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MODIFIED CHARLES OPERATION FOR PRIMARY FIBROSCLEROTIC LYMPHEDEMA

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ABSTRACT

Radical excision of lymphedematous tissue with skin grafting (Charles operation) may be required for patients with advanced fibrosclerotic lower extremity lymphedema. Complications of this procedure include papillomatosis, wart formation, intractable skin ulcerations and weeping of lymph and are often considered major drawbacks of the operation. We have largely circumvented these sequelae by burying a strip of shaved split-thickness skin graft into the deep subcutaneous tissue thereby modifying the Charles operation. The strip of deepithelialized skin seemingly connects the superficial dermal lymphatics with subfascial deep lymphatics thereby facilitating lymph drainage and minimizing lymphedema accumulation and the complications outlined above. We have now treated 4 patients with advanced primary fibrosclerotic lymphedema using this modified technique. Not only were the patients improved in appearance and function with less trophic changes, but lymphscintigraphy using 99mTc-dextran also suggested improved interstitial tracer transport.

Operative treatment of chronic limb lymphedema is either "physiologic" or "excisional." Physiologic operations attempt to improve lymphatic drainage whereas excisional therapy aims to remove the involved edematous subcutaneous tissue with or without the overlying skin. At the beginning of this century, Kondoleon (1) attempted to drain the abnormal subcutaneous or superficial compartment into the uninvolved deep compartment by excising strips of underlying muscle fascia. Long strands of silk (2) or nylon (3) into the subcutaneous tissue have also been inserted to act as substitute interstitial spaces to facilitate lymph drainage. Thompson (4) introduced the concept of establishing subcutaneous drainage into the deep subfascial compartment using a buried dermal flap. Goldsmith and de los Santos (5) transposed a pedicle of omentum from the abdominal cavity into the lymphedematous extremity with the hope that this highly vascularized structure would serve as a bridging conduit for lymph drainage. Microsurgical lymphaticovenous anastomoses have been advocated in early secondary lymphedema where lymphatics are plentiful and advanced tissue changes such as fibrosis have not as yet occurred (6,7).

Excisional procedures include staged removal of subcutaneous tissue beneath skin flaps (8) or excision of the entire superficial compartment including the skin and the muscle fascia as originally described by Charles (9). Although several reports describe the efficacy of microlymphatic-venous anastomoses for treatment of secondary lymphedema, there is no ideal operation once trophic changes such as severe fibrosclerosis have become superimposed on chronic

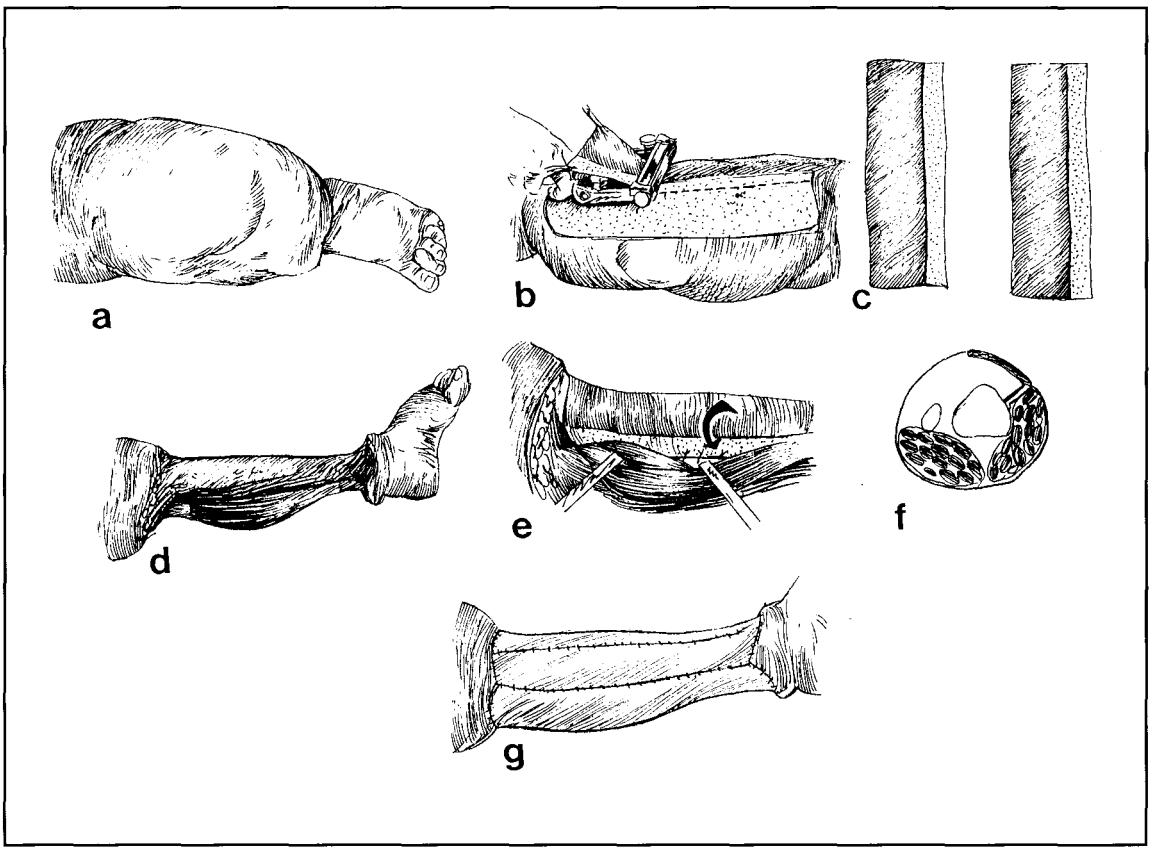

Fig. 1. Schematic outline of operative technique; a) Fibrosclerotic lymphedema of lower extremity. b) Harvesting of split-thickness skin grafts which contain epithelialized and deepithelialized areas. c) 3.5 inches wide grafts which contain 1 inch wide deepithelialized borders. d) Lymphedematous tissue excised including underlying muscle fascia. e) Deepithelialized parts of the graft are buried into the deep layer. f) Cross-section of the extremity. g) Grafts have been sutured to one another to cover the defect.

lymphedema (7,10,11). Although the Charles operation has been successful in minimizing recurrent swelling (12), this procedure has notable drawbacks related to skin coverage with split-thickness grafts. These include skin papillomatosis, skin-surface weeping of lymph, local tissue breakdown and ulceration, recurrent cellulitis, keloid and wart formation, and recurrence of subcutaneous edema with incomplete removal of subcutaneous fat (13,14). If these complications could be circumvented, the Charles operation would likely be a useful operation for management of marked fibrosclerotic lymphedema associated with impaired locomotion and recurrent local infection and ulceration. The technique described below adds an important modification to the "classic" Charles operation, which seems to enhance lymph drainage with a subsequent reduction in the previously described trophic complications.

CLINICAL EXPERIENCE

From December 1989 to May 1991, four patients with advanced primary fibrosclerotic lymphedema were operated upon with a modified Charles operation. The circumferences of the edematous and contralateral normal leg were measured both before and

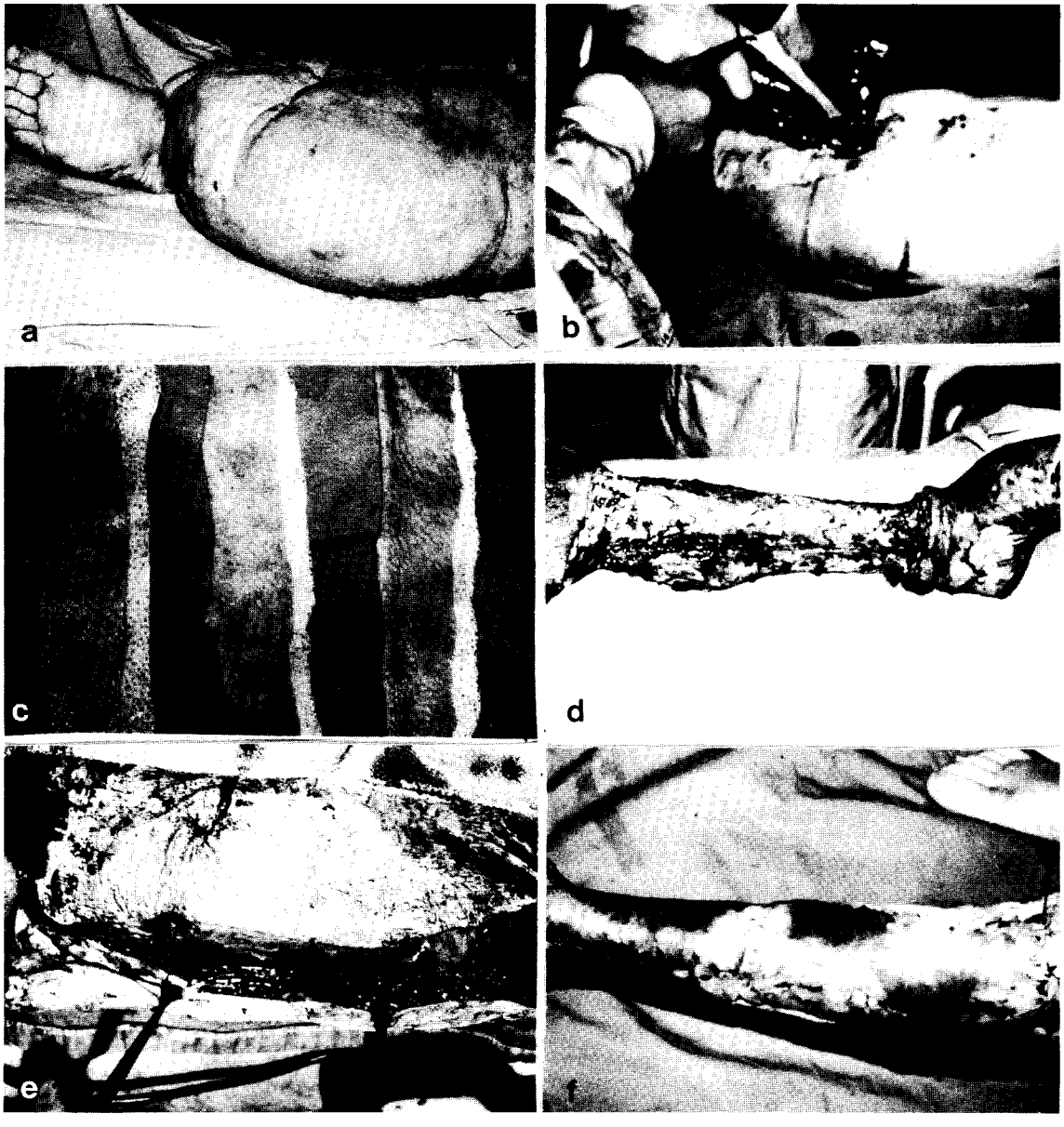

Fig. 2. a) Preoperative appearance of a lymphedematous leg. b) Split thickness skin grafts are harvested with a Brown electrical dermatome. 1 inch strip of the graft is taken from the previous donor site to create a shaved area. c) Split-thickness skin grafts containing deepithelialized strips. d) The lymphedematous tissues are excised including the underlying muscle fascia. e) Deepithelialized parts of the grafts are sutured adjacent to the posterior tibial blood vessels to create a link between the superficial and deep lymphatics. f) The grafts are sutured to one another to cover the exposed areas.

after operation. Lymph drainage of the legs was examined via lymphscintigraphy using radiolabeled 99mTc-dextran both pre- and postoperatively. 99mTc-dextran was injected intradermally between the second and third toes, on both feet. Each injection contained 1.0mCi radioactivity and 2mg dextran in 0.05ml solution.

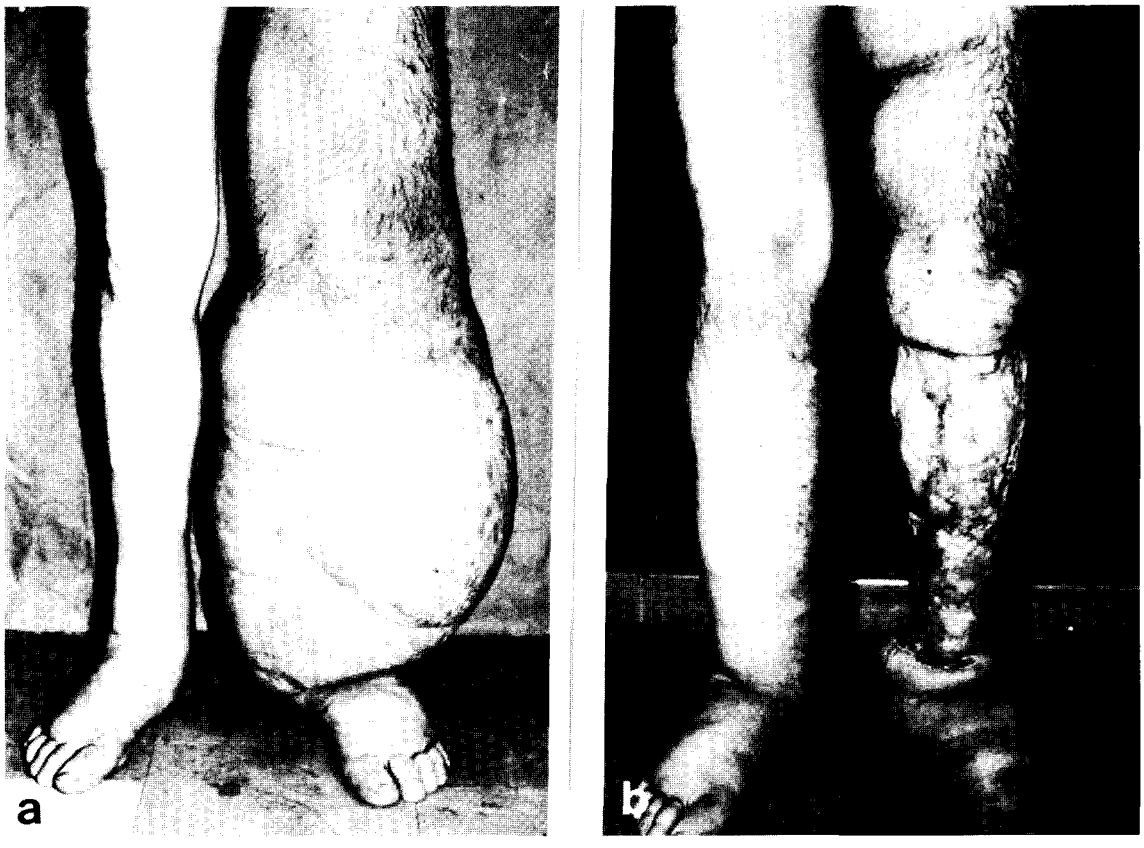

Fig. 3. a) Preoperative appearance of a patient with advanced fibrosclerotic lymphedema with impaired locomotion. b) Appearance of the patient after a modified Charles operation. Despite mild scar hypertrophy on the grafted leg, there is no lymph leakage or ulceration.

Operative Technique

Thick split-thickness skin grafts were harvested from the relatively smooth areas of the affected extremity or from the contra-lateral thigh. A Brown electrical dermatome was adjusted to 3.5 inches in width and 25/1000 inch in thickness. Each time when taking the graft, 1 inch width of the dermatome was placed over the donor site of the previous graft while the remaining 2.5 inches width of the blade rested on the new donor site. In this mann er we obtained a skin graft 3.5 inches in width containing 1 inch wide deepithelialized and 2.5 inches wide epithelialized strips *(Figs. 1a,b,c; 2a,b,c)*. The lymphedematous tissues including skin, subcutaneous tissue and muscle fascia were excised. The lymphedematous tissue on the dorsum of the foot and around the ankle was spared *(Figs. 1d,2d)*. The deepithelialized margin of the skin graft was sutured to the periosteum of the tibia on the anterio-lateral and medial aspects, and through the split muscle fibers in proximity to the posterior tibial artery and veins on the posterior aspect *(Figs. 1e,1f,2e)*. The epithelized margin of the composite graft was sutured to the border separating the epithelialized and deepithe-lialized areas of the previous graft. Five strips of split thickness grafts were usually sufficient for coverage of the lower leg after excising the lymphedematous tissue *(Fig. 1g,2f)*. The grafts were then covered with petrolatum gauze and

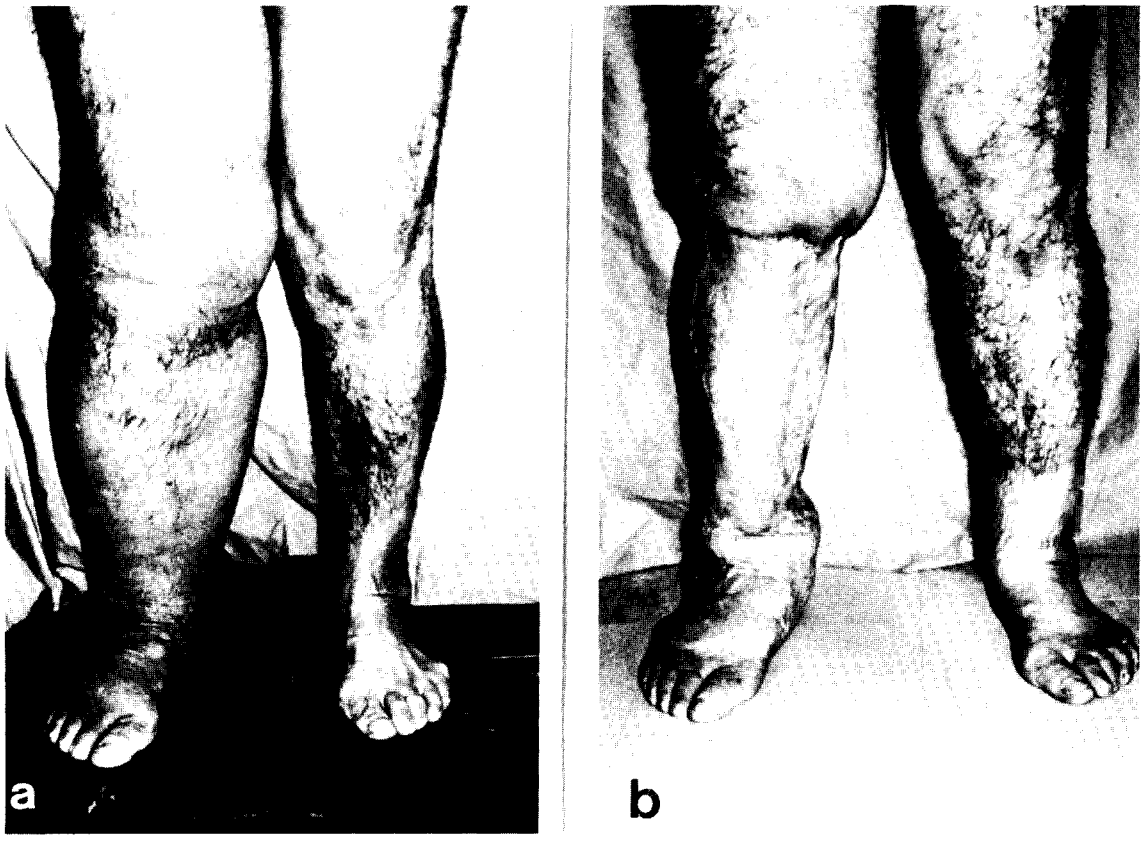

Fig. 4. a) Preoperative appearance of patient with lymphedema on right leg. b) Postoperative appearance on the same patient after a modified Charles operation.

moist dressings and wrapped with elastic bandages in order to maintain better contact between the grafts and recipient bed.

RESULTS

We have now followed these 4 patients for 1 to 3 years after the modified Charles operation. Thus far, there has been no lymphatic weeping, ulceration, or wart formation. Hypertrophic scarring occurred in two patients. Where lymphedematous tissue on the foot was not excised, there was no progression of disease *(Figs. 3,4)*. Whereas preoperative lymphscintigrams taken 2 hours postinjection showed almost complete absence of tracer transport on the involved leg, postoperative scintigrams uniformly demonstrated an increase in tracer dispersion (dermal backflow) *(Fig. 5)*.

DISCUSSION

Although developments in microsurgery opened new horizons for surgical treatment of secondary lymphedema (6,7), this option is unavailable for primary hypoplastic lymphedema. Nonoperative management remains the mainstay for treatment of primary lymphedema and operation is reserved for advanced disease (15,16). Thus, where bulkiness of leg lymphedema impairs movement and skin changes have occurred with marked acanthosis, warty overgrowth, consideration of excisional therapy is appropriate (10-12). The Charles procedure, which is the most radical

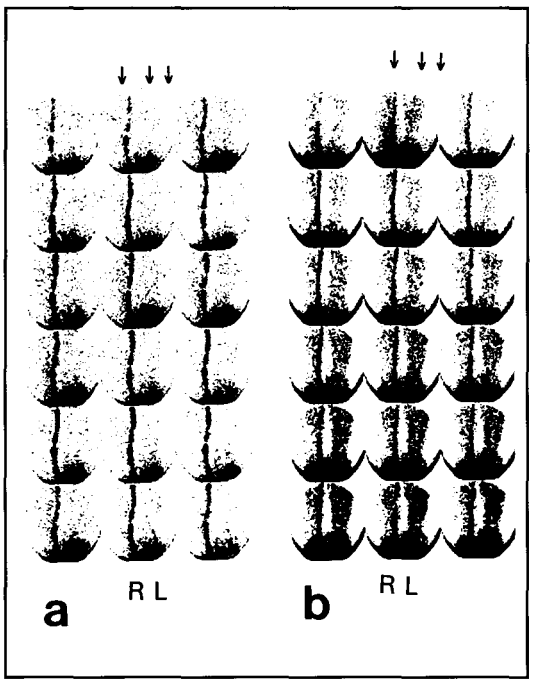

Fig. 5. a) Lymphscintigraphy demonstrating normal tracer transport in the right leg (↓) but absence of lymph flow on the left leg (↓↓) before a modified Charles operation. b) After a modified Charles operation, dispersion of tracer into the soft tissues in the left leg can be seen (↓↓) consistent with filling of dermal collateral lymph vessels. R=right leg; L=left leg.

of the excisional operations, has been advocated (12,14) but it is often associated with a hyperkeratotic verrucous lower leg, ulceration and weeping of lymph from the skin surface (4,14). In a "classic" Charles excision and grafting procedure, these complications probably arise as a consequence of inadequate lymph drainage from the grafted skin areas. Residual dermal lymphatics are unable to function because the proximal border of the excised area contains sclerosed lymphatics and there is no continuity between the graft sites and the deep lymphatics. These lymphatic connections between superficial and deep systems are recognized (17), even though the deep lymphatic system is enigmatically not involved in the lymphedema process (16). By modifying the Charles operation to include insertion of deepithelialized skin graft, we believe that lymphatic connections are favored between the deep and superficial lymphatic network. Dermal lymphatics that are present in the graft begin to function and drain into deep lymphatics through the 1 inch long lymphatic bridge. This lymphatic flow, although limited for draining the full lymph load of the leg, is nonetheless seemingly adequate to prevent surface leakage of lymph, ulceration of the skin graft, and verrucous papillomatosis. After operation, each patient demonstrated via lymphscintigraphy dermal backflow at 1 hour which represents fluid drainage through intradermal lymphatic collaterals in conjunction with lymphatic obstruction (18,19). These dermal lymphatic collateral pathways serve as an alternate route for lymph return. Whereas this alternate route is insufficient to handle the total lymph load, it may be adequate to minimize the complications often associated with the standard Charles operation.

Although nonoperative methods are still advocated for treatment of most patients with lymphedema, some patients still require surgery either to enhance locomotion or to improve an otherwise unmanageable hygienic state. When operation is appropriate, the Charles procedure with the modification we have described inserting an epithelialized-deepithelialized skin graft to facilitate lymphatic drainage both "debulks" the lymphedema while minimizing the likelihood of otherwise undesirable sequelae of weeping of fluid, ulceration, warty overgrowth, and papillomatosis.

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