

## Assessment of posture: Accuracy of the plumb line method

Christelle du Plessis, Occupational Therapy student \_\_\_\_\_

Mireille R le Roux, Occupational Therapy student \_\_\_\_\_

Jani Prinsloo, Occupational Therapy student \_\_\_\_\_

Absu S Smit, Occupational Therapy student \_\_\_\_\_

Jeanine Swart, Occupational Therapy student \_\_\_\_\_

Cornelia van Zyl, Occupational Therapy student \_\_\_\_\_

**Affiliation of students:** Department of Occupational Therapy, School for Allied Health Professions, Faculty of Health Sciences, University of the Free State, Bloemfontein

**Petronella A Hough, M. Occupational Therapy** \_\_\_\_\_

Lecturer, Department of Occupational Therapy, School for Allied Health Professions, Faculty of Health Sciences, University of the Free State

**Mariette Nel, M Med Sc** \_\_\_\_\_

Lecturer, Department of Biostatistics, Faculty of Health Sciences, University of the Free State, Bloemfontein

### Introduction

Posture serves as the basis for movement and needs stability and efficiency of movement during a person's participation in activities<sup>1</sup>. Research has shown that incorrect body alignment could have a negative effect on the general health of an individual, resulting in numerous medical conditions and occupational afflictions<sup>2</sup>. In order to address malalignment in posture efficiently, posture needs to be assessed correctly.

Currently, a plumb line is used in Occupational Therapy as the standard method of assessing posture. Since many variables may occur in this method, no consistency exists in the values obtained during the evaluation, and these values are in fact nothing less than a mere estimation<sup>3</sup>.

Estimation is associated with inaccuracy, insecurity and the possibility of making mistakes. Taking this into account, the question could be asked whether the instrument currently being used, i.e. assessment by means of a plumb line, is sufficiently accurate to draw conclusions from the results for planning treatment programmes.

The aim of this study was to investigate the accuracy of the standard plumb line method used to assess posture.

### Methodology

Occupational Therapy students at the University of the Free State (UFS) participated in this cross-sectional study during academic hours. This study was approved by the Ethics Committee of the Faculty of Health Sciences, UFS (ETOVS Number 15/08).

In order to minimise measurement errors, a lateral view of a full-size photograph of a person was displayed. The assessment instrument, i.e. the plumb line, was set up against the photograph according to the standard method for assessing posture which requires that the plumb line "cuts" through specified anatomical landmarks on the person's body. These landmarks included the

external auditory meatus, mid-acromion, greater trochanter, anterior of the mid-knee, and anterior of the lateral malleolus. When posture is being assessed, it is important to ensure that the plumb line "cuts" anterior to the lateral malleolus.<sup>3</sup>

Participants recorded the difference between the anatomical landmarks and the plumb line in millimeters on the posture assessment form. A questionnaire in which the opinion of the participants was asked regarding the accuracy of the plumb line method was also completed.

The plumb line measurements were compared with those obtained by the Posture Analysis Toolkit (PAT), a computer programme exclusively developed for the accurate observation of anatomical landmarks during assessment of posture.<sup>4</sup> At the moment the PAT is an exact and user-friendly method available to researchers in clinical practice.

When a participant indicated the plumb line assessment of a landmark as posterior to the PAT result, a negative value was allocated to the deviation, with the opposite applicable for plumb line assessments anterior to the PAT result. The smaller the difference between the participant's plumb line assessment and the PAT result, the more accurate the participant's assessment. Descriptive statistics namely medians and quartiles for continuous data, and frequencies and percentages for categorical data were calculated. Medians were used to summarise as the data were skewed. 95% confidence intervals (CI) for paired data were calculated to compare the plumb line values and the PAT values.

### Results

Eighty-three Occupational Therapy students between the ages of 19 and 26 years (median age 21 years) participated in this study. More than 80% of the participants regarded the plumb line as an inaccurate method of assessing posture. Some participants (41.8%)

Table 1: Deviations in millimeters (mm) for each landmark as assessed with the plumb line method and PAT, and 95% Confidence Intervals for the median difference between the respective assessing methods.

Anatomical landmark	Frequency (%) (n=83)	Plumb line method Deviation (mm)			PAT	95% CI*
		Minimum	Median	Maximum		
External auditory meatus	75 (90.4)	3	20	100	99	[77 ; 89]#
Mid-acromion	82 (98.8)	2	24.5	150	92	[67 ; 77]#
Greater trochanter	80 (96.4)	2	20	150	74	[54 ; 64]#
Slightly anterior to the mid-knee	46 (5.4)	1	10	100	23	[18 ; 23]#
Anterior to the lateral malleolus	12 (14.5)	2	10	50	0	[0 ; 0]

\*95% confidence interval

#Differences were statistically significant.



regarded the method as subjective, while 68.7% indicated that it was not accurate and exact as it is based on estimation, or influenced by variables.

After completion of the assessment of posture, deviations on the posture photograph as measured with the plumb line method were annotated by the participants. *Table 1* shows the deviations at each landmark, indicated in millimeters, for the respective methods used to assess posture.

*Table 1* also shows the 95% confidence intervals for the differences observed between the plumb line method and the PAT results. As can be seen in the table the deviation becomes larger from the lower to the upper anatomical landmarks.

## Discussion

An assessment instrument should be accurate and objective and should limit variables to a minimum. Literature states that even an experienced evaluator has to estimate<sup>5</sup>, corroborating the supposition that when a measuring instrument is inaccurate, or the evaluator experiences uncertainty, or the instrument cannot be guaranteed to be free from errors, it can consequently not be regarded as valid.

The differences between the plumb line and the PAT assessments are indicative of statistically significant inaccuracy resulting from the plumb line method.

## Conclusions and recommendations

It is the occupational therapists' responsibility to produce accurate assessment results that will lead to appropriate intervention, which in turn assists the client to reach his/her goals. When the standard plumb line method used to assess posture is regarded as inaccurate, it is by implication invalid and unreliable, and treatment will be approached from a flawed perspective. The results of our study should be kept in mind and caution is recommended when using

the plumb line method for the assessment of posture.

## Acknowledgments

The Occupational Therapy students who participated in the study; Ms. Daleen Struwig, for technical and editorial preparation of the manuscript for publication.

## References

1. Kendall FP, McCreary EK, Provance PG. Muscle testing and function with posture and pain, 5<sup>th</sup> ed. Baltimore: Lippincott, Williams&Wilkins; 2005:71.
2. Fatahllah FA, Miller BJ, Miles JA. Low back disorders in agriculture and the role of stooped work: scope, potential interventions, and research needs. J Agric Saf Health. 2008;14(2):221-45.
3. Kendall FP, McCreary EK, Provance PG. Muscle testing and function with posture and pain, 3<sup>rd</sup> ed. Baltimore: Lippincott, Williams&Wilkins; 1993:75.
4. Hough PA, Beukes A, Clarke V, Frankim M, Jewell T, Mathee M, Nel M. The influence of hipster fashion on body alignment. South African Journal of Occupational Therapy; 39(2):6-10.
5. Kendall HO, Kendall FP, Boynton DA. Posture and pain. 8<sup>th</sup> ed. Huntington, NY: Robert E Krieger Publication Co. Inc., 1975. □

### Corresponding author's address

**Ms. Ronette Hough**

Department of Occupational Therapy (G44)

Faculty of Health Sciences

University of the Free State

PO Box 339

Bloemfontein

9300

Email address [gmatpae.md@ufs.ac.za](mailto:gmatpae.md@ufs.ac.za)