

# An Evolution in the Care of the Child Amputee

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During the past twenty years the child amputee has emerged as a clinical entity requiring specialized medical and paramedical services. Prior to World War II, no precise methods of management existed. Common practice in fitting a child amputee with a prosthesis involved procrastination.

The extent of the change that has occurred is well illustrated by two articles appearing in this issue of *Artificial Limbs: Recent Concepts in the Treatment of the Limb-Deficient Child*, by Cameron B. Hall, M.D., and the report of the Consultants to the Subcommittee on Child Prosthetics Problems on *Nomenclature for Congenital Skeletal Limb Deficiencies*. Dr. Hall's article presents an overview of current thinking on the subject, while the nomenclature focuses attention on the precise identification of congenital limb malformations. Many events have contributed to this evolution in thinking and practice.

In September 1946, under the aegis of the Michigan Crippled Children Commission, an amputee training center was inaugurated at the Mary Free Bed Guild Children's Hospital and Orthopaedic Center in Grand Rapids, Mich. This project was inspired by the late Carleton Dean, M.D., who was then Director of the Michigan Crippled Children Commission. In the early 1940's, Dr. Dean had recognized that something was amiss in the habilitation of child amputees. He was vitally interested in the amputee program that had been developed by the Armed Services and the Veterans Administration. The science of prosthetics was advancing at a phenomenal pace. New mechanical components were being developed and were proving to be superior to anything heretofore available. Plastic protheses were supplanting the old conventional wooden limbs. Dr. Dean argued that there was no reason why these advances could not be used for child amputees.

<sup>1</sup> Chairman, Subcommittee on Child Prosthetics Problems, December 5, 1955-June 30, 1966. When the Subcommittee was formed in 1955 it was a part of the Prosthetics Research Board, the predecessor of the present Committee on Prosthetics Research and Development. The Subcommittee became a standing subcommittee of CPRD when CPRD was formed in 1959. Dr. Frantz, an orthopaedic surgeon in Grand Rapids, Mich., is Medical Co-Director of the Area Child Amputee Program, Michigan Crippled Children Commission. On July 1, 1966, Dr. George T. Aitken, who also is an orthopaedic surgeon in Grand Rapids and Medical Co-Director of the Area Child Amputee Program, Michigan Crippled Children Commission, became Chairman of the Subcommittee on Child Prosthetics Problems.

Little (if any) literature on the management of the child amputee was available, although Dr. Atha Thomas, of Denver, had written a very interesting and instructive chapter entitled "Prostheses for Children" in his book, *Amputation Prosthesis* (3). In this chapter he advocated amputation in tibial hemimelia, foot removal in proximal femoral focal deficiency, and in pseudoarthrosis of the tibia. Dr. Thomas discussed overgrowth of the fibula as a complication of the child amputee and advocated osteoplastic procedures as described by Nikitin (2) and Barber (1). Of singular significance is the fact that Thomas advocated "early fitting."

Four years after the opening of the child amputee center in Grand Rapids, the professional personnel presented a formal paper on *The Juvenile Amputee* at the annual meeting of the American Academy of Orthopaedic Surgeons in February 1950. One hundred ninety-two cases were analyzed in detail. In addition to this presentation, a 28-minute motion picture depicted the problems of the child amputee and demonstrated fitting and training techniques. A scientific exhibit outlining the methods utilized in the care of the child amputee through the team approach was also displayed. Thus, for the first time, the child amputee was identified as an entity to the medical community. Five principles of treatment were stressed:

1. Physical examination and stump evaluation.
2. Utilization of physical and occupational therapeutic methods.
3. Detailed coordination of prosthetic fabrication and fitting.
4. Inpatient prosthetic training.
5. Regularly scheduled outpatient follow-up in an organized child amputee clinic.

In January 1954 a workshop was held in Grand Rapids to review the total child amputee problem. Representatives of the Children's Bureau of the Department of Health, Education, and Welfare, the University of California at Los Angeles, New York University, and the Army Prosthetics Research Laboratory (now the Army Medical Biomechanical Research Laboratory) attended. The individual members of the conference enthusiastically endorsed the proposition that an organized program of treatment for child amputees in the United States was definitely indicated. An attempt was made to define the child amputee as compared to the adult amputee. It was agreed that the child amputee could be described as a growing, immature, dependent individual whose long bone epiphyses were still "open."

In December 1955, in formal session, the Prosthetics Research Board appointed an *ad hoc* committee of seven members charged with developing recommendations relative to child amputees in the United States. The outcome of this effort was the formation of the Subcommittee on Child Prosthetics Problems. Its mission was to develop information, and to advise the Prosthetics Research Board on all aspects of the child amputee situation in the United States.

During March 1956 the Subcommittee on Child Prosthetics Problems mailed questionnaires to 84 prosthetists and 25 orthopaedic clinics throughout the United States. The response was prompt and enlightening. Analysis of the re-

turns indicated universal interest in child amputee treatment procedures. Shop practices were sharply individualized, and no precise criteria for training existed. At this time there appeared to be only four specialized juvenile amputee clinics in the United States.<sup>2</sup>

With this background of information, the Subcommittee proceeded to encourage the development of child-sized prosthetic components. This endeavor involved not only the miniaturization of adult-sized components but also the introduction of specially designed features so that the devices could be operated by young children. With the assistance of the Army Prosthetics Research Laboratory under the direction of Colonel M. J. Fletcher, the Child Amputee Prosthetics Project at UCLA under the direction of Drs. Craig Taylor and Milo Brooks, and the sound evaluation services of New York University under the direction of Dr. Sidney Fishman, components were gradually developed, fitted, and evaluated relative to their efficiency on child amputees.

Stimulated by Dr. Arthur J. Lesser of the Children's Bureau (who was then a member of the Subcommittee on Child Prosthetics Problems), significant steps were taken to encourage the formation of specialized child amputee clinics as a means of standardizing practices in the management of juvenile amputees throughout the country. With the ultimate goal of having a clinic within reach of every child amputee in the nation, definite criteria outlining the requirements for the operation of a satisfactory amputee clinic were formulated. As qualified clinics were established, the cooperative investigation of difficult clinical problems was undertaken. Since these clinics were devoting their efforts exclusively to the child amputee, techniques, appliances, and practices could be introduced and critically evaluated through New York University. Over the years the findings of these studies, which have been analyzed and published, have resulted in the evolution of standards of management never before attained. The fruitfulness of these endeavors is well illustrated by the fact that the Committee for Care of the Handicapped Child of the American Academy of Orthopaedic Surgeons, in conjunction with the Children's Bureau, recently published a document entitled *Standards for the Care of the Juvenile Amputee*. These standards, which have had nationwide distribution, are essentially the same as those that have evolved through the cooperative research program.

The growth in the number of child amputee clinics has been most gratifying. As of January 1966 they numbered twenty in the United States and two in the Dominion of Canada.

During the early years of the child amputee program, clinical statistics indicated a ratio of two post-traumatic or postsurgical amputees to one congenital amputee. However, in a period of eight to ten years, a dramatic change has occurred: *First*, because of the publicity given to the treatment program, chil-

<sup>2</sup> Area Child Amputee Center, Michigan Crippled Children Commission, Grand Rapids, Mich., George T. Aitken, M.D., and Charles H. Frantz, M.D. (1946); Kessler Institute for Rehabilitation, West Orange, N.J., Henry H. Kessler, M.D. (1949); University of Illinois Amputee Clinic, Chicago, Ill., Claude N. Lambert, M.D. (1952); Child Amputee Prosthetics Project, University of California, Los Angeles, Calif., Milo B. Brooks, M.D. (1953).

dren began to appear in clinics at a much younger age than previously. At this very young age, the majority of patients have limb deficiencies that are congenital in nature. *Second*, the logical consequence was a tipping of the scales of etiological incidence to the congenital type. At present, the majority of clinics report a ratio of five congenital types of deficiencies to two acquired types.

Thus the meaning of the term "juvenile amputee" has broadened to encompass post-traumatic amputees, postsurgical amputees, and congenital limb deficiencies and malformations.

In 1961 another significant step was taken by the Subcommittee on Child Prosthetics Problems. In that year it initiated publication of the *Inter-Clinic Information Bulletin*. The first issue was published in October 1961, and the *Bulletin* has appeared monthly ever since with articles written by the clinic chiefs pertinent to the child amputee. The success of this project is attested by the figures of March 1966 when 1,700 copies were printed and 1,565 were distributed; 351 individuals and institutions received 630 copies. In addition 400 copies were sent to the World Rehabilitation Fund for distribution to its members and 535 to the American Orthotics and Prosthetics Association for distribution to its membership.

The impact of the thalidomide tragedy in Europe (West Germany and England) in 1959-1962 focused attention again on the need to improve prostheses, especially when malformed limbs or the complete absence thereof made it difficult to fit conventional suspension and power and cable systems.

Heidelberg University had worked with pneumatic power and applied its principles very successfully to these children. Since then there has been a concerted effort in the United States to exploit external power, utilizing compressed carbon dioxide and electricity as power sources. At the present time, a significant number of children throughout the country are wearing externally powered prostheses on an experimental basis.

Laboratories are continuing to develop devices in an effort to decrease weight, provide easier application, and improve power sources. There is good reason to believe that as time goes on these endeavors will bear fruit in improved, practical prosthetic function. Interest in child amputees is growing steadily in all parts of the world. These children—many of them multihandicapped—now have a much greater hope for better appliances and services than they ever had in the past.

In retrospect, it is evident that much has been achieved by the Subcommittee on Child Prosthetics Problems during the past ten years, but also that much remains to be done. Hopefully, the foundations have been laid for further advances.

#### LITERATURE CITED

1. Barber, G. C. P., *Amputation of the lower leg with induced synostosis of the distal ends of the tibia and fibia*, J. Bone & Joint Surg., 13:68, 1939.
2. Nikitin, A. A., *Comparative evaluation of late results of various amputations of lower extremities in children*, Ortop. i travmatol, Kharkov, (Nos. 4-5) 13:68-75, 1939.
3. Thomas, Atha, and Chester C. Haddan, *Amputation prosthesis*, J. B. Lippincott, Philadelphia, 1945.