# A Clinical Method of Quantitative Gait Analysis

## Suggestion from the Field

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Quantitative methods of gait analysis are needed for documenting patient progress and for doing clinical research. Abnormal measures of velocity, step length, step width, stride length, and cadence have been shown to be important indicators of gait dysfunction.[1-4] Improvements in function are paralleled by improvements in these measures.

Sophisticated electronic methods are the simplest and most accurate methods of gait analysis; however, they are not usually available to the clinician. These methods are expensive[2] and are found in only a few locomotion laboratories.[5]

This paper describes a clinical method of quantitative gait analysis, different from the clinical methods that have been described in the literature,[2,6] that can be used in any clinical setting. This method can be used to quantify stride length, step length, step width, cadence, and velocity of walking, and it requires less equipment and may be simpler to use than other clinical methods. Also, this method provides a way of teaching objective gait analysis to physical therapy students.

### PROCEDURE

The procedure requires only a stopwatch, two felt-tip marking pens with washable ink, and a 16-m (53 ft) walkway that is premeasured and marked with masking tape at four points. A hallway, an outside cement area at a clinic, or patient's home, as well as a portion of a clinic floor can be used for the walkway. The walkway is marked to show a center area 6 m long and two 5-m areas on each end (Fig. 1). Measurements are made within the 6-m area only; the two 5-m areas allow for warming up to "normal" velocity before measurement and slowing down after measurement. Using these extensions of the measurement area of the walkway is intended to eliminate measurement errors.

Felt-tip marking pens are taped to the back of the patient's shoes so that the tip just reaches the floor when he is standing (Fig. 2). Before the procedure, the patient should take a few steps at the side of the walkway to ensure that the markers are correctly positioned to indicate heel contact. If several trials are done on the same walkway, marks must be erased after each trial. If several patients are to be tested at the same time, different colored pens can be used to eliminate the need to erase the marks after each patient's walk.

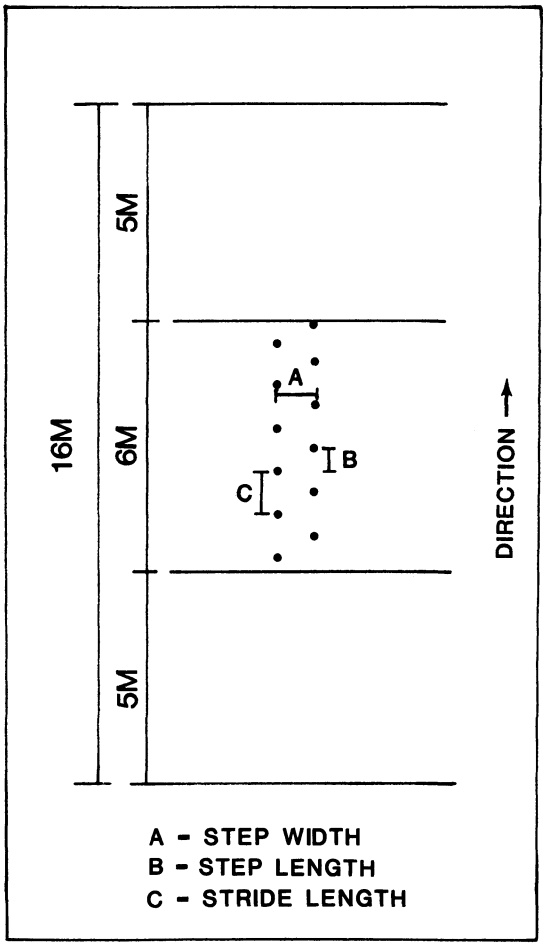


*Fig. 1. Walkway with heel contact marks shown in center 6-m measurement area. Five-meter areas on each end of measurement area are used for warming up to normal velocity and slowing down after measurement.*

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*This article was submitted August 3, 1982; was with the author for revision 14 weeks; and was accepted for publication February 18, 1983.*

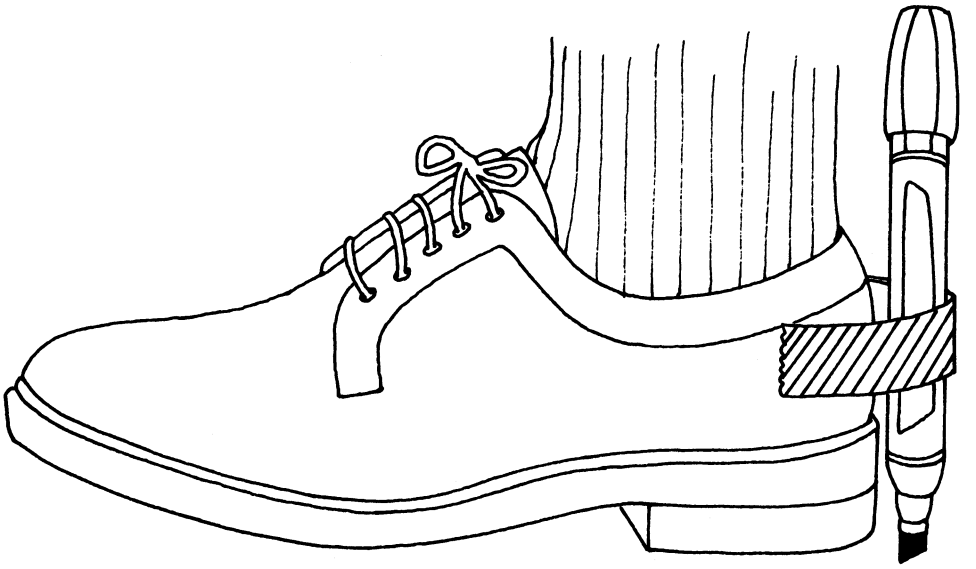

*Fig. 2. Felt-tip pen taped to back of shoe for marking heel contact.*

The patient is instructed to walk at his usual walking speed from one end of the 16-m walkway to the other end. The therapist, using a stopwatch, records the time taken for the patient to walk the center 6 m. Measurements within the 6-m area are then made of distances from each heel contact pen mark to the next heel contact pen mark on the same side (stride length) and on alternate sides (step length) and of distances of width between successive marks (step width). (Sometimes the marker leaves a line mark as the heel nears the floor for contact. The point at the termination of the line mark should be used for measurement.) Also, the total number of contact marks in the center 6 m is counted.

## CALCULATIONS

Velocity is calculated in meters per minute by dividing 360 by the number of seconds it took the patient to traverse the 6-m area (6m × 60 sec ÷ time for walk in sec). Markings are not used for this.

Cadence is calculated in steps per minute by dividing the product of the number of marks in the center 6 m and 60 by the number of seconds it took to traverse the 6-m area (# marks × 60 ÷ time for walk in sec).

Stride length, the distance from heel contact mark to heel contact mark by the same foot, is calculated by averaging the middle three strides (Fig. 1).

The step length measurement is the average of the middle three steps on the right side by measurements in the line of progression from the left contact pen mark to the right contact pen mark and on the left side by measurements from the right contact mark to the left contact pen mark (Fig. 1).

Step width is the distance perpendicular to the line of progression from left contact mark to right and from right to left. The middle three steps are averaged for each side (Fig. 1) to obtain this measurement.

## DISCUSSION

There are several advantages of this method of quantitative gait analysis. The costs are low; a good stopwatch can be purchased for approximately $30, and felt-tip marking pens and masking tape are readily available and inexpensive. Other advantages are that the method can be performed by one therapist in any clinical setting, that setup time and equipment requirements are minimal, and that the information gained can be used to document a patient's walking ability before and after treatment.

## REFERENCES


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# LAMPIRAN NILAI UJI

1. Nilai Uji Normalitas

**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| sebelum_1 | .167 | 5 | .200* | .957 | 5 | .790 |
| sebelum_2 | .303 | 5 | .149 | .885 | 5 | .335 |
| sesudah_1 | .232 | 5 | .200* | .896 | 5 | .390 |
| sesudah_2 | .252 | 5 | .200* | .926 | 5 | .566 |
| selisih_1 | .233 | 5 | .200* | .902 | 5 | .418 |
| selisih_2 | .264 | 5 | .200* | .883 | 5 | .322 |

2. Nilai Uji Homogenitas

**Test of Homogeneity of Variances**

Sebelum_intervensi_kelompok_1_dan_kelompok_2

| Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|
| 4.008 | 1 | 8 | .080 |

3. Nilai Uji Hipotesis I

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | sb1 - sd1 | -15.40000 | 7.63544 | 3.41467 | -24.88066 | -5.91934 | -4.510 | 4 | .011 |

4. Nilai Uji Hipotesis II

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | sb2 - sd2 | 342.8000 | 228.67160 | 102.26505 | 58.86671 | 626.73329 | 3.352 | 4 | .029 |

5. Nilai Uji Hipotesis III

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confi |
| | | | | | | | | | Lower |
| selisih_1_dan_selisih_2 | Equal variances assumed | 5.671 | .044 | -3.918 | 8 | .004 | -337.00000 | | 86.014 |
| | Equal variances not assumed | | | -3.918 | 4.013 | .017 | -337.00000 | | 86.014 |

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