WEST-hand™ Terse Manual in English

General Information

1. The lengths of the filaments may be different (because they're calibrated).
2. Filaments may not be parallel to one another or may have a slight bend (to improve stimulation).
3. **If a filament has a sharp bend, return for recalibration.**
4. You may rotate several filaments for faster testing, but please store the instrument with all the filament pointing in the same general direction.
5. If a filament becomes stuck, rotate it in the opposite direction.

Method to obtain sensation levels

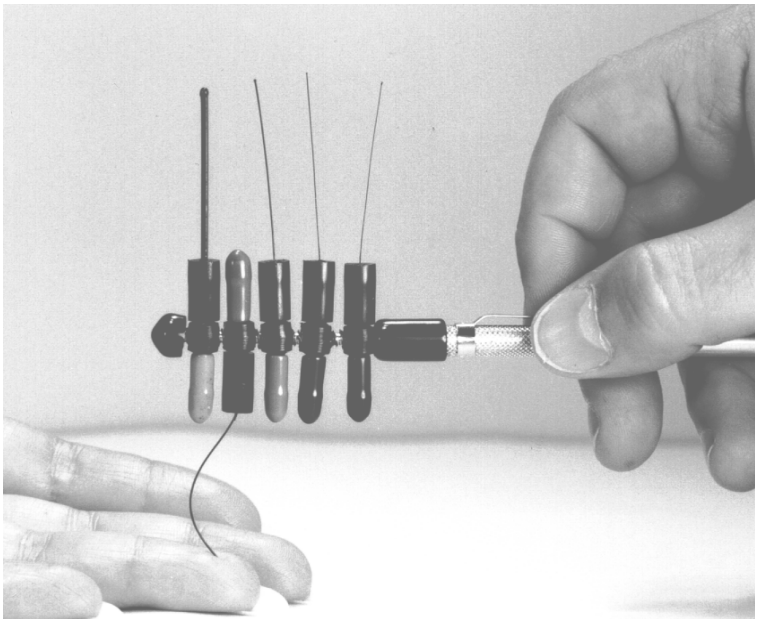
Rapid Threshold Procedure™

Use a descending threshold procedure (e.g., start at 4 g). Use catch trails (act as if you are stimulating, but don't). Make sure that the patient cannot solve the tactile sensory task using visual information. We enclose a clicker because indicating the interval of potential stimulation helps the patient solve the detection task and eases creation of catch trials. Threshold is not solely determined by the first failure to detect. At the first failure to detect, stimulate with the next more forceful filament. At this point, either the person detects or not. If not, this level is threshold. (The patient has just detected and failed to detect this level.) If detects, proceed to the missed detection level (i.e., one filament lower in force) and stimulate. At this point, either the person detects or not. If not, the threshold is taken as half way between the last twice-detected filament and this twice-missed filament. (The more forceful filament was detected twice, and the less forceful filament was missed twice.) Note, in this case threshold does not correspond to a filament value, but to a value between filaments. If detects, then proceed as if the patient never missed (looking for a new first failure to detect). The Rapid Threshold Procedure works if the patient does not give false positive responses to the catch trails. In experience, it works even if the patient initially gives false positive responses. Otherwise, use some other procedure, for example, The Carpal Tunnel Test™.

Dos and Don'ts

- Avoid touching the stalks of the filaments, which may affect calibration.
- Excessive heat affects calibration. Keeps filaments off window sills and away from fire.
- Never test open wounds, eyes, mucous membranes, oral cavity or damaged skin.
- Larger forces (>0.2 g) may damage newly grafted, transplanted or fragile skin.
- The contacting filament tips should be disinfected between patients.
- The tips and stalks are nylon. Anything that affects nylon is contraindicated.
- Do not place the stalks into a disinfecting solution – just the contacting tips.

See Carpal Tunnel Test and see Star method for recording WEST testing procedure.



Monofilament Esthesiometry 101

-- Curt Weinstein, President, Connecticut Bioinstruments

1. The instrument should be calibrated to ensure it applies the expected force. At Connecticut Bioinstruments we calibrate each monofilament found on the WEST-foot™ and CT-Bio 10g™ by applying it to an artificial foot that is attached to a precision scale. We alter each monofilament, as necessary, to ensure that the monofilament delivers the specified force (within 15% of its specifications).
2. The patient should know the interval in which a monofilament touch may occur. Each WEST-foot is accompanied with a CT-Bio™ Interval Marker, so that you can get the best testing.
3. When a sharp stimulus is used, the evaluator confounds evaluation for touch-pressure sensation. Different forces describe touch and pain thresholds. Connecticut Bioinstruments employs patented Softip™ monofilaments ensuring that the stimulation is not sharp.
4. The protocol is important. The linkage between threshold and body-site was created by touching the population only once with each level of force. If you were to use a different protocol you might change the established linkage. For example, if you allow the patient to detect using a protocol of one report out of three attempts, then the linkage would be inappropriately changed.
5. The protocol is important. To achieve greater reliability without changing the normal linkage between force and body-site, accept two or three reports of sensation out of three stimulations (the "two out of three" criterion). Why does this work? The original protocol (accept 1 out of 1 attempt) has two outcomes – miss or detect. Selecting the one detect divides the outcomes in two – the 50% point. The two-out-of-three protocol has four outcomes – miss three, detect one, detect two, or detect three. Selecting the outcomes detect two and detect three divides the outcomes in two – the 50% point.

Perhaps this is more than you want to know. If so, just know that Connecticut Bioinstruments makes each WEST-hand, WEST-foot and WEST-D esthesiometer by hand to exacting specifications. You cannot purchase a better monofilament esthesiometer. Otherwise, see Powerful Protocols: Rationale Behind 2-out-of-3 Rule.

Why WEST?

The Semmes Weinstein Aesthesiometer, i.e., Semmes Weinstein Monofilaments, comprise a set of 20 monofilaments. The set helps in the evaluation of skin sensation and, therefore, peripheral neuropathy. It was invented by Sidney Weinstein, Ph.D., with assistance from Josephine Semmes, Ph.D.

Some fifty years later, Dr. Weinstein also created the Weinstein Enhanced Sensory TestsTM, variants of the Semmes Weinstein monofilaments. Motivating the newer creation was the sloppy manufacture of the Semmes Weinstein Monofilaments, which were being made to size specifications but not force specifications. The product manufacturers were not guaranteeing that the correct force was applied. As the nylon manufacturing changed, inadvertently the force values changed in the Semmes Weinstein Aesthesiometer.

The instrument's calibration for values of force, however, was not the only change we engineered. Dr. Weinstein, now working with Dr. Drozdenko and Mr. Curt Weinstein, configured a new and functional look to the instrument. The Weinstein Enhanced Sensory TestTM, as the new configuration is called, employs a clever design that protects the lower-force monofilaments from breakage. Basically, the stiffer monofilaments on top protect the fragile monofilaments below. The design presented five monofilaments on one handle, thereby allowing faster and easier testing. Subsets of the WESTTM, such as the WEST-handTM, WEST-footTM, and WEST-DTM were created. Each of the previous three mentioned instruments employs only five monofilaments, for specialty applications. Perhaps the greatest advantage of the WEST system, however, was in its SoftipTM monofilaments. The SoftipTM advantage is two fold.

SoftipTM fixes one of the problems with the common monofilament. The monofilaments of the Semmes Weinstein Aesthesiometer bend upon application, resulting in a three-dimensional crescent pressing into the skin. Often the edge of the crescent is perceived as sharp by the neuropathic-free individual (for the patient with neuropathy, the edge helps lead the tester away from validity). Why sharpness presents a problem for the Semmes Weinstein monofilaments can be explained as follows. The force-detection relationship is a pain-free relationship. When the monofilaments induce pain (or equivalently, a feeling of sharpness), the smaller unmylinated neural fibers may dominate. These small fibers are not similar to the larger neural fibers that are related to the sensation of touch. For example, the small unmylinated fibers are resistant to damage (neuropathy) to a much greater degree than the larger neural fibers. The usefulness of the Semmes Weinstein monofilaments – the force-detection relationship – is not related to pain sensations produced. SoftipTM monofilaments present a solution this problem. Softip provides the same not-sharp contacting face to the skin as it twists. Thus, the WEST system does not produce the problem of painful stimulation that the Semmes Weinstein can – a Softip advantage.

There is another advantage to the Softip monofilament. The second advantage to Softip has to do with the force of the monofilament. Sometimes the Semmes Weinstein monofilament will momentarily produce an uncharacteristically greater force than expected. You can see this on force-by-time traces at the onset of applying the monofilament. More usually the original Semmes-Weinstein Monofilament will twist a potentially painful edge into the skin. When, however, it does not immediately twist – holding its shape momentarily too long without bending – that action results in a momentary overshoot of its characteristic force. That is, for a moment it applies a force too high. Softip monofilaments do not do that because their tips are curved, and they twist as a ball when the monofilament bends. Thus, the second advantage to the Softip monofilament is that it does not produce an overshoot of its characteristic force – it is more valid.

These two advantages (from the Softip) enabled the successful application of a superior testing procedure. The Rapid Threshold ProcedureTM (RTP) relies on the WEST's ability both to avoid painful stimulation and also to avoid incorrect (too high force) stimulation. The RTP helps the tester to find the patient's threshold very quickly and reliably. Wait, it doesn't always work; patients who are prone to false-positive indications of stimulation are poor candidates for the RTP; but these patients are easily culled. Most patients can be tested quickly and accurately with the WEST using the RTP. The RTP helps the tester find threshold quickly. But that alone is not the only advantage.

Another amazing and highly desirable trait of the RTP is that it splits hairs – it finds a threshold at a force between two adjacent Softip monofilament values. That means that a five-monofilament WEST, such as the WEST-hand, can give one of nine possible outcomes (or unconventionally, eleven). For example, when the patient detects a force level f1 and yet fails to detect the next lower force level f2, then the threshold is obviously between the two forces [(f1+f2)/2]. Gee, that was easy. Five monofilaments yield one of nine thresholds.

In conclusion, the WEST is a superior Semmes-Weinstein. It finds thresholds faster. It's easier to use. It is individually calibrated for applied force.

Powerful Protocols: Rationale Behind 2-out-of-3 Rule

Monofilament esthesiometers help clinicians to measure tactile neuropathy. Clinicians infer tactile neuropathy based on a history of publications linking sensibility and body part to graded neuropathy. In pursuit of more reliable evaluations, some have suggested alternative protocols. Others have called for protocol consistency because protocols affect validity. I offer a compromise – increased reliability without affecting validity.

For monofilament esthesiometers, the detection rule forms a critical aspect of the protocol. This essay discusses detection rules. The following terminology will ease the discussion. Some clinicians define the detection of a monofilament using this detection rule: one or more reports out of three opportunities to sense. For brevity, we describe this detection rule as 1-3. In analogy, researchers at Connecticut Bioinstruments have suggested using 2-3. The original detection rule is 1-1, one report of the one opportunity to sense. Note that the published linkage between neuropathy and sensibility has largely been based on the detection rule 1-1. We will show that detection rules may detect differently, and, hence, not yield the same linkage between sensibility and neuropathy. We will show advantage to the suggestions of Connecticut Bioinstruments.

Researchers sometimes divide the world of sensation into those reporting more than 50% of the opportunities versus less. If the patient reports the stimulus more than 50% of the opportunities, they say the patient feels that force. The problem arises, however, that the 1-1 rule when applied by the clinician will miss many patients that researchers would say feel that force. For simplicity, consider patients that detect a 0.1-N (i.e., 10-g) monofilament 75% of the time using 1-1. Rule 1-1 will wrongly classify a full 25% of these patients as insensitive to that force. Thus, we can see why clinicians might seek a better detection rule. The obvious path to improve reliability is to test more, but with what detection rule shall we test as not to destroy validity? Although we could conceivably create an entirely new linkage between sensibility and neuropathy, the price would steep, abandoning a long history linking the variables of population, body part, neuropathy and sensibility. Therefore, a new detection rule should not alter this linkage, while correctly detecting more patients.

Let us play an instructive game. We have mentioned the rules 1-3 and 2-3; now also consider 0-3. How do these three detection rules handle, for example, those 75%-detecting patients mentioned above? The rule 0-3 detects 100%, while 1-3 detects 98%, and 2-3 detects 84%. Before we conclude that we want 0-3, examine patients who have lost protective sensation, patients with LOPS. Consider LOPS patients who fail to detect 0.1 N 75% of the time (using 1-1). We want a rule that will detect more than 75% of these patients, because 1-1 detects 75%. Considering 0-3, clinicians will find 0% of these patients correctly classified, while correctly classifying only 42% with 1-3 and 84% with 2-3. Please note while both rules 0-3 and 1-3 correctly enhance the detection of those 75%-detecting patients, these same rules largely fail to classify those LOPS patients correctly. In contrast, 2-3 enhances correct detection both of sensing patients and of LOPS patients.

Of the three alternative rules considered, only 2-3 preserves validity by preserving the linkage between neuropathy and sensibility. Whatever result 1-1 would yield on the average (detect or not), 2-3 agrees on the average but with greater reliability (higher detection rates).

Other detection rules that preserve validity and increase reliability are 3-5 and 4-7. For example, considering those 75%-detecting patients from rule 1-1 above, rule 4-7 will correctly find 93%. Further, considering those LOPS patients above, 4-7 will correctly find 93% patients with LOPS instead of 75%.

In conclusion, the detection rule forms an important aspect of the protocol. Further, by a choice of protocol, we can alter detection rates (i.e., increase reliability) without destroying the published linkage between neuropathy and sensibility (i.e., preserve validity).

Tactile Test for Carpal tunnel Syndrome using the WEST-hand™

1. Rationale

Sensory-nerve damage is often both detected and classified by the loss of tactile sensation. Loss of tactile sensation is usually estimated by determining an absolute threshold, i.e., the smallest force reliably detectable. A potential confound has been found for patients with the job classification of physical laborer. Even before they become patients, scientific evaluations show that they have increased thresholds, and, thus, it is difficult to detect mild or early-onset of nerve damage accurately in this population using an absolute threshold. In patients with repetitive motion syndromes, such as Carpal Tunnel Syndrome (CTS), loss of tactile sensation due to nerve injury may be correlated with loss of tactile sensation due to protective skin thickening (including callus). This correlation does not present a problem for the evaluation of severe cases of CTS. For the detection of early-developing CTS, however, the correlation creates a problem in detection. Good estimates of the smallest detectable force are not sufficient to differentiate between impaired nerves and affected skin in cases of first emerging CTS. Thus, the discovery of a minimally elevated threshold will not reveal whether the nerves are compromised or whether the skin was thickened. An alternative procedure, fortunately, can be used to test for sensory deficit, even in the presence of callus.[1] This alternative procedure tests the ability of the patient to differentiate between easily detectable stimuli, i.e., super-threshold forces. The confounding effect of skin thickening affects the evaluation of threshold-level forces to a much greater extent than these super-threshold forces. To evaluate CTS, this procedure measures the patient's ability to differentiate between two super-threshold forces. This procedure may also detect malingerers, patients who deliberately try to confound the test by lying.

2. Overview

The test requires twenty trials. Each trial consists of the application of two different forces in close temporal proximity and with a randomized order of presentation. The patient's task is to report which of the two stimuli feels heavier. Each stimulus is applied for one full second, with a half second interval of separation. Therefore, each trial takes about 2.5 seconds for the tester to administer and about three additional seconds for the patient to respond either "first" or "second." The twenty trials take less than two minutes. For the test to be scored correctly, patients must indicate a preference, even if they only guess.[2] Unaffected patients should score a perfect 20 correct. When the patient is totally anesthetic, the statistically expected score is ten correct responses. Therefore, scores statistically lower than ten (e.g., less than six) indicate at least one of the following: (1) the patient is malingering or (2) the instructions are misunderstood or (3) a very infrequent event has occurred..

3. Detailed Procedures

3.1 Choose one of the four CTS Test Forms below. Each form presents a particular 20-item random sequence of paired trials -- 2 vs. 4 g. The patient compares the two stimuli twenty times. The score is the number of correct trials. Scores less than twenty reflect neuropathy. Scores less than six reflect additional concerns (see section 4.).

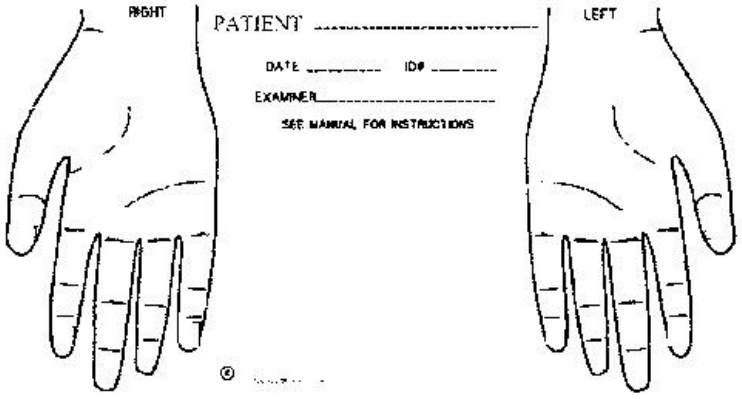
3.2 Instructions to patient: I will be touching you in succession with two differently weighed probes. Your job is to tell me which probe feels heavier -- the first or the second. So you know when the touches should occur, surrounding each touch will be a click. This is what you should experience: hear a click, feel touch number one, hear a click, and then hear a click, feel touch number two, hear a click. After the fourth click, tell me whether the first or second touch was heavier. If you are unsure, please guess. There is no penalty for guessing; do the best you can. We will be repeating the procedure several times. Any questions?

Tactile Test for Carpal tunnel Syndrome using the WEST-hand™ - continued

3.3 Instruction to tester: The patient's view of the testing site should be blocked. Apply the first filament (2 or 4 g) to the base of the thumb (or the site of sensory complaint) for a full second. Just before you slowly bend the filament onto the skin, press the clicker to cue the patient of the start of the stimulus interval. Then silently say "one Mississippi" to approximate a one-second application, and then slowly lift the filament from the skin. Release the clicker to cue the patient of the end of the first interval. Wait about half a second and apply the second filament (4 or 2 g) in the same slow, deliberate manner, cueing the patient with the clicker. Prompt the patient for a response, only if necessary. The patient should catch on and respond after the second click of the second stimulus. Record all responses on the testing form. After the twentieth response from the patient, tell the patient that the test is complete. Count the number of correct trials, and record that count next to "Total.""

4. Expected Results

We believe that most people without neuropathy and without heavy callus at the site of testing will score 20. A greater sensory deficit scores lower--to a point. Certainly scores from 19 to 10 suggest an increasingly greater deficit. Statistically speaking, however, patients void of tactile sensation will have a mean score of 10 with a standard deviation of about 2.2. Patients with greater tactile sensation will have higher scores with smaller standard deviations. Scores statistically lower than ten (e.g., less than six) indicate that the patient may be malingering. Other valid interpretations to a low score include: the instructions may have been be misunderstood, or a rare event occurred by chance in a person with diminished tactile sensibility. As necessary, you may retest the patient, using another test form, to obtain a better index of sensibility (average the two scores, unless you suspect that the patient had misunderstood the original instructions).



[1] Weinstein, S., Drozdenko, R., & Weinstein, C. (1996) Evaluation of sensory methods in neuropathy. Chapter 8 in Tendon and Nerve Surgery in the Hand – A Third Decade Review, J. M. Hunter, L.H. Schneider, E.J. Mackin (Ed).

[2] Even when the patients are very unsure of their responses, the guess usually contains useful information--very few guesses are random, for most people. And when the guesses are random, that information is also useful.

Four random testing orders (forms) are encoded on one test sheet, following.

Test Forms

Patient_____ O = correct or **x** = wrong

Form 1	Date	Form 2	Date	Form 3	Date	Form 4	Date
Trial	O or X	Trial	O or X	Trial	O or X	Trial	O or X
1	2g:4g	1	2g:4g	1	2g:4g	1	2g:4g
2	2g:4g	2	2g:4g	2	2g:4g	2	2g:4g
3	2g:4g	3	2g:4g	3	2g:4g	3	2g:4g
4	2g:4g	4	2g:4g	4	2g:4g	4	2g:4g
5	2g:4g	5	2g:4g	5	2g:4g	5	2g:4g
6	2g:4g	6	2g:4g	6	2g:4g	6	2g:4g
7	2g:4g	7	2g:4g	7	2g:4g	7	2g:4g
8	2g:4g	8	2g:4g	8	2g:4g	8	2g:4g
9	2g:4g	9	2g:4g	9	2g:4g	9	2g:4g
10	2g:4g	10	2g:4g	10	2g:4g	10	2g:4g
11	2g:4g	11	2g:4g	11	2g:4g	11	2g:4g
12	2g:4g	12	2g:4g	12	2g:4g	12	2g:4g
13	2g:4g	13	2g:4g	13	2g:4g	13	2g:4g
14	2g:4g	14	2g:4g	14	2g:4g	14	2g:4g
15	2g:4g	15	2g:4g	15	2g:4g	15	2g:4g
16	2g:4g	16	2g:4g	16	2g:4g	16	2g:4g
17	2g:4g	17	2g:4g	17	2g:4g	17	2g:4g
18	2g:4g	18	2g:4g	18	2g:4g	18	2g:4g
19	2g:4g	19	2g:4g	19	2g:4g	19	2g:4g
20	2g:4g	20	2g:4g	20	2g:4g	20	2g:4g
Total		Total		Total		Total	
Tester		Tester		Tester		Tester	

Encoding Thresholds: WEST-hand and the Rapid Threshold Procedure.

The five Softip™ monofilament esthesiometer WEST-hand™ can be used to find thresholds with a variety of testing procedures. When employing the *Rapid Threshold Procedure*, one of eleven outcomes results. Using the CT-Bio Star, you can encode both the location of testing and the one outcome from eleven possibilities. Location is encoded by the position of the CT-Bio star on the body map. Outcome is encoded as follows.

An unmarked CT-Bio Star™ means the site was not tested.

If the threshold is 0.07 g (green), circle the top point, as shown.

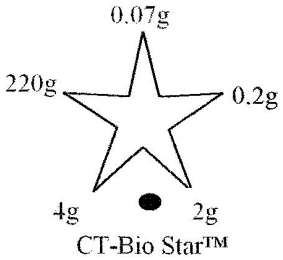
In a like manner, circle points to show thresholds that correspond to Softip monofilament values. See following.

This point corresponds to the second Softip filament value, 0.2 g.

To indicate 2.0 g threshold, circle the bottom right point.

Circle the bottom left point to show a threshold of 4.0 g, borderline LOPS.

Circle the top left point to show a threshold of 220 g.



CT-Bio Star™

Lower than 0.07 is encoded as shown to the right.

(0.07 + 0.2)/2 = .135 g. Show 0.135g as in the CT-Bio Star on the right.

Similarly, mark indentations to show outcomes between values of the Softip monofilaments. See following.

The CT-Bio Star to the right shows a threshold of 1.1 g.

The CT-Bio Star to the right shows a threshold of 3 g.

The CT-Bio Star to the right shows a threshold of 112 g.

If the patient does not detect any stimulation, mark like this.

How to Use The Testing Form

Photocopy the blank testing form. Draw a CT-Bio Star at the sites of testing. Test using the Rapid Threshold Procedure. Mark the CT-Bio Star as shown in this document to create a record of sensation.

- Notice that higher thresholds are encoded on the left of the CT-Bio Star. More clockwise is more insensitive.
- Notice that thresholds that correspond to a Softip™ monofilament value are encoded at the points of the CT-Bio Star with a circle.
- Notice that thresholds found between Softip monofilament values are encoded at an indentation with a line, between the two Softip monofilaments.
- Standard Calibration is within 15% of values given. The dot between arms 4 g and 2 g signifies star bottom.