

Canadian Candidate

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Throughout the 200-odd years since its inception, the surgical procedure known as disarticulation of the hip has been fraught with danger and disappointment both medically and prosthetically. On few persons has the operation been performed, and fewer still have survived for any gratifying period. Because hip disarticulation is so severe a measure, and because in recent years it has for the most part been carried out only in the attempt to forestall fatal disease, the level of medical success thus far attained has been disturbing. Because the hip-disarticulation amputee presents such a difficult problem in anatomical deficiency, his successful rehabilitation prosthetically has proved particularly evasive.

Although even in modern times postoperative mortality from residual systemic disease has remained alarmingly high, recent advances in surgical techniques and in medicine as a whole have done much to encourage hip disarticulation where it might not otherwise have been attempted. This circumstance, together with a growing tendency toward the use of radical amputation surgery as a curative measure in cases of malignancy, has been responsible for an increasing incidence of hip-disarticulation amputees. Meanwhile, the problem of providing a reasonably satisfactory substitute for a lower extremity amputated at hip level has over a long period of years continued to be most difficult for the limbmaker and most exasperating for the patient.

To satisfy functional requirements in amputations at or about the hip, the prosthetist has not only to furnish a limb with three simulated anatomical joints, all of which have to be stabilized in the stance phase of walking, but he must do so with only the torso and associated structures as a source of activation and control. In the absence of an adequate thigh stump, reliable management of an articulated lower-extremity prosthesis calls for the use of various locks, or equivalent, and for the coordinated action of pelvis, trunk, and remaining sound leg. The saving grace in this situation is that weight-bearing can still be provided on one of Nature's chosen seats of election, the ischium.

The hip-disarticulation prosthesis to which this issue of ARTIFICIAL LIMBS is devoted is the culmination of many years of practical work, later combined

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with present-day methods of organized research and the application of new materials. Canada has had much experience in the provision of orthopedic and prosthetic appliances in the aftercare of her veterans. Early in 1916, the government of the day was confronted with the matter of supply for members and ex-members of the Canadian Expeditionary Force. After thorough investigation, it was found that existing facilities were extremely limited and unable to cope with the problem. Further, although standardization of appliances was deemed essential to provide ready maintenance or renewal accessible to the veteran's place of residence over the breadth of the country, no such standardization existed throughout the Dominion. Government proprietorship was considered the best means for keeping in touch with latest developments in prosthetics from other countries and also seemed to offer the most expeditious way of initiating a domestic program of experimental work that would be productive of results in keeping with the policy of standardization.

The agency thus established, which today is known as the Prosthetic Services Branch of the Department of Veterans Affairs, now consists of some twelve operating centres and six visiting facilities situated in or adjacent to Departmental hospitals in the principal Canadian cities from coast to coast. The largest centre, located at Sunnybrook Hospital in Toronto, serves as the central manufacturing facility for the production of standard parts and stores for supply to all other centres. Here also is located a research section technically staffed for the investigation of new designs, materials, and techniques. Situated close to the medical and production facilities, and with patient personnel from the largest veteran area, this unit provides ample opportunity for field-testing and final approval for manufacture in other District facilities across the country. It was here that Colin McLaurin and James Foort were inducted into the field of prosthetics research and here also that, early in 1954, McLaurin brought into production the hip-disarticulation leg now generally known as the "Canadian type."

To produce an improved prosthesis for the hip-disarticulation case was already one of the problems confronting the design section organized in 1916. At that time, the choice of willow setups, wood or leather sockets, and heavy joints did not provide for a light limb or for good control. Later, in 1926, the Department adopted the J. E. Hanger English metal limb, which included a design known as the "tilting-table leg." This limb, although of lightweight construction and representing a decided improvement over former designs, did not eliminate locks, and, moreover, the location of the hip joint directly under the ischial seat created, when the wearer sat, a pelvic tilt that was tiresome over any lengthy period. Further design work was carried out after World War II using a lateral hip joint and folding-latch mechanism. But this device, while solving the "tilt" problem, necessitated heavy construction and gave little improvement in control. Because of this discouraging state of affairs, many hip-disarticulation and short-stump above-knee amputees had long

preferred crutch ambulation rather than bother with the best prosthesis available.

The current design of the Canadian-type hip-disarticulation prosthesis was evolved by McLaurin after some three years of work in which the scope of investigation was broadened to explore more features than the height of the joint under the seat. Included were a mechanical design of the hip joint to promote walking with a free hip, an alignment that provides stability through all phases of the walking cycle, and, finally, a new concept of a plastic socket-waistband. This all-plastic member embraces the pelvis and incorporates a rather rigid band which encircles the waist. When well fitted, it provides comfortable weight-bearing, a suspension that requires only the tightening of the front restraining strap, and a degree of control which permits the amputee to move the limb freely and confidently.

Performance on the new device by a test amputee exceeded all expectations, despite the fact that in addition to an amputation at the right hip he had suffered amputation of the right arm above the elbow. Shortly after trials, he reported his ability to walk forty city blocks with less effort than he had formerly expended in two blocks with the old-style metal limb. The ease of donning and removing the new leg with the simple yet secure suspension was impressive. Further field-testing on a larger number of hip-level amputees justified the acceptance of the design as a standard of production, and by September of 1954, through instruction and training of District fitters, it was made available on a Dominionwide basis. Some thirty-two cases have been fitted to date, and twenty-five of these have been classified as successful.

Following the results attained at Sunnybrook, the Prosthetics Research Group at the University of California at Berkeley undertook to assess the new device and to work out improved procedures for construction and fitting, and in the spring of 1956 the Committee on Prosthetics Research and Development of the Prosthetics Research Board approved the issuance of the Canadian-type hip-disarticulation prosthesis to veteran beneficiaries throughout the United States. Here, then, is a Canadian candidate for utilization by clinic teams everywhere in dealing successfully with one of the most troublesome prosthetic problems of all.