



# Modified Universal Goniometer for Objective Assessment of Forward Head Posture in Clinical Settings

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## ABSTRACT

Accurate assessment of the forward head posture needs sophisticated, high-end equipment, which may not be available always. A modified universal goniometer was designed for routine clinical use by which forward head posture can be assessed by measuring craniocervical and craniohorizontal angles. The device was tested in 23 young male subjects by two independent testers and was found to be reasonably accurate. The device is simple, cost-effective and reliable for use in clinical physiotherapy for objective assessment of the forward head posture.

**Keywords:** Angles, Assessment, Goniometer, Posture.

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## INTRODUCTION

Posture is the way you position your body or body segments with reference to each other and with reference to the surrounding space. Human positions refer to the different physical configurations that the human body can take. A position is a general term for a configuration of the human body whereas posture means an intentionally or habitually assumed position.<sup>1</sup>

There is no rigid formula to define an ideal posture. It is usually considered to be the natural and comfortable attitude of the body in normal, healthy persons. A good posture is a posture in which the body segments are balanced in the position of least strain and maximum support. In this position, all bodily organs are positioned optimally and muscles work efficiently. Good posture is dependent on various factors such as anatomical and physiological integrity of the musculoskeletal system, neural system and sensory system including vision and

kinesthesia, psychological factors, socio-cultural factors, as well as the external factors like demands of the workplace and recreational habits.<sup>2-6</sup> Deviations from the normal postural alignment can lead to the development of a number of musculoskeletal and other problems. Forward head posture, though more common in an elderly population, is being seen increasingly in young people also because of the widespread use of computers and mobile phones.

The objective assessment of the forward head posture is done by measuring two angles namely the craniocervical angle and the craniohorizontal angle.<sup>7</sup> Techniques of objective assessment of the forward head posture include X-ray imaging, radiographs,<sup>8</sup> fastrack electromagnetic system, and computerized dynamic posturography. Due to the non-availability of these sophisticated high-tech evaluation equipments,<sup>8-12</sup> in clinical practice assessment is made with a naked eye and photographic methods,<sup>13-14</sup> but these are not very accurate. So a need was felt to develop a simple device for measuring the head-neck posture, which would be convenient to use, cost-effective and which shows good reliability and reproducibility.

## MATERIALS AND METHODS

A simple instrument has been developed by modifying the universal goniometer (Fig. 1) which is routinely used by physiotherapists for measuring the ranges of motion of the peripheral joints. The universal goniometer is a simple measuring device which has a protractor and two arms



Fig. 1: Universal goniometer

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Fig. 2: Modified goniometer: front view



Fig. 3: Modified goniometer: oblique side view

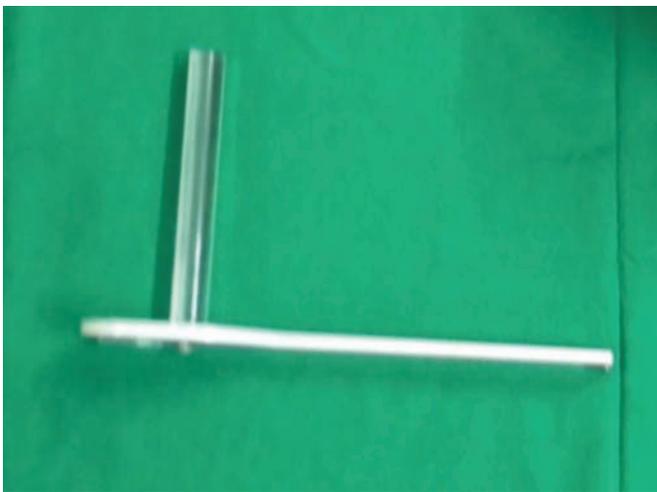


Fig. 4: Modified goniometer: superior view

attached to the protractor, one of which is fixed to the protractor and the other arm is movable at the fulcrum which is the center of the protractor. This instrument, however, is capable of measuring only a two-dimensional motion.

The modified goniometer was constructed by attaching a perpendicular rod at the fulcrum of half circle universal goniometer, posteriorly. Figures 2 to 4 show anterior, oblique and superior views of the modified device respectively. With this device, it is possible to measure craniovertebral angle and craniohorizontal angle, to get an accurate estimation of head posture. The craniovertebral angle can be assessed using modified goniometer and craniohorizontal angle by using simple universal goniometer. Both the angles are measured as two-dimensional angles.

The craniovertebral angle is measured in degrees between a horizontal line passing through the spinous process of C<sub>7</sub> and the line joining the tragus of the ear and the spinous process of C<sub>7</sub>. The tragus of the ear is taken as a reference point as it is visible and it moves in direct relation to the skull. The spinous process of C<sub>7</sub> is

taken as another point for lower cervical spine as it can be easily located by palpation. An angle less than 50° indicates forward head posture.<sup>13</sup> Figures 5 and 6 show the method of measurement.

The craniohorizontal angle was measured between a horizontal line through tragus and another line joining tragus and external canthus of the ipsilateral eye. It provides an estimation of head on neck angle or position of the upper cervical spine.<sup>15</sup> The normal range of craniohorizontal angle is 16.3 +/- 6.0°. Figure 7 illustrates the method of measurement. Each subject was then asked to walk around freely in the room for 5 minutes and the procedure was repeated twice. The same measurements were also repeated by another independent therapist who was blinded to the results of the previous examiner.

### Testing of the Device

The modified goniometer was tested in 23 volunteers. All were male and their age ranged from 18 to 25 years. Their consent was taken. The mean age was 21. Craniovertebral and the Craniohorizontal angles were measured by two independent examiners. Three readings were taken by each, one at rest and two more after asking them to walk in the room for 5 minutes.

Inter-rater reliability was quantified by interclass correlation coefficients (ICCs) for consistency of measurement using Cronbach's alpha. The Cronbach's alpha value of 0.893 showed good internal consistency (Tables 1 and 2).

Table 1: Reliability statistics

Cronbach's Alpha	N of Items
0.893	2



Fig. 5: Measurement: Cranio vertebral angle



Fig. 6: Measurement: Cranio vertebral angle; posterior view



Fig. 7: Measurement: Cranio horizontal angle

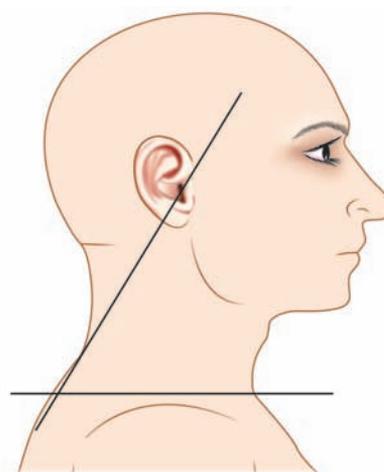


Fig. 8: Diagrammatic representation: C-V angle

## DISCUSSION

By using the observational method, which is the most commonly used method, different therapists rate the severity of the forward head posture as mild, moderate or severe, without any objective or numeric value.<sup>16</sup> A decision regarding normality or otherwise is then based on a clinician's experience and perception of what constitutes a normal or "ideal" posture and is therefore considered to be a potential source of error. The decision is subjective as opposed to objectively measured findings.<sup>17</sup> One objective and widely used method of assessing head posture is through measuring the craniovertebral (CV) angle (Fig. 8).<sup>16,18</sup> The CV angle is the angle between a horizontal line through the spinous process of C7 and a line from the spinous process of C7 through the tragus of the ear.

Other forms of objective measurement of FHP include various "head tilt angles" where the true horizontal is measured against angles used in conjunction with the tragus to the canthus (known as the Ear-Eye line), tragus to the bottom of the eye socket (Frankfurt Line), tragus to the nasion (the middle of the nasofrontal suture), and tragus to the infra-orbital notch (junction of the lateral third and medial two-thirds of the inferior orbital rim).<sup>19-20</sup> Plain film radiographs of head and neck to measure the relationships between bony structures, without reference to any external landmark have also been described. However, the availability of the costly and high-end equipments and the ethical aspects of subjecting the patients to repeated radiographic assessment, make it undesirable to use in clinical practice for evaluation of the head neck postures. Since the inter-rater reliability

Table 2: Intraclass correlation coefficient

	Intraclass correlation <sup>a</sup>	95% confidence interval		F test with true value 0			
		Lower bound	Upper bound	Value	df1	df2	Sig
Single measures	0.798 <sup>b</sup>	0.583	0.908	9.351	22	22	0.000
Average measures	0.887 <sup>c</sup>	0.737	0.952	9.351	22	22	0.000

for the measurements of both the craniovertebral and craniohorizontal angles has been found to be good ( $a = 0.893$ ), this particular device method may be useful in routine clinical physiotherapy practice for assessment of the head posture.

## CONCLUSION

The modified goniometer as described in this paper is a simple and cost-effective modification of the universal goniometer, routinely used by physiotherapists. It is a reliable method for objectively assessing forward head posture in day to day clinical physiotherapy practice as a reliable alternative to high-end equipment which may not be always available.

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