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Methodological Notes on the Determination of Plantar Main-Line Index and Transversality

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The proximal radiants of the digital triradii, located at the bases of the toes, constitute the plantar main lines. The terminations of these main lines, placed in the fibulo-tibial order, form the mai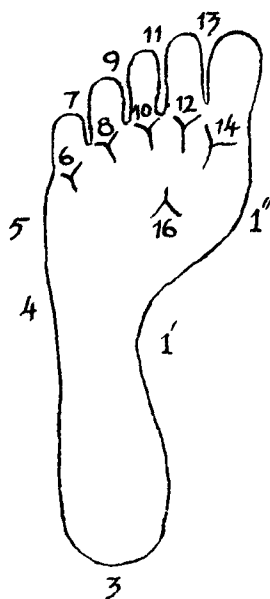n-line formula. A general idea of the alignment of ridges, covering the distal plantar region, may be obtained from the main-line formula of an individual. In the dialing of the periphery of the plantar surface fifteen areas or points have been distinguished (Wilder, 1903) by applying numerical symbols, used for homologous intervals and points in the palm. However, symbols 14 and 16 have been added in the sole for the triradius of the great toe and the proximal triradius which have no counterparts in the palmar scheme (fig. 1). Out of these fifteen figures, five taken at a time to present the main-line formula, result in numerous combinations and therefore the frequencies of the various types of formulae are reduced to highly insignificant values. It was, therefore, suggested by Cummins and Midlo (1926) and Steggerda and Steggerda (1936) to apply 'modal types' to the palmar main lines in order to reduce these innumerable combinations of main-line formulae into sufficiently large groups.

With a view to securing uniformity in the treatment of palm and sole, only four homologous plantar main lines out of five, i.e. those originating from the triradii d, c, b and a have been employed for 'modal types' and therefore the plantar main lines D and A, instead of D and E, have been taken into account for the determination of main-line index. As such on the principles applicable to palmar main lines, the terminations of the plantar main lines D, C, B and A have been grouped into four 'modal types' each, i.e. 7, 9, 11 and 13, which are as follows:

Fig. 1. Plantar surface with border positions and their symbols

Main Line D

  7 - 7, X and 5
  9 - 9, 10 and 8
11 - 11 and 12
13 - 13, 14, 16 and 1″

Main Line C

  7 - 7, 6 and 5
  9 - 9, 10 and X
11 - 11 and 12
13 - 13, 14, 16 and 1″

Main Line B

  7 - 7, 6 and 5
  9 - 9, X and 8
11 - 11 and 12
13 - 13, 14, 16 and 1″

Main Line A

  7 - 7, 6 and 5
  9 - 9, 10 and 8
11 - 11 and X
13 - 13, 14, 16 and 1″

In determining the ' modal types ' for the individual main lines, it has been ensured to bring together only those terminations which are closely related to eachother. By such a grouping the artificial differences involved between certain terminations (e.g. between 9 and 10, 11 and 12 etc.) have been considerably reduced. The application of ' modal types ' results in slightly minimising the defect of selecting only certain main-line formulae for comparative purposes, but it does not completely eliminate it. In the main-line index, however, not only the entire sample is utilized but a single figure is computed which can be most effectively used in racial comparisons. This index was designed by Cummins in 1936 to determine the ' directional attributes ' of the main lines. It is a better and simple device for recording the most significant features of the total main-line formula.

The technique for the formulation of plantar main-line index is similar to that used for palms. " The main-line index is in a sense expression of the direction of a neutral line; its inclination being determined by the courses of lines D and A. This index is not a proportion but a summation of values describing the courses of these two lines " — Cummins and Midlo (1961). As such, the main lines D and A alone, which embrace the ridges of main lines B and C also, are considered sufficient to give a picture of the generalized alignment of the distal plantar ridges. In calculating this index the values assigned to the terminations of these main lines are added and a single figure thus derived results in the main-line index.

The author (1961) has devised his scheme of values for various plantar terminations, keeping in view the geometric orientation of the alignment of ridges and the anatomical structure of the plantar surface (figs. 2 and 3). Although the entire peripheral margin of the sole has been classified into various areas or points, ranging from 1′ to 16, yet the numerical values have been assigned only to termination nos. 5 to 14 and 1″ because in their courses the plantar main lines restrict themselves to the distal plantar area, which includes the above-mentioned terminations alone. Numerical symbol 16, representing the proximal triradius, has been eliminated from the list of values, for a main line fusing with the proximal triradius is short of a complete line and therefore should not be taken into account for the formulation of main-
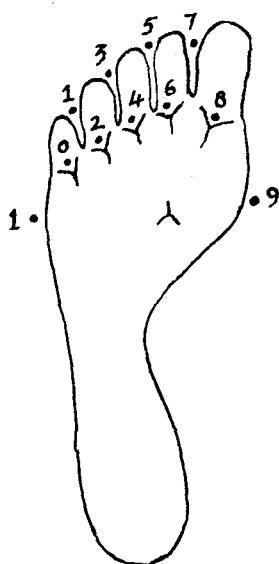
Fig. 2. Main line D   Fig. 3. Main line A

Numerical values for the terminations of plantar main lines D and A

line index. However, when a main line joins this triradius its continuation should be traced and value assigned depending upon the point of termination on the peripheral region of the plantar surface, in accordance with the scheme of values. The following table presents a list of various terminations of the main lines D and A and the numerical values assigned to them:

Main line D		Main line A	
Termination	Value	Termination	Value
5	1	5	7
6	0	6	6
7	1	7	5
8	2	8	4
9	3	9	3
10	4	10	2
11	5	11	1
12	6	12	0
13	7	13	1
14	8	14	2
1''	9	1''	3

From a study of the above given table, it will be noted that the range of index for a sole is from 2 to 14; smaller values indicating longitudinality and higher values

transversality of the plantar ridges. The position 6 of the main line D has been taken as zero, because it is the point of origin of the main line. On both sides, position 5 and 7 have been given value 1 each. For the terminations 8 to 14, the values assigned for main line D, increase from 2 to 8 in the same order, as the main lines record greater transversality. Position 1″, as it occupies the most transverse position on the tibial border from the triradius d, has been given the highest value 9. Similarly, for the main line A, position 12 has a value of zero and on either side the values go on increasing with greater transversality of the ridges. Thus, termination symbol 5 attains the maximum value of 7, because it lies across on the fibular border at a most transverse position from the triradius a. Theoretically, the maximum possible value of the main-line index is 16, but in practice it is never achieved because of the fact that main lines D and A never terminate at position 1″ and 5 simultaneously, on the same plantar surface. As such, the maximum index for a sole is 14 (D.A. - 1″.7.) which depicts the maximum transversality of the plantar ridges. However, the smallest index 2 is possible from the formula 7.11., whereas a no. of other combinations give intermediate values depending upon the degree of transversality of the main lines.

Occasionally one may come across cases where the triradius d or the triradius a is completely non-existent and therefore the main lines cannot be traced (o). Sometimes the triradius is present but the main line shows an abortive condition (X) and is immediately surrounded by curvulear ridges of the sole originating from the base of that digit, associated with the next digital triradius. Under these circumstances it is impossible to determine mean ridge directioning as either the line is completely non-existent or it is abortive and non-curvulear. It is suggested, therefore, that such cases be eliminated from the scope of the assessment of the main-line index.

Transversality

For calculating transversality of the palmar main lines, the mean main-line index of the right and left sides is taken into consideration. It can be determined, directly, from the right/left ratio of the mean main-line index. Alternatively, it can be calculated, indirectly, by applying the following formula:

$$\text{Transversality } (\%) = \frac{\text{M.-L. Index (right) - M.-L. Index (left)}}{\text{M.-L. Index (left)}} \times 100$$

The method stated above for calculating transversality has a major drawback that it gives only a relative picture of the right and left sides but does not indicate anything about the degree or magnitude of transversality in that particular population. This shortcoming can result in similar figures for transversality in two completely different groups. In order to overcome this difficulty it is proposed that the maximum possible main-line index, presenting the greatest degree of transversality, may be employed in the determination of transversality of the distal plantar area. As already pointed out, the highest possible index is 14, and the % proportion of the mean main-

line index of a population can give a useful measure indicating the degree of transversality, which can be more effectively utilized for the comparative studies. It is, therefore, proposed that the following formula may be applied for computing the transversality of plantar main lines:

$$\text{Transversality } (\%): \frac{\text{Mean Plantar M.-L. Index}}{14} \times 100$$

Summary

Methods have been presented for the determination of main-line index and transversality of the distal plantar ridges. For studying the collective main-line formula, a scheme of 'modal types' for the four main lines has been introduced. The computation of the summational main-line index has been made possible by devising a scheme of numerical values for the various terminations of main lines D and A. Cases where the main line D or A is abortive or non-existent should be eliminated from the assessment of main-line index. The degree of transversality should be determined from the percentage proportion of the mean main-line index with the maximum possible index.

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RIASSUNTO

Vengono presentati metodi per la determinazione dell'indice della linea principale e della trasversalità delle creste plantari distali. Per studiare la formula complessiva della linea principale, è stato introdotto uno schema di « tipo modale ». Il calcolo dell'indice complessivo della linea principale è stato possibile ideando uno schema di valori numerici per le diverse terminazioni delle linee principali D ed A. I casi in cui la linea D o A è abortiva, o inesistente, vanno eliminati dal calcolo dell'indice complessivo. Il grado di trasversalità va determinato dalla proporzione percentuale dell'indice medio della linea principale e del massimo indice possibile.

RÉSUMÉ

L'on présente des méthodes pour la détermination de l'index de la ligne principale et de la transversalité des crêtes plantaires distales. Afin d'étudier la formule générale de la ligne principale, un schéma de « type modal » a été introduit. Le calcul de l'index général a été possible moyennant un schéma de valeurs numériques pour les diverses terminaisons des lignes principales D et A. Les cas où la ligne principale D ou A est abortive, ou inexistante, devraient être éliminés du calcul de l'index général. Le degré de transversalité devrait être déterminé par la proportion en pourcentage de l'index moyen de la ligne principale et de l'index maximum possible.

ZUSAMMENFASSUNG

Es werden Methoden angegeben, um den Hauptlinienindex und die Transversalität der distalen Fussohlenleisten zu bestimmen. Zum Studium der gesamten Hauptlinienformel wurde ein Schema von « Modaltypen » für die vier Hauptlinien eingeführt. Um den summierten Hauptlinienindex zu berechnen, wurde ein Schema von Zahlenwerten für die verschiedenen Endungen der Hauptlinien D und A ausgedacht. Die Fälle, in denen die Hauptlinie D oder A unvollkommen oder gar nicht vorhanden ist, sollten nicht in die Berechnung des Hauptlinienindexes einbeschlossen werden. Der Grad der Transversalität sollte aus dem prozentuellen Verhältnis zwischen Hauptlinienindex und dem höchstmöglichen Index abgeleitet werden.