

Pediatric Prosthetics

BobEmerson CP

Background

- In the 1940's the first pediatric amputee center was founded by two young orthopedic surgeons, Thomas Aitken, MD and Charles Frantz, MD.
- Through their efforts and other clinics that followed the unique needs of the juvenile amputee were identified and addressed.
- In June of 1961 at the first clinic chiefs national meeting the Association of Children's Prosthetic-Orthotic Clinics (ACPOC) was founded.
- Today it comprises more than 80 clinical teams that serve as essential multidisciplinary forum.

Causes of Amputations

- Emergency Amputations
- Congenital Deficiencies
- Elective

Acquired Amputations

- Trauma accounts for about 70% of acquired amputations.
- Differ in four ways from adults in amputation surgery.
 - ***Preservation of all possible epiphysis.*** To allow continued longitudinal growth.
 - ***Consideration of osseous overgrowth (exotosis).*** Represents the most common surgical consideration among children 10 and under.
 - ***Exuberant healing processes.***
 - ***Disarticulation vs. transections.*** Present five distinct advantages over transections in the pediatric population.
 1. ***Epiphyseal growth is preserved.***
 2. ***Terminal overgrowth is avoided.***
 3. ***Longer lever.***
 4. ***Suspension and rotational control are enhanced.***
 5. ***Distal weight bearing tolerance.***

Congenital Deficiencies

- About 60% of children treated have congenital deficiencies; another 10% have congenital anomalies either treated as, or require amputation.
- Some are the result of amniotic band constriction (Streeter's Dysplasia). Others may be familial, as in cases of longitudinal deficiency of the radius or ulna.
- Most are probably due to injury or developmental failure in the first six weeks of pregnancy. In most cases the cause is not identifiable.

Congenital Anomalies

- When a parent or patient refuse surgical conversion but a device will facilitate ambulation.
- Surgical conversion is delayed either to clarify surgical outcome or maturity will improve conditions.
- Surgical corrections can take years in cases involving longitudinal deficiencies.
- Are often defined as hybrid between an orthosis and a prosthesis. In general the prosthesis accommodates for leg length discrepancy and provides stability. Each must be designed on a case by case basis to meet the unique needs of the individual.

Elective Amputations

- Usually are planned to preserve as much skeletal growth as possible.
 - ***Skin grafts.*** Usually thicken over time and effectively tolerate weight bearing.
 - ***Partial foot amputations.*** Generally provide good function and preserves tissues in the event a revision becomes necessary.
 - ***Burns.*** Typically tissues heal better in a child. Precautions are the same as adults when it comes time for fitting.
 - ***Revisions.*** During the growing years children may require several revisions to correct subperiosteal terminal bone overgrowth.
 - ***Disarticulations.*** Since affected bones do not continue to grow normally the residual limb will have all the benefits without affecting cosmetic appearance in adulthood.

Physical Considerations

- **Staging.** Due to the dynamic nature of the child prosthetic design should be staged based on the developmental readiness.
- **Fitting Ages.** Prosthetic intervention generally occurs when he or she begins to pull to stand, usually between nine and twelve months of age. Ambulation will begin between 15 and 22 months with a wide base gait with hips and knees flexed. Heel to toe patterns emerge at the age of five.
- **Growth.** Due to longitudinal and circumferential numerous methods have been proven that allow for changes to prolong the life of the prosthesis.
- **Follow-up.** A three to four month frequency is necessary to manage the adjustments to accommodate for growth. An average life expectancy for the prosthesis is eighteen months and is dependent on skeletal growth.

Upper Extremity Considerations

- When baby achieves independent sitting balance.
- Preferable to fit prior to the age of two. They tend to develop better wearing patterns.
- No active control is provided at infant fitting.
- Generally control is added when developmentally ready between 24 months and 30 months.
- Some advocate

Prosthetic Systems

- **Protect from injury.** Distal pads, higher trim lines, stabilize where necessary.
- **Maximize prosthetic performance.** Utilize componentry that is geared toward the physically active.
- **Growth orientated.** Planned for growth and change
- **Modular systems.** Allow for quick changes to height and alignment.
- **Minimize weight.** Without sacrificing strength the prosthesis should be as light as possible.

Psycho-Social

- Mentally and emotionally immature. Instructions are forgotten. Problems often go unreported until they are severe.
- Parent Involvement. Extremely important to the long term success.
- Goals. Are ever changing as the child grows and matures.

Conclusion

- Individual treatment is paramount to the success of the child with limb deficiency. Success begins with a dedicated team committed to the treatment plan to ensure growth and change are managed effectively.

References

- Donald R. Cummings, CP Susan L. Kapp, CP. Lower-Limb Pediatric Prosthetics: General Considerations and Philosophy JPO 1992 Vol. 4, Num. 4 pp 196-206
- Joanna Grace Patton, B.S., O.T.R. Developmental Approach to Pediatric Upper-Limb Prosthetic Training Atlas of Limb Prosthetics: Surgical, Prosthetic, and Rehabilitation Principles Upper-Limb Deficiencies: edition 2, 1992, reprinted 2002.

MIT OpenCourseWare
<http://ocw.mit.edu>

EC.722 Special Topics at Edgerton Center:Developing World Prosthetics
Spring 2010

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.