Flat-foot / by A.G. Miller.

(9.)

FLAT-FOOT.

I.

CLINICAL LECTURE: POST-GRADUATE COURSE.

EDINBURGH, OCTOBER 1889.

II.

PAPER READ BEFORE EDINBURGH MEDICO-CHIRURGICAL SOCIETY.

MAY 1890.

BY

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MDCCCXC.

I selected the subject of Flat-foot for the Post-Graduate Course for two reasons,—First, because it is a common, and, in my opinion, not thoroughly understood affection, difficult to treat. Secondly, I had at the time several illustrative cases in my wards, that exhibited some varieties of the deformity, and some of the complications to which I referred, such as talipes valgus, genu valgum, etc. The paper read before the Edinburgh Medico-Chirurgical Society was the result of a number of inquiries as to the way in which the "wedge-sole" benefits flat-foot, made to me by students and others.

In reprinting these papers I must express my regret that they are so fragmentary; but to systematize them would require a rewriting of the whole subject, and that of course would not be a reprint.

I am willing to let them stand as they are as an expression of my experience and opinions. The main points that I would emphasize are :—1. The diagnosis of Pes Planus from Talipes Valgus (page 6). 2. The importance of the Calcaneo-scaphoid Ligament (pp. 12, 13, 14). 3. The *modus operandi* of the "Wedge-sole" (p. 15); and the fact that this method is not new (pp. 9 and 14). 4. The special importance of exercise and massage in the treatment of Pes Planus (pp. 15 and 16).

A. G. MILLER.

EDINBURGH, *September* 1890.

I.

CLINICAL LECTURE ON FLAT-FOOT, Delivered in the Royal Infirmary, Edinburgh, on 3rd October 1889, during the Post-Graduate Course. Illustrated by Cases, Casts, and Drawings.

Gentlemen,—Flat-foot, or Pes Planus, is a very common affection, and there are many various forms in which one sees it manifested in young and in old.

Flat-foot may be variously divided. It may be spoken of as—1. Natural and acquired; 2. Slight and severe; 3. Simple and complicated; 4. Painful and painless; 5. Progressive and complete; 6. Traumatic and idiopathic; 7. True and false, etc. But whilst there are many varieties and degrees of flat-foot, I think there are two principal types to which most of the cases that present themselves for treatment may be referred.

Before describing these types I wish to refer to the terms used above in reference to this disease.

1. *Natural and Acquired.*—By "natural" flat-foot I mean that condition of the foot which might perhaps be called congenital, in which the arch of the foot is naturally very low, or entirely awanting, and in which, therefore, the whole of the plantar surface of the foot comes in contact with the ground in progression. This condition is called "splay-foot," and requires no treatment, because it causes no pain or discomfort beyond a certain amount of awkwardness in walking. The term "acquired" would include every other form of flat-foot.

2. *Slight and Severe.*—There might be a great advantage in considering flat-foot under the heads slight and severe. The symptoms are different, the treatment would be different, and the importance of early diagnosis would come under consideration. On this point permit me to observe that it is of very great importance to be able to diagnose and treat flat-foot properly when it is beginning. The slight limp, the turning out of one foot more than the other in walking, the slight groove in the boot or shoe just behind the ball of the great toe near the sole, the feeling of tiredness hardly amounting to pain;—these symptoms, if early recognised, and treated with rest, gymnastics, properly made boots and tonics, may quickly disappear, and an unpleasant, painful, and unsightly deformity be prevented.

3. *Simple and Complicated.*—By these terms I would draw a

distinction between those cases in which the loss of the plantar arch (or rather arches) is the only deformity and the only disease, and those in which other conditions are present—such as (*a.*) genu valgum; (*b.*) talipes valgus; (*c.*) hallux rigidus; (*d.*) gout in the tarsal joints; (*e.*) varicose veins; (*f.*) strumous disease; (*g.*) rheumatism; (*h.*) the effects of some injury, such as sprain or fracture, etc.

Such a distinction is of importance, especially as regards treatment.

(*a.*) For instance, genu valgum and flat-foot are said to be always associated. This I have not found. In a case of genu valgum, seeing that the leg is abducted from the knee downwards,—in other words, slopes obliquely outwards,—the inner side of the foot comes in contact with the ground principally in walking, or ought to, at any rate. As, however, this deformity (genu valgum) occurs gradually and not suddenly, the foot is educated into adopting a position of inversion that brings the whole sole, and not merely the inner side, in contact with the ground. The proof of this is easily seen after the limb has been straightened, say by Macewen's operation, when the sole of the foot is seen to turn inwards, and it is some time, in aggravated cases, before the patient learns to turn the foot out again, for at first he walks on the outside of the foot. The foot, indeed, is in a condition resembling somewhat talipes varus, and not valgus, as is also sometimes erroneously stated. The primary condition in genu valgum is not flat-foot properly speaking, far less talipes valgus, but certainly resembles flat-foot. I admit, however, that flat-foot and genu valgum may occur together. But it is a mere coincidence, as of any other two affections, which may occur on the same side or opposite sides of the body. If flat-foot is only simulated, the diagnosis is easy, for on careful examination of the foot the existence of a tarsal arch that cannot be opened out is made out at once.

(*b.*) Talipes valgus is sometimes confounded with flat-foot. Even eminent writers do not hesitate to say that the two are virtually or practically the same. The two may exist together, and thus prove their separate identity. Talipes valgus, I take it, consists essentially in a turning outwards of the whole foot, including the astragalus as well as every other bone of the tarsus, and is associated with paralysis. Except when very aggravated, Pes Planus does not affect the astragalus, or even the os calcis, materially in the way of eversion, and is not due to paralysis, but is essentially a giving way of the arch of the foot, and is associated with stretching of the ligaments.

(*c.*) Hallux rigidus is sometimes a complication of flat-foot. That it is a result of flat-foot I doubt very much. I cannot enter into an argument on that subject here. I would only say this from a clinical point of view. I have found the rigidity of the great toe disappear to a great extent under anæsthesia. It was due, there-

fore, to muscular spasm. Muscular spasm is generally associated with joint disease. Pes Planus is not a joint disease, but an affection of the ligaments, and associated with muscular relaxation and atrophy. Hallux rigidus is always associated, sooner or later, with changes in the cartilage and bone of the joint that is made rigid. I am inclined to think, therefore, that the rigidity ought to be the result of the joint disease, and not of the flat-foot directly.

(*d.*) Gout is not unfrequently associated with flat-foot in persons of the "good dinner" old gentleman type. The gout here is a cause of the flat-foot in a way I shall afterwards explain.

(*e.*) Varicose veins are often present in cases of flat-foot—probably because they are both due to the same cause, namely, standing. I do not think I would look on either of the two as a serious complication of the other. The presence of varicose veins, however, is apt to mask the flat-foot in some cases and to simulate it in others, because, as is well known, the veins at the inner side of the foot are often varicose. In such cases the inside of the foot is swollen, and the normal hollow disappears. In this way flat-foot is simulated, or masked, as I have already said, if really present. As regards treatment, I don't think that the presence of varicose veins would have any injurious influence. The application of Martin's bandage, if properly done, would materially help the flat-foot, and appropriate treatment applied to the latter would be likely to benefit the former.

(*f.*) The co-existence of strumous disease (in tarsus or ankle) with flat-foot would, of course, throw the latter into the shade entirely. And I need therefore say nothing about it beyond this, that I have seen the one mistaken for the other, and have also seen the slighter apparently merge into the graver affection.

(*g.*) Rheumatism of the joints of the foot may be mistaken for flat-foot, and *vice versa*,—the latter more frequently. The two affections, of course, may also exist together.

(*h.*) A sprain of the tarsal ligaments may give rise to flat-foot. A sprain of the ankle (internal or external lateral ligaments) may give rise to a condition resembling flat-foot. And Pott's fracture of the fibula, if not properly treated, may leave an amount of eversion of the foot that will give an appearance resembling flat-foot. Such an injury may also leave behind it a weakness of the limb that permits a subsequent falling of the arch of the foot, more especially if the limb is used too early in progression.

4. *Painful and Painless.*—The use of these terms would divide flat-foot, first, into what I have called the natural and acquired forms, the former being quite painless of course. Then the latter would have again to be divided, for some forms are more painful than others, and sometimes flat-foot, after being very painful, becomes almost quite painless when the arch has fairly descended, and there is no longer any strain on the ligaments.

5. *Progressive and Complete*—Were one to divide flat-foot under

these heads it would be for the purpose of treatment,—the former needing every care and attention, the latter often requiring almost no treatment. Indeed, in view of what I said under the former head, it is sometimes a question whether a complete flat-foot should be treated at all, unless there is some marked symptom, such as pain, calling for interference.

6. *Traumatic and Idiopathic.*—Under this head I will only say, that sometimes flat-foot may result from some injury, perhaps slight, to the ligaments of the foot, and that these cases, if diagnosed early, ought to be very amenable to treatment.

7. *True and False.*—I have already mentioned several conditions which may be mistaken for flat-foot, and some conditions that are deliberately confounded with it. I will now attempt to describe the principal types of true flat-foot, to which, I think, most cases that present themselves for treatment may be referred.

I will not attempt a description of the pathology of this affection. This has been ably done by Symington and others. Besides, I wish to treat the subject from a clinical point of view, and also to dwell on the treatment specially. I will therefore content myself with defining true flat-foot as mainly a giving way, or straightening out of the arch of the foot, the result of which is, that the patient when walking and leaning his weight on the foot brings the inner as well as the outer side of the foot (more or less) in contact with the ground. The common proof of this, as is well known, is the impression that is left on the floor by the wet foot. In the normal condition one sees the heel, outer side of the foot, and toes only, while in flat-foot the inner side of the foot leaves its mark also.

A. *First Type.*—The *mechanical*, due to carrying heavy weights, etc.

B. *Second Type.*—The *atonic*, due to debility of patient and part.

A. *Mechanical Flat-foot.*—This form of flat-foot is met with in porters and those who carry heavy loads, in cooks and persons who stand much, and in those who are unusually stout and heavy. The flattening of the arch comes on very gradually, as the tarsus is fairly borne down with the superincumbent weight. There is no diseased condition, only deformity. Those affected do not often present themselves for treatment. When they do, it is on account of an aching pain across the instep, or just below the external malleolus. The former is caused by jambing together of the upper surfaces of the tarsal bones. The pain below the external malleolus is due to pressure of the malleolus' tip on the os calcis. This occurs when the foot is rotated outwards as well as flattened, and is, as we have seen, not common (*vide* page 14).

The diagnosis is easily made, the deformity being well advanced before the patient applies for advice.

The treatment is, if the cause cannot be removed, to support the part with some mechanical appliance, such as a pad, or steel spring in the boot, or to throw the weight of the body, in standing

or walking, on to the outer side of the foot by a simple arrangement that I first heard recommended by Dr Heron Watson long ago, and have found to be very useful. The method is simply to have the sole of the boot made twice as thick on the inner as on the outer side of the foot. To effect this, the patient has only to get a wedge-shaped piece of leather put on the inner side of the sole. He should be directed, at the same time, to walk with the foot straight, and to try to lean on the outer side.

I have never performed any operation for flat-foot. But I could imagine a case in which, on account of severe pain unrelieved by simpler means, it would be necessary to do something to enable the sufferer to go about and to work. Under such circumstances I think that the removal of the scaphoid, as recommended by Mr Davy, which permits the arch of the foot to fall at once, or the supra-malleolar operation of Trendelenburg, which throws the weight of the body on to the outer side of the foot by supinating it, might be appropriate.

Flat-foot may also be due to *habit*. This form of flat-foot occurs in those who stand or walk awkwardly, *i.e.*, on their heels, I have noticed it mostly in adults, and especially in butlers, and those who go about in slippers. Various causes may give rise to the "heel walking." It may be due to mere awkwardness, or to gouty tenderness of the ball of the great toe, or to corns. In any case the result is twofold. From want of exercise the muscles of the leg and especially of the calf atrophy, and consequently the plantar ligaments are not properly reinforced and assisted by the tibials. In consequence these ligaments in time give way. And they do this all the more certainly that they have an undue strain put upon them. In standing or walking, mainly on the heels, the whole weight of the body is imparted to the os calcis, only the posterior tip of which touches the ground. This tends to tilt the bone forwards, which throws a considerable strain on the ligaments uniting it to the other bones of the tarsus.

Such persons, whose condition I have tried to describe, seldom apply for advice unless they suffer from some other affection, such as varicose veins. These two conditions, indeed, are very frequently combined in this class of cases. Many persons have only one foot affected—or one much more than the other. It will generally be found that that one is the favourite one on which they stand. It will also be more turned out in walking.

The treatment should be, if the case is seen early (which unfortunately is not likely), to explain to the patient the cause of the deformity, and how it can be cured, or prevented getting worse, by proper walking. I would advise the person to have his corns cured, or to get rid of his gout, and when standing to lean forward so as to feel the toes on the ground. I would tell him to work his toes and the muscles acting on the foot, and to walk with the foot directed straight forward, and to feel his toes on the ground

at each step. Of course such little things, requiring considerable attention till they become a habit, are very distasteful to most people, and they won't take the trouble to practise them. But if so, they must just do as they prefer—and take the consequences.

B. The *Atonic* type of *Flat-foot.*—This is by far the most important form of flat-foot. It is the most painful, the most frequently seen in our hospitals, and the most difficult to treat. Indeed, it is the only form of flat-foot that can truly be called a disease.

The patients are generally young, delicate, atonic, often strumous-looking boys and girls, who have to walk much, carry weights, and are poorly fed. If only one foot is affected it is turned out more than the other in standing and walking. It is carefully saved when the patient is standing, and he will limp on it when walking. There will be pain on the inner side of the foot, just behind and below the tubercle of the scaphoid. The pain is of a dull aching character, and is almost constant, though worse after walking or standing. The patient is usually much depressed and unable to carry on his employment as message boy. The pain is a well-marked symptom, is that for which the patient asks advice, and is due to an inflamed condition of the overtaxed calcaneo-scaphoid ligament. If the disease has gone on for some time and the deformity is well marked, the pain may have left the inner side of the foot and gone to the front or outer side, as in the other form.

The diagnosis is usually easy. The pain on pressing the calcaneo-scaphoid ligament is quite characteristic. The boy or girl looks ill-fed, over-worked, chronically tired, and unhappy. The leg is flabby and thin. The foot is soft and unnaturally plastic. When pressure upwards is made on the ball of the great toe, the foot does not rise as a whole, but becomes flattened—so much so, in a well-marked case, that a pencil or ruler can be laid flat along the inside of the foot touching the skin in its whole length.

In regard to treatment a great deal may be said, but, unfortunately, little can be done to cure this most distressing affection. Still there is some comfort for the patient in the prospect of relief from pain when the tarsus has completely descended, and the ligaments cease to be on the stretch.

I have called this type the "atonic." The treatment consists in the administration of tonics, both to the system and to the part. The best of all, when it can be got, is rest, combined with change of air and healthy exercise. Iron, quinine, and strychnine may be given internally. Gymnastics should be practised to increase the tone and power of the tibial muscles and other supporters of the tarsal ligaments.

We have seen that the calcaneo-scaphoid ligament is the one chiefly affected. I believe that its condition is partly the result of the undue strain put upon it on account of the tibialis posticus failing to support it. In some persons the ligament would slowly give way, and flat-foot would be the gradual result, without pain

because without inflammation. But in the class of patients of whom I am speaking at present the strain is more sudden, more severe, or more irritating, and hence the inflammation and the pain. While in mechanical flat-foot weight is the main factor, in the class of cases I have been describing the weak and sensitive condition of the plantar ligaments comes into play in the production of the flat-foot.

The first requirement, therefore, in treatment is rest; the next the toning up of the tibialis posticus along with the other muscles and the system generally; and, thirdly, the employment of some apparatus that will help to support the arch of the foot, and perhaps correct the deformity that is forming.

For a time, if possible, the boy or girl should walk as little as possible, and should not stand or carry weights at all. The tone and power of the muscles and system generally should be worked up by massage. Not the skin polishing process that is sometimes employed, but deep kneading of the muscles combined with free movement of all the joints. The patient should be taught to flex, extend, and circumduct the foot, and to practise this exercise frequently every day. The battery also may be employed with benefit. The patient should also be taught to walk on the outside of the foot, and to use all his muscles in walking. Standing on the toes is an excellent exercise, after a time, when it can be done.

For mechanical appliances I would recommend the plan of making the inner side of the sole of the boot thicker than the outer side for slight cases. For more advanced cases a steel support fixed into the inside of the boot, or a pad of cork, may help to make progression more comfortable and natural. Mr Archibald Young, surgical instrument maker, has devised a boot which I have found useful in some cases. It has a strap which passes under the instep, and lifts it up at each step which the wearer takes. In advanced cases I have found no good whatever from mechanical supports while the patient continues his or her previous employment. I am thoroughly convinced that without relief to the over-strained ligament, and toning up of the system and limb, no cure can possibly be effected.

II.

PAPER ON THE TREATMENT OF FLAT-FOOT, Read before the Medico-Chirurgical Society of Edinburgh, 7th May 1890, with Demonstrations on a Patient, and from Preparations kindly lent by Dr Symington.

Mr President and Gentlemen,—The subject of flat-foot has acquired some prominence within the last ten years from the writings of Von Meyer, of Ogston, and of many orthopædic surgeons, both in England and America. To Symington we owe what is apparently the only account of the anatomical features of the deformity. Recently many papers and letters have appeared in the medical journals, which demonstrate that there are many different views held as to the treatment of flat-foot, and even as to its nature. I do not profess to be able to lay before you anything new or original, but I hope by my statement or demonstration to simplify the pathology and treatment of *pes planus*. If in so doing I have to go through some elementary and familiar details, I trust you will excuse and bear with me.

For my present purpose I will define flat-foot as simply the giving way of the arch of the foot. The inner and more important portion of this arch is composed of the os calcis, the astragalus, the scaphoid, the internal cuneiform, and the metatarsal bone of the great toe. All these are firmly united to one another, in a continuous sequence, by strong ligaments, except the astragalus, which has loose and movable connexions with the os calcis and scaphoid (more especially the latter), between which it is situated. This comparatively loose connexion is necessary to permit the various lateral movements of the foot to take place at what may be called in general terms, the ankle. The astragalus being pretty firmly wedged between the two malleoli, the rest of the tarsal bones, in lateral movements (pronation and supination) move upon it. In order to atone for this looseness of attachment of the astragalus, there are specially strong connexions between the os calcis and the scaphoid, so as to maintain the solidity of the arch of the foot. This is all the more necessary seeing the astragalus is, as it were, the keystone of the arch; and as the weight of the body is transmitted to the foot through it, it might, in its peculiar position, act as a wedge to break up the arch of the foot instead of strengthening it.[1]

[1] Symington (*Journal of Anat. and Phys.*, October 1884) has shown that an action of this kind does occur normally. He says (quoting von Meyer), "When the sole of the foot is placed upon the ground, and pressure exerted upon the astragalus from above, its body glides forward upon the os calcis, while the head of the bone sinks downwards and inwards."

To support the astragalus on the inner side we find—(1), the *sustentaculum tali*, a projection from the inner side of the os calcis; and (2), a strong ligament, the *inferior calcaneo-scaphoid*. This important ligament passes from the sustentaculum tali to the under surface of the scaphoid, thus filling up what would otherwise be a gap of quite half an inch in extent. The head of the astragalus, covered with articular cartilage, lies on, but is not attached to it, a synovial membrane intervening. In fact, this ligament forms part of the capsule of the ball-and-socket joint which exists between the astragalus and scaphoid. On this ligament evidently the main strain falls when the astragalus is pressed downwards by the weight of the body (*vide* previous note). Of course a part is taken in maintaining the solidity of the foot by all the tarsal ligaments more or less, and support is also given by the various muscles whose tendons pass to the sole of the foot, especially the *tibialis posticus* and the *flexor longus pollicis*. The tendon of the former is in contact with the calcaneo-scaphoid ligament, and that of the latter passes forwards under the sustentaculum tali.

Now, if the arch of the foot is dependent on this calcaneo-scaphoid ligament, and if flat-foot is a giving way of the arch of the foot, any undue straining of this ligament may produce flat-foot; and this is done in the way that I have already indicated viz., by the astragalus forcing asunder the os calcis and scaphoid, and so stretching the calcaneo-scaphoid ligament.

If I am correct, then the treatment of flat-foot is reduced to perfect simplicity. We have to *relieve the strain on the calcaneo-scaphoid ligament.*

Of course there is nothing new in this view. It is sometimes called the old view. To overthrow it von Meyer, about ten years ago, declared that in flat-foot this ligament is not elongated, and that the inner border of the foot is not increased in length. He came to this conclusion by comparing normal with flat feet in living subjects. But Symington tells us, from a comparison of dissected feet, that in a case of flat-foot the length of the ligament was as 35 mm. to 22 mm., and 19 mm. in two normal feet. Besides, he says, "independent of measurements, the general increase in size of the ligament is quite apparent."

In support of this view let me remind you that in flat-foot pain is experienced in three situations—(*a*), on the inner and inferior aspect of the foot; (*b*), across the dorsum; and (*c*), on the outer side.

In the first situation the pain, which is always an early and prominent symptom, is elicited by pressure just behind and below the tubercle of the scaphoid, which is the position of the inferior calcaneo-scaphoid ligament. Symington has told us that in the specimen of flat-foot which he dissected (an aggravated case), "the cartilage covering the surfaces that articulate with the scaphoid and sustentaculum tali were normal, but that connected

with the inferior calcaneo-scaphoid ligament was thickened, softened, and in a few places it was completely destroyed, and the subjacent bone was in a condition of porosis." This condition he attributes to "irritation resulting from pressure against the ground." I would be inclined rather to attribute it to contact with an inflamed structure, viz., the calcaneo-scaphoid ligament. Symington does not mention whether that ligament showed signs of inflammation or not. But in the early stages of flat-foot the bone and cartilage cannot have suffered from contact with the ground, the pain is distinctly referable to the calcaneo-scaphoid ligament, and stretching is most likely to be the irritant.

The pain in the second situation (viz., across the dorsum of the foot), which is a somewhat later symptom, is due evidently to the pressure of the astragalus against the scaphoid after the normal relation of these bones has become somewhat altered. Symington says that this abnormal pressure may actually wear away part of the upper surface of the scaphoid.

In the third situation the pain is certainly due to pressure of the external malleolus on the os calcis. This is the result of rotation of the os calcis, and occurs in advanced cases. It is therefore a late symptom and a proof of aggravated flat-foot. Symington has demonstrated that at first articular facets form on the os calcis from the pressure of the fibula, but that inflammation and softening of the bone may take place later on.

In further support of this view of the pathology of flat-foot let me remind you that those who suffer from the deformity are those who have to stand much or to carry burdens. In such there is an undue pressure downwards on the arch of the foot. Again, in those who have a tendency to flattening of one foot only, it is the one on which they habitually stand that is affected. Ill-fed, growing children, also, whose muscles are deficient in power and tone, frequently are sufferers, because the additional support to the ligaments is awanting which ought to be given by the muscles.

How, then, can we take the strain off the calcaneo-scaphoid ligament? Of course making the patient avoid the upright position will do this. But those suffering from flat-foot seldom can or will lay up. It is necessary, therefore, that they should be instructed in some method of standing and walking that will take the strain off the inner side of the foot. This is most easily done by a simple method which I find was published in my father's *Practice of Surgery* in 1846. It is possibly much older, though recently claimed by an English surgeon as his own invention. It consists in making the sole of the patient's boot thicker on the inner than on the outer side, and in this way throwing the weight of the body more on the outer side of the foot. The *modus operandi* of this simple plan is easily seen on the skeleton, and it is indeed wonderful how very slight an inclination of the foot throws the line of gravity over to the inner or outer side. Many

persons suffering from commencing flat-foot naturally adopt this method, and habitually stand on the outer side of the foot.

It has been demonstrated by von Meyer and Symington that in the normal foot the centre of the astragalus is outside a line drawn from the heel to the ball of the great toe, and inside that line in flat-foot.[1] Any one, however, can move von Meyer's line to the outer or inner side of the centre point of the astragalus by simply pronating or supinating the foot, and it is this power that is utilized in the above treatment. The result of the elevation of the inner side of the foot (by the wedge-shaped sole) is to place the centre-point of the astragalus on the outer side of the line, or, in other words, within the triangle on which the weight of the body is normally borne. This triangle, as described by von Meyer, being the tip of the heel, the ball of the great toe, and the ball of the fifth toe.

It is easy to see that this alteration of the relation of the astragalus to the other bones of the foot relieves the inner at the expense of the outer side. It will take some strain off the calcaneo-scaphoid ligament, therefore, and will also prevent the contact of the os calcis with the tip of the fibula. But can the outer side of the foot bear the extra burden? It ought to do so, for the strain is distributed among a large number of ligaments, and the bones are arranged in such a manner that the transverse arch of the foot is brought into play; besides, the outer side of the foot is in contact with the ground almost throughout its entire extent normally.

Now, the second point in the treatment is support. How is support to be got for the calcaneo-scaphoid ligament? Some recommend mechanical means, such as a spring or pad in the boot, and there may be cases in which this treatment is useful. But in many instances the pressure on the under surface of the arch of the foot only increases the patient's discomfort. And one can easily understand how this is, if we are right in supposing that the calcaneo-scaphoid ligament is in an irritated condition from the abnormal strain thrown upon it.

The main support of the astragalus (on its inner and under surface), we have seen, is the inferior calcaneo-scaphoid ligament; the main supporters of it, in its turn, are the posterior muscles of the leg. If they are strengthened, therefore, the ligament will be relieved, more especially in walking. To tone them up a system of gymnastics must be adopted. Flexion and extension of the ankle-joint, circumduction of the foot when raised from the ground, rising on the toes several times in succession, and also walking on the toes, are good exercises. The last is useful also in taking the strain off the arch of the foot by transmitting the weight

[1] In some normal feet the astragalus centre is slightly inside such a line. Symington calls this a mechanical tendency to flat-foot, and perhaps it is in such persons that the down-pressure in standing and carrying weights develops flat-foot.

of the body more directly from the astragalus to the scaphoid. I trust that it is not necessary for me to dwell on the importance of toning up the muscles, and, indeed, of the whole system, in such cases as those of flat-foot, in which the deformity is the result of inability on the part of one portion of the organism to fulfil its function and meet the demand made upon it under, in some instances, even normal conditions. It is quite evident that all the constituent parts of the lower extremity are dependent on one another, just as the various organs of the body are. It is equally evident that the ligaments of the foot are very dependent on the muscles of the leg, and that when the latter are deficient in their duty there is extra strain put on the former.

I have devoted a considerable portion of this paper to a demonstration of how a slight mechanical alteration of the relation of the foot to the astragalus will benefit flat-footed persons. But I think that on the whole, especially in incipient cases, more ultimate good will be derived from devoting attention to the strengthening of the muscles of the leg and foot. Massage and such exercises as those I have indicated will be found very useful towards this end.

I have not dealt with the subject of diagnosis specially, having already published my opinions on this point in a clinical lecture which appeared in the *Edinburgh Medical Journal* for November 1889. Mr Ellis of Gloucester has honoured me by referring to that lecture in a paper contributed to the *Edinburgh Medical Journal* for January 1890. I find that he and I are agreed as to the importance of the muscles of the leg in the proper treatment of flat-foot, and also as to the way in which they ought to be trained and strengthened. Mr Ellis, however, does not approve of the method of throwing the weight of the body on to the outer side to save the inner side of the foot.

I will not attempt to deal at present with the question of what operation should be performed in aggravated cases of *pes planus*. Patients do not generally elect to undergo operations for mere deformities; but they are often willing to submit to anything for the relief of pain. Now, the pain in flat-foot ought to be relieved by the treatment to which I have referred. The supinated position of the foot and the strengthening of the muscles of the leg will take the strain off the calcaneo-scaphoid ligament, will prevent the contact of the os calcis with the fibula, and ought in time to restore the astragalus to its normal relation to the scaphoid. In very aggravated cases one might commence treatment by confining the patient to bed for a short time, during which massage might be employed. I have not yet performed any cutting operation for this affection. I will, therefore, wait till I have failed with the above treatment before I decide what special operation I will adopt.