



TO ASSESS DECADE WISE AND SITE WISE SENSORY THRESHOLD OF FEET IN HEALTHY ADULTS FROM 20-80 YEARS USING SEMMES WEINSTEIN MONOFILAMENT.

Physiotherapy

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ABSTRACT

This descriptive study was conducted on 180 healthy adults from 20-80 years of age, to assess sensory threshold of feet at different standard sites, decade wise and analyse them for any difference. Subjects fitting the inclusion criteria were tested on standard locations of feet using semmes weinstein monofilaments from large to small diameter to find the minimum size perceived, i.e. sensory threshold at each site, decadewise. It was observed that the sensory threshold differed at different sites, the most sensitive sites being dorsal base of metatarsus, head of dorsal base of 3rd metatarsus and the least sensitive sites are heel, medial and lateral arch. As age increased, the sensory threshold of feet also showed an increase. Thus it can be concluded that even within a particular decade, different sites respond to different diameters.

KEYWORDS

Sensory threshold, Semmes weinstein monofilament

INTRODUCTION :

Sensory testing is an integral part of neurological examination, especially for patients with suspected sensory loss. Individuals with sensory loss can have affection of either sensory receptors, the afferent nerve, the tracts carrying the sensation or the sensory cortex. One of the most common causes for loss of sensation is peripheral neuropathy. The prevalence of peripheral neuropathy(PN) is not known, but it is caused by various systemic diseases which affects individuals of all ages^[1]. Screening for sensory loss via assessment of superficial and deep sensations, precedes the gold standard testing done by Electromyographic studies/Nerve conduction velocity^[1]. Objectivity in clinical testing of superficial sensation can be brought by Semmes Wienstein Monofilament(SWME) examination which is a non invasive, low cost, rapid, and easy to apply test. Monofilaments are thin nylon that are calibrated according to the force required to cause them to buckle when briefly pressed against the skin at right angles.^[2] Testing of neuropathy, or lack of protective sensation can be reliably and easily completed with the use of a monofilament of 5.07(Evaluator size) which helps to assess protective sensation of feet.^{[3][4]} The thinner the filament, the lower the monofilament number and less force required to induce buckling. The thinner filaments are therefore, considered more sensitive.^[2] Monofilament testing should be performed at several sites on the foot emphasizing areas exposed to high weight-bearing pressure and regions at highest risk of skin breakdown.^{[3][5]}

diminished light touch, 3.61(Blue) & 2.83(Green) interprets normal sensation is perceived.

MATERIALS AND METHODOLOGY:

This was a descriptive study with purposive sampling including 180 healthy adults, both male and female from age 20-80 years with 30 individuals in each decade. Exclusion criteria was ulcers on foot, known sensory loss, systemic diseases such as leprosy, diabetes and diabetic neuropathy known to cause sensory loss^[1], any previous surgery of ankle or foot & extreme dry skin, extreme cracks & callus formation.

PROCEDURE:

Subjects fitting the inclusion criteria were explained testing procedure of sensory threshold of feet at different standard sites by different diameters of monofilament. Subject was shown monofilament testing with eyes open to familiarise the process. Subject's vision was then occluded by asking them to look away and was instructed to affirm when sensation was perceived. The sleeve is rotated to expose the filament and then flipped back to lock it at 90 degrees angle. The filament is held in place for 1.5 seconds and then removed. Starting with the larger mono filaments 6.65(Red) to 4.56(Red) ,then 4.31(Purple) to 3.61(Blue) and 2.83(Green). For mono filament from 2.83 to 4.31 the stimulus in same location is applied up to 3 times^[7]. The last least diameter stimuli perceived is marked as the sensory threshold for that particular site. Each site on the foot had the Semmes Weinstein monofilaments applied to it with the nylon filament perpendicular to the skin surface and just enough pressure to buckle the filament. This procedure was performed on every individual of every decade on both the feet.

RESULT:

The mode (most frequently occurring) of sensory threshold at each site for every decade was found and compared site-wise and decade-wise. It was found that at every decade, the site wise sensory threshold for left as well as right feet were the same, hence a common mode value for both feet was used for analysis.

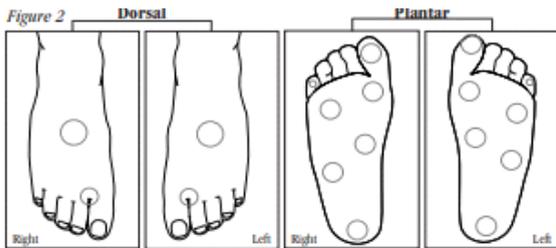


Fig No.1 Sites for assessment^[7]

Table No.1 Name of the sites

1. Centre of Hallux(A)	4. 5th Metatarsal head(D)	7. Heel(G)
2. Distal Phalynx(B)	5. Medial Arch(E)	8. Dorsal base of Metatarsus (H)
3. 1st Metatarsal head (C)	6. Lateral Arch(F)	9. Dorsal 3rd Metatarsal head (I)

INTERPRETATION OF MONOFILAMENTS: Evaluator size of 6.65(Red) interprets loss of deep pressure sensation, 4.56(Red) interprets as diminished protective sensation, 4.31(Purple) interprets

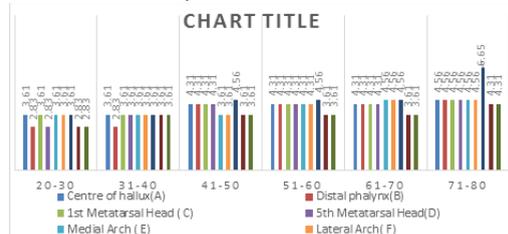


Figure No. 2 Graph for decade wise sensory threshold across different standard sites of foot.

DISCUSSION:

The present study was conducted to assess sensory threshold of feet on 180 healthy adults, both male and female, from the age group of 20-80 years, with 30 adults in each age group using semmes weinstein monofilament. 2.83, 3.61, 4.31, 4.56 & 6.65 are different evaluator sizes.

Mode for all the decades, site wise was taken and a graph was plotted. According to the graph, between 20-30 years it can be seen that sites B,D,H & I respond up to the evaluator size of 2.83 and sites A,C,E,F,G respond up to evaluator size of 3.61 which denotes normal sensation.

In 31-40 decade, all of the sites have responded up to 3.61 except distal phalynx, which had a sensory threshold of 2.83 which also denotes normal sensation is perceived across all sites.

In 41-50 decade the sites A,B,C & D perceive up to the evaluator size of 4.31, after which the smaller sizes are not perceived, denoting diminished light touch as per monofilament testing standards.

However they were normal individuals without sensory impairments and yet majority of individuals at this age group responded to higher diameter of monofilament as compared to previous age group. As per the study done by Rabbia J as age increases, the mechanoreceptors varied in shape and size .Sites E,F,H & I respond to 3.61 denoting normal sensation. The monofilament perceived at heel is 4.56 which denotes diminished protective sensation.

In 51-60 decade, sites A,B,C,D,E,F respond to evaluator size of up to 4.31 which according to the monofilament testing denotes diminished light touch. At heel the last monofilament perceived was 4.56 that denotes diminished protective sensation. Sites H & I respond to 3.61 which denotes to normal sensation.

In 61-70 decade age group A,B,C,D sites respond last to the monofilament size 4.31 denoting diminished light touch. Sites E,F,H respond to evaluator size of 4.56 which denotes loss of protective sensation. Sites H & I still have the same sensitivity as per the previous age group.

In 71-80 decade age group sites A,B,C,D,E,F all of these respond only up to evaluator size of 4.56 which suggests diminished of protective sensation. At heel the last monofilament perceived was 6.65 which according to monofilament testing denotes deep pressure sensation loss. Sites H and I respond to the evaluator size of 4.31 which suggests diminished light touch.

As seen in all decades different sites respond to different diameter of monofilament especially in 20-30, 31-40 years of age group. There is a lack of uniformity in the diameter of monofilaments perceived at different sites and at different decades.We also see that the monofilament size perceived by different sites have increased as the age was increased.

This difference in perception of different monofilament sizes at different sites can be attributed to the different distribution of receptors. The distribution of mechanoreceptors was studied by Kennedy & Inglis (2009)^[7]

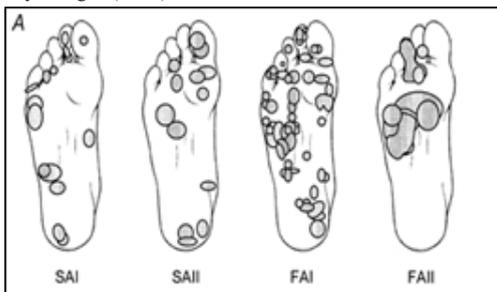


Figure No.3 Distribution of receptors (Kennedy & Inglis)

SAI are Merkel's discs, SAII are Ruffini endings, FAI are Meissner corpuscles, FAII are Pacinian corpuscles. The receptive fields of these units were round to oval in shape.SAI show a sparse distribution at the centre of 1st toe,2nd ,& proximal phalange of 4th and 5th toe, below last metatarsal, at medial and lateral arch and few over heel.SAII are

present at great toe and below it, over proximal phalange of 3rd toe and below it, over 4th metatarsal, below medial arch and on heel.FAI is seen overlapping with SAII in few areas, it is seen over forefoot, mid foot more over lateral arch and lateral border of forefoot and mid foot, and above heel.FAII is seen over 3rd toe, and over forefoot.

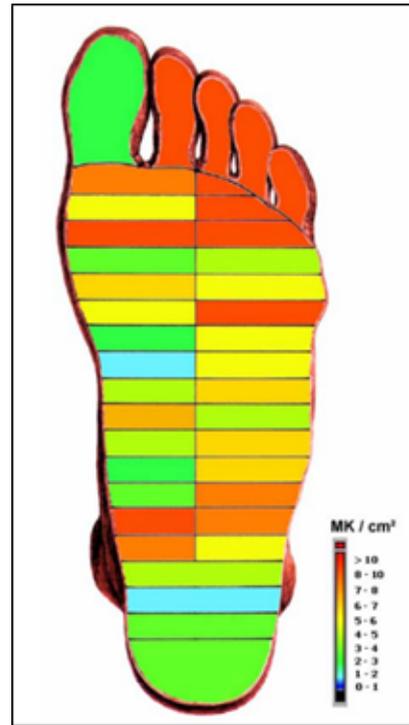


Figure No.4 Distribution of mechanoreceptors(Gunther Schlee 2010)

We can see the distribution of Meissner corpuscles, which also suggests that there are less mechanoreceptors on heel which also supports the findings of present study that the diameter perceived by heel was increased as the age increased because the distribution of meissner corpuscles is less.While showing a high density of Meissner corpuscles in the area between the third and the fifth metatarsal heads as well as between the second to fifth toes.^[8]

As the age increases there is atrophy in Meissner corpuscles which may result in decreased sensitivity of the skin on sole of foot. These corpuscles,are limited to hairless areas, and become sparse, take on an irregular distribution, and vary in size and shape with age^[5]

Also, electrophysiological studies have identified a gradual reduction in conduction velocity of sensory nerves with advancing age, this may reflect degenerative changes in myelin sheaths or loss or reduction in size of sensory axons.^[9]

R. Periysamy, Snehanand, A.C. Ammini^[10] studied the effect of aging on the hardness of foot sole skin. They concluded that biomechanical properties or elastic properties of foot sole changes in healthy adults. There is hyperkeratinization which causes hypertrophy of cells and it also causes tissue damage. There was consistent increase in foot sole hardness from proximal (Hind foot) to distal regions (Big toe).

The result of present study are consistent with the findings of Nicholas D. S., John Triano, Chris K Lam that studied the relationship of thresholds of skin sensitivity influenced by mechanical property of skin on the foot sole. Heel is found to be thickest and hardest site thus it was least sensitive.^[11] From comparison of different sites at different decades, we also see that the most sensitive sites are dorsal metatarsus & dorsal 3rd metatarsal head as subjects at all decades perceive lower diameter of monofilament at these sites compared to others.

The least sensitive sites are heel followed by medial arch and lateral arch as when compared to other sites the subjects perceived higher diameters at the heel in every decade. The reasons could be due to the distribution of mechanoreceptors is less over heel, increased thickness as well as hyperkeratinisation as compared to other areas.^[10] Medial

and lateral arch could be due to degenerative changes seen in these receptors as the age increased.

Ewald Max Henning, & Thorsten Sterzing^[12] studied the touch and vibration perception threshold values from 30 plantar and dorsal foot locations in 40 women and men between 20 and 35 years. The least sensitive touch regions were the heel, followed by the most proximal site on the foot dorsum, the medial and lateral malleoli and the Achilles tendon. The medial longitudinal arch location and plantar as well as the dorsal toe regions had the best sensitivities for touch.

This is consistent with our finding that also suggests that the dorsal base of metatarsus, dorsal 3rd metatarsal head are most sensitive.

CONCLUSION:

The present study concluded different sites respond to different diameter of monofilaments, in these the most sensitive sites are dorsal base of metatarsus, head of dorsal base of 3rd metatarsus. The heel, medial and lateral arch were least sensitive. This study concludes that even within a particular decade, when the mode value of the monofilament diameter perceived is taken, different sites respond to different diameters..

LIMITATION AND FUTURE SCOPE OF STUDY:

This Study can be further done comparing each age group rather than decades to find age wise sensory thresholds at different sites of feet.

CLINICAL IMPLICATION:

There is a difference in sensory threshold across different sites and gradual increase in the size of monofilament that is perceived, so one standard should not be maintained for all sites across all ages.

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