Some American Experience with Syme Prostheses

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At its research and service facilities in New York City, the U. S. Veterans Administration has during more than a decade accumulated considerable experience with Syme prostheses in a variety of conventional and experimental designs. Some of the patients involved were Army casualties of World War II fitted originally (for the most part at Thomas England General Hospital, Atlantic City) with molded leather socket, anterior lacing over soft leather tongue, and steel reinforcing straps medially and laterally (page 55). Others, similarly fitted with anterior tongue and lacing but with carved wood socket and sometimes with metal reinforcements, came from commercial limb-shops (Fig. 1). The Orthopedic Shop of the VA's New York Regional Office (now the Limb and Brace Section of the Veterans Administration Prosthetics Center) accommodated an occasional beneficiary with wood socket and anterior opening, and it also constructed and applied a few prostheses with wood socket but with medial opening.

At the end of the Korean conflict, six Syme amputees, young Puerto Rican males then patients at the Fort Hamilton VA Hospital in Brooklyn, were seen by New York units of the VA's Prosthetic and Sensory Aids Service. Small, agile, and at the time having only recently undergone amputation, they had rejected the conventional willow or leather-and-steel prostheses as too heavy and cumbersome. Instead they wore high combat boots stuffed with newspaper or pieces of cloth to substitute for the amputated parts. They walked with full end-bearing and a scarcely perceptible limp and were able to run, turn, and stop easily. Some were fitted with a plastic Syme prosthesis similar to the Canadian type with posterior opening but with a rubber-block ankle joint and a more or less conventional foot (1).

Although because these patients soon returned to Puerto Rico no follow-up study was undertaken, presumably several factors—increasing age, gain in weight, loss of agility,, unconventional appearance of the modified combat boot, not to mention difficulty of obtaining service for an experimental prosthesis—would have resulted in eventual replacement of either the boot or the plastic prosthesis by a more conventional prosthesis. The boot was, of course, a temporary expedient intended only to make ambulation possible. Prolonged use would probably have been unsatisfactory because fundamental fitting principles in the design of weight-bearing areas and in fixation of the stump were ignored. Nevertheless, the great difference between the boot and the conventional prosthesis served to emphasize the importance of simplicity and lightness in the development of a Syme prosthesis.

In May 1957, VAPC was requested to determine the adequacy of the procedures outlined by Foort (J) for fabricating and fitting plastic Syme prostheses patterned after earlier developments of the Prosthetic Services Centre, Department of Veterans Affairs, Toronto *(2;* see also page 87). Initially, amputee acceptance of the plastic prosthesis over prostheses previously worn was exceptionally high, but structural failure of the socket occurred

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Fig. 1. Carved wood Syme prosthesis with anterior opening and lacer. Often steel straps are embedded in the wood medially and laterally as reinforcements. This prosthesis, finished with rawhide and paint, had a leather-covered felt toe and a single-axis ankle joint with flexion-control bumpers.

often, and a number of amputees, though capable of assuming weight-bearing on the end of the stump for a part of the day, complained that no provision was made to any appreciable extent, for assuming weight-bearing in other areas (5). From the experience gained in the clinical trials, the so-called "VAPC Medial-Opening Syme Prosthesis" (4; see also page 57) was developed.

During the course of the ensuing years, 24 Syme cases were fitted at VAPC with the medial-opening Syme prosthesis. From the clinical histories there have been selected, purely on the basis of availability, eight cases for re-examination and follow-up. Together with some supplementary data on the other 16, they constitute the basis of this report.

All but one of the 24 cases had worn the more conventional molded leather or carved willow prostheses for at least two years before trying the VAPC type. Some amputees had had experience with polyester-Fiberglas Syme prostheses with full posterior opening. The prior experience of these cases provided opportunity to make comparisons as to comfort, weight, durability, cosmesis, and so on. When the cases were last reviewed, the new prostheses had been worn for periods ranging from 7 months to 43 months (Table 1).

EIGHT CASE HISTORIES

Case 1 (H. H.)

Case 1, a 38-year-old college student weighing 140 lb. and standing 5 ft. 8 in., suffered irreparable damage to his left foot and left upper extremity in a landmine explosion in Korea in 1954. In emergency treatment in Korea, left Chopart and left below-elbow amputations were performed. In January 1955, at Walter Reed General Hospital, a left Syme amputation was carried out because of poor healing at the prior level, and the stump was permitted to drain. In July 1955, the patient was admitted to the VA Hospital, Brooklyn, New York, to have the stump drainage cleared. By the time he was seen for this study, the flap had migrated posteriorly, as shown in Figure 2. Portions of the scar had moved nearer to the usual area for end-bearing and had thus created wrinkles in the skin on the postero-distal aspect of the stump.

The first prosthesis, made late in 1955, was a conventional wood-and-leather Syme prosthesis with anterior lacing. It was worn until 1957, when, because of great discomfort at the end of the stump, the patient was unable to use the limb continuously. Early in 1957 the patient was referred to the Veterans Administration Prosthetics Clinic, where another conventional prosthesis was made. It was worn a few months with moderate success but with some need for repair.

In September 1957, a plastic VAPC Syme prosthesis with medial opening was delivered. But presumably because of the displaced flap

Table 1

Summary of 24 Cases Fitted in VA Prosthetics Center With Medial-Opening, Polyester-Nylon Syme Prostheses *

Case No. and Initials	Age (yr.)	Wt. (lb.)	Hgt. (in.)	Occupation	Other Major Medical Problems	Last Syme Prosthesis	Last Prosthesis from VAPC (date issued)
1. H. H.	38	140	68	Student	Left below-elbow amputation	Polyester-Nylon Medial opening	11/59
2. R. W.	40	170	69	Machinist	None	Polyester-Fiberglas Posterior opening[b]	8/58
3. K. K.	39	150	71	Auditor	None	Polyester-Nylon Medial opening	5/58[a]
4. A. M.	38	175	66.5	Diemaker	None	Polyester-Fiberglas Posterior opening	11/58
5. J. J.	43	220	71	Janitor	Bilateral Syme as of 2/60, when left Syme was performed	Polyester-Fiberglas Posterior opening (right side)	10/58
6. J. B.	39	160	76	Salesman	None	Polyester-Fiberglas Posterior opening	7/59
7. S. G.	43	160	64	Clerk	None	Polyester-Fiberglas Posterior opening	10/58
8. N. B.	50	165	67.25	Tailor	None	Polyester-Nylon Anterior opening	2/59
9. H. M.	38	195	74	Design Engineer	None	Carved wood	9/59
10. L. B.	43	195	67	Clerk	None	Carved wood	11/56
11. F. C.	43	185	67	Student	Right Chopart with left Syme	Carved wood	3/59
12. A. R.	27	168	72	Truck Driver	Bilateral Syme	Bilateral carved wood	9/58 (Bilateral)
13. W. B.	36	212	72	Clerk	None	Steel and leather	1/59
14. E. V.	45	170	72	Truck Driver	None	Carved wood	1/59
15. S. C.	28	230	70 .5	Drapery Hanger	None	Steel and leather	1/58
16. S. F.	35	155	68	Gardener	Right below-knee with left Syme, some paralysis in both lower extremities	Steel and leather	2/58
17. H. C.	34	175	70	Salesman	None	Carved wood	9/58
18. J. S.	35	144	72.5	Factory wkr.	None	Steel and leather	7/58
19. I. C.	35	145	70	Tailor	None	Carved wood	3/59
20. J. R.	48	125	63	Clerk	None	Steel and leather	10/58
21. E. L.	49	204	73	Carpenter	None	Carved wood	1/59
22. E. Z.	29	170	67	Accountant	Bilateral Syme	Bilateral carved wood	10/59 (Bilateral)
23. W. S.	44	170	72	Pattern-maker	Peripheral vascular weakness	Steel and leather	8/59
24. M. M.	43	175	68	Clerk	None	Carved wood	11/59

(Moved Down)

Case No. and Initials	Type of Weight-Bearing Provided in Prosthesis	Months Worn to July 1960 (last prosthesis)	Patient Status as of July 1960 (last prosthesis)
1. H. H.	Full proximal	7	Wearing, no trouble
2. R. W.	Mainly distal with some proximal	22	Wearing, no trouble
3. K. K.	Distal partial posterior opening[a]	25	Wearing, no trouble
4. A. M.	Mainly distal with some proximal	19	Wearing, no trouble
5. J. J.	Mainly distal with some proximal	18 (to 4/60; see text)	Not wearing. Now wears bilateral polyester-nylon full posterior opening with steel uprights made 4/60 in Buffalo, N. Y.
6. J. B.	Mainly distal with some proximal	11	Wearing, no trouble

6. J. B.	Mainly distal with some proximal	11	Wearing, no trouble
7. S. G.	Mainly distal with some proximal	20	Wearing, no trouble
8. N. B.	Mainly distal with some proximal	16	Wearing, no trouble
9. H. M.	Mainly distal with some proximal	9	Wearing, no trouble
10. L. B.	Mainly distal with some proximal	43	Wearing, no trouble
11. F. C.	Mainly distal with some proximal	15	Wearing, no trouble; duplicate spare now being fabricated
12. A. R.	Mainly distal with some proximal	21	Wearing bilaterally, no trouble
13. W B.	Mainly distal with some proximal	17	Wearing at work, using spare M-0 Syme at home
14. E. V.	Mainly distal with some proximal	17	Wearing, no trouble
15. S. C.	Mainly distal with some proximal	29	Wearing, no trouble
16. S. F.	Mainly distal with some proximal	28	Wearing, no trouble
17. H. C.	Mainly distal with some proximal	21	Wearing, no trouble
18. J. S.	Mainly proximal with some distal	23	Wearing, no trouble
19. I. C.	Mainly distal with some proximal	15	Wearing, no trouble
20. J. R.	Mainly distal with some proximal	20	Wearing, no trouble
21. E. L.	Mainly distal with some proximal	17	Wearing, no trouble
22. E. Z.	Mainly distal with some proximal	8	Wearing bilaterally, no trouble
23. W. S.	Mainly distal with some proximal	10	Wearing, no trouble; uses for swimming
24. M. M.	Mainly distal with some proximal	7	Wearing, no trouble

Except for Cases 1 and 2, all of these cases felt that they were taking weight on the ends of their stumps. The proximal component of weight-bearing apparently was not too noticeable among these cases. Cases 1 and 2 were able to discern the proximal weight-bearing provided, Case 2 being the only on distinguising the "same proximal" in his fitting. [a]With the exception of Case 3, who in May 1958 was eventually given a polyester-nylon, partial-posterior-opening prosthesis (Fig. 4). [b]Unless otherwise noted, "posterior opening" refers to full posterior flap hinged at the bottom. [e]There is probably a large component of peripheral support owing to the clamping action of the cover for the posterior opening.

the patient was unable to tolerate end-bearing. Accordingly, all support was transferred to the proximal portion of the shank, the socket being fitted and relieved as for a below-knee prosthesis. Gait was excellent. For the first time the patient was able to use a prosthesis continuously while actively wearing it an average of 16 hours a day. In November 1959, after the prosthesis had been worn for a little over two years, some stump shrinkage in the proximal weight-bearing areas required the fabrication of a new prosthesis.

Case 2 (R. W.)

During the campaign in the Philippines in 1945, Case 2, a 40-year-old machinist 5 ft. 9 in. tall and weighing 170 lb., received wounds in his left foot from a mortar-shell explosion. An emergency transmetatarsal amputation (through all metatarsals but the first) was performed in a field hospital. Osteomyelitis developed two years later and again in 1948. As a result, a Syme amputation was performed at a VA hospital in 1950.

a *b*

Fig. 2. Stump of Case 1, a left Syme amputee, *a,* Posterior view; *b,* anterior view. Note migration of skin flap.

The first Syme prosthesis, issued in 1950, consisted of the usual willow socket and an anterior leather lacer over a soft tongue. From the outset, the patient experienced difficulties on the anterior aspect of the shank along the tibial crest. When the patient was first seen in 1957, concentrated pressure of the lacing had led gradually to an ulcer along the upper two thirds of the anterior aspect of the shank.

In the same year, a Fiberglas, Canadian-type prosthesis with full-length posterior opening was delivered. It allowed full end-bearing, although tightening of the encircling strap tended to compress the posterior door against the stump, thus possibly increasing the proportion of weight-bearing on the sides of the socket and perhaps on flaring portions under the tibial condyles. The upper portion of the anterior socket wall was made from a cast of the stump and was padded but not specifically relieved over the tibial crest. Although the patient thus continued to have considerable discomfort along the ulcerated area of the tibial crest, he wore the prosthesis for three and a half months.

Several mechanical failures occurred at and just above the ankle region. On August 1, 1958, therefore, a new Syme prosthesis, VAPC type, was delivered. It consisted of a semi-flexible plastic laminate over a modified plaster model and made provision for bearing part of the weight proximally. With the new device, the ulceration along the anteroproximal two thirds of the leg cleared, presumably because of the relief provided along the tibial crest. The patient was comfortable for the first time since amputation. He still wears the limb as of July 1960.

Case 3 (K. K.)

Case 3, a 39-year-old auditor 5 ft. 11 in. tall and weighing 150 lb., suffered damage to his right foot in France in 1945 in a landmine explosion. Emergency surgery performed in a field hospital was followed several months later by a Syme amputation. About two months after that, the patient was provided with a temporary prosthesis and then, later, with a conventional prosthesis fabricated of leather with a steel frame. After two more months he developed a painful callus along the line of suture, and surgery was undertaken to refashion the scar. Irregularities on the distal end of the tibia (Fig. 3) apparently caused no difficulty.

Fig. 3. X-ray (anterior view) of stump of Case 3, a right Syme amputee. Note rough surface on base of tibia and residuum of compound fracture in upper third of fibula.

In 1946, a conventional Syme prosthesis made of wood and leather was provided by the New York VA. It broke down several times owing to structural failure, as did also two other conventional prostheses. Finally, in December 1957, the patient was supplied with a polyester-Fiberglas Syme prosthesis having a full posterior opening. In February 1958 the prosthesis was returned, again because of mechanical failure.

Repairs having been made, the patient was next referred to the VAPC Prosthetics Clinic Team, where a VAPC polyester-nylon Syme prosthesis with medial opening was prescribed. But the patient complained that, because of the bulbous end of the stump, he encountered difficulty in donning the typical prosthesis with medial opening. Later, in May 1958, to meet the patient's request, a prosthesis having a small posterior opening but closed top third (Fig. 4) was prescribed and fabricated despite apparent weakening of the structure.

This final prosthesis has been worn continuously for 16 to 18 hours a day since its initial delivery. Most of the weight-bearing is of the "distal" type, but some component of support is absorbed peripherally by the clamping action of the cover for the posterior window. The old, healed fracture with ossification near the head of the fibula (Fig. 3) did not interfere with fitting or use. Patient continues to use the last prosthesis as of July 1960.

Case 4 (A. M.)

Case 4, a 175-lb., 38-year-old diemaker measuring 5 ft. 6 1/2 in., stepped on a landmine in Germany in 1944. A considerable portion of his right foot was shattered, and infection and gangrene followed. Surgical amputation of part of the foot was carried out in England. In October 1945, in the United States, a Syme amputation was performed, the fibula being transected higher than the tibia (Fig. 5).

Several weeks after the Syme amputation the patient was given a pylon, which he wore for about three months. A conventional Syme prosthesis fabricated of leather with a steel frame was then fitted, but two successive replacements were necessary because of mechanical breakdown. The patient was referred to the VAPC Prosthetics Clinic Team in

Fig. 4. Modified VAPC Syme prosthesis, partial posterior opening for Case 3, a right Syme amputee.

February 1958, at which time a Syme prosthesis of Fiberglas and polyester resin and with full-length posterior opening was prescribed. Frequent breakage of the metal hinge at the back as well as cracking of the plastic at the ankle section occurred, and the patient complained of insufficient support in the socket and of pinching of the skin at the crevices resulting from the two-piece construction of the prosthesis (J). Moreover, he had a painful callus at the end of the stump in the region of the scar.

In November 1958 a medial-opening Syme prosthesis was delivered, and a checkup at the end of 30 days showed a reduction in the callus, absence of pain, and excellent skin over the end of the stump. Much pleased with the prosthesis, the patient wore it continuously for about 16 hours a day. He is still wearing it as of July 1960.

Case 5 (J. J.)

Because of chronic osteomyelitis of the toes bilaterally, Case 5, a 43-year-old janitor weighing 220 lb. and standing 5 ft. 11 in., was in 1946 subjected to amputation of the first toe of his right foot. In 1947, the second toe of the right foot was amputated. In 1948, the left second toe was amputated. Then, in 1955, because of progressive osteomyelitis, the second and third metatarsals of his right foot were excised. Despite these measures, he developed an ulceration of his right foot with drainage. In 1957, therefore, a right Syme amputation was performed. A conventional Syme prosthesis, supplied later in 1957, consisted of a Celastic socket *(6)* mounted in a steel frame. Mechanical failures were numerous, and because of anterior lacing constant pressure was experienced along the tibial crest (Fig. 6). In April 1958, a Fiberglas-reinforced polyester-plastic prosthesis with a full posterior opening was supplied, but it also suffered numerous mechanical failures, the most frequent involving cracking of the plastic at the ankle section.

A VAPC prosthesis with medial opening was provided in October 1958. Several follow-ups revealed excellent gait with only a slight limp. The patient wore the prosthesis 16 hours daily and had no complaints until, in February 1960, osteomyelitis in the left foot required a left Syme amputation—in Buffalo, N. Y. The newly acquired bilaterality necessitated a revision in the alignment previously formulated for the one prosthesis and allowed some flexibility in designing the height of both prostheses. Accordingly, the VAPC prosthesis was condemned as no longer serviceable. New bilateral Syme prostheses, procured in Buffalo in April 1960, were of the polyester-nylon type with full posterior opening but with upright steel reinforcements laminated on the medial and lateral sides.

Case 6 (J. B.)

In April 1955, a 39-year-old salesman weighing 160 lb. and standing 6 ft. 4 in. required a

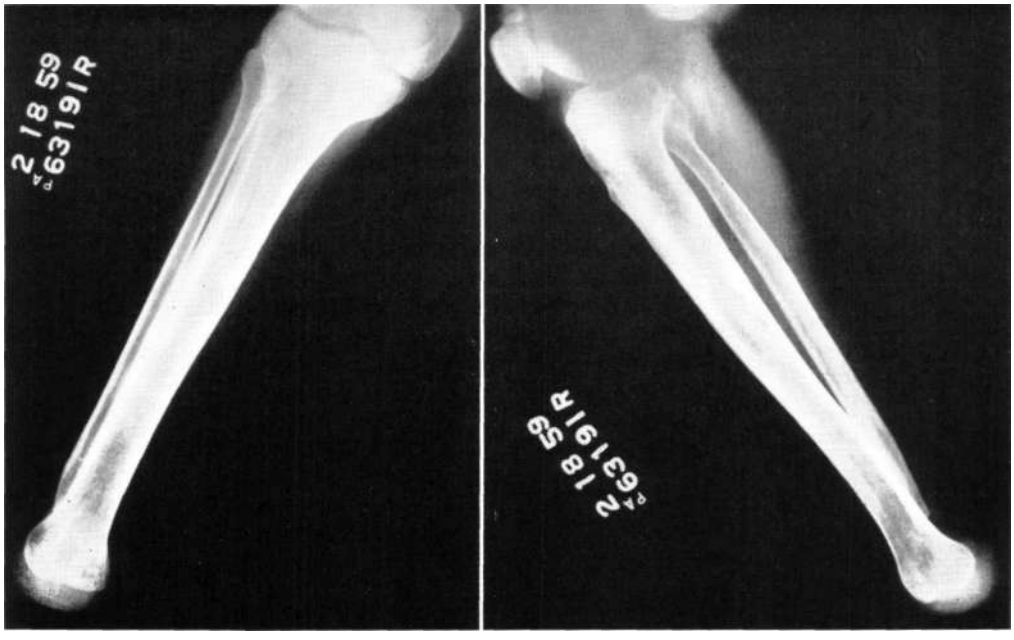

Fig. 5. X-rays of stump of Case 4, a right Syme amputee, *a,* Anterior view; *b,* medial view. Note that fibula is shorter than tibia, presumably owing to trauma.

Syme amputation for osteomyelitis, with which he had suffered for 11 years. In the same year he was given his first prosthesis, one fabricated of wood, and in March 1958 he was referred to VAPC. Provided with a prosthesis with posterior opening, he noted pressure on the tibial crest. Several unsuccessful attempts to relieve the pressure led in July 1959 to fabrication of a medial-opening VAPC prosthesis with partial proximal weight-bearing, whereupon the previous pressure areas were relieved. With the new prosthesis, the patient was able to get about easily for 16 hours daily. He continues to wear this prosthesis as of July 1960.

Case 7 (S. G.)

A 43-year-old clerk weighing 160 lb. and standing 5 ft. 4 in. suffered irreparable injuries to his right foot in November 1944 when he stepped on a landmine in Germany. A Chopart amputation was performed shortly thereafter in Holland, and a Syme amputation occasioned by osteomyelitis followed in the United States in 1945. A leather-and-steel prosthesis was furnished in June 1945, and the patient subsequently received, one after another, three wood-and-leather conventional prostheses, which he wore successively until 1957. At that time a posterior-opening plastic Syme prosthesis was fitted, but the patient complained that it caused constant pressure on the tibial crest, with repeated breakdown of the skin in that area, and that the numerous modifications did not relieve the pain and discomfort. In October 1958, a VAPC prosthesis with medial opening was fabricated with the usual relieved areas over the tibial crest and neighboring bony prominences. Patient now walks with no discomfort and has no complaints. He continues to wear the prosthesis as of July 1960.

Case 8 (IV. *B.)*

Case 8, a 50-year-old, 165-lb. production tailor 5 ft. 7 1/4 in. tall, received wounds of the left leg from shellfire in France in 1944. Emergency surgery was performed in an evacuation hospital, and a left Syme amputation was performed in the United States in 1945. Compound fracture of the upper end of the tibia, with subsequent osteomyelitis, resulted in the defects shown in Figures 7, 8, and 9. Severe scarring and then scalelike surface tissues replaced normal skin in the area concerned.

Fig. 6. Effect of tight lacing and soft tongue on tissues overlying tibial crest, especially in the vicinity of the tibial tuberosity, as evidenced by short diagonal skin discolorations (right Syme stump of Case 5).

Although the patient wore a semiflexible polyester-nylon Syme prosthesis with full-length anterior opening, leather tongue, and conventional foot (Fig. 10), he was never able to wear it continuously because on the anteroproximal aspect of the leg, especially at the margin of the tibial defect (where the laces caused concentrated pressure), he experienced severe pain and frequent breakdown of scar tissue and of skin otherwise abnormal. A new Syme prosthesis, with medial opening and sufficient relief to provide air space between the anteroproximal wall of the socket and the sensitive anteroproximal scar tissue, has given complete relief of the earlier symptoms since February 1959. As of July 1960 the patient continues to wear the prosthesis.

SUMMARY AND CONCLUSIONS

Details concerning these eight cases, and also some information on the 16 others, are summarized in Table 1. In all of the 24 cases fitted at VAPC with the medial-opening Syme prosthesis, the surgery appeared to be adequate. In general, the long bones had been cut not necessarily perpendicular to their longitudinal axes but so that, when the patient stood, the planes of the ends were substantially parallel to the floor. Because in all cases the surgeon handled the periosteum carefully, no serious bone spurs had developed, though in a few cases *(e.g.,* Cases 3 and 8) x-rays showed that slight irregularities had formed on the cut end of the tibia. In Case 4 (Fig. 5), the fibula had been cut above the level of the tibia, probably because of damage to the end of the fibula with subsequent infection. None of the cases indicated bony cross-union between tibia and fibula.

In general, soft-tissue surgery was good, so that adequate fat pads remained in the heel cushion and good circulation prevailed in the skin flap as well as in the whole stump. A good circular flap was provided, and no significant dog-ears were noted. In Case 1 the flap was displaced (Fig. 2); in all others it was in the proper position.

All but two of the 24 preferred the VAPC type of prosthesis to any of the prostheses worn

Fig. 7. X-ray (medial view) of stump of Case 8, left Syme amputee. Note anterior indentation of tibia due to compound fracture.

previously, and they all wore it rather routinely.[3] Each of the patients had at one time used the so-called "conventional" Syme prosthesis (wood or leather-and-steel socket with laced opening on the anterior aspect), and six had been provided later with plastic (Fiberglas-polyester) Syme prostheses incorporating a SACH foot and full-length posterior opening and fabricated and fitted according to Foort *(3).* In two instances, discomfort alone prompted the change to the VAPC type of socket; in another two instances rupture of the plastic caused the change; in the remaining two instances both discomfort and mechanical failure occurred. Had the so-called "Canadian-type" prostheses been fabricated of Fiberglas cloth, Fiberglas roving, and *epoxy* resin, the mechanical failures would likely not have occurred. It is probable also that, had the same meticulous care been employed as is now used in modification of the socket and in alignment of the prosthesis, some of the problems of discomfort would not have developed.

As Table 1 shows, weight-bearing typically was distributed between the end of the stump and the condyles of the tibia at the proximal end of the prosthesis. Presumably the sloping walls of the socket also carried some share of the load. Generally, the VAPC prosthesis fitted precisely on the stump to a higher level than had the older prostheses. Proportioning of the weight distribution was judged by the individual prosthetist, but only one wearer (Case 3), who indeed had slight irregularities at the end of the tibia (Fig. 3), was able to utilize end-bearing alone. In contrast, Case 1 was unable to tolerate any end-bearing, though the long lever arm of the shank was advantageous. The remaining cases required weight distribution between the distal end of the stump, the sloping walls of the shank, and the proximal region in the vicinity of the tibial condyles, Case 18 alone requiring more of a proximal component than of a distal one.

Concentration of pressure on the tibial crest,

[3] Cases 3 and 5 converted to posterior openings, as already mentioned.

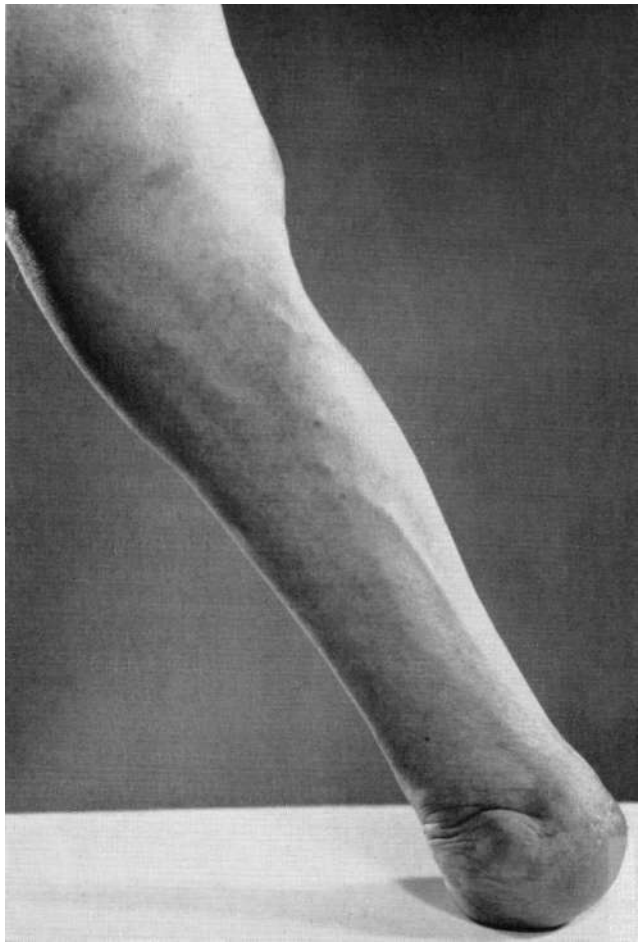

Fig. 8. Stump of Case 8 (left Syme amputee), medial view showing anterior deformity.

particularly near the tibial tuberosity, was relatively common with wood or leather prostheses having an anterior opening laced over a relatively soft leather tongue. Late in the stance phase, the Syme amputee supports his weight on the ball of the artificial foot with the heel off the ground. Biomechanical analysis (page 76) shows that at that time the prosthesis not only presses upward on weight-bearing areas with a considerable leverage behind the point where the ball of the foot contacts the floor but also exerts on the stump compensatory forces substantially horizontal—backward on the tibia near the proximal end of the socket and forward on the bulbous distal end of the stump.

In the older prostheses with anterior lacing, the proximal forces were concentrated largely in the upper laces and the knot. Deforming the soft tongue, these forces caused high pressures on the thinly padded anteromedial aspect of the tibia and especially on the sharp tibial crest (Fig. 6). Force concentration was particularly serious at the bulky knot, which typically was near the projecting tibial tuberosity. Loose laces allowed exceptional concentration near the top and the knot, while tightening of the laces in an attempt to relieve an uncomfortable stump merely added constant pressure to the inevitable dynamic pressure accompanying every step. Furthermore, any axial pumping (due to cushioning of the distal end or distortion of either the stump or the pros-

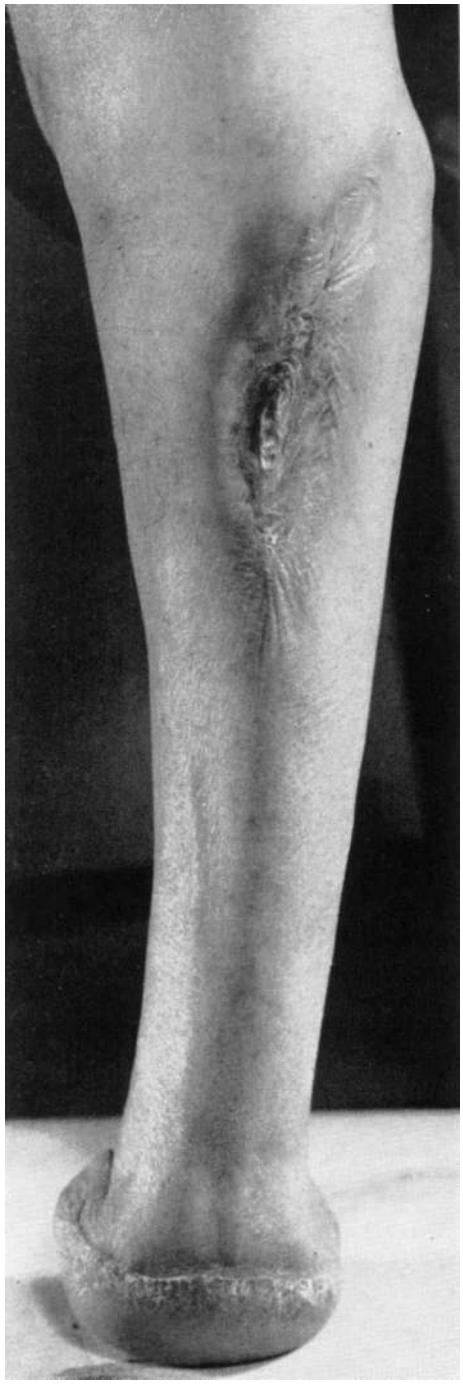

Fig. 9. Stump of Case 8 (left Syme amputee), anterior view showing scarring and tissue deterioration in region of fracture, subsequent osteomyelitis.

Fig. 10. Plastic Syme prosthesis worn by Case 8, left Syme amputee, until February 1959. The posterior portion of the socket was made of a fully rigid resin, the formulation being so controlled as to produce a gradual change to full flexibility in the anterior portion, which forms part of the lacer. A leather tongue was used in the anterior opening, and a conventional foot, attached to the bottom of the socket by a cable, had a well for a rubber block which provided control in flexion-extension, inversion-eversion, and torsion.

thesis) added chafing to an already unsatisfactory set of circumstances. The high incidence of discomfort and of outright ulceration in such cases is therefore not surprising. In the VAPC type of Syme prosthesis, elimination of the conventional anterior lacing and soft leather tongue, or of the snugly strapped door closing a posterior opening, relieved both dynamic and constant pressures along the anterior aspect of the tibia, especially near the tibial tuberosity. Many areas previously ulcerated were thus cured.

In one case callus developed along the scar during wear of the conventional prosthesis;

in another it formed while the Canadian type with posterior opening was used. Possibly callus of this kind arises in response to the horizontal forces on the rear of the bulbous end of the stump late in the stance phase. It may be aggravated by chafing either from antero-posterior motion or from axial pumping of an atrophied stump by virtue of loose fit of the socket below the region that can be tightened by the laces. Obviously, such callus may develop with any type of Syme prosthesis if chafing occurs, and for this reason every effort should be made to provide a socket giving the least possible degree of relative motion while avoiding constriction.

All of the eight subjects discussed in detail in this paper complained of the excessive weight of their old devices. The new prostheses were from 1 to 1 1/2 lb. lighter than the corresponding old prostheses. Durability seemed improved in the relatively short period recorded here. Width at the broadest portion of the ankle was less than with the conventional, bulky, metal sidebars formerly used to reinforce leather or Celastic sockets.

The results achieved thus far present a convincing argument in favor of the VAPC Syme prosthesis. Distribution of weight-bearing over broad areas reduces unit pressures in the socket of any artificial leg. Thus any Syme limb that offers the prosthetist the facility for *controlled* distribution of weight in distal *and* proximal regions not only offers a distinct advantage with respect to socket comfort but also allows full control of the prosthesis by the stump. A design limited primarily to distal weight-bearing but with some possibility of weight-bearing over peripheral fleshy areas of the stump through a clamping action of a posterior "door" does not ordinarily provide the limbfitter with the weight-bearing control "adjustments" available in the "medial-window" Syme, where normal below-knee weight-bearing areas may or may not be employed as local circumstances warrant. For these reasons the VAPC Syme prosthesis deserves especially the serious consideration of those surgeons who, for the sole reason that they considered the Syme prosthesis to be unacceptable, have heretofore favored higher amputations of the leg when Syme's amputation might otherwise have sufficed. Prosthetists likewise may consider the VAPC design as a means of facilitating the fitting of Syme amputees.

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