AN OPERATION FOR THE CURE OF FLATFOOT

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THE OPERATION to be described was first performed by the writer in December, 1926. A résumé of his observations was published[1] in 1928. In March, 1936, the operation was performed before a group of surgeons attending a regional meeting of the American College of Surgeons in Dallas. It has the distinction of being a restorative measure as compared with those operations which depend upon arthrodesis (joint destruction) for their success. The loss of resiliency and motion incident to these arthrodeses must be quite apparent.

Weak foot (flatfoot) is a condition which, under the influence of weight-bearing, is characterized, anatomically, by a valgus attitude and clinically, by early fatigue. Depression of the longitudinal arch, while often noticed, may be very slight even in cases clinically serious.

Etiology.—It is reasonably certain that the majority of cases have a congenital basis, although the symptoms are frequently not apparent until such time as increased weight or activity or debilitating disease calls attention to them. The influence of trauma, rickets and such deformities as bowlegs and knock knees is not to be overlooked. The faulty transference of weight in such deformities is doubtless a factor in the production of symptoms and perhaps of deformity as well. The custom of walking with the toes turned outward is, at least, conducive to the onset of symptoms. Certain individuals of generalized ligamentous relaxation ("loose-jointed") are exceptionally prone to the affection.[2]

Morbid Anatomy.—An accurate knowledge of certain features of the normal anatomy of the bones and ligaments of the tarsus and their interrelation, is essential to a logical understanding of the pathology. Roberts[3] called attention to the "rounded under surface of the os calcis, its small bearing area" and the strong ligamentous connection between this bone and other bones of the tarsus. He went into some detail as to the mechanics of weak foot as based on these important considerations. The author has gone a step further: The os calcis (calcaneus) is approximately of the same width as the astragalus (talus) at the level of the subastragalar joint, but below the sustentaculum tali, or overhanging shelf of the heel bone, it becomes narrowed at the expense of its medial side. Hence the weight-bearing part of the heel bone is off-center with reference to the astragalus and tibia. In other words, a vertical line drawn down the middle of the tibia behind, and passing through the center of the astragalus, will necessarily fall toward the medial aspect of the bearing surface of the os calcis (Fig. 1). This line represents the course of the center of weight or gravity below the knee, the fibula being for

Submitted for publication May 19, 1938.

practical purposes a brace or strut on the side of the leg and ankle. It is seen that a mechanical situation exists which gives rise to a natural tendency of the heel bone to deviate or rotate outward under body weight. The restraining hold of the medial ligament of the ankle joint (deltoid) prevents such deviation in normal feet. Thus it is seen that a too-long or overstretched deltoid ligament is the basis for all weak feet. The scaphoid (navicular) bone reaches a lower level, the os calcis tilts outward below and with these the rest of the bones of the foot follow suit. This is not to say that in traumatic weak foot, certain other factors may not enter the picture, as in poorly treated Pott's fracture, *etc.*

Spasticity of the peronei muscles is a sequence and not a primary cause of the pathology. The same is true of arthritis, infectious or otherwise. A short tendo achillis is a frequent concomitant condition; swelling and congestion are not infrequent.

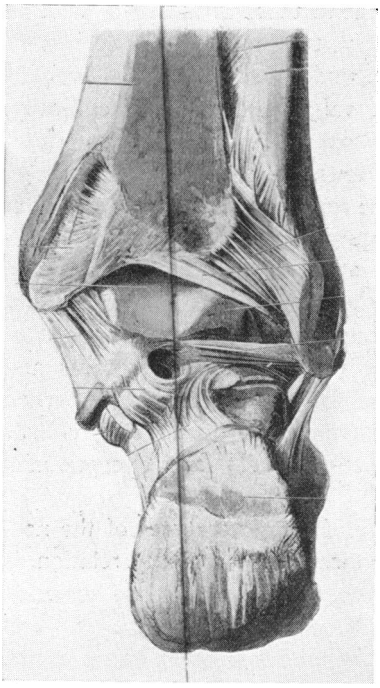

FIG. 1.—Posterior view of the ankle joint (Cunningham). Vertical line connecting center of tibia above with center of astragalus and continued downward, represents the center of gravity and shows the os calcis to be off-center below the sustentaculum tali, *i.e.*, narrowed on its medial side.

Symptoms.—Early fatigue in the erect attitude is a constant symptom, quite often the only subjective one present. This is particularly true in early childhood, when it may be noted that patients will not play long in the erect attitude. In standing, children often flex the great toe sharply so that the medial border of the foot is raised, thus unwittingly correcting the position of the foot. Pain is more often present in adolescents and adults seeking relief and its location is somewhat variable. It may be confined to the medial border of the foot in the vicinity of the deltoid ligament, to the lateral border about the tip of the external malleolus, to the undersurface of the heel and plantar fascia or it may be quite general throughout the foot. More remote pain may be felt in the lower back, hips, medial sides of the knees or the calves of the legs. This is due to the strain incident to malalignment of the feet or to a short tendo achillis in case of pain in the calf of the leg. It is of note that cases exist with pronounced deformity without appreciable discomfort to the patient.

Diagnosis.—The patient should stand with bare feet, their medial borders held parallel and sufficiently separated to allow a good view between the feet. It will be noted in case of weak feet that the heel bones do not stand erect but incline outwardly from above downward (as viewed from the rear).

The medial borders of the feet are apt to bulge more or less prominently, especially in the vicinity of the scaphoid bone. The longitudinal arch may be depressed to a greater or less degree. The feet may be red and swollen (Figs. 2 and 3). Tenderness to pressure over the deltoid ligament, beneath the tip of the lateral malleolus or under the heel bone at the attachment of the plantar fascia or even along this structure, may be elicited. In some cases the peronei tendons stand out prominently, due to spasm. There may be a limp and the patient often complains of inability to obtain comfortable shoes, a situation due to the feet rather than the shoes. In case of rigid weak foot, there is marked stiffness and loss of suppleness due to concomitant arthritis,

FIG. 2.—J. L., Case 4: An instance of bilateral flatfoot. Note bulging medial borders of ankles and outward slant of heels.

FIG. 3.—Same case as Figure 2: Note flatness of longitudinal arch and venous congestion.

either infectious or coming on as a consequence of the prolonged strain of malalignment. Such feet require special treatment not coming within the province of this article.

Treatment.—Conservative treatment has been undertaken for a long time but without permanent results—the deformity remains. Strapping of the feet with adhesive plaster, Thomas heels and numerous types of braces, or "arch supports," have all been used with some success in alleviating or relieving the symptoms. Exercises designed to strengthen the tibial muscles have been emphasized, but no voluntary muscle alone, however strong, will continuously hold firmly against the outward rotation of the foot under weight-bearing.* Maury,[4] the gynecologist, used to tell the class in discussing

* By this, I do not mean to imply that the exercises are not beneficial, only that they do not effect cures *per se*.

perineorrhaphy: "The fasciae of the pelvic floor must be brought together and sutured for adequate support of the pelvic organs. One cannot rely upon the muscles of the pelvic floor, for no voluntary muscle will withstand constant strain without fatigue and relaxation. The fasciae, being of connective tissue, will do that." An axiomatic truth is there expressed and holds equally good here.

Author's Operation.—A curved incision is made behind and below the internal (medial) malleolus, beginning about one inch above the level of the

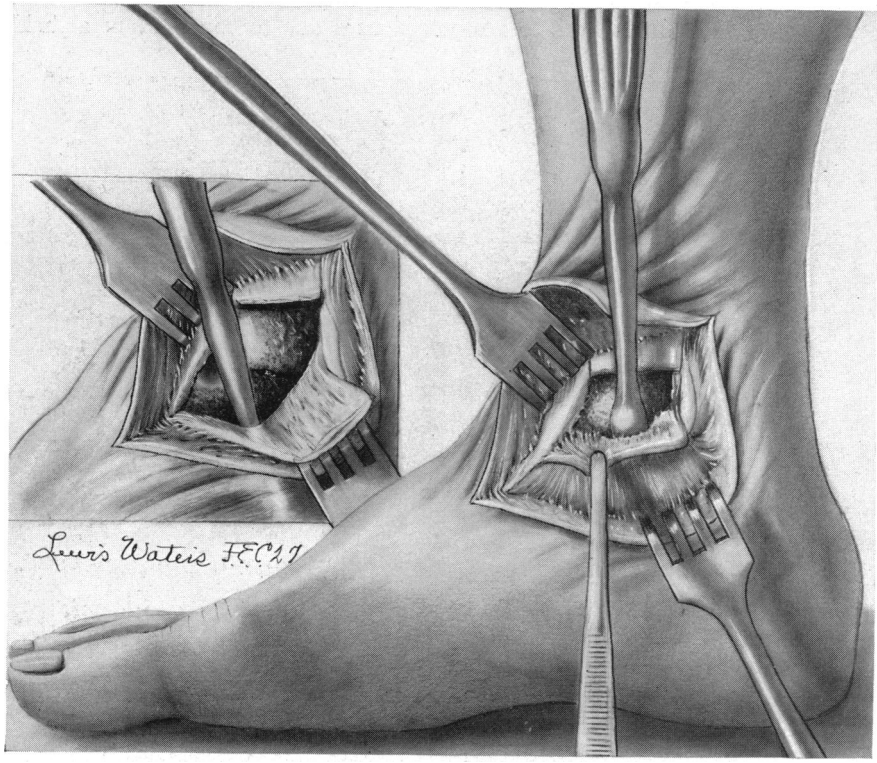

FIG. 4.—Author's Operation: Malleolus exposed and dissection of periosteal flap begun. Note tendon of the tibialis posterior undisturbed. Inset: Dissection continued downward, stripping the deltoid ligament from the medial malleolus, side of astragalus and forward to scaphoid bone. The ankle joint is thus exposed. Note elevation of periosteum above, facilitating later closure.

tip of that bone and midway between the bone and the adjacent margin of the tendo achillis and carried down and forward to the astragaloscaphoid joint (talonavicular). A skin flap is dissected up proximal to this incision in such manner as to uncover the malleolus. With a scalpel, the periosteum is incised transversely to the bone above and vertically from the ends of this incision so as to outline the front and back limits of the malleolus. Care should be taken not to open the sheaths of the tendons behind. From the lower end of the front incision, the soft parts are incised obliquely downward and forward along the anterior margin of the deltoid ligament to the scaphoid bone. A periosteal elevator is now used to free the periosteum from the bone both

downward and slightly upward from the transverse incision, this latter to allow easy suturing later on. The dissection of the periosteum is continued downward to pick up the deltoid ligament, freeing it from the malleolus and the medial aspect of the astragalus. The dissection is carried close onto the bone, forward to the scaphoid, downward to the sustentaculum and backward and downward alongside the astragalus.* The elevator must be turned rather vertically in freeing the ligament from the tip of the malleolus, obliquely from that point on. The dissection passes beneath the tendons in this vicinity

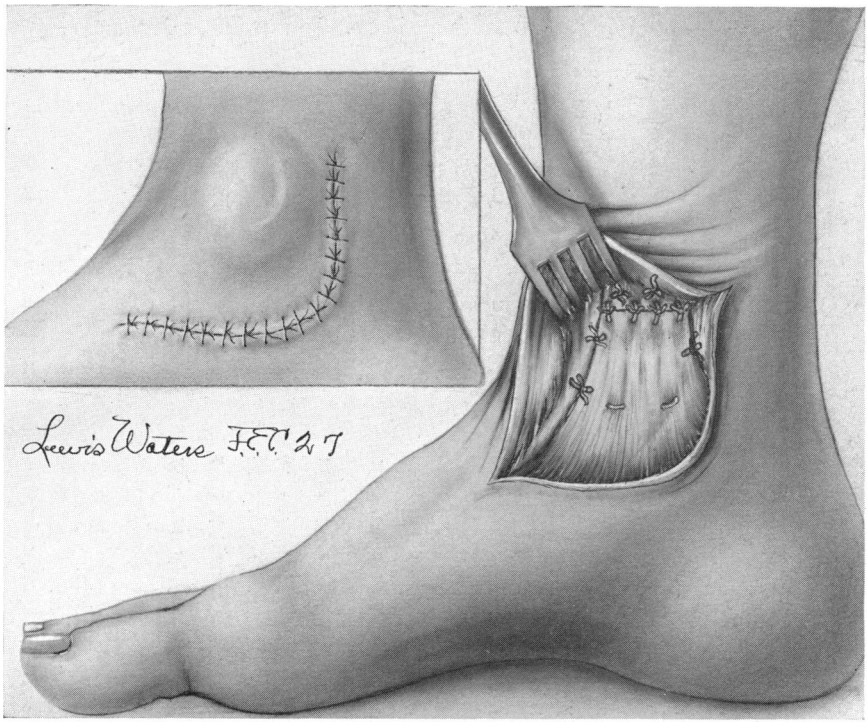

FIG. 5.—Author's Operation: The foot is held in marked varus, the periosteal-ligamentous flap drawn tautly upward and sufficiently excised above to take up the slack. Sutures have been put in. Note "stay" sutures of mattress type. Inset: Skin incision as closed.

and they are returned undamaged to their normal relationships in closure. The deltoid ligament is now free down to its distal fan-shaped insertion (Fig. 4). An assistant now holds the foot in a marked varus attitude with special attention to the heel. Tension upward is put upon the periosteo-ligamentous flap and this is excised above to the extent that it overlaps the transverse periosteal incision. Chromic gut or kangaroo tendon is used to suture the flap above and at its sides but it is well to place a few deep "stay" sutures, of mattress type, through the thick part of the deltoid to be attached above as a preliminary. The skin may be closed with dermal sutures (Fig. 5). If the tendo achillis is too short, it should be elongated by the "Z-method" as a pre-

* A slight flow of synovial fluid will indicate exposure of the joints.

TABLE I

SUMMARY OF EXPERIENCE WITH OPERATION

Case	Patient	Age	Sex	Nationality	Date of Oper's.	No. of Oper's.	Last Exam.	Results	
								Clinical	Deformity
1.	W. T.	18	M.	White American	Rt., Dec. 13, 1926 Lt., Apr. 11, 1927	2	April, 1938	Good	Corrected
2.	J. G. C.	30	M.	Mexican	June 29, 1927	2	Dec., 1927	Good	Corrected
3.	J. T.	18	M.	White American	Lt., Feb. 15, 1928 Rt., June 27, 1928	2	April, 1930	Good	Corrected
4.	J. L.	30	M.	Hebrew	April 25, 1928	2	Jan. 10, 1939	Good	Corrected
5.	R. C. M.	11	M.	White American	Nov. 16, 1929	2	Jan., 1938	Good	Corrected
6.	C. B. B.	3	M.	White American	Feb. 22, 1930	2	1937	Good	Corrected
7.	H. G. G., Jr.	6½	M.	White American	July 29, 1930	2	Jan., 1938	Good	Corrected
8.	L. M. A.	12	F.	White American	July 29, 1930	2	Jan., 1939	Good	Corrected
9.	J. E.	22	F.	German	July 22, 1931	2	Oct. 21, 1938	Rt. Good Lt. Poor	Corrected Recurred*
10.	E. H.	6	F.	White American	Sept. 3, 1932	2	Oct. 28, 1938	Lt. Good Rt. Fair	Corrected Partial recurrence†
11.	G. B.	12	M.	White American	Mar. 4, 1936	1	Oct. 29, 1938	Poor	Recurrence†
12.	A. A.	34	M.	Negro	July 15, 1936	1	Oct. 24, 1938	Good	Partial recurrence*
13.	W. L.	22	M.	Negro	April 7, 1937	2	Nov. 1, 1938	Rt. Good Lt. Pain*	Corrected Corrected
14.	L. F.	39	M.	Negro	July 12, 1937	1	Dec. 20, 1938	Good	Corrected
	Total					25‡			

* These patients had periostitis, *etc.*, of gonorrheal origin.

† These patients showed poor cooperation in after-care.

‡ This does not represent all of the cases operated upon, only those on whom results could be traced.

liminary. A plaster-of-paris bandage is applied over the sterile dressings, extending from the toe tips nearly to the knee. Naturally, the foot and heel must be held firmly in inversion or varus until the plaster has become firm.

Postoperative Care.—Upon completion of the operation, the foot appears to have a varus deformity and the same is true upon removal of the plaster bandage some weeks later, but this need cause no concern, as it will soon regain its normal appearance and must, in fact, be protected against undue strain lest a recurrence of the deformity take place after the removal of the plaster bandage. For that purpose, adhesive plaster strapping may be used until the

FIG. 6 FIG. 7

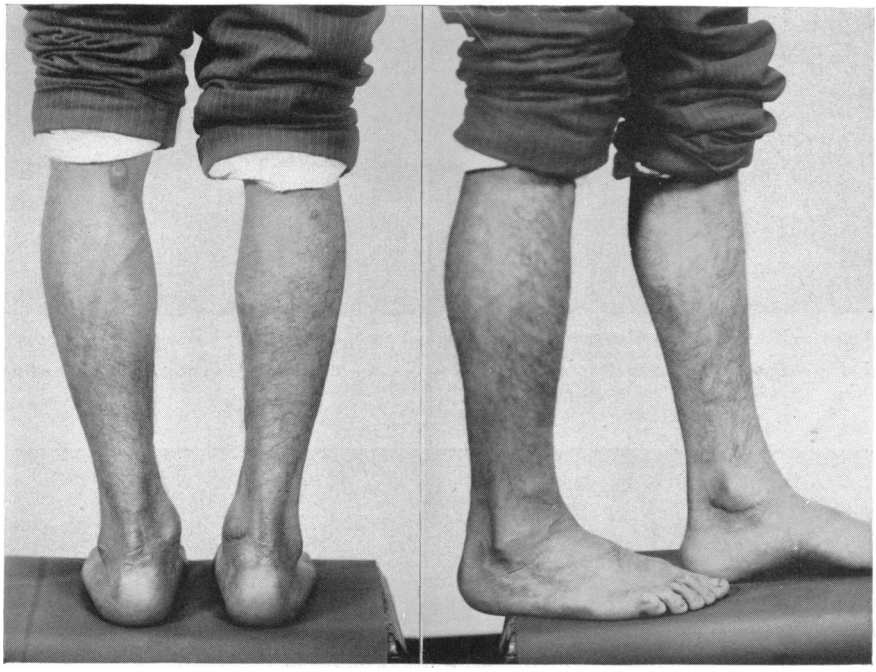

FIG. 6.—Case 2: Postoperative result at the end of six months. Note vertical attitude of the heels.
FIG. 7.—Same patient as in Figure 6. Operated upon in 1927, showing the result six months postoperative. Note longitudinal arch as restored in left foot. Plaster casts of feet, before and after operation, show not only correction of extreme deformity but shortening of medial borders of feet as well.

tenderness has lessened following removal of the sutures. Thomas heels or braces (or both) are used to raise the medial sides of the heels when the patient begins to walk. The weight must be kept off the feet for at least five or six weeks following operation. During that period, the patient may sit up, get about in a wheel-chair or be transported in an automobile. But time must be allowed for firm union of the ligament to the bones to occur before the patient is allowed to stand or walk without adequate support.* Of course, if

* This support should be kept up for at least six months. This is very important to success.

FIG. 8

FIG. 9

FIG. 8.—Case 7: Postoperative results after seven and one-half years. Note excellent alignment of feet and absence of bulging on medial sides of ankles.
FIG. 9.—Same patient as in Figure 8: Showing a good longitudinal arch on the right foot, and a correct alignment of the left foot.

FIG. 10

FIG. 11

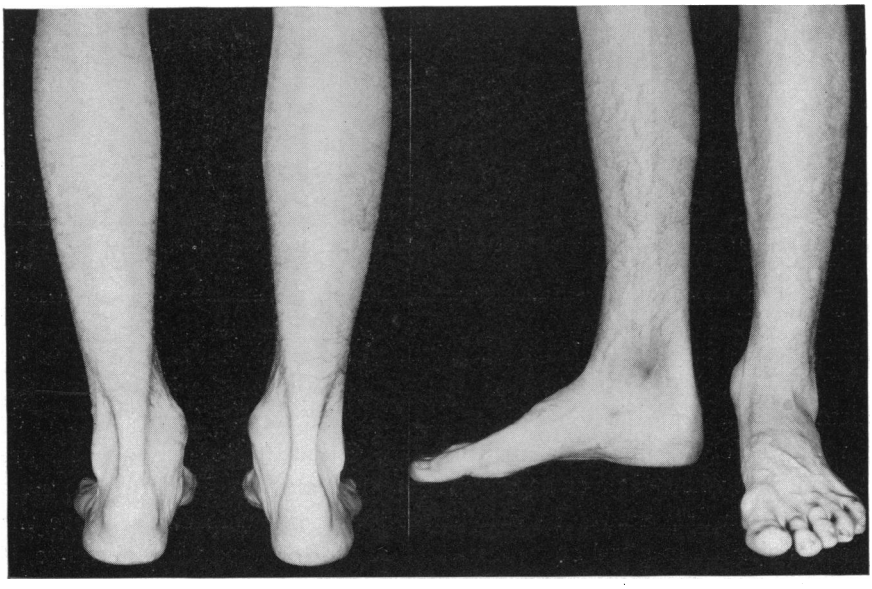

FIG. 10.—Case 5: Postoperative result after eight years. Note the vertical attitude of the heels with absence of bulging in the scaphoid regions.
FIG. 11.—Same patient as in Figure 10: Note the excellent restoration of the longitudinal arch of the right foot, and the correct alignment of left foot.

only one foot at a time is operated upon, crutches may be used and the patient made ambulatory.

Since 1926, the author has performed 25 of these operations, a sufficient length of time having elapsed, therefore, to afford a test of the durability of the results (Table I). Some of the patients have been lost sight of, largely through moving to distant points, but great effort has been made to ascertain their present status, if they could be found. Recurrence of deformity, either partial or complete, has not been frequent. It is chargeable to poor cooperation in after-care or subsequent development of inflammatory disturbance of gonorrheal origin in some of the adults. The existence of calcaneal "spurs" in these latter is highly suggestive as to the source of trouble. A low state of nutrition in some of the younger patients may have been a factor. The majority of patients have been from charity clinics, hence the presence of such obstacles to success is easily explainable. The ages of the patients have ranged from three to 39. In the youngest case, the separation of the flap was difficult on account of the great softness of the bones. For that reason, it is perhaps better to wait until the patient has reached the age of six or eight.

Any opinion expressed by the writer would be purely personal as to the effectiveness of this procedure, but it is his belief that, when it is carried out properly on well selected cases, the results both clinically and anatomically will be highly satisfactory in the majority of cases.

In three operations, the technic was modified to include an arthrodesis of the astragaloscaphoid joint of one foot, and a shortening of the plantar fascia by imbrication through a transverse incision in both feet of another patient. The results in those patients did not appear to warrant the additional procedure, and the operation as above described has been used exclusively within recent years.

CONCLUSIONS

(1) Flatfoot is the direct consequence of a deltoid ligament too long to perform its normal function of holding the os calcis in the erect attitude during weight-bearing.

(2) The valgus attitude, or outward slanting of the heel, is the only constant, appreciable objective sign.*

(3) Early fatigue is the one constant, subjective symptom.

(4) Palliative measures may relieve symptoms but do not effect cures.

(5) Restoration to normal can be attained only by attacking the problem at its source—the deltoid ligament must be shortened surgically.

(6) The operation is adequate, because it utilizes the normal anatomy of the foot in correcting the deformity. No joints are destroyed by arthrodesis as has been done in practically all of the operations heretofore reported.

* It will be noted that throughout this discussion, the height of the longitudinal arch is not stressed, this factor being regarded as of secondary importance and having no real value in the cause of the pathology.

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