

explanation of the unknown was ever wrapped in mystery, and the mind that sought it was often attuned to mysticism. The sapphire throne and He that sat upon it; the Ancient of days before whom stood ten thousand times ten thousand; or again, He that sat upon the great white throne when the books were opened, or the vision of the conquering martyrs and saints, came easily to the mystic type of mind. But these visions did not end there; on the contrary, they were handed down by the devout from generation to generation, and their influence and importance in no wise diminished as the centuries slipped away. The Abbess of Bingen is but a connecting link between the early mystics and those of to-day; she does not stand alone, but her forceful personality, her migrainous attacks and her marvellous power of portraying vividly what she saw, have singled her out for our interest and attention. The mystic is just as much with us to-day as he was in the past, though his mysticism now takes other forms, and is rarely, if ever, founded on the visual phenomena of migraine, but the influence of the seers and prophets of the past is still strong, not only on him, but also on a very large proportion of our contemporaries. Take away from the Bible the books of Ezekiel, Daniel and the Revelation, or at least take away from these books the elements of mysticism, which I have endeavoured to show you have developed from migrainous phenomena, and what a difference you would make to the accepted beliefs of the present day. I have shown reason to think that we may admit Moses and St. Paul into the same great company. If we do so, then the profound influence of migraine on the beliefs and on the trend of thought of the world will be realized. It is for these reasons that I have named this lecture "Migraine and Mysticism."

USE AND ABUSE OF TOES.

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IN this article I want to state the case for the toes; the attention of the public, both lay and medical, has for too long been concentrated on the arches of the feet alone.

The toes are designed to perform *two* functions, *prehensile* and *ambulatory*, and because of this their structure and musculature are more complicated than appears on the surface.

The mechanism of the foot is that of a lever of the second order with the fulcrum at the metatarsal heads, and for any system of levers to work efficiently the fulcrum must be stable and the lever rigid.

When walking on soft, crumbling soil, it is easier to progress barefooted because the toes can grip the ground and stabilize the fulcrum, but for ordinary walking on a firm, smooth surface, the necessity to stabilize the fulcrum no longer exists.

The important consideration, then, is *how to prevent wear and tear of the fulcrum from constant use*; for it is a matter of common knowledge that when all the weight constantly falls on the metatarsal heads, metatarsalgia, in varying degrees of acuteness, inevitably occurs.

To avoid this Nature has devised a method of enlarging the area of the fulcrum which operates effectively at whatever height the heel is raised from the ground.

One of the reasons why there is difficulty in understanding toe action, is because the names given to some of the muscles which control the toes are misleading. Who can blame a student for thinking that the chief action for the flexor longus digitorum muscle is to flex the toes, when it is called by that name? Yet it is a fact that at no phase of an ordinary walk do the toes ever flex.

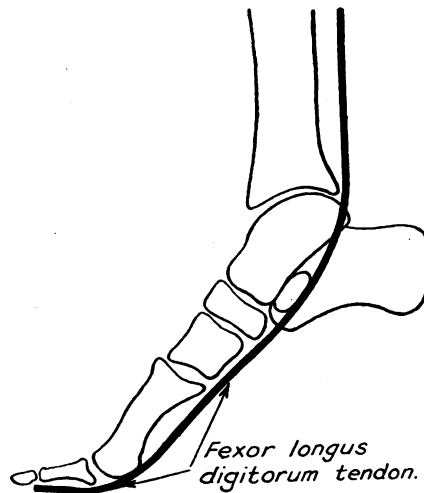
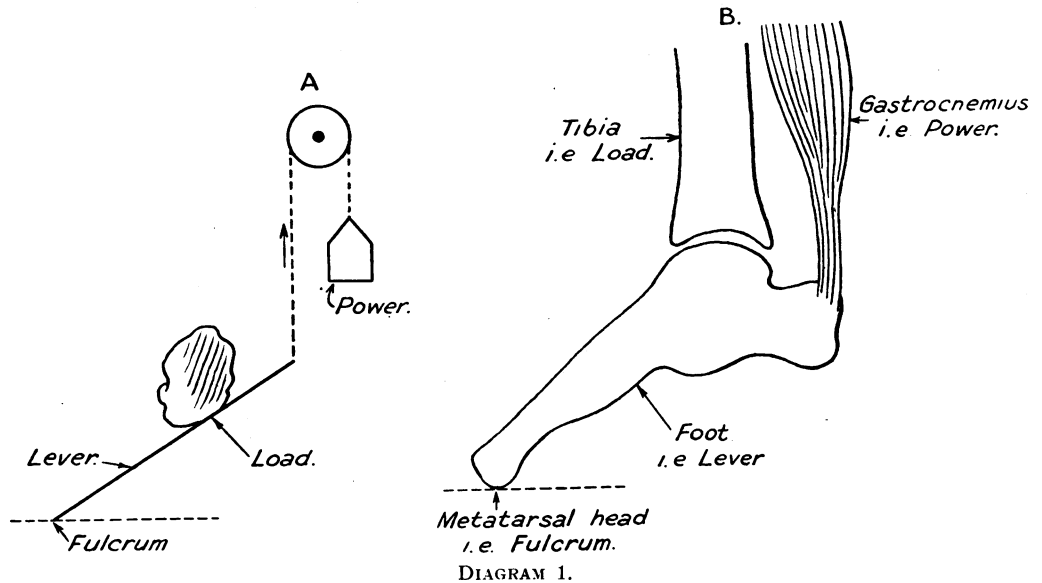


DIAGRAM 2.—Showing its supporting, sling-like action, to the metatarsal head ; also its close proximity to the tarsal bones and tarso-metatarsal joint.

The best way to understand the function of this muscle is to regard the toes as the fixed point.

Diagram 2 shows that its tendon passes under the metatarsal head, and if the toe is straight and firmly planted on the ground, when the muscle contracts the tendon will support the metatarsal head. It is a sling-like action with the toes as a fixed point.

In this way when the heel is raised the weight falls not only on the metatarsal heads, but on the whole of the area of the toes as well.

But, it may be asked, how can the flexor longus digitorum contract without flexing the phalanges and causing painful callosities on the tips to appear?

A schematic representation of the arrangement of the intrinsic muscles of the toes is shown in *Diagram 3*. Since these muscles are inserted into the dorsal expansion of the extensor tendons, it is evident that their chief action is to extend the phalanges whatever the position of the metatarso-phalangeal joint may be.

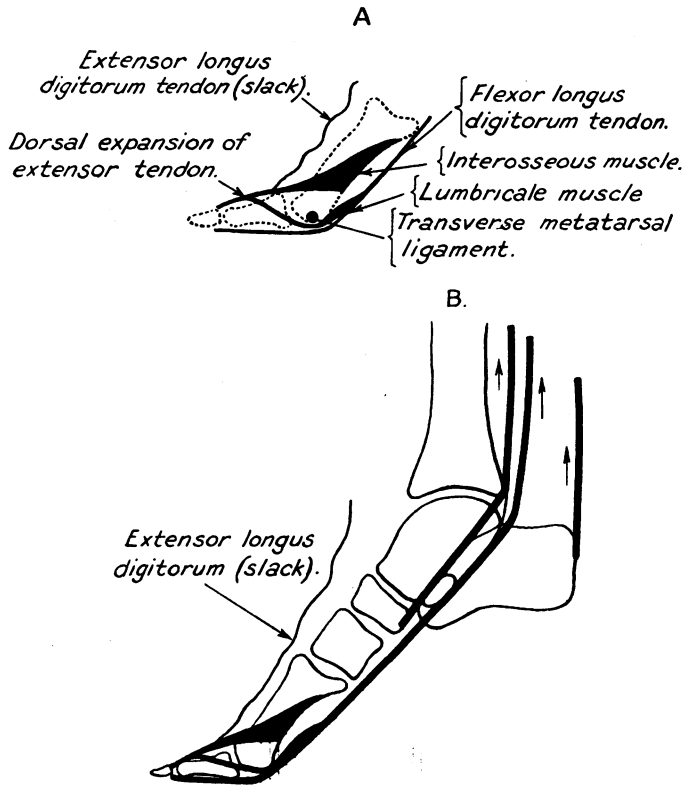


DIAGRAM 3.—Showing synchronous contraction of the gastrocnemius, tibialis posticus, flexor longus digitorum, and the intrinsic muscles of the toes during the step forward.

Moreover, they act synergically with the long flexor muscle of the toes, and keep the phalanges straight while the latter contracts, thus enabling it to perform its threefold function of supporting the metatarsal heads, enlarging the area of the fulcrum, and giving spring to the gait (*Diagram 3b*).

The reflex mechanism controlling the action of the toes is therefore very complicated and necessarily varies according to whether the toes are performing their ambulatory or prehensile function. For, whereas the former function requires the synchronous contraction of the intrinsics with the flexor muscle, the latter demands a reflex inhibition of the intrinsics, because without this it would be impossible to flex the toes and grip the ground. This is an important consideration in treatment.

So far, the action of the toes has been considered only in their relation to the fulcrum, but they exert also an important influence on the lever.

The foot, like the toes, serves a dual purpose : at one moment it is a rigid lever, at the next a spring cushion to absorb shock. For this reason it is composed of several bones.

When standing the foot is comparatively flat, and the first action in taking a step forward is to form an arch, for it is only in this way that the foot can be converted into a rigid lever. The tibialis anticus lifts up the arch, and the peroneus longus and the tibialis posticus lock the mid-tarsal joint, the former acting on the calneo-cuboid, and the latter on the astragalo-scaploid joints. Thus the lever consists of two parts, the metatarsal bone anteriorly, and the os calcis, astragalus, scaphoid and cuboid, locked together as one bone, posteriorly. These two elements are joined through the medium of the tarsal bones. With the exception of the first, the cuneiform and the metatarsal bones have no powerful muscles inserted into them ; they are attached to the scaphoid only through extensions of the tendinous insertions of the tibialis posticus into the scaphoid tubercle. However powerful these tendinous extensions may be, they will, if subjected to long-continued strain, eventually give. The tarsal and especially the tarso-metatarsal joints do therefore constitute a weak point in the rigidity of the foot when considered as a lever. But *Diagram 2* and *3b* shows that the tendons of the long flexor muscle of the toes lie in close proximity to these joints, and when it contracts the tendons do give considerable support to this potentially weak region, provided, of course, that the toes act as a fixed point.

In this way, I believe, can be explained the frequent association of tarsal and particularly tarso-metatarsal arthritis with defective toe action.

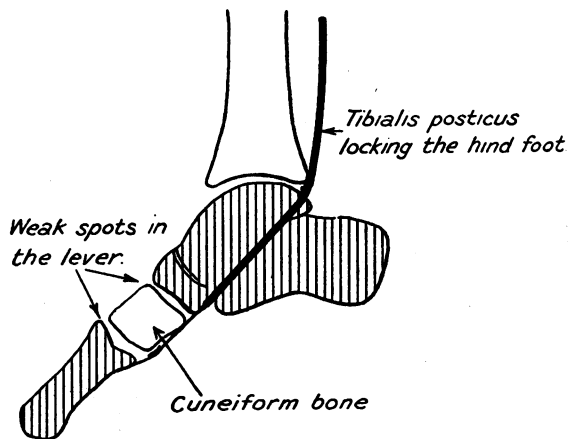


DIAGRAM 4.—To show the two components of the lever joined together by the tarsal bones.

Throughout this description of the function of the toes, the point that has been repeatedly insisted upon is that for ordinary walking the toes must be straight and on the ground. The muscles responsible for this are the interossei and lumbricales. Weakness of these muscles is always followed by a claw-toe deformity, so when the flexor longus digitorum contracts there is no fixed point, and the useful power of that muscle is wasted.

Peroneal muscular atrophy, or abortive forms of this disease, and infantile paralysis are the most frequent neurological causes of the claw-toes, but by far the commonest factor in the production of defective toe action and fixed deformities is the disuse atrophy of the muscles consequent upon the cramping of the toes into short shoes and socks.

From point of treatment, therefore, the only important consideration is whether and to what extent the muscles are capable of re-education and development.

There are three stages in the evolution of toe deformities, from whatever cause. Firstly, the appearance of corns, either on the tips of the terminal phalanges or on the dorsum of the proximal interphalangeal joints; secondly, the inability when barefooted voluntarily to straighten the toes, though there is no resistance to passive correction; thirdly, the fixation of the deformity by contractures of ligaments and tendons, the appearance of callosities under the anterior arch, and metatarsalgic symptoms.

Attention to the shoes and exercises to restore the tone of the interossei and lumbrical muscles will soon cure the first two stages, but in the case of the third the deformity must first be corrected by tenotomy of the extensor tendons, and the correction maintained by suitable means for a few weeks before useful exercises can be performed. In a large number of cases this will suffice.

If, however, this stage has persisted for too long, the intrinsic muscles of the toes will have atrophied beyond repair, in which case the mere correction of the deformity will not be enough to restore the function of the toes, and the deformity and symptoms will undoubtedly recur. Something more has to be done.

The operation of transplanting the tendons of the extensor longus digitorum into the metatarsal heads has been recommended. It is based on the untenable assumption that this muscle, when inserted into its new position, will lift up the anterior arch. Except as a voluntary action opposing muscles do not contract synchronously; the flexors and the extensors of the toes are opposing muscles, and the mere accident of an altered insertion will not make them otherwise. Consequently, the extensor muscle will be slack when the flexor muscle contracts; the former muscle, therefore, cannot exert any influence whatever on the anterior arch during the step forward. This operation acts as a palliative to prevent repair of the extensor tendons after tenotomy, but does nothing to restore the function of the toes.

At the beginning of this article it was stated that their structure and musculature were complicated because the toes were designed by Nature to perform two functions, ambulatory and prehensile. The former is of course the more important, because in a civilized state the ground on which we walk is for the most part firm, and the surface is always smooth on account of our habit of wearing shoes; further, it has been shown that for ambulatory purposes all that is required of the toes is that they should be straight and firm on the ground. Consequently for this function alone we would be as well off with one straight long phalanx as with three short ones. The rational procedure then to restore the useful function of the toes when the interossei and lumbricals are paralysed, is to combine tenotomy of the extensor tendons with an arthrodesis of all the interphalangeal joints of all the toes with the exception of the fifth toe which is best amputated, in order to convert the toes into one straight long phalanx, so that the action of the intrinsic muscles can be dispensed with. It is a tedious procedure, and often has to be done in two stages, but it is well worth doing.

There is yet a **fourth stage in the evolution of toe deformities**, a late and extremely

painful stage, where in addition to callosities on the toes and under the anterior arch, there exist subluxations and arthritis of the metatarsal phalangeal joints. It is advisable in these cases to attempt to procure relief by palliative measures, such as by special boots and supports, because operative interference is usually disappointing.

From the foregoing it will be realized that it is impossible to have perfect action of the foot unless the toes have free play and are under adequate muscular control.

Even in this short article, which was intended primarily to draw attention to the function of the toes, it was found necessary to refer to the structure and function of the arches of the feet as well. It is irrational to lay stress upon the importance of one part of an organ to the exclusion of another, yet for years, in regard to foot matters, the public, both lay and medical, has adopted this pernicious habit and has concentrated its thought almost entirely on the arches of the feet alone.

It is the business of the medical practitioner to instruct the public in matters of hygiene, and how to obtain the maximum efficiency out of their bodies. In this connection, small and insignificant though they may appear to be, the toes, nevertheless, are deserving of more respect than is usually meted out to them.

N.B.—In order to simplify the diagrams as much as possible, the flexor brevis digitorum muscle has not been shown, and the toes have been made to consist of two phalanges instead of three. But this, of course, does not alter the validity of the arguments.

NOTES ON SO-CALLED CONGENITAL HYPERTROPHIC PYLORIC STENOSIS IN INFANTS.

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THE subject of congenital hypertrophic pyloric stenosis is always considered in one lecture at least at each of our three Post-Graduate Courses which are held every year at the Infants Hospital. Further, it is often dealt with independently by the physician, the surgeon, the pathologist, and the radiologist. This is done because we have very abundant material on which to demonstrate, and because from our respective points of view we all take a great interest in the subject.

For my part, my views on this subject are not exactly orthodox, and they never have been ever since the time I made it the subject of the thesis for my M.D. degree at Oxford some thirty years ago, and was compelled to alter the title to please the examiners and fit in with prevailing opinion. The name usually given to this condition is in my opinion conceived in misunderstanding and born in violation of the very obvious underlying pathogenesis. The term *congenital* is misleading, because the hypertrophy is practically always acquired through overaction of the muscles of the antrum, not of the sphincter proper, and usually *after* birth. The term *stenosis* is wrong, because it implies that the obstruction is due to some organic narrowing of the sphincter, whereas it is actually functional and due to want of relaxation of muscles which are normally in a condition of tonus. The orifice of the sphincter is not