves. Fortunately, the limb reconstruction surgeon can be portrayed as a resource to manage complicated patients that other surgeons do not want rather than as a direct competitor for cases. For example, make yourself available to manage complicated extremity fractures that present when other orthopaedic colleagues are on call. In many cases, by demonstrating a readiness to take care of complex patients, more straight-forward cases will gradually start to follow. Establish a set of criteria for desired and appropriate patient referrals not only with your partners but also with your scheduling department (i.e., leg length evaluations, knock-knee/bowing, contractures, etc.). Convincing your colleagues that it is worthwhile to send all the guided growth and angular/rotational osteotomy cases is critical since these patients will likely become the bulk of your practice. Providing your services as a ‘resource’ for colleagues, rather than a ‘competitor’ is a nuanced skillset that one must learn to navigate as your practice grows.

4) Marketing

Your hospital should help to market your program to attract new patients. This should be a multi-layered approach including print media and social media. The goal is to increase community awareness of your program. Create brochures and newsletters that highlight patient success stories, explain unique features of your program, and describe the services your limb



Figure 6. Example of a photo suite for taking patient images during clinic.

reconstruction team provides. These should be consistently updated and mailed out repeatedly to all physicians in the region. While having a website is essential, it is even more important to have a motivated marketing team to constantly manage and update the content. Emphasizing key internet search terms will help to keep your website relevant. Other forms of social media, such as Facebook pages, blogs, or support groups, can be helpful but are time consuming. Find a team member who is interested and willing to dedicate time to maintaining your program’s social media presence rather than trying to do it by yourself.

5) Speaking Engagements

Speaking engagements are an understated but valuable commodity. Get in front of as many groups of people as possible to showcase the value of your program. No matter how small the audience, speaking is the most effective method to spread awareness of your practice in the community. Try to give a grand rounds lecture at every hospital in the area. Speak to every department that may be a potential referral source, such as family medicine, pediatrics, endocrinology, nephrology, and genetics. It always helps to place a face with a name—physicians will be more likely to refer appropriate patients to you if they know who you are and what you do. Limb reconstruction is a very visual medium which

lends itself well to presentations. Most audiences aren't aware of the current limb reconstruction capabilities and generally leave the talks very impressed with what is possible.

6) Be Available

If you are affable, available, and able, colleagues will notice and increase their willingness to send patients your way. Word of mouth in your local medical community will spread awareness of your skills which will create opportunities for growth. However, for a limb reconstruction program to be successful, it is vitally important that the surgeon stay in one place for a prolonged period of time to develop a strong referral pattern and community awareness.

7) Adult Patients

Even in the best circumstances, there may not be enough pediatric limb reconstruction patients to entirely fill your practice. Opening your clinic to adults with limb reconstruction needs has the potential to vastly increase your volume. Although some pediatric hospitals have strict age restriction rules, many centers will allow healthy adult patients to have surgery, especially young adults.

Practice Habits

Being organized and punctual are essential prerequisites to maximizing your potential as a limb reconstruction surgeon. The following suggestions represent some of the fundamental habits to adopt in your limb reconstruction practice.

1) Preoperative Planning

Spend time planning and reviewing each surgical case as thoroughly as possible. Formulating a plan several days or weeks ahead of the surgery date is recommended. Waiting until the night before the case is scheduled is often too late. Last minute preparation makes it difficult to change or add unanticipated equipment: "Fail to prepare, prepare for failure."

By analyzing, templating, illustrating, and writing out the surgical plan step-by-step ahead of time, the surgeon will have mentally visualized the surgery prior to entering the operating room. This virtual surgical rehearsal will improve the OR efficiency and allow potential problems to be anticipated and addressed before surgery rather than during surgery. Try to involve your assistants, nurses, and mid-level providers to participate in the preoperative planning. It helps them understand the procedure and postoperative care better. Bring your plan to the operating room and share it with the staff so everyone is aware of your intentions. Post your preoperative plans on the wall, easily seen by all members of the OR staff. Include a brief description of the patient's pathology and your surgical steps at the preoperative team huddle before initiating the case. Finally, no matter how many times you may have performed the same surgery, always bring your cross-sectional anatomy atlas to the operating room to use as a reference when placing half pins or Ilizarov wires.

2) Surgical Journal

Keep a journal of your surgical cases. After each case, record things that went well and any obstacles you encountered. Whenever you are planning a similar case in the future, you can refer to your notes to ensure you don't repeat the same mistakes again. By continually recording the modifications and refinements to each technique, your surgical skill and proficiency will keep improving.

3) Weekly Clinic Visits

Any patient that is in the process of lengthening or adjusting an external fixator should be seen on a weekly basis. Because the potential for complications to arise in these patients is so great, a weekly visit is advisable to recognize any subtle changes and intervene before they become more complex problems. In clinic, the mid-level provider can be utilized to see postoperative patients. This allows the surgeon to be available to see all new patients and regular follow-up patients.

However, it is still critical that the surgeon visit with all the postoperative patients even if just for a moment.

4) Accepting Complications

Complications are going to happen. While we may all strive for perfection, no limb reconstruction surgeon can expect to have a perfect outcome every time. Rather than ignoring a problem, it is crucial that the surgeon recognizes when a patient is having trouble and acts aggressively to solve the issue. Very often, serious complications start with insignificant problems which are not properly addressed. Ignoring a problem is not going to make it go away. In fact, in most cases it will only continue to get worse until something is done to correct it. Being open and honest with the patient and the family is always the best policy. Acknowledge the concern with the patient and family and then outline the plans to resolve it. Do not hesitate to eagerly and openly seek counsel from a mentor or colleague when you sense an impending complication and take immediate steps to mitigate the problem.

When a complication does occur, however, do not let it consume you. If you are losing sleep or becoming depressed over a particular incident, then you are preventing yourself from being at your best for all your other patients. It is normal to feel empathy and concern when something goes wrong but try not to let it dominate your thoughts for an extended period of time. If you plan thoroughly, operate carefully, and treat your patient with compassion and respect, then there is not much more you can expect from yourself.

5) Pre- and Post-Clinic Huddle

Because limb reconstruction patients can have so many details to coordinate and monitor, it is important that all team members are regularly updated on any new information or changes in the care plan. Gathering the team members together to look at the day's list before clinic, including preparation for frame adjustments and ensuring appropriate X-ray orders, can help the day go more smoothly. Also, any planned frame adjustments or

more time-consuming visits can be adjusted for best clinic flow. There is no better way to stop a clinic in its tracks than to have simultaneous complex frame cases that need adjustments scheduled back-to-back. The entire team should also meet at the end of clinic to review each patient seen that day to ensure that a consistent plan can be delivered to the patient from all team members.

6) Team Meetings

To keep the team organized and cohesive, schedule regular team meetings involving all the key clinic and OR personnel involved in the limb reconstruction program. The common goal of the meetings should be to identify opportunities to improve patient care and clinic/OR efficiency at every level. Acknowledging and implementing other team members' ideas gives everyone a sense of involvement in the success of the group. Cultivating and maintaining relationships between the individual team members will help to boost the overall team morale.

7) Conferences

A regular schedule of conferences can pique and maintain interest in the program, further enhancing common knowledge and sharing insights by team members. This also provides an opportunity for resident staff to learn and become involved in case planning, furthering the input from different members.

8) Branding

Another method to unify the team is to create a brand for your program. Design a team name, slogan, or emblem that can be displayed on apparel, office supplies, and accessories. For example, wearing matching team scrubs or shirts in clinic not only encourages team unity but it presents a consistent message to the patients.

9) Customer Service

Like it or not, medicine has become a business. Patients can go online and rate their visit with the provider just like any other purchase or life experience. Negative ratings from patients, warranted or not, attract attention.

Successful businesses demand excellent customer service from their employees. Emphasize the concept of treating patients the way you would want to be treated. A few simple points like answering all patient calls and emails in a timely manner, reporting test results immediately, and keeping patient appointments on time will produce positive feedback for the program.

Working with Industry

Limb reconstruction often requires unique equipment from orthopaedic device companies to be used during surgery. Because a company representative (rep) is responsible for arranging that the appropriate equipment is available for each case, it is important to develop clear lines of communication with each rep. Establish a list of preferences with each rep and clarify your expectations of his/her role. Order equipment with as much advanced notice as possible.

Hospital Commitment

Developing a dedicated pediatric limb reconstruction program requires commitment and understanding from the hospital administration. Establishing the program will benefit the hospital because it can publicize a unique patient care element that most other institutions do not have. However, a clear conversation with the hospital administration about the resources required to be successful is recommended prior to agreeing to develop the program. The hospital will need to invest substantial resources (as outlined above) in the program from the outset and accept that the return of the investment will take time to materialize. At a minimum, when negotiating with the hospital, make sure that the program will have the appropriate clinic team staffing, available and appropriate clinic and OR space, a thorough marketing plan, and opportunities for expansion. The creation of a program research team that will manage patient databases, administer outcome measures/consent forms, write grants, and submit institutional research board (IRB) protocols, should also be discussed.

In terms of compensation, it is important to communicate that the process of managing limb reconstruction patients is different than other types of pediatric orthopaedic patients. Because of their complexity, a smaller number of patients can be seen within a given clinic block compared to colleagues seeing primarily fractures and sports injuries. Many clinic spaces will also be occupied for weeks at a time by postoperative lengthening/fixator patients during the global period when there is no charge for the visit. In addition, many limb reconstruction surgeries don't have recognized current procedural terminology (CPT) codes that accurately characterize the complexity of the cases. Consequently, when negotiating a salary, any portion that is based on the annual relative value units (RVUs) accumulated by the surgeon will need to have realistically low value expectations. During negotiations, emphasize to the administration that a limb reconstruction program can generate huge downstream revenue for an institution when physical therapy visits, psychology assessments, radiologic imaging, in-patient hospital stays, and regional anesthesia charges from patients are included in the business analysis.

Managing Expectations

Many young surgeons find limb reconstruction to be an attractive sub-specialty. However, it is a demanding field that requires dedication, a desire to stay and work in one location, and an unwavering passion for the discipline. While there is tremendous satisfaction in the patient success stories, there can also be devastating disappointments when complications occur. Before you start down this path, honestly analyze yourself and be sure that your personality is wired to handle the tremendous ups and downs of a limb reconstruction practice.

In a world where instant gratification is expected, building a limb reconstruction program takes tremendous patience. Unless you are in the rare situation to join an existing pediatric limb reconstruction practice, it will take years to build up a steady stream of

cases and it requires continuous effort to maintain the case referrals. While you may have to supplement your practice with other types of cases in the beginning, don't become frustrated or lose faith in your decision. A career in pediatric limb reconstruction surgery is an extremely rewarding and intellectually stimulating experience that is worth navigating the difficulties that exist when first getting started.

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Appendix A – Reading List

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