

Historical Development of Upper Extremity Prosthetics

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EDITOR'S NOTE: This calendar of important landmarks in the history of Upper Extremity Prosthetics is reprinted by permission from "A Manual for Occupational Therapists on the Rehabilitation of Upper Extremity Amputees." Miss Thelma L. Wellerson is Director of Occupational Therapy in the Institute for the Crippled and Disabled and an instructor in that subject in the College of Physicians and Surgeons at Columbia University. A book review of her Manual will be found elsewhere in the Journal.

Man has attempted since the beginning of time to substitute a mechanical device for the loss of an extremity. An abundance of recorded history is available on lower extremity prosthetics as testament to man's great need for locomotion and his attempts to fulfill that need. However, the recordings of such developmental history of upper extremity prosthetics is not so complete. The following is a compilation from a number of sources which attempts to give the reader a brief historical development of upper extremity prosthetics:

61 A.D. Pliny wrote that a Roman general, Marcus Sergius lost his right hand in the Second Punic War (218-201 B.C.). The general had an iron hand made with which he supported his shield.

1509 produced the classic example of an early artificial hand. A mailed fist was made for Goetz von Berlichingen which was equipped with jointed fingers that could passively grip his sword like a vise.

1564 was the year that the great military French surgeon, Ambrose Pare, published his ten-volume work on surgery. Pare presented illustrations and descriptions of artificial arms and legs which, he claimed, could be reproduced by any locksmith. These upper extremity prostheses were hands which, set in given positions passively, were then locked by the other extremity. Release was possible by pressure against an object or by use of the other extremity. Pare also designed cosmetic devices of moulded leather or gummed paper which held objects such as a pen. However, none of these devices had any volitional control.

1564 was also the date found on a tomb of an Alsatian which when opened in 1919 revealed the remains of another sixteenth century artificial arm. It apparently was designed for an above elbow amputee. The elbow joint as well as the wrist was capable of passive movement. The thumb and fingers could be flexed at both phalangeal and metacarpophalangeal joints. By pressing buttons the thumb and fingers extended.

These devices were apparently for the wealthy. For the common soldier an arm prosthesis consisted simply of a leather bucket and hook, allowing no volitional control, and fastened to the body by straps.

1818, after the Napoleonic Wars, was a year which produced great advancement in upper extremity prosthetics. A Berlin dentist, Peter Baliff,

appears to have been the first to introduce the use of the trunk and shoulder girdle muscles as sources of power to flex or extend the fingers. Baliff reversed the spring action of the Pare and Goetz hands by having the terminal device extend through action of the sound shoulder. The two weak points of the prosthesis were its weakness of grasp and the fact that it was designed only for a forearm amputation.

1844 produced the first arm for an above elbow amputee in which Baliff's principle was applied to flexion of the elbow. This device was invented by a Dutch sculptor, Van Peeterssen.

1860 brought the Crimean and Italian campaigns in which the French Empire was engaged. This engagement left a number of amputees whose needs were met by Comte de Beaufort who gave the amputee control through a shoulder harness. The controlling power started with a strap buttoned into the front button on the trousers, passed through a loop to the opposite axilla, over to the amputated side to a pulley at the elbow and to the artificial hand. M. de Beaufort also invented a simple hand with a movable thumb; an above elbow prosthesis, in which the elbow was flexed by pressure of a lever against the side of the chest; a hand in which opening and closing of the fingers was effected by repeated pulls on the same cord; and a double spring hook for holding objects similar to that of the well known split hook of today.

1866, some fifty years before the First World War, attempts were being made in France to devise practical appliances for the laborer. Dr. Gripouilleau, a physician of France, developed a simple attachment to an arm stump by which the wearer could handle the common agricultural implements. It was comprised of hooks and rings which would fit around farm tools and literally harnessed the laborer to his tools.

1873 demonstrated through writings of Gripouilleau and others that the hand was in disregard. The hand was only used to "raise a hat or carry a cane." The feelings of the time were concerned with enabling the "poor man to raise cabbages" and returning the amputee to the farm to fill the nation's larder.

1914-17 brought a tremendous loss of man power in all countries through war casualties. Therefore all countries were forced through necessity to equip as many of their amputees as possible to carry on accustomed trades by means of mechanical aids. A great effort was made to send the amputee back to the farm, to the blacksmith shop, to the trades of a war economy. The amputee therefore was given a socket and a "universal" terminal device harnessing the amputee to his work tool. The device would grasp only a limited number of work tools. When the amputee desired to accomplish other tasks in the same trade he spent time changing devices.

In Great Britain the amputee was given a work arm with the "universal" tool of his particular trade plus a "dummy" hand.

In Canada the amputee was given one or two hooks for general utility and a "dummy" hand.

However, in the United States a hook was developed which was a split hook closed by rubber bands. This device satisfied the American appetite for speed and true universality. The devices harnessing the amputee to his work tool never did develop in the United States.

1917, in April, the Surgeon General of the United States Army issued an invitation to limb makers to meet in Washington, D. C. From this meet-

ing developed the Association of Limb Manufacturers of America which later evolved into the American Orthopedic Limb Manufacturers Association, a national group which when organized absorbed the then existing state groups. The present national group is called the Orthopedic Appliance and Limb Manufacturers Association.

1948 inaugurated a Certification Program for prosthetists and orthotists. This was a step towards professionalizing the industry. To qualify as a Certified Orthotist or Prosthetist a candidate must first meet the prerequisites as established by the American Board for Certification. Secondly, the man must pass a formal National Certification Examination. Therefore, a successful candidate is entitled to wear an arm patch which identifies the certified fitter.*

Contemporary Developments

A qualified facility is a business which has been established for a prescribed number of years, which has certain physical requirements, and which has the necessary number of certified men as full time personnel.

The over-all developments since 1917 have resulted in close understanding between surgeon and prosthetist and brought forth sound scientific and educational programs.

At the close of World War II a great national need was felt to provide better artificial limbs for the veteran amputee. Therefore, in 1945 the National Research Council, a government supported organization, established the Committee on Prosthetic Devices, which became the Advisory Committee on Artificial Limbs, and later the Prosthetic Research Board. The Committee discovered that while satisfactory lower extremity prostheses were available, the same could not be said for upper extremity prostheses. A project, therefore, was set up at the University of California in Los Angeles to undertake basic studies. Northrop Aircraft, California, and Army Prosthetics Research Laboratory, Washington, D. C., were assigned the task of developing arms and terminal devices. Later New York University, assisted by Prosthetic Testing and Development Laboratory, Veterans Administration, New York, was given the responsibility of testing and following up results on selected arm amputees. After approximately seven years of organized effort in development of research, techniques, working models, and studies on a considerable number of arm amputees, certain basic conclusions were formed concerning principles and techniques in prescription, fabrication, and training the upper extremity amputee. It was therefore important to disseminate this information throughout the United States to various individuals directly concerned with the upper extremity amputee and his problems. Consequently, a series of courses were set up at the University of California at Los Angeles to accomplish this task, under the direction of Craig L. Taylor, Ph.D., Project Leader. Fourteen schools for physicians, therapists, and prosthetists were held from January 1953 through June 1955. In June 1956 a similar course, was held at New York University, under the direction of Sidney Fishman, Ph.D., Project Leader.

The overall effect of such educational programs has been one of greatly increased advantages to the upper extremity amputee on a national basis.

**Editor's Note: C.O.:* Certified Orthotist. *C.P.:* Certified Prosthetist.