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CONCLUSIONS DRAWN FROM A COMPARATIVE STUDY OF THE FEET OF BAREFOOTED AND SHOE-WEARING PEOPLE

The American Journal of Orthopedic Surgery (1905)

by Phil Hoffmann, M.D.

Introduction by Dr. Ray McClanahan

Commentary by Mark Cucuzzella, M.D., Casey Kerrigan, M.D.,
and Dr. Phil Maffetone



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Introduction

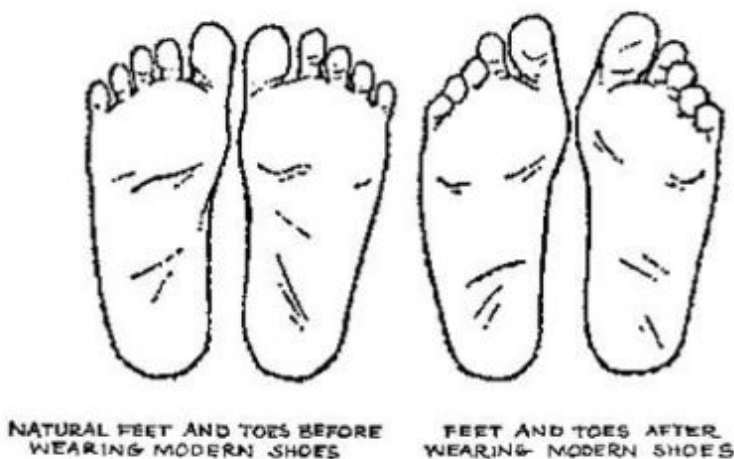
by Ray McClanahan, DPM

Most of what we now know about foot health—*true* foot health, that is—comes from scholarly writings that were published, in some cases, well over 100 years ago. These studies, along with the wisdom we have gained from unshod or minimally shod populations, are crucial to our understanding of what constitutes normal, healthy foot anatomy and how to preserve this beautiful, spade-foot shape through adulthood and well into old age.

Dr. Hoffman's 1905 study entitled "Conclusions Drawn From a Comparative Study of the Feet of Barefooted and Shoe-Wearing People," is just such a study. This study, published in the *American Journal of Orthopedic Surgery*, is as illuminating about natural foot health as it is troublesome for the fact that it has largely been forgotten and ignored by contemporary podiatry and the Western world at large. It is a window through which we can see how our natural foot health heritage has been corrupted and co-opted by footwear that has tried to dominate and improve upon an already (and inherently) brilliant design.

Healthy feet and toes are our *birthright*. Almost every single one of us was born with perfect feet, and with the proper care and attention, and in the absence of traumatic injury, we can maintain healthy foot and toe anatomy and function nearly indefinitely. It's important, though, to understand what, exactly, constitutes a healthy foot, so that it can be restored and/or preserved. My two decades of experience as a sports podiatrist, the life-changing months I spent in Liberia, and the extensive research studies that I've reviewed have led me to this unmistakable conclusion about the human foot:

A healthy foot is a foot that's widest at the ends of the toes, possesses a strong and sturdy arch (arch height is irrelevant), and has straight, dexterous toes that are sufficiently splayed (especially the hallux, or big toe, which should be spaced well away from the second toe). A healthy foot is free of fungal infection, has incredible *natural* arch support (due to proper toe orientation; that is, toes in line with their corresponding metatarsal bones), and possesses the ability to withstand the rigors of weight-bearing activity without any outside interference.



Amazingly, and fortuitously, examples of healthy feet still exist in the world and can be seen in unshod or minimally-shod cultures around the world. The temporal thread that connects the modern-day potato farmer in Peru, mountain porter in Nepal, and rickshaw peddler in Bangladesh with the groups discussed in Dr. Hoffman's article is strong, healthy, and anatomically perfect feet, due to an adherence to minimal footwear. The goal of our contemporary, shoe-wearing population should be to emulate our unshod or minimally-shod peers. But just because the healthiest feet in the world belong to the unshod doesn't necessarily mean that we all need to be barefoot; it just means that we should use footwear that stays out of the way of our foot and does not alter the structure

or function of our foot in any way.

Contemporary footwear companies would do well to review Dr. Hoffman's study and apply his findings and conclusions to their product offerings. There remains a conspicuous lack of footwear options available today that truly *respect* the human foot and allow the toes to splay the way nature intended. Heel elevation, toe spring, tapering toe boxes, and rigid, inflexible soles are still regular inclusions in most shoes and boots available to consumers. These injurious design features are the product of misguided thought, of the belief that the human foot needs to be altered to remain healthy and strong. In truth, the foot needs none of this. What the foot needs (truly needs) is for us to stay out of its way, to let it function the way that it was designed to function. We can be enablers of foot health if we take a more subtle approach and employ natural footgear that respects nature's designs.

Dr. Hoffman's article is both a treasure *and* a time capsule. It's a chance to look back in time to gain a better understanding of who we are as human beings and how we can best care for our feet. Dr. Hoffman's article also challenges us to accept the idea that we don't always need to tinker with nature to realize optimal health. I hope that you are moved by Dr. Hoffman's article, just as I have been. Onward, then, to natural foot health!

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CONCLUSIONS DRAWN FROM A COMPARATIVE STUDY OF THE FEET OF BAREFOOTED AND SHOE WEARING PEOPLES

The American Journal of Orthopedic Surgery 1905

PHIL. HOFFMANN, M.D., ST. LOUIS.

Ample opportunity for the study of feet of individuals that had never worn footwear was furnished by the Philippine exhibit and by the Central African or Pigmy group at the Louisiana Purchase Exposition. Such studies were made on one hundred eighty six pairs of feet.

Objects of the work:

1. General observations on the foot in barefooted races compared with the same in shoe-wearers, including its shape, functions, range of voluntary and passive motion, and relative length as a whole and of its component parts.
2. Height and shape of the longitudinal arch and its bearing on the usefulness of the foot.
3. Relationship or coincidence, if any, between the height of the arch and the gait.
4. Collection of specimens.

Measurements were made of the body-height and of the length of the foot and its component parts; record was made of the gait whether straight or everted and the degree of eversion; footprints on smoked paper were taken to record the weight-

bearing area of the foot and, in many instances to show the extent of foot expansion and arch depression under pressure, two plaster of Paris casts of the same foot were made, one in repose and the other bearing the body-weight. The camera also was used to record toe action in climbing and grasping and habitual foot posture in standing and walking.

From observations on the field and subsequent study of the material gathered there, I feel justified in reporting the following conclusions:

The relative length of the foot to body-height and of the phalanges to foot length are practically the same in barefooted as in shoe-wearing races. This is true of both the infant and adult.

The shape of the foot and its range of voluntary and passive motion are practically the same in barefooted and shoe-wearing races up to the time of the use of footwear that compresses and splints the foot, usually about the end of the first year, after which, in shoe-wearers, there is progressive narrowing of the anterior portion of the foot and diminution in the range of motion of its phalangeal, tarsal and ankle joints.

The lasts over which the footwear of civilization is shaped are rarely modeled in the spirit of truth that would make them conform to the contour of a normal foot. The whim of society and the manufacturers' enterprise alone regulate their shape. Society, apparently, agrees that the human foot as formed by nature is coarse, vulgar and unsightly, and that its width, especially at the toes, is entirely too great. It regards the small, especially the narrow foot, as the beautiful one. The dictum of fashion has greater influence than reason. Perhaps the statement that society admires the small foot is not exactly true, for society, as such, never sees the naked foot; but what it so commonly does admire is the dainty little shoe that hides its own handiwork-the distorted, cramped, calloused and repulsive foot. Here beauty is less than skin deep, or at most lies no deeper than the calfskin product of the cobbler's art.

The manufacturer through ignorance and self interest fits the desires of his patrons rather than their feet, and places upon the market footwear that more or less crowds the front of the foot.

The widest part of an undistorted foot corresponds to a line drawn from the end of the little toe to the base of the great one. (Fig. 1 and Fig. 11 B.) It is just at this point that the conventional shoe is made narrowest. In the normal foot the phalanges are in line with their metatarsals, and when bearing the body-weight the toes separate and widen the base of support.

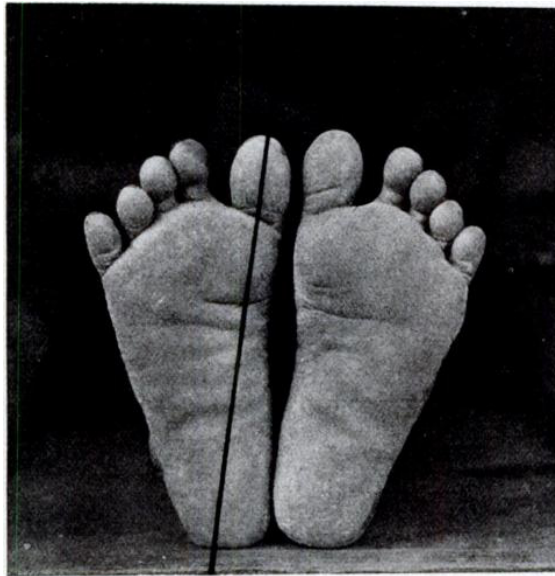


FIG. 1 PLANTAR VIEW OF FEET OF NEGRITO, SHOWING STRAIGHTNESS AND SEPARATENESS OF TOES; TRANSVERSE FOLDS IN SKIN OF SOLE; WIDEST PART OF FOOT AT TOES; LONG AXIS OF GREAT TOE PROLONGED BACKWARD STRIKES CENTER OF HEEL.

Especially is this true of the great toe, which is separated from its neighbor by a considerable interval, and in this position assists in keeping the foot adducted and! is a considerable

factor in the work of leverage. This is universal among barefooted races. (Figs. 2, 21, 22, 23, 24 and 25.) As evidenced! by classic sculpture, this toe separation was the rule also in ancient sandal-wearers, whose footwear did not compress the feet.



FIG. 2 DORSAL VIEW OF WEIGHT-BEARING FEET OF A BAGOBO, SHOWING TOE SEPARATION, ABDUCTION OF GREAT TOE AND MINUTE FOLDS IN SKIN.

(Figs. 3 and 4.) The same is likewise true of modern sandal wearers as found among the Cingalese and Japanese. (Fig. 5.) A condition that may be considered almost universal among shoe-wearing adults, is one of more or less crowding of the toes, especially of the great toe, which either underlies or overlaps its neighbor. Fig. 6 shows a pair of such feet compared to the shoes worn on them. The relative size of the two photographs corresponds to the originals. Observe the compression of the toes and narrowing of the front of the foot and that the line prolonging the long axis of the great toe backward falls well to the inner side of the heel. The degree of shoe deformity shown in these feet, while slightly greater than the average, is not at all uncommon, especially among women. It will be seen that the shoes are not only of an improper shape

but that they are entirely too small, even for feet already so much distorted, and one can readily imagine the crowding necessary to adjust the foot to the shoe. A single pair of shoes was not the sole cause of the distortion, but the condition could have been brought about only by years of such abuse. The illustrations are of interest as showing a predominant type of footwear and its inevitable effect.

Examine the feet of young children before they have been crippled by shoes. Observe how distinct and separate each toe is: no one crowding its neighbor, the great and lesser toes in line with their metatarsals, and the inner border of the foot a straight line. The long axis of the great toe prolonged backward will, in the normal foot, strike about the center of the heel. That this condition would continue throughout life in an unhampered foot is proved by the shape of adult feet among barefooted races. (Fig. 1 and Fig. 11, B.)



FIG. 3 FOOT OF HERMES OF PRAXITELES, SHOWING STRAIGHTNESS AND SEPARATENESS OF TOES.



FIG. 4 ANCIENT BRONZE FROM HERCULANEUM, SHOWING ADDUCTION OF FOOT AND OF GREAT TOE.

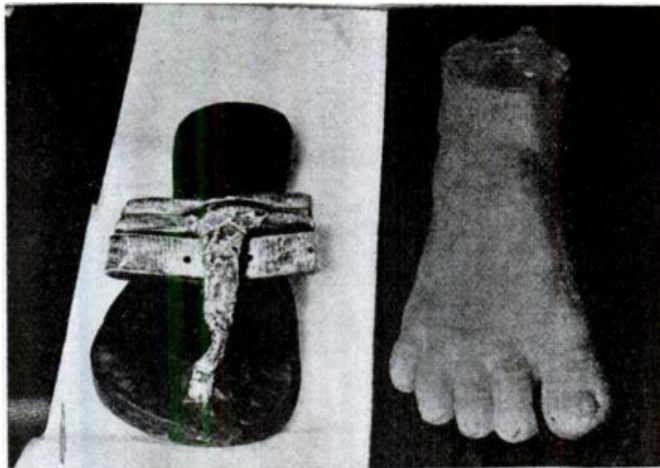


FIG. 5 PHOTOGRAPH OF CAST OF WEIGHT-BEARING FOOT OF CINGALESE AND SANDAL WORN ON FOOT. SHAPE OF FOOT SIMILAR TO THAT FOUND IN MODERN BAREFOOTED RACES AND IN ANCIENT SANDAL-WEARERS.



FIG. 6 A PREDOMINANT TYPE OF FOOTWEAR AND ITS INEVITABLE EFFECT. THE SHAPE OF THE FOOT CONFORMS TO THAT OF THE SHOE.



FIG. 7 PERMANENT METATARSO-PHALANGEAL HYPEREXTENSION AND INTERPHALANGEAL FLEXION.

The high heel, especially the one placed well forward, compels the wearer to stand largely on the front of the foot, which must bear more than its proportionate share of the body-weight.

The habitual wearing of high-heeled shoes leads to shortening of the calf muscles through accommodation to the continually assumed attitude. This is probably the reason that a large percentage of middle-aged women cannot dorso-flex the foot to quite a right angle without relaxing the calf muscles by bending the knee.

The permanent hyperextension of the metatarso-phalangeal joints, common in shoe wearers, is but the fixation of a position necessarily assumed by the heel elevating the posterior end of the foot. The spring or turning upward of the front of the sole of the conventional boot tends to intensify the hyperextension, while crowding of the toes by a too short or narrow shoe adds to this deformity one of interphalangeal joint flexion. (Fig. 7.)

A foot showing no compression deformity must be exceedingly rare among shoe wearing adults. I have never seen it except in instances where it had been impossible to wear an ordinary shoe, as in certain congenital clubfeet that had worn coverings that did not compress the toes. As an illustration of how accustomed civilization has become to certain foot deformities, and how unaware the average individual is of deformity present in his own feet, I will mention a photograph of the naked body of a well-known instructor of physical culture, which was displayed in show windows as an advertisement. In one corner of the card was printed: "One of the finest-formed athletes in the world"; yet, absolutely no attempt was made to hide the right foot, the toes of which presented shoe deformities developed far beyond the average.

The foot, especially in the young, is very plastic; continued pressure can give it almost any shape. A familiar example is the foot of the high caste Chinese lady. By a system of bandaging, begun at the fifth or sixth year, the anterior half of the foot, by extreme flexion at the mid-tarsus, is made to approach the posterior, so that the toes and heel may fit into a dainty little shoe no larger than a teacup. Fig. 8 is a photograph of a pair of such feet, and Fig. 9, a photograph of

shoes worn on them.

What matters it if the lady cannot stand still, but must constantly step backward and forward to retain her balance, or that she can barely walk at all without support if, only, she possesses a pair of “golden lilies,” as such feet are fancifully called? But why smile at the absurdity of the Chinese lady? How about some women, and men too, outside of China, who incase their “golden lilies” in shoes that are little more than half as wide as nature indicated they should be and often much too short? What matters it if they do suffer from deformed, weakened and painful feet if, only, they can place them in shoes much too small with toes that vanish into nothingness and perch them on a fancy, slender, high - and insecure heel? Here, too, the binding begins at a very tender age. The difference is not so much in kind as in degree.

Interesting examples of what a few weeks of shoe compression will do to young feet were encountered in the Bagobo village. On September 22, I made impressions and tracings of the feet of a few of these people, among them a boy of twelve and a girl of eight. On November 16, I made impressions and tracings of all the members of the Bagobo household, including the above-mentioned boy and girl.

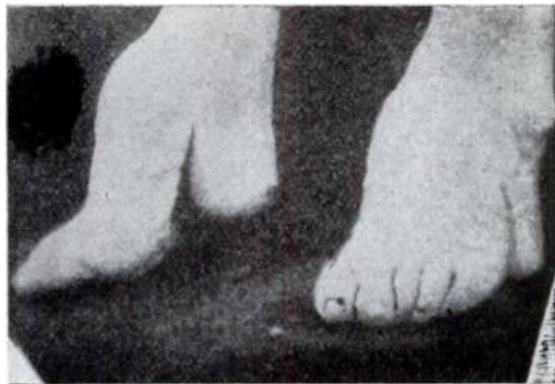


FIG. 8 FEET OF HIGH CASTE CHINESE LADY SHOWING TYPICAL DEFORMITY FROM BANDAGING



FIG. 9 SHOES WORN ON THE FEET PICTURED IN FIG. 8.

Comparing the tracings, marked difference was observed between the old and the new, the latter showing narrowing of the front of the foot, and the direction of the long axis of the great toe somewhat changed. (Fig. 10.) The cause of this was not hard to find. Late in October, the weather becoming too cold for the tropic-horn Bagobos to wear their native costumes with any degree of comfort., most of them, including these two children, began wearing shoes, which, made over the conventional American lasts, were, of course, much too narrow for their feet of pristine form. Another Bagobo boy of twelve, who had worn shoes for a number of months before leaving his native island, presented well advanced shoe deformity. Fig. 11 shows a photograph of a plaster cast of one of his feet contrasted with that of an adult Bagoho male that had never worn shoes.

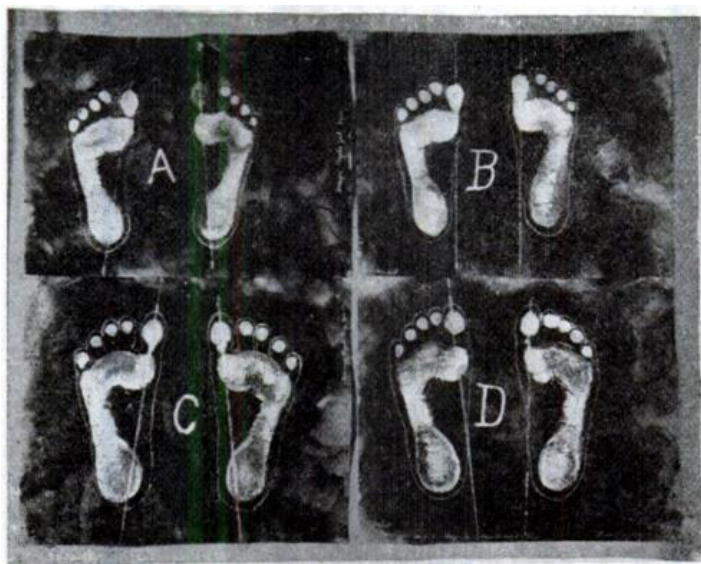


FIG. 10 FOOT IMPRESSIONS AND TRACINGS OF BAGOBO CHILDREN, SHOWING THE EFFECT OF A FEW WEEKS OF SHOE-WEARING. A AND C BEFORE, AND B AND D AFTER SHOE-WEARING. NOTE NARROWING OF FRONT OF FOOT AND CHANGE IN DIRECTION OF LONG AXIS OF GREAT TOE.

Though shoe-wearing evidently made some of the primitive Filipinos very uncomfortable, it was remarkable that the majority appeared but little inconvenienced by their first trial of footwear, which was not, in many instances, much over half the normal width of the foot. it concealed. This led me to determine to what extent it was possible to painlessly compress their feet. Two records of these experiments, one in a Moro and the other in a Bontoc Igorrote, both adult males, are shown in Fig. 12. The solid lines show the normal foot outlines and the dotted ones show outlines of the same feet manually compressed without pain. In Fig. 13 are shown the results of similar experiments on adults of a shoe-wearing community. The range of painless compression, while not as great as in the barefoot, is considerable. If foot compression always led to immediate and severe discomfort, it would not

perhaps, be quite so common. Nevertheless, painful or painless, when long continued, it must result in irreparable damage.

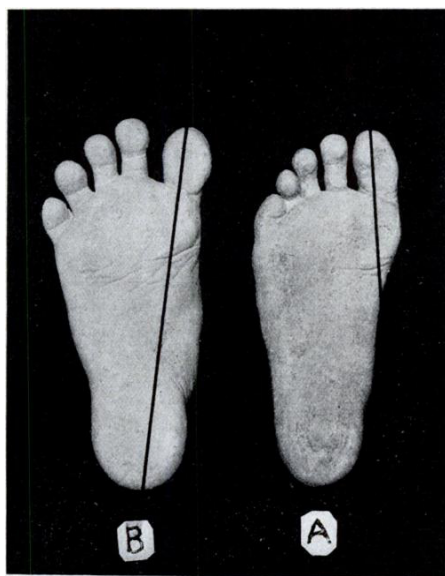


FIG. 11 A, PHOTOGRAPH OF PLASTER CAST OF FOOT OF BAGOBO BOY THAT HAD WORN SHOES A FEW MONTHS, CONTRASTED WITH B, PHOTOGRAPH OF AN ADULT BAGOBO THAT HAD NEVER WORN SHOES.

Fig. 14 represents outlines of feet and their coverings as found in shoe-wearing communities. The solid lines show those of the feet and the dotted ones those of their respective shoes. These are not exceptional but average illustrations, and fairly indicate the pressure to which millions of human feet are subjected day after day through a lifetime. The feet in time become so used to compression that they cease to be conscious of it.

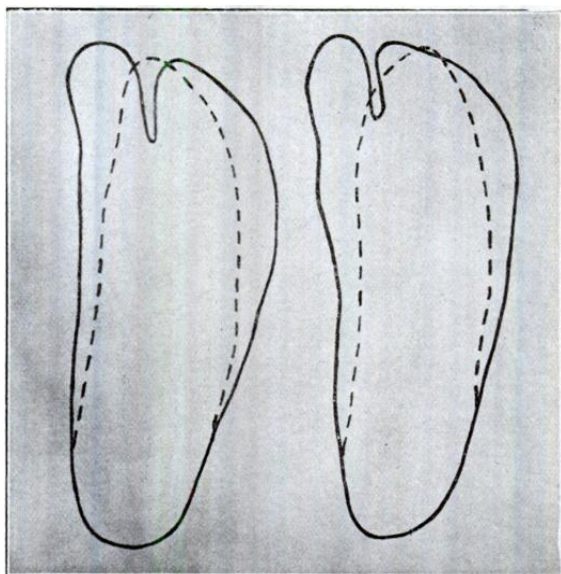


FIG. 12 RANGE OF PAINLESS COMPRESSION OF FEET IN BAREFOOTED PEOPLES. BONTOC IGORROTE AND MORO. SOLID LINES SHOW NORMAL FOOT OUTLINES; DOTTED ONES, OUTLINES OF SAME FEET MANUALLY COMPRESSED WITHOUT PAIN. COMPARE WITH FIG. 13.

Shoes as they are usually worn, not only deform but interfere with the functions of the foot by restricting the movements of its many small joints. Their action is more or less that of a splint. Normally, the toes can be hyper-extended to nearly a right angle and flexed well beyond one. The range of adduction at the medio-tarsal articulation should be between 30 and 40 degrees. In watching the naked foot of an infant, it will be seen that there is a considerable range of lateral motion of the toes which permits their voluntary separation. This persists in older children whose feet have not been injuriously compressed by shoes, and was found also in nearly all adults among the barefooted tribes. These movements are rarely so free in shoe wearing adults, and their range largely depends upon the type of shoe that has been worn, especially during childhood. It is rare to find an adult in a shoe-wearing community that retains even slight power of laterally

separating the toes.

In most adult shoe-wearers the toes, beyond giving additional length to the foot, are practically functionless, while in barefooted peoples they serve a variety of functions, as in climbing and grasping. (Figs. 15, 16, 17 and 18.) This difference in function is not due to a congenital difference in structure, but is dependent upon daily use and development of such functions in the bare foot and their inhibition in the shoe-wearer. The same development, of toe function could undoubtedly be attained by individuals of shoe-wearing races. I remember seeing a young man, who, born without hands, had so thoroughly trained his toes to perform many of those functions for which fingers are ordinarily considered indispensable, that he could use knife and fork, comb and brush, and pen and ink; could wash and dress himself, perform on the piano and do many other things with considerable ease. This was very unusual, but it well illustrates to what extensive intricate uses the commonly cramped and abused foot may be put.

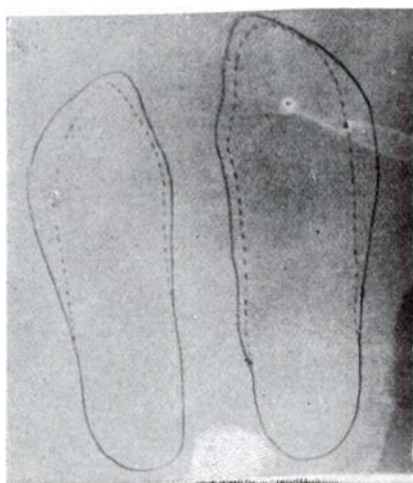


FIG. 13.-RANGE OF PAINLESS COMPRESSION OF SHOE WEARING FEET. COMPARE WITH FIG. 12.

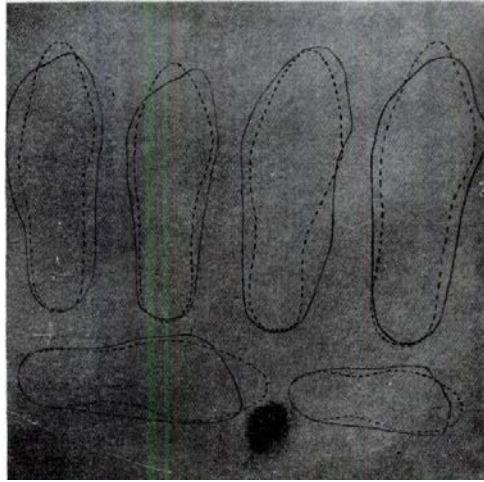


FIG. 14 OUTLINES OF AVERAGE FEET AND FOOTWEAR. SOLID LINES SHOW OUTLINES OF FEET; DOTTED ONES, OUTLINES OF SHOES WORN ON THESE FEET

The ancient sandal did not compress the toes or interfere with their independent movements. The result of this freedom is shown in classic sculpture, which represents strong toe action in many of its athletic figures. An especially good example is the right foot of the famous Discus Thrower, attributed to Myron (Fig. 19), the toes of which fairly grasp the ground to aid in steadying the athlete at the moment of supreme effort when he is straining every muscle to begin the forward motion of the arm.



FIG. 15.-NEGRITOS. USING TOES IN CLIMBING.



FIG. 16.-NEGRITO BOY, USING TOES IN GRASPING.

My attention was especially attracted to the condition of the

skin covering the primitive foot; to a remarkable degree it resembles that of the hand. The skin of the sole is thick and tough, though very pliable, and free from the callous spots due to continued friction of time hoot, common in shoe-wearers. It is marked by deep transverse folds corresponding to the lines of joint flexion, similar to those universally present in the palm of the hand. (Fig. 1 and Fig. 11, B.1). The skin of the dorsum presents numerous minute, though well marked, folds, such as may be seen on the back of the hand. (Fig. 2.1) The depth and distinctness of these folds in the barefooted is probably due to the almost constant movements of the phalangeal and tarsal joints with the concomitant intermittent folding of the skin.

Observations on the longitudinal arch of the foot led to the conclusion, contrary to common opinion and teaching, that its height and shape are of little or no value in estimating the usefulness of the foot, and that there is no one type as the normal, but that normal feet present high, medium and low arches. While it is true that time moderately high arch is in preponderance, the very low arch, when present, seems to be no indication of weakness, and in the many instances where it was found in the Primitive Filipino or African, it was associated with a foot that was strong and flexible. The lowness of the arch was real and not merely simulated by an underlying pad of fat. The impression records of the longitudinal arch, commonly made by surgeons, are, apparently, of no value in the diagnosis of the so called flat foot, whose symptoms are dependent upon a weakened arch and not upon its lowness, except in so far as its lowness is a transition from an original higher condition with concomitant change in the relationship of the tarsal hones and strain of ligaments and muscles. Such transition, in my opinion, rarely occurs. It is not uncommon to find the same symptoms associated with arches of good height and I have frequently found them associated with an extraordinarily high arch. It is equally as common to find low arches in symptomless feet.



FIG. 17.-PREHENSILE FUNCTION OF PRIMITIVE FOOT.



FIG. 18.-BAGOBO WOMAN, USING TOES AS A THIRD HAND TO HOLD YARN TAUT.

It is very significant that in the one hundred eighty six pairs of primitive feet examined, I did not find a single foot associated with the symptoms of weakness so characteristic and common

in adult shoe-wearing feet, which are weakened by the restraint the shoe exerts over function. Through interpreters I made careful inquiry in regard to this, especially whenever I found an arch that was exceptionally low.

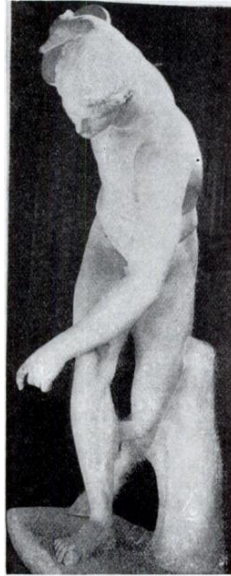


FIG. 19.-DISCOBOLUS OF MYRON, SHOWING STRONG TOE ACTION.

Fig. 20 illustrates some of the types of arches found in normal feet. These impression records, which were made by the common method of weight-bearing on smoked paper, do not really show the height of the longitudinal arch, but show how much of the sole comes in contact with the ground in weight-bearing. This, however, usually bears a relationship to the height of the arch, and I speak of height in connection with these records in this sense only. Comparison of smoked imprints with plaster casts of the same feet, taken while bearing the body-weight, showed a correspondence in each instance to the flattened area of the sole of the cast caused by body-weight compression. This showed that the weight-bearing area could be accurately determined by this method. The casts also showed that there was an almost constant

relationship between the extent of this area and the arch height; that is, the farther the imprint extended inward, the lower was the arch.

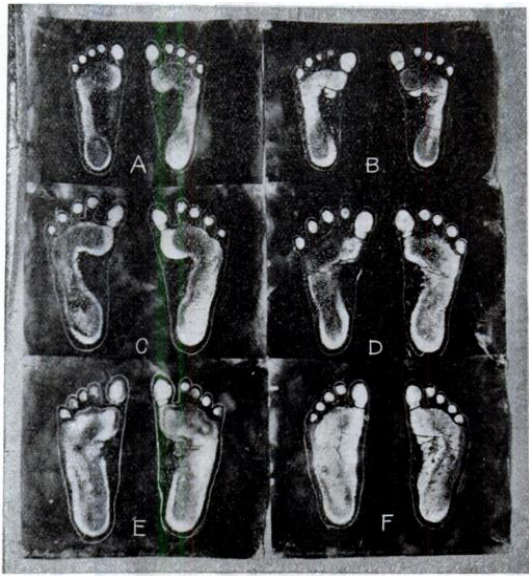


FIG. 20.-A FEW OF THE TYPES OF ARCHES FOUND IN NORMAL FEET.

The following tables illustrate the frequency with which the different types occurred in the 186 barefooted subjects examined. Of course there were many intermediate grades, which are included in the types they most nearly resemble.

Table 1. Frequency of different types in 46 Moros, Philippine Islands, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	4	8 $\frac{1}{2}$ $\frac{2}{3}$
B.....	6	13 $\frac{1}{2}$ $\frac{1}{3}$
C.....	7	15 $\frac{5}{2}$ $\frac{2}{3}$
D.....	7	15 $\frac{5}{2}$ $\frac{2}{3}$
E.....	9	19 $\frac{1}{2}$ $\frac{2}{3}$
F.....	13	28 $\frac{4}{2}$ $\frac{2}{3}$
	46	100

Table 2. Frequency of different types in 27 Bagobos, Philippine Islands, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	2	7 $\frac{1}{3}$
B.....	6	22 $\frac{1}{3}$
C.....	5	18 $\frac{1}{3}$
D.....	4	14 $\frac{2}{3}$
E.....	5	18 $\frac{1}{3}$
F.....	5	18 $\frac{1}{3}$
	<hr/> 27	<hr/> 100

Table 3. Frequency of different types in 3 Mangyans, Philippine Islands, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
C.....	1	33 $\frac{1}{3}$
E.....	2	66 $\frac{2}{3}$
	<hr/> 3	<hr/> 100

Table 4. Frequency of different types in 70 Igorrotes, Philippine Islands, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	6	8 $\frac{2}{3}$
B.....	2	2 $\frac{6}{7}$
C.....	8	11 $\frac{1}{3}$
D.....	24	34 $\frac{2}{3}$
E.....	18	25 $\frac{4}{5}$
F.....	12	17 $\frac{1}{3}$
	<hr/> 70	<hr/> 100

Table 5. Frequency of different types in 33 Negritos, Philippine Islands, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	3	9 $\frac{3}{33}$
B.....	4	12 $\frac{4}{33}$
C.....	5	15 $\frac{5}{33}$
D.....	6	18 $\frac{6}{33}$
E.....	6	18 $\frac{6}{33}$
F.....	9	27 $\frac{9}{33}$
	<hr/> 33	<hr/> 100

Table 6. Frequency of different types in all Philippine tribes, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	15	8 $\frac{1}{5}$
B.....	18	10
C.....	26	14 $\frac{2}{5}$
D.....	41	22 $\frac{1}{5}$
E.....	40	22 $\frac{1}{5}$
F.....	39	21 $\frac{4}{5}$
	<hr/> 179	<hr/> 100

Table 7. Frequency of different types in 7 Central African Negroes, *i. e.*, Pigmy, Baluba, Chiri Chiri and Bakuba, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	2	28 $\frac{2}{3}$
B.....	1	14 $\frac{2}{3}$
D.....	2	28 $\frac{2}{3}$
E.....	1	14 $\frac{2}{3}$
F.....	1	14 $\frac{2}{3}$
	<u>7</u>	<u>100</u>

Table 8. Frequency with which the types of arches shown in Fig. 20 occurred in all barefooted subjects examined. Feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	17	9 $\frac{4}{11}$
B.....	19	10 $\frac{7}{11}$
C.....	26	14
D.....	43	23 $\frac{4}{11}$
E.....	41	22
F.....	40	21 $\frac{5}{11}$
	<u>186</u>	<u>100</u>

In addition to the 186 barefooted individuals forming the basis of these statistics, I examined 45 South African Negroes, *i. e.*, Matabele, Zambesi, Hottentot, etc., all adult males who had gone barefooted up to early manhood and had worn shoes during the last five or six years only. Table 9, which tabulates records of their foot impressions, may be of interest as showing the frequency of the different types of arches in this group.

Table 9. Frequency of different types in 45 South African Negroes, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	6	13 $\frac{3}{5}$
B.....	7	15 $\frac{3}{5}$
C.....	8	17 $\frac{3}{5}$
D.....	7	15 $\frac{3}{5}$
E.....	11	24 $\frac{3}{5}$
F.....	6	13 $\frac{3}{5}$
	<u>45</u>	<u>100</u>

That as great variation in the height and shape of the longitudinal arch exists in Caucasian shoe-wearers as in

barefooted peoples, is shown in Table 10, which is based upon the examination of 200 pairs of normal, or at least symptomless, feet.

Table 10. Frequency of different types in 200 Caucasian shoe-wearers, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	27	13½
B.....	20	10
C.....	27	13½
D.....	53	26½
E.....	40	20
F.....	33	16½
	<hr/> 200	<hr/> 100

That the same is true of the American shoe-wearing Negro is shown in Table 11, which is based upon the examination of 100 pairs of symptomless feet.

Table 11. Frequency of different types in 100 American shoe-wearing Negroes, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
A.....	18	18
B.....	13	13
C.....	19	19
D.....	21	21
E.....	16	16
F.....	13	13
	<hr/> 100	<hr/> 100

Table 12 shows the variation in five sandal-wearing Ainus.

Table 12. Frequency of different types in 5 Ainus, Caucasian Sandal-wearers; Northern Japan, feet symptomless.

TYPE OF ARCH.	NUMBER OF INDIVIDUALS.	PERCENT.
B.....	1	20
C.....	1	20
D.....	1	20
E.....	2	40
	<hr/> 5	<hr/> 100

It is probably true that weakness of the structures composing and maintaining the longitudinal arch is in some instances accompanied by depression of the arch, and that on account of this depression a greater area of the sole of the foot comes in contact with the ground. However, it was demonstrated by examination of imprints on smoked paper of 560 feet treated by me, all presenting more or less typical symptoms of weakness of the longitudinal arch, and nearly all deriving benefit from arch supports, that arch depression is not as frequent and marked as is commonly taught; in fact, that the average character of the imprints commonly made for diagnostic purposes does not differ much from the average character of those found in symptomless feet. The result of this examination is shown in Table 13.

Table 13. Frequency of different types in 560 Caucasian shoe-wearing feet that presented symptoms of weakness of the longitudinal arch.

TYPE OF ARCH.	NUMBER OF FEET.	PERCENT.
A.....	64	11 $\frac{3}{7}$
B.....	72	12 $\frac{6}{7}$
C.....	76	13 $\frac{4}{7}$
D.....	92	16 $\frac{3}{7}$
E.....	108	19 $\frac{2}{7}$
F.....	148	26 $\frac{3}{7}$
	<u>560</u>	<u>100</u>

Table 14 shows the comparative frequency with which the different types of arches shown in Fig. 20 occurred in Philippine Malays (Barefooted); Central African Negroes (Barefooted); South African Negroes (Barefooted up to last six years); American Negroes (Shoe-wearers); Caucasians (Shoe-wearers); Ainus, Caucasians, Northern Japan (Sandal-wearers); all presenting symptomless feet; and in Caucasians (Shoe-wearers) under treatment for symptoms of weakness of the longitudinal arch.

TABLE 14.

FOR TYPES SEE FIG. 20.		PHILIPPINE MALAYS, BARE-FOOTED, FEET SYMPTOMLESS. INDIVIDUALS EXAM- INED, 179.	CENTRAL AFRICAN NEGROES, BARE- FOOTED, FEET SYMPTOMLESS. INDIV- IDUALS EXAMINED, 7. NUMBER TOO SMALL FOR RELIABLE CONCLUSIONS.	SOUTH AFRICAN NEGROES, BARE-FOOTED UP TO LAST SIX YEARS, FEET SYMPTOM- LESS. INDIVIDUALS EXAMINED, 45.	AMERICAN NEGROES, SHOE-WEARERS, FEET SYMPTOMLESS. INDIVIDUALS EX- AMINED, 100.	CAUCASIANS, SHOE-WEARERS, FEET SYMP- TOMLESS. INDIVIDUALS EXAMINED, 200.	AINUS, CAUCASIANS, NORTHERN JAPAN, SANDAL-WEARERS, FEET SYMPTOMLESS. INDIVIDUALS EXAMINED, 5. NUMBER TOO SMALL FOR RELIABLE CONCLUSIONS.	CAUCASIANS, SHOE-WEARERS, UNDER TREATMENT FOR SYMPTOMS OF WEAK- NESS OF THE LONGITUDINAL ARCH. IN- DIVIDUALS EXAMINED, 560.
Type A	84%	284%	133%	18%	131%	—	117%	
" B	10	147	152	13	10	20	128	
" C	14	—	171	19	134	20	134	
" D	22	284	152	21	264	20	162	
" E	22	144	242	16	20	40	197	
" F	21	144	138	13	164	—	267	
	100%	100%	100%	100%	100%	100%	100%	

Analysis of Table 14 shows that in the 536 individuals of different races, with symptomless feet, the American and primitive Negroes presented a smaller percentage of low and a larger percentage of high arches than did the Caucasians. This contradicts a commonly accepted view. The Philippine Malay showed a somewhat larger percentage of low arches than did either the Negro or Caucasian. Another thing shown in this table is that the 560 Caucasian feet with symptoms of weakened arches, did not present a much larger percentage of low arches than did the symptomless Caucasian feet. The histories accompanying these 560 impression records, show that the feet with long standing or severe symptoms did not occur oftener among the lower arch-types than did those whose symptoms were mild or of short duration.



FIG. 21 .-PHOTOGRAPH OF NEGRITOS, SHOWING HABITUAL FOOT POSTURE IN STANDING.



FIG. 22.-PHOTOGRAPH OF NEGRITOS, SHOWING HABITUAL FOOT POSTURE IN WALKING.

If these statistics are a fair index for all feet, the conclusion is justified that weakness of time longitudinal arch rarely results in its depression, and that flat foot as a pathological entity hardly exists.

The height of the arch appeared to bear no relationship to the gait. In shoe-wearers, the affection commonly called flat foot is often associated with more than ordinary eversion of the foot on standing and walking. This eversion is due not to the low arch, but to the associated weakness or stiffness of the joints of the foot and weakness of the muscles controlling them. To walk with the toes pointing forward is to use the foot as a lever that raises and propels the body. This means muscle exertion and joint motion. To avoid the performance of this work, the weakened foot is everted. The more it is everted, the less is its leverage function used, and, finally, it degenerates into a mere pedestal that bears the body weight. Among the Negritos who practically all have a very straight walk, i. e., the toes pointing forward or even slightly inward, very low arches were common, while among the Bagobos it was just as common to find high arches associated with more or less eversion.



FIG. 23.-BONTOC IGORROTE STANDING.



FIG. 24.-BONTOC AND SUYOC IGORROTES WALKING.

I must say that I was somewhat disappointed at not finding the straight or leverage gait as common among primitive peoples as I had supposed, though, on the whole, it is far more common than among shoe-wearers. As mentioned it was found practically universal in the Negritos (Figs. 21 and 22); in the Bontoc Igorrotes it was the rule (Figs. 23 and 24); in the Suyoc Igorrotes it was less common and in the Moros much less so, while in the Bagobos the everted gait, often very marked, was predominant. (Fig. 25.)



FIG. 25.-BAGOBO WALKING AND GROUP OF BAGOBO IN BACKGROUND STANDING.

The position of the feet on standing in most instances corresponded to that of the leisurely gait; on rapid walking, the toes were turned more inward in those individuals that everted when walking slowly.

Among time Central African group eight individuals were examined: namely, four Pygmies, two Bakubas, one Chiri Chiri and one Baluba. All had fine arches except the Baluba, who had a strong and symptomless foot though practically no arch., He everted twenty degrees, i. e., each foot ten degrees from the median line; the same degree of eversion was noted in one of the Pygmies, who had! a very good arch. Three of the group had a very straight walk, one everted three degrees, one

sixteen and one eighteen degrees. By the degree of eversion is meant the angle between the inner borders of the feet. This, of course, makes the eversion of each foot only half of the record.

The foot structure suggested nothing as to the cause of the difference in gait. Mode of life or local terrestrial conditions may have something to do with it, but I must confess that my inquiries in these directions were not very diligent.

SUMMARY

The relative lengths of the foot and its component parts are practically the same in barefooted and shoe-wearing races. Its form, functions and range of voluntary and passive motion are the same in both up to the time of shoe-wearing, after which progressive characteristic deformation and inhibition of function ensue. Here, as in other instances, acquired characteristics are not transmitted. The children of shoe-wearers inherit the same type of foot as do those of barefooted races, and this type is changed only in so far as footwear modifies it.

The height and shape of the longitudinal arch have no bearing on the strength or usefulness of the foot. Weakness of the arch is rarely, if ever, accompanied by breaking or lowering, and flat foot as a pathological entity hardly exists.

There is no relationship or coincidence between the height of the arch and the character of the gait.

These studies were by no means as thorough as I would like to have made them, though they represent the congenial work of many hours stolen from the humdrum of practical existence. I am deeply indebted to Dr. W J McGee, Chief of the Department of Anthropology, Louisiana Purchase Exposition, and Dr. W. P. Wilson, President of the Philippine Exposition Board, through whose aid these studies were rendered possible.

DISCUSSION

Dr. HENRY LING TAYLOR, of New York, wished to express his deep interest and appreciation of this work and the interesting results which had been obtained. Such information should be more largely disseminated so that the public might know of it. There are many points about the shape of the feet and their relation to shoe wearing, and about postures in standing and walking, which when known and applied by experts in various fields, especially in gymnastics, military drill, and in shop and factory work, will result in increased efficiency and diminished suffering.

Dr. A. H. FREIBERG wished to know how long the tracings were taken after the shoe was removed from the foot. He thought that more compression would be shown by the tracing immediately upon removing the shoe than some time afterward. He asked also what was considered a negro in making a study of the feet of negroes. He said that there were a good many shades of negroes and very few that are actually black, in Cincinnati. These latter were the only ones that he used in his investigations unless otherwise specified. He thought it important in the result to know how much Caucasian blood was mixed with the black blood.

Dr. T. HALSTED MYERS, of New York, said that with regard to the statement that the height of the arch and general shape of the foot were not a measure of symptoms that he believed the same to be true in the white races and that one cannot always judge from the shape of the foot what the symptoms might be.

Dr. JOHN RIDLON said that the question of diagnosis of the condition being a flat foot, or beginning flat foot, because it was relieved by a steel support, was not necessarily so. A steel support might relieve pain in the foot, or pain might be due not to the flat foot, but to a lack of normal dorsal flexion which might be due to a shortening of the calf muscles or what Schaffer has called non-deforming club-foot.

Dr. PHIL. HOFFMANN, in closing, said that all the cases included in the analysis of primitives were barefooted except the five Ainus, who were sandal wearers. Later, for comparison, he had taken 200 white and 100 black shoe wearers. In examining the latter he had endeavored to secure those of as nearly pure African blood as possible. Among the shoe-wearers nearly every case had presented a certain amount of hallux valgus, but no special attention had been paid to this relationship. The group presenting symptoms were selected from Caucasians for the purpose of comparing with symptomless Caucasian feet. He did not find one primitive foot with symptoms. All had good strong feet. The diagnosis of weakened arch was based upon the symptom-complex, and not upon the fact of relief by an arch support.

You Have a Foot Size, *Not* Shoe Size

by Mark Cucuzzella, M.D.

The Latin expression, *nihil novi sub sole*, which translated means “there is nothing new under the sun,” came to mind when I first come across Dr. Phil Hoffman’s 1905 study of feet from the Philippines and Pygmies of Central Africa. Neither group ever wore shoes. Their feet were healthy. As for the shoe-wearing population, Hoffman concluded that most modern shoes not only ignored the natural shape of the human foot, but also end up ruining them because they were too narrow.

The shape of the foot and its range of voluntary and passive motion are practically the same in barefooted and shoe-wearing races up to the time of the use of footwear that compresses and splints the foot, usually about the end of the first year, after which, in shoe-wearers, there is progressive narrowing of the anterior portion of the foot and diminution in the range of motion of its phalangeal, tarsal and ankle joints. The {shoe} lasts over which the footwear of civilization is shaped are rarely modeled in the spirit of truth that would make them conform to the contour of a normal foot..., Society, apparently, agrees that the human foot as formed by nature is coarse, vulgar and! unsightly, and that its width, especially at the toes, is entirely too great. It regards the small, especially the narrow foot, as the beautiful one.

I’m always scouring the web looking for both old and new studies about the human foot. Leonardo da Vinci called the foot a “masterpiece of engineering”. I couldn’t agree more. The subject of feet and shoes fascinates me on several fronts—as a medical doctor, owner of a natural running and walking store, father of two active young children, and someone who

has been running for over 30 years.

Hoffman's study surfaced while I was doing research for a *Running Times's* article on children running shoes and foot health that I co-wrote with gait expert Jay Dicharry, who is the author of the popular book, "Anatomy for Runners."

Here's an excerpt from my contribution to the magazine piece:

When parents have questions regarding the health needs of their children, they often seek the advice of medical professionals. As a family practice physician, I consider prevention and overall health as important as disease treatment. Unfortunately, when it comes to the science on feet, footwear, overuse injuries, structural development, and even nutrition, our education is wanting.

We often defer to the conventional wisdom of the day. "Of course a foot needs cushion and support," we reflexively think, in the same paradigm of "to prevent getting fat, you should eat low-fat." We are slowly discovering that much conventional wisdom is not grounded in science, and the results are showing.

Foot experts seem to offer little more. The American Academy of Podiatric Sports Medicine has a Children's Page, which gives little information on the properties of shoes. The American Podiatric Medical Association's position paper on children's shoes says, "Select a shoe that's rigid in the middle. Does your shoe twist? Your shoe should never twist in the middle." Right below that, in fine print, you find, "This does not apply to toddlers shoes. For toddlers, shoes should be as flexible as possible." To us, this raises the question, "So at what time does a toddler become a child and we restrict their feet?"

In recent years, leading gait and running researchers Irene Davis and Daniel Lieberman have been giving us the basic science of how we run in barefoot and shod conditions and

how footwear affects this, even at a young age. This has shifted the conventional wisdom toward shoes that allow a more natural gait for adults. But their research is even more relevant for youths, as childhood is the time when the neuromuscular pathways are forming,

Jay Dicharry is in the same camp as Irene, Daniel, and myself when it comes to foot health for all age groups. Here's an excerpt from what Jay wrote in *Running Times*:

In essence, we still practice the ancient art of Chinese foot-binding. Glance over at the foot of any newborn and you'll notice that the widest part of their foot is not the ball of the foot but their toes. Then take a look down at your foot. You'll likely notice that these feet don't look the same. The narrow toe boxes in athletic and fashion footwear have changed the alignment of our feet, just like braces once did to legs. We've been taught that a pointy shoe looks normal — both fashionable and fast — and we're willing to change our foot shape to accommodate this look.

I've had the privilege of working with a number of runners who grew up sans shoes, and their feet are different from ours. As adults, these runners don't rely on stiff shoes because they've developed strong, stiff feet. Years of barefoot movement have resulted in robust muscular attachments to anchor and stabilize the foot. The average Western foot — having grown up dependent on shoes — pales in comparison.

Jay's experience with runners is perfectly aligned with Hoffman's medical observations about the two barefoot populations. Since the early 1900s, scientific fieldwork has only validated Hoffman's work.

As a military officer in the U.S. Air Force, I'm involved in finding ways to make soldiers healthier, and that often begins with their feet and the shoes they wear. I can't help but marvel at the life and work of Brigadier General Edward Lyman Munson. As Professor of Military Hygiene at the Army Service

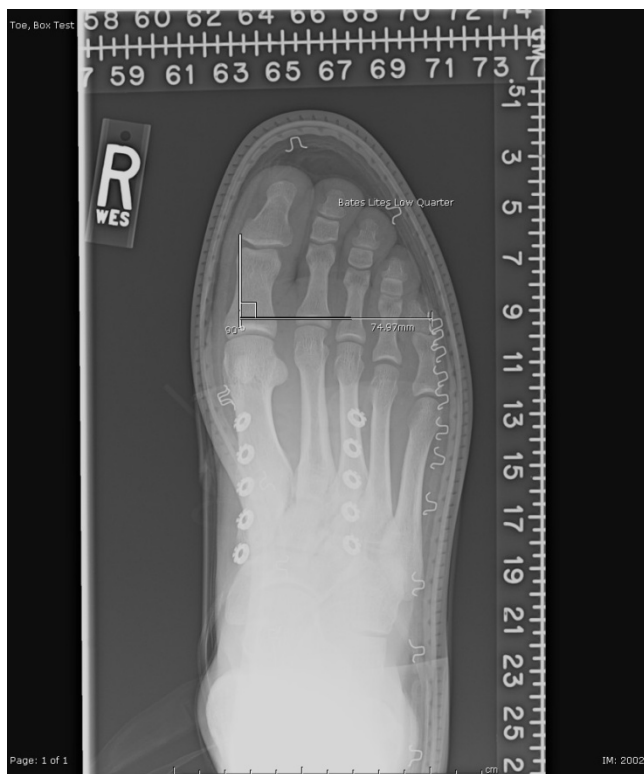
School in Washington, in 1912, Dr. Munson designed the military field shoe. For an infantryman, who often walked all day, proper care of his feet was important as carrying a clean, working rifle. The amount of disability from foot problems was incalculable, and in those days an army with food in their bellies and healthy, functional feet meant that soldiers were better equipped to fight. The boot last (or shape) that Munson created served the U.S. Army soldiers right through the Second World War. Known as the G.I. shoe, it was shaped like a bare foot with a wide toe box, no heel rise, and flexibility throughout.



Barefoot X-Ray

General Munson wrote several books on Army hygiene, including the authoritative work, "The Soldier's Foot and the Military Shoe." Munson observed that many in the military viewed the foot problems as an inevitable outcome of the

soldier's own physical conditions, but he knew this was not really the case. "The human foot is not to be regarded, as seems almost to be the idea with many, as an in coordinating mass of flesh, bone and gristle which may with impunity be crowded into almost any sort of protective covering to form a fleshy peg, more or less similar to a horse's hoof, on which to walk. It is, on the contrary, one of the most intricate anatomical structures of the human body."



Military Dress Shoe X-Ray

On the topic of fashion footwear, he was especially brutal: "The construction of shoes for civilians is influenced almost wholly by considerations of fashion and style. These are irrational and are frequently changed in the financial interest of the shoe trade. The lasts are devised by persons grossly ignorant of, and quite indifferent to, the structure of the human foot and its physiological requirements as to covering."

Moving a forward in time, there's a fascinating barefoot vs. shoe survey by Samuel B. Shulman, "Survey in China and India of Feet That Have Never Worn Shoes," that appeared in *The Journal of the National Association of Chiropodists* (1949). Shulman looked at a large population of 5,000 shod and barefoot men and women. His interpretation of the data seems a lot like what one reads on many of the barefoot blogs appearing more than 60 years later: "People who have never worn shoes acquire very few foot defects, most of which are painless and non-debilitating. The range of their foot motions are remarkably great, allowing for full foot activity. Shoes are not necessary for healthy feet and are the cause of most foot troubles. Children should not be encouraged to walk prematurely and should not wear any footwear until absolutely necessary. Footgear is the greatest enemy of the human foot."

So how do these earlier works relate to modern issues on foot health? At Two Rivers Treads, we defy old-school thinking of sizing and narrow-shaped, ill-fitting conventional shoes. Improper shoe sizing and shape are, in my experience, the primary cause of common ailments such as ingrown toenails, bunions, corns, and hammer toes. Shoes that don't fit your feet correctly can also lead to muscular imbalances in the body, leading to foot, knee, and hip injuries.

A proper fit accounts for the natural expansion of the foot upon ground contact. Excess waste is eliminated, along with everything that inhibits your foot's natural motion. So your foot is free to move and work the way nature intended, or what is essentially barefoot motion. Call it toe-wiggle freedom.

Instead, from an early age, our shoes deny us this natural freedom. When I had toe surgery in 2000, I did not fully understand why both of my great toes were bent in (a painful condition called *hallux valgus*). Like so many competitive runners, I accepted the foot pain and repetitive stress injuries as part of running. At the time, none of the foot specialists that I saw ever mentioned to me that the problem could have been

due to wearing running and street shoes that were too narrow. Before I had surgery, I used to squeeze my feet into a size-10 shoe, believing it was perfectly normal and acceptable to have snug-fitting shoes. I now wear a size 12.5 or 13.



My feet post-op 2000. Notice the angle of my large toe.

By wearing small shoes, my big toes had become crooked. Since that corrective surgery, I have been running without pain. Just as C. H. Barnett, M.D. wrote in the 1962 *Journal of Anatomy*, “the large toe can regain some of its straightness when taken out of modern shoes”. My toes are now straighter although they are far from perfect. I do a lot of barefoot running. Because I’m on my feet all day at the hospital, I wear flat-sole, roomy shoes. I also keep my toes straight with a product called Correct Toes. Podiatrist Dr. Ray McClanahan, who wrote the introduction to this booklet, is the creator of Correct Toes.

Finding the Best Shoe For Your Feet

Half of the customers who enter Two River Treads have no interest in running or buying running shoes. That's because we are not exclusively a "minimalist running store". We also carry shoes for walkers and hikers. But we tell *all* our customers that they need to abandon the notion that they have a *shoe size*. Instead they have a *foot size*. Moreover, wearing an ill-fitting shoe offsets the benefits of going to a flat-soled, minimalist shoe.

When I look at what is an *ideal shoe*, I base it on what is ideal to complement natural foot function. Let's start with the hypothesis that the foot is designed to work on its own *without* the need of modern bracing, cushioning, and motion- control technology. One may deviate some from this to compensate for a specific structure or foot-strength issue. The goal is progressive rehabilitation toward the ideal and getting the walker or runner in the *least amount of shoe that is safe for them while they work on the functional corrections*. For rough terrain and long distances a bit more protection and cushion is preferred by some, but the principles are still the same.

So what are the four simple features of an ideal shoe?

1. **Level Heel to Toe (Zero-Drop).** Our arches are designed to be supported at the ends, and that means heel, ball, and toes in level and balanced contact. This facilitates stability and balance in mid-stance. A shoe should not have "toe-spring" either. This upward curving of the shoe places toes in extension and contributes to extension deformities (hammer toes). Level shoes also complement a proper posture.

2. **Flexible Last.** Your foot naturally bends in all directions as should your shoe. Most shoes are stiff in the middle and stiff where your toes bend at the ball of the foot (MTP joint). Recent research also validates that strong metatarsals also bend a bit but do not break.

3. **Wide Toe Box.** When the big toe is compressed to be out of alignment the front end of the arch does not work. The big toe is not allowed to aid in balance, stability, and propulsion.

4. **Not too soft or too thick.** The thinner and firmer the shoe the more ground feel (proprioception) you have. *The increased ground feel allows your body to adjust to the forces of running in a more efficient way and is optimal for learning natural running form and technique.* Without a firm message to the nervous system our body does not know which muscles to use, how hard to turn them on, and how long to keep them on for. To get a clear message in thick/soft shoes we are forced to strike the ground harder and drive the foot onto a firm surface to give us the feedback we require.

Bottom line here: You need to let your feet come and splay. Obviously, given a lifelong addition to poor-fitting shoes and designs, an addiction that is not necessarily the fault of the consumer but is the result of media and market manipulation, many runners and walkers aren't always ready to go straight to minimalism.



Dr. Mark and his children Leo and Lily enjoy the outdoors and movement barefoot and in minimal shoes.

At Two Rivers Treads, we see many customers who have a structural, strength, or mobility issue that does not allow the ideal foot function. So we give them specific corrections with exercises they can do all day. If they have the *hallux valgus* deformity we suggest they use Correct Toes. Metatarsal pads are useful for toes held high in extension as the client works on getting toes down on the floor through the toe-yoga exercises. For almost of us, get in a flat shoe *all day* – for walking and standing. Wear the thinnest and most flexible shoe you can to aid in foot retraining.

At our store, we never had a customer return shoes because they were too big. Do not assume you are the same size as a previous shoe.

Here then are some guidelines in selecting shoes that properly fit your feet:

- Take your time and try several shoes on, preferably at the end of the day. Go run in them. Do not try them on sitting.
- Always try both shoes on. If feet are slightly different size fit the larger foot.
- Take out the shoe removable insole out and see how your foot fits against the insole as a template. Is there room at the toes or does your foot spill over the insole? If no room to spare or if your foot spills over this shoe will not fit comfortably.
- Keep going half size up until the shoes are obviously too big.
- Try on shoes at end of day when feet are most flattened and swollen.
- Try on with the type of sock you will wear for activity. Which style of socks you wear (low-cut or above the ankle) and what they're made of (natural fibers such as wool or cotton, or a blend of synthetics) is up to you. But like shoes, make sure they fit well; and be careful to avoid the sock interfering with shoe fit. My preference is merino wool or light synthetic blend.

- For women, the fit might be better in a men's shoe for width.
- Do not lace the shoes up tight. Allow spread in the midfoot and forefoot.
- Go up onto the ball of the foot. Can you put your index finger between your heel and the back of the shoe? If not, it's likely too small.
- Consider not using the soft insole. This takes up space in the shoe and interferes with ground feel.
- Walk on a firm surface, not a carpeted one.
- If you are a runner you must run in the shoe. What feels nice and soft when walking is the opposite of what you need when running, which is a more firm base to give the message up your kinetic chain to stabilize.
- Sandals are great as they allow for natural foot spread without restriction from an upper.
- Remember, you have a foot size, not shoe size.

Concluding Thoughts

Dr. William Rossi, author of over 200 scientific papers and a leading researcher in the field of Podiatry, concluded the following after 60 years in the field: "The shoe, ideally, should be an anatomical and functional replica of the foot. And this should be considered a biomechanical law: The less a shoe does to a foot, the better it is for a foot. To what degree possible a shoe has two functions: as a non-intrusive, protective covering, and as an ornamental dressing. The moment a shoe assumes a therapeutic function for the average foot, the foot is in trouble."

Finally, I'd like to end this essay with my own experience and observations as a physician. At the hospital where I spend most of my days, we often admit elderly patients who are frail or have taken a bad fall. Many come in with fractured bones. Outside of the occasional rural farmer, all the patients

have weak and deformed weak feet with toes bent in, narrow forefeet, and toes extended up in the air. If we cannot get these patients to walk, their frailty will progress which quickly leads to more disability and death.

Renowned aging specialist and Boston Marathoner Dr. Walter Bortz, 80, defines frailty as “a body-wide set of linked deteriorations including, but not confined to, musculoskeletal, cardiovascular, metabolic, and immunologic systems. The common final pathway that leads to this constellation of findings is usually keyed to a decline in physical activity either as a result of habit or disease inputs.”

In the medical model we are often trying to discover a specific cause and treatment for the frailty and in the process the patient inevitably becomes weaker as he or she goes to bed rest. Weak and dysfunctional feet bring patients closer to the red line of frailty. And once someone is below this threshold, full recovery is difficult, if not likely,

The remedy then is to take care of your feet. They need to last a lifetime.

Notes and References

- Hoffman, P (1905) Conclusions Drawn from Comparisons of the Feet of Barefooted Shoe Wearing Peoples. Amer. Journal Of Orthopedic Surgery, vol 3,2.
- Barnett, C. H. (1962). “The normal orientation of the human hallux and the effect of footwear”, J. Anat., Lond. , 96, 4, pp. 489-494
- Samuel B. Shulman (1949). "Survey in China and India of Feet That Have Never Worn Shoes," The Journal of the National Association of Chiropractors, 49, 1949, pp. 26-30
- Munson, E L (1912) “The Soldier's Foot and the Military Shoe.” “The Soldier’s Foot and the Military Shoe” is

available for download

(<http://archive.org/details/soldiersfootmili00munsrich>) Like the Hoffman study, this is a must-

read for anyone who wishes to understand the foot and the shoe.

- Bortz W M J (2002) A Conceptual Framework of Frailty: A Review” Gerontol A Biol Sci Med Sci;57:M283-M288
- Tudor, A (2009) Flat-Footedness Is Not a Disadvantage for Athletic Performance in Children Ages 11-15. Pediatrics 2;123:e386
- Wegener et al (2011) Effect of children’s shoes on gait: a systematic review and meta-analysis. Journal of Foot and Ankle Research, 4:3
- Lieberman D. E., et al. (2010) Foot strike patterns and collision forces in habitually barefoot versus shod runners. Nature, 463, 531-5.
- Staheli L (1991) Shoes for Children: A Review Pediatrics ;88;371
- Vanstory, M., Chamblis, M.L. (2010) How should you treat a child with flat feet? Journal of Family Practice. 59, 6.
- Rossi, William (1999) Why shoes Make Normal Gait Impossible. Podiatry Management. Mar 1999
- Rossi, William (2002) Children’s Footwear: Launching Site for Adult Foot Ills. Podiatry Management. October 2002



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Footwear Research: A Scientific Approach

by Casey Kerrigan, M.D.

Eventually science prevails.

Old studies like the one conducted by Dr. Phil Hoffman over a hundred years ago, make one think that if the scientific medical community knew about these studies, why didn't shoe design change right then and there? Well, let me tell you, even when both the scientific community and general press greatly applaud your own footwear research, uncommon persistence is needed to translate that research into shoe design.



X-Ray of Woman's Foot in High-Heel Shoe

Back in 1998, I discovered that stiletto or high-heeled shoes increase knee joint torques (forces about the joint that determine joint or “bone on bone” pressures) related to the

development and progression of knee osteoarthritis by 23% compared to barefoot. That research was acknowledged by my scientific peers as being a breakthrough in understanding the relationship between footwear and forces related to injury, and was featured in all the major news outlets around the world.

In fact, “ABC 20/20” covered the story, coming to my laboratory and repeating some of the study for the benefit of demonstrating how my team collected and analyzed the data. They started the segment by showing horrific pictures of foot deformities caused by high heels with the main message being, if the damage that high-heels do to your feet isn’t reason enough to stop wearing them, then the findings from Harvard Medical School (where I did the research) should be a red flag.

But that study was just the tip of the iceberg. In 2001 and 2005, I found that not just stilettos, but also wide-based heels and so-called “sensible” women’s dress shoes with only a moderately elevated heel, also substantially increase knee joint torques by 26% and 19% respectively. That research similarly received much attention and it is now common knowledge that elevated heels, of any height, abnormally increase joint torques that are related to the development and progression of knee osteoarthritis.

Then in 2009 I published that the typical running shoe increases those exact same torques associated with knee osteoarthritis by 38% during running compared to barefoot. Moreover I published that the typical running shoe also unnecessarily increases torques at the hip and ankle. By this time, it wasn’t just our group studying the effects of shoes on knee joint torques. A group at Rush University in Chicago showed significantly increased knee joint torques in a variety of traditional shoes during walking.

It is clear that *any* traditional shoe, whether it’s dress, comfort, or (the *hidden* high-heeled) running shoe, detrimentally increases knee joint torques. While the reason for this is somewhat complex and I’ve found other factors in

shoe design that affect these torques, an elevated heel is certainly a key factor.

Knee osteoarthritis currently causes more disability with respect to mobility than any other singular disease in the elderly. My research helps explain why women get it nearly twice as often as men.

For years, both athletic and now comfort shoe companies have been making shoes with elevated cushioned heels. And for years they've promoted the idea that cushioning the heel cushions the joints. However, that idea was never based on any biomechanical data and moreover had *never* been tested in a laboratory. Our findings that a typical running shoe doesn't decrease but actually *increases* joint torques (associated with increased pressures on the joints) came as a surprise to many.

Why wouldn't all the major shoe companies who promote their shoes as being "healthy" want to recognize this work and instantly change how shoes are made? Well, I've come to learn that those companies are slaves to tradition and especially wedded to their own research, published or proprietary. Even just lowering the heel, which should be a fairly obvious thing to do from my published research, is a big ordeal because the manufacturing and tooling revolves around a traditional shoe shape that has an elevated heel. Forget about using an altogether different sole design using materials that depart radically from the typical foams used in midsoles. That would require investing into altogether different processing methods and equipment.

In the meantime, I started a company and a factory (**OESHshoes.com**) to make shoes specifically for women who need change the most. The designs and manufacturing really just follow my research. I'm finally now seeing the rewards with a healthy group of loyal followers. I wouldn't say it was easy. I had to build something far more sophisticated than Bill Bowerman's waffle iron to create a shoe tread. But it

sure was a heck of a lot easier than trying to convince multi-billion dollar shoe companies that they need to start over. Completely.

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Strengthen Your Feet With “Free” Barefoot Therapy

by Dr. Phil Maffetone

Nearly 100 years after Hoffman's study was published in 1905, my fourth health-and-fitness related book came out: “Fix Your Feet: Build the Best Foundation for Healthy, Pain-Free Knees, Hips, and Spine.” Only several thousand copies ended up being sold, and then the publisher allowed the book to go out of print. (You can still buy used copies on Amazon.) There seemed to be tepid interest at best in the topic of healthy feet or going barefoot to improve one's health. As “Fix Your Feet” faded from view, Christopher McDougall's “Born to Run” appeared on bestseller lists, and it was as if this giant light bulb had gone off in runners' heads. Almost overnight, runners made the strong connection between over-supported, large-heel running shoes and an inability to achieve good, natural running form. These traditional running shoes often lead to chronic physical injuries. Chris observed that “running shoes may be the most destructive force to ever hit the human foot.”

The past few years have seen an explosion of minimalist-style running shoes—lightweight, flexible, little cushioning, and flat sole. Some of these shoes are often called barefoot-style. But nothing beats going completely barefoot.

Without exaggeration, I have spent most of my life barefoot. I did not realize it during my youth, but being barefoot is the oldest natural remedy for the body. Looking back, I attribute my lack of physical injuries, despite being very active in many sports, to keeping my feet out of bad, overly supported and thick-soled shoes. When I do wear shoes, they are usually lightweight sandals, flat sports shoes, or thin-soled cheap sneakers.

I cannot emphasize it enough: being barefoot is therapeutic not just for the feet, but the entire body, regardless of who you are or what your level of athleticism is.

Early in private practice I noticed that many popular sports shoes were harming my patients. Not only were running shoes a potential problem, but those from all sports created havoc on one's feet. Over time, by wearing poorly fitting shoes, those with over-supporting arches or thick heels, the foot's arch will fail to do its job well, normal foot motion will distort and structures above the foot and ankle will be stressed—especially the joints in the knee, hip, spine and even areas higher up such as the neck and shoulders. I quickly learned that going barefoot would be required to restore optimal muscle function and structure.

So years ago, I began recommending barefoot rehabilitation to my patients. And of the dozens of therapies that I used throughout my 35-plus year career of treating physical injuries, from acupuncture and biofeedback to manipulation and the many types of foot exercises, being barefoot is one of the most powerful, easiest to apply, and quickest to get results. In a society that is full of remedies of all sorts, and for a price, barefoot therapy is usually overlooked because it is simple and free.

Barefoot therapy has helped many people rehabilitate their feet—it is necessary because wearing almost all shoes, whether for running, walking, leisure or dress up, can damage a foot's delicate muscles, nerves, and bones. Being barefoot trains the feet to function better, and helps support the many structures above: the ankle, calf, knee, hip, back, and all structures up to the head. The result is that many aches and pains—including what some would consider chronic injuries like that bad hip or shoulder—get better.

It is important to note that one cannot abruptly “go barefoot” after years of wearing harmful footwear. Weakened muscles, especially the arches, need time to adjust and strengthen, so

remember to slowly build the amount of time you spend barefoot. Then you can begin to look for footwear that will allow your feet to move as naturally as possible.



10 Steps to Help You Strengthen Your Feet

1. Take off your shoes. Go barefoot at home as much as possible and only wear shoes when you are outdoors. It is best to walk around the house without socks on, but a thin pair that is not too tight will be okay. Walk on the bare floor, carpeted areas, and wherever your feet take you. The different terrains provide various types of foot stimulation to help muscles work better—the first step in rehabilitating your feet. Do this for a couple of weeks before the next step.

2. Now go outdoors in your bare feet. Stick with smooth surfaces first—your driveway, sidewalk, and porch, which will provide additional stimulation to hard floors and carpet. Do this for at least 10 minutes a day. As your bare feet experience different textures and temperatures, the dormant nerves will become stimulated and alive. Of course, avoid the extremes in weather conditions, especially freezing temperatures, snow and ice, and hot surfaces. A week or so of this additional activity and you are ready to move on.

3. Now venture off to uneven natural ground. Walking on grass, dirt, and sand, will provide greater motivation for your feet to function better, helping the structures above be more stable. Start with just a few minutes if your feet are sensitive and build up to a point where you can comfortably walk around your neighborhood barefoot a few weeks later.

4. Switch to wearing the best fitting, flat shoes that you can find. Almost all of us have to wear shoes for various activities—work, exercise, shopping, golf and social occasions. During this rehab period, there are two important things to do with your shoes. First, start wearing thinner, simple footwear, preferably without the supports they may come with, or others you may have added, which includes heel lifts, arch supports, and orthotics. And second, make sure all the shoes you slip your feet into are a perfect fit because there are three main issues that people suffer from with their footwear:

- Shoes are too small or too narrow.
- Shoes have excessive support and a raised heel instead of minimal support and a flat sole.
- Shoes have to be broken in when they should be comfortable enough to wear right out of the box.

5. Massage your feet. Almost everyone can take the first four steps. Many people need more foot stimulus for additional rehabilitation. Being barefoot will do this eventually, but you can speed the process. A professional massage is always great, but you can treat your own feet daily at home, either by yourself or trading treatments with others. Even a five-minute massage for each foot can work wonders. Start with the feet relaxed, clean, and dry. A small amount of organic coconut oil is a nice option. Slowly and gently rub the foot all over using both hands, working up the leg where important foot muscles originate. Pay particular attention to the bottoms of the feet, from front to back, and massage each toe. Use firm pressure, but it should not be painful. Do this daily or as often as possible.

6. Practice balance. A key feature of optimal foot function is that it helps balance the whole body during walking, running, even climbing stairs. By encouraging the foot-brain balance mechanisms, your overall balance can improve significantly. The easiest way to improve it is by practicing standing on one bare foot, and then the other, for 30 seconds at a time. If you cannot perform this action, it is probably due to foot dysfunction. Start by attempting to balance on one foot for as long as you can, even if just for a few seconds; next, try the other foot. Balancing on each foot can gradually improve the communication between feet and brain promoting better balance throughout the body. When you get really good, try it, in a safe setting, with your eyes closed.

7. Make time to cool off your feet. If you are standing a lot throughout the day, especially if you have shoes on, it is likely that you will get home with tired, sore, and hot feet. Cool them. A cold footbath can work wonders, even after a hot shower. It improves circulation, tones muscles and improves foot function, while helping them recover from the rigors of the day. Use a large enough bucket or foot tub that fits your feet without jamming your toes. Place your feet in cold water so they are completely submerged above the ankle. Add a small amount of ice to prevent the water from getting warm, but do not fill the tub with ice as this can freeze the foot, risking damage to nerves, blood vessels and muscles. Keep your foot immersed for five to fifteen minutes.

8. Also make time to warm up your feet. Sometimes, the use of a hot footbath can be therapeutic, not to mention comforting. Moist heat works better than a heating pad because it penetrates into the foot better. Use the same size footbath as mentioned above, and fill with hot water, but not scalding. Most people can tolerate temperatures of around 90 to 100 degrees Fahrenheit. Adding Epsom salt (magnesium sulfate) is also soothing. Beware: Heat comes with contraindications. Do not use heat if you have an acute injury, especially one that is inflamed, swollen, or bruised, and avoid

heat with any skin disorder, diabetes, circulatory problem, or an open wound. When in doubt about using heat, avoid it.

9. Barefoot walking is a good warm-up. Before heading out for a run, a barefoot warm-up is a great idea. Ten minutes around the backyard or neighborhood will get your muscles warm and ready for running. Stretching cold muscles can be dangerous, and lead to injury, but an easy walk is great for getting your body ready.

10. Invest in healthy shoes. Once you have weaned off bad shoes, rehabbed your feet, and restored good foot function, be careful to avoid returning to old unhealthy habits by wearing bad, ill-fitting, over-supported shoes. It is that simple.

Rehabilitating your feet with barefoot therapy, and ridding your body of its reliance on poor footwear will quickly bring renewed physical function. It can restore the spring and vigor in your step, prevent injuries, and help maintain overall physical activity for years to come.

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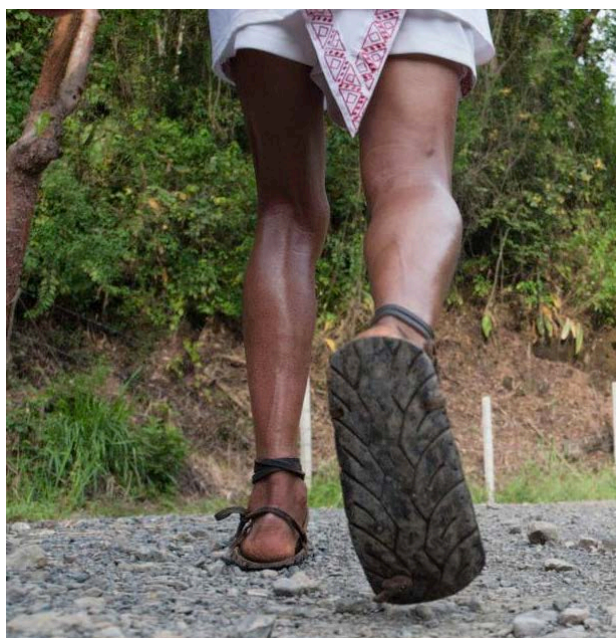
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The Healthy Feet of the Tarahumara (2013)

The feet of several male Tarahumara Indian runners prior to the start of the 2013 La Ruta Ultra Run, a 100-kilometer off-road race in Costa Rica.





Photos by Eduardo. R. Paniagua

CONTRIBUTOR BIOS

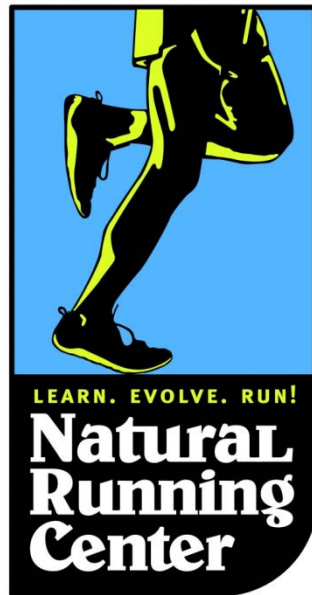
Dr. Mark Cucuzzella is a Professor at West Virginia University School of Medicine and US Air Force Reserve Lt. Col. He is the race director of Freedoms Run race series in West Virginia, executive director of the Natural Running Center, and owner of **Two Rivers Treads** — A Center for Natural Running and Walking in his hometown of Shepherdstown, West Virginia. "Dr. Mark" has been a competitive runner for over 30 years — with more than 100 marathon and ultramarathon finishes — and continues to compete as a national-level Masters runner. His marathon best is 2:24 and he has won the Air Force Marathon twice. He is designing programs to promote healthier and better running in the military with the USAF Efficient Running Project. You can view these modules on www.efficientrunning.net

Dr. Casey Kerrigan is a Harvard Medical School graduate known by her academic peers for her groundbreaking peer-reviewed published research on gait (walking and running) and the effects of footwear, left her perfectly good job at the University of Virginia, where she was tenured professor and chair of the department of physical medicine and rehabilitation, professor of mechanical and aerospace engineering, and professor of sports medicine, to make OESH footwear (oeshshoes.com) that uses an innovative technology in which the midsole provides compression and release. Dr. Kerrigan is a Science Advisor to the Natural Running Center.

Dr. Ray McClanahan is a podiatric physician with over 17 years experience in Portland, Oregon. He specializes in sports medicine and preventative foot care. At his medical clinic, **NW Foot & Ankle Clinic**, his emphasis is on sports medicine, preventative and conservative options as well as education on

proper footwear. An active runner and athlete, McClanahan finished 14th in the U.S. National Men's Cross-Country Championships in 1999, and had a near-Olympic Trials qualifying 5,000 meter time of 13:56 in 2000. He is also the creator of Correct Toes spacer, which spreads the toes to their natural and correct position. Dr. Ray McClanahan is a Health Advisor to the Natural Running Center.

Dr. Phil Maffetone is an internationally recognized researcher, educator, clinician and author in the field of endurance, nutrition, health and biofeedback. During his 35-year career, which included 20 years in private practice, **Dr. Maffetone** has been a respected pioneer in the field of complementary medicine, bringing the latest advances to healthcare professionals around the world. He was named coach of the year by Triathlete Magazine. Maffetone is the author of more than a dozen books, including "The Big Book of Endurance Training and Racing" and "The Big Book of Health and Fitness". He is also an accomplished songwriter and musician who has worked with Rick Rubin and the late Johnny Cash. Dr. Maffetone is a Health and Fitness Advisor to the Natural Running Center.



<http://naturalrunningcenter.com>