

Canadian Hip Disarticulation Prosthesis

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Amputation at the hip level poses a difficult problem for the prosthetist. He is not only faced with providing a limb with the three anatomical joints, ankle, knee and hip, but is faced with the problem of having no stump to activate the limb and hence difficulty of control. As compensation, however, weight bearing is provided on one of nature's chosen seats of election—the ischium.

The World War I Canadian limb for this site of amputation was of willow construction to the hip level and sockets were made of leather, steel or willow. The leg was heavy and was by no means universally accepted. In 1926 the Department adopted the J. E. Hanger Tilting Table metal limb along with other metal legs of British design. The monel metal socket or pelvic cap was joined to the thigh piece by a hip joint. The lock in the hip joint was engaged while walking and disengaged while seated. The hip joint was placed directly under the seat of the socket which effected a tiresome raise or tilt when seated. The leg was light but noisy.

Subsequent to World War II, experiments were carried out and a leg with a lateral hip joint and folding latch solved the tilt problem, but the plunger locking the thigh and spring loaded crank folding latch to hold the socket and set up together during the walking phase again necessitated heavy construction and there was little improvement in control.

Further development to provide a limb with free hip movement, was continued. A design was adopted in which about 15°-20° flexion of the mechanical hip joint occurred at the end of the swing phase. To prevent hyperextension, use was made of an elastic restraining strap. The hip joint was so placed that locking forces developed automatically with weight bearing.

About 1951, the development of the use of plastics permitted a radical redesign of the socket. By combining a plastic pelvic cap with a band enclosing the trunk at the level of the anterior superior spines, a snug, good fitting socket was obtained. No other suspension is necessary and the quick release retaining strap permits ready donning of the appliance.

The details of the limb are described by C. A. McLaurin, formerly Research Engineer, Prosthetic Services Centre, Toronto, in his report of March 19, 1954, as follows:

Socket—The socket and waistband, or pelvic cradle, is constructed of reinforced plastic in one continuous piece, as illustrated in the attached print.

First, with the amputee standing, a cast is taken of the entire pelvic area from above iliac crests to the ischium of the amputated side. A positive plaster cast is then poured and severely modified by removing an inch or more in the fleshy areas and shaping the remainder to provide an accurate fit over the ilium and ischial tuberosity. The cast is then sealed with cellulose acetate or wax and the socket layed up with resin reinforced by glass cloth or mat with an ample

* Based on reports of E. A. Weir, B.A., Sc., and C. A. McLaurin, B.A., Sc.

Charles A. Bell was born in Toronto in 1891 and is a graduate of the University of Toronto. He enlisted in August, 1914, in the First Division of the Canadian Engineers and rose through the ranks to become an officer, leaving the Service in April, 1920, with the rank of Major. While in the Service he was wounded in action three times eventually resulting in bilateral below knee amputation and loss of the right eye. Returning to civilian life, Major Bell became connected with the Canadian Department of Veterans Affairs and since 1938 has been Director of Prosthetic Services for the Department. He received the Military Cross and Bar during the first World War and the Order of the British



Charles A. Bell

Empire in 1946. Major Bell was married in 1919 to Nursing Sister, Honorary Lt. H. S. Gillian. They have a son and daughter.

quantity of monofilament glass roving in the waistband.

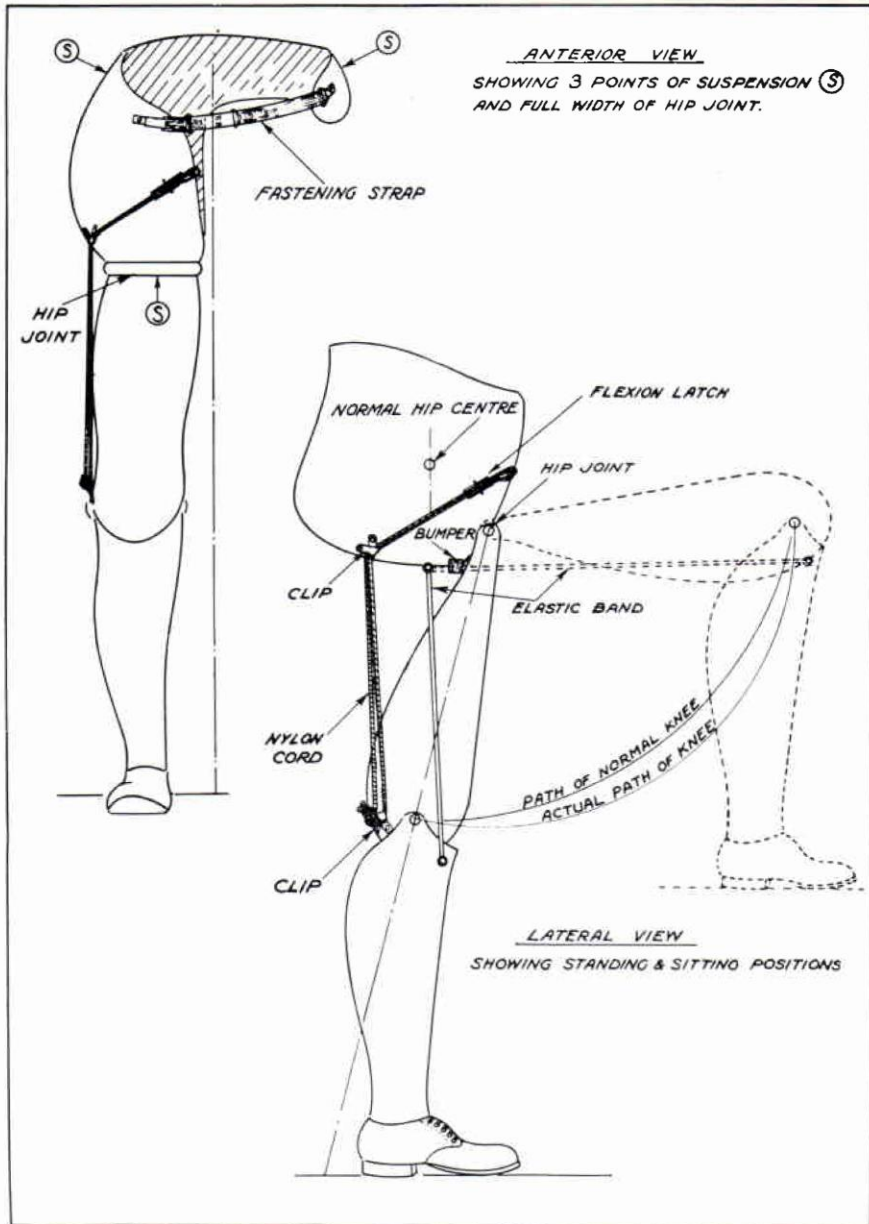
No shoulder strap is fitted. A good fit over the ilium is necessary to support the prosthesis firmly and comfortably. It has been found that the best place for support is on the ridge between the crest of the ilium and the anterior superior spine. The section of the belt across the abdomen is cut off and a heavy elastic webbing with an adjustable fastener is applied to maintain a snug fit.

The socket can be tried on before the leg is fitted. It should fit comfortably, but firmly, so that very little motion can occur between the socket and the pelvis.

Alignment—The leg is attached on the surface of the socket and well forward of the ischial tuberosity, as shown in the attached print. This has two effects. The joint can be made the full width of the leg and

hence have adequate strength laterally. Also, if a stop is placed behind the joint to prevent hyper-extension, no hip lock is necessary. An elastic strap should be added, however, to prevent the hip joint from flexing too far while walking, and to give the amputee some control over the leg.

The leg walks better with a free knee joint. For stability, the knee must be set up with a little hyper-extension. Thus when the hip is flexed, the knee is stable. In learning to use the leg, some difficulty is experienced in gaining confidence during this part of the stride at heel contact. It is necessary for the amputee to learn to walk into the leg and not attempt to have the hip joint reach its stop before the foot is flat on the floor. The axis of the hip joint should be more or less parallel to the knee joint and should be positioned to provide satisfactory alignment and thigh



length in sitting as well as standing.

Flexion Limiter—In the latest case to be fitted, a hip flexion limiter was provided. It consists of a latch-controlled nylon cord that allows the hip to flex only enough for walking. It must be released before sitting.

The device gives the amputee confidence, prevents too long a stride and gives control during abnormal conditions, like high winds, jostling in crowds, climbing ladders, digging, etc. As the latch is not automatic, it need be used only when desired.

From the standpoint of safety in falling, it is considered that the free hip joint is preferable because the leg collapses letting the amputee fall as he will, rather than vaulting him out of control.

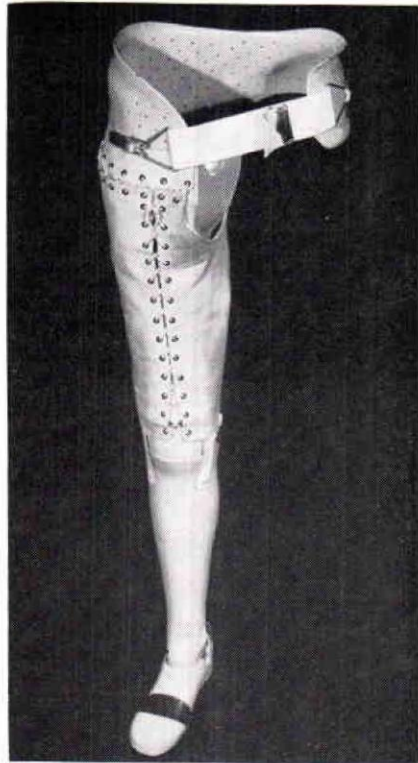
Construction Notes—In practice, the hip joint is mounted on a dural plate. The socket is built up in the attachment area with cork and a mixture of epoxy resin and sawdust, and finally covered with glass cloth and resin. The dural plate can then be temporarily attached with bolts or screws. Adjustments may be made to the position after the leg has been worn, and the final position should be secured with epoxy resin (adhesive). It has been found that epoxy resins produce a more durable socket than polyesters. Due to their excellent adhesive properties, the socket can be readily modified or patched without fear of subsequent failure.

A fairing of soft leather backed with foam rubber may be added to give the thigh a normal shape.

Advantage—The advantages of the prosthesis are freedom from hip locks, excellent lateral control, strong hip joint and freedom from shoulder harness. In practice, it has been observed that walking effort has been greatly reduced, but it has not been demonstrated how much of this is due to the free swinging hip joint or the firm pelvic suspension.

Further experimentation is in progress at present as to possible advantages that may be provided by the SACH foot, an all-plastic set-up in lieu of our standard metal set-up, and a five-link knee mechanism to provide positive lock on heel contact.

The design at present has exceeded our expectations in performance. It gives a feeling of security of control, abduction and adduction are possible, and walking ability is increased with far less fatigue. In fact, one test amputee stated that he could walk forty city blocks with less effort than he previously put forth in walking two blocks.



Hip Disarticulation Leg with Pelvic Socket.

It is most important that amputees who have previously worn a leg with a locked hip and in some cases a locked knee, approach this new appliance with an open mind and be prepared to spend some time on gait training. Some have felt a sense of insecurity with the free hip under certain conditions, and a lock to limit this is available. This is described as the "Flexion Latch" in the accompanying drawing. It will permit a locked joint or one with restricted flexion during walking and will be helpful, or a "mental crutch" to those who feel insecure on a free hip joint. It should only be used as a last resort and after fair trial, otherwise one of the most promising features of the new leg is lost entirely.

The Department have had twenty-two cases referred to date for fittings

of this type of prosthesis with results as follows:

Cases	Success	Failure
22	14	4
<i>In process</i>		<i>Deceased</i>
2		2

The four failures were due to lack of cooperation.

The adoption of this design has re-

duced our construction and fitting time some 45% over previous standards and the measure of success has been most encouraging and demonstrates the acceptability of this design. Further developments may increase its efficiency even to the extent of application in the case of fitting bilateral amputees of this type.

“What’s New(s)”



Discussing the Blair Hyperextension Brace at the S. H. Camp & Company office in Jackson, Michigan, left to right, Camp President F. I. Yeakey, Robert Blair, of Blair Associate, C. E. Yesalis, Camp Sales Manager and E. G. Weaver, Managing Director of S. H. Camp & Company of Canada.

• S. H. Camp & Company, Jackson, Michigan, has been selected by ROBERT C. BLAIR, JR., of Blair's Associate, Orlando, Florida, as sole distributor in the United States and foreign countries of Blair's Braces and Appliances. Mr. Blair has been meeting Camp representatives to better acquaint them with the fitting procedure of his products. Besides spending time at the Camp factory in Jackson, he instructed groups in New York and Chicago.

• J. E. Hanger, Inc. of Indiana is moving its Indianapolis office on April 1st. This Certified Facility will occupy modern facilities at 1529-33 N. Illinois Street and will have three times the space of the former location. The new facility has been engineered for modern limb production, using all the latest developed mechanized equipment. It will be completely air-conditioned and provide adequate parking space for patients and employees. M. G. Manwaring, Vice President of the Company, is in charge of the Indianapolis office.