

Original Research Article

Measuring Table Tilts- Trigonometry and Electronics

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ABSTRACT

INTRODUCTION

The main purpose of tilt table testing (TTT) is to determine the underlying cause of orthostatic intolerance, near-fainting episodes, and unexplained syncope. The aim of present study is to measure table tilt using trigonometry and electronic medium.

MATERIAL AND METHODS

The present prospective study was done among 25 patients undergoing pelvic surgery at tertiary care centre during the study period of one year. Inclinator, bubble app and mathematical formula were used to measure the tilt. Results were analyzed using SPSS version 25.0.

RESULTS

The mean age of patients in our study was 37.8 ± 5.9 years. The Mean \pm SD angle measured by three methods were 13.1 ± 2.8 degree by inclinometer, 13.2 ± 2.6 degree by bubble app and 13.1 ± 2.6 degree by mathematical formula and results were significant with p value .000.

CONCLUSION

All the three methods were easy to use and were efficient in measuring table tilt with almost same results.

KEYWORDS

Android App, Electronic, Inclinator, Table Test, Tilt, Trigonometry

INTRODUCTION

The main purpose of tilt table testing (TTT) is to determine the underlying cause of orthostatic intolerance, near-fainting episodes, and unexplained syncope. The test has been used clinically

for the examination of syncope for forty years, despite its original development for physiological research of the human hemodynamic response to orthostatic provocation.^[1] In addition to causing and reproducing vasovagal syncope (VVS) and any type of transient loss of consciousness (TLOC), TTT is used to diagnose chronic orthostatic intolerance, which may or may not include orthostatic hypotension (OH), postural orthostatic tachycardia syndrome (POTS), and TLOC. It could also be applied to the patient's education of these ailments.^[2]

In a nutshell, TTT is tilting a specifically made table to a particular angle to mimic a shift in posture from a laying to an upright position, which can cause fainting symptoms in people with specific disorders. The subject is tilted from 60° to 80° during the test after being strapped down using Velcro straps. The exam, which usually takes 20 to 45 minutes, monitors the patient's heart rate (HR), blood pressure (BP), and symptoms. The goal of TTT is to assess how the body reacts to a change in posture and to find any underlying medical issues that might be causing orthostatic intolerance or loss of consciousness.^[3]

Unfortunately, most OT tables do not have the ability to assess tilt provided. Due to their experiences, clinicians form an arbitrary belief about the safest tilt degree for their patients. While it is generally effective, giving more tilt than is necessary might nevertheless cause nausea and vomiting in a considerable proportion of patients due to hypotension. Numerous other patients have insufficient levels, which can cause discomfort for the patient, the surgeon, and the anesthesiologist and sometimes even require switching to general anesthesia. An essential determining factor like tilt cannot be left to subjective trial and error in modern world where patient safety during the perioperative period is prioritized.^[4]

There are various methods used now a days like inclinometer, mathematical formulas and android apps for measuring tilt but there is lack of literature in the past proving their efficiency. Hence the present study will be done to measure table tilt using trigonometry and electronic medium.

MATERIAL AND METHODS

The present prospective study was done in the operation theatre of a tertiary care centre among patients who were undergoing pelvic surgery during the study period of one year. The ethical permission was taken from institutional ethical committee before the commencement of study and patients were asked to sign an informed consent form before starting the procedure.

Total 25 patients who were undergoing pelvic surgery which was in head down tilt selected by consecutive sampling on the basis of selection criteria. Tilt was checked in those patients table only who were above age of 18 years, had single episode of syncope and were willing to participate in the study. Patients who were below 18 years, did not signed informed consent and had undergone any operation in the past were excluded from the study.

The vital characteristics as age, weight, height, sex, registration number, surgery to be performed were noted. The final tilt of the table was calculated using three methods for each patient-

Inclinometer – It was easy to handle instrument which comes with magnetic stand and sticks with table. The readings from the instrument was noted by observer. (Figure 1)



Figure 1: Inclinometer

Bubble app – It is an electronic app which was easily accessible from android store having digital display and accuracy of 0.3. The readings were captured b help of screenshot. (Figure 2)

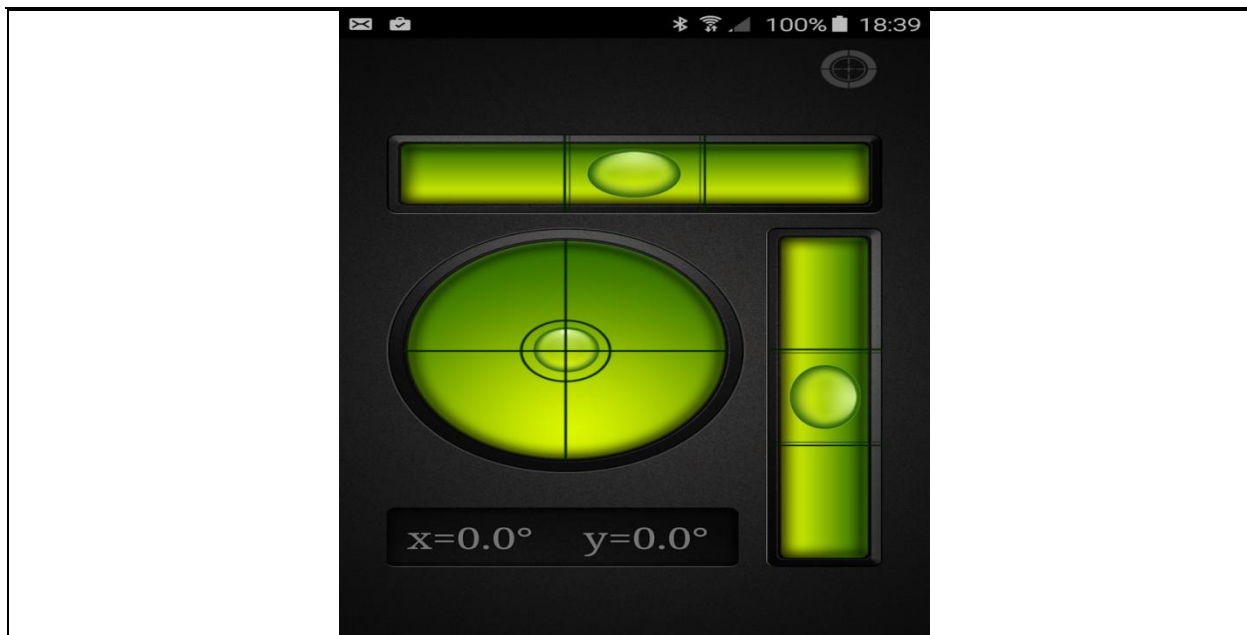


Figure 2: Bubble app

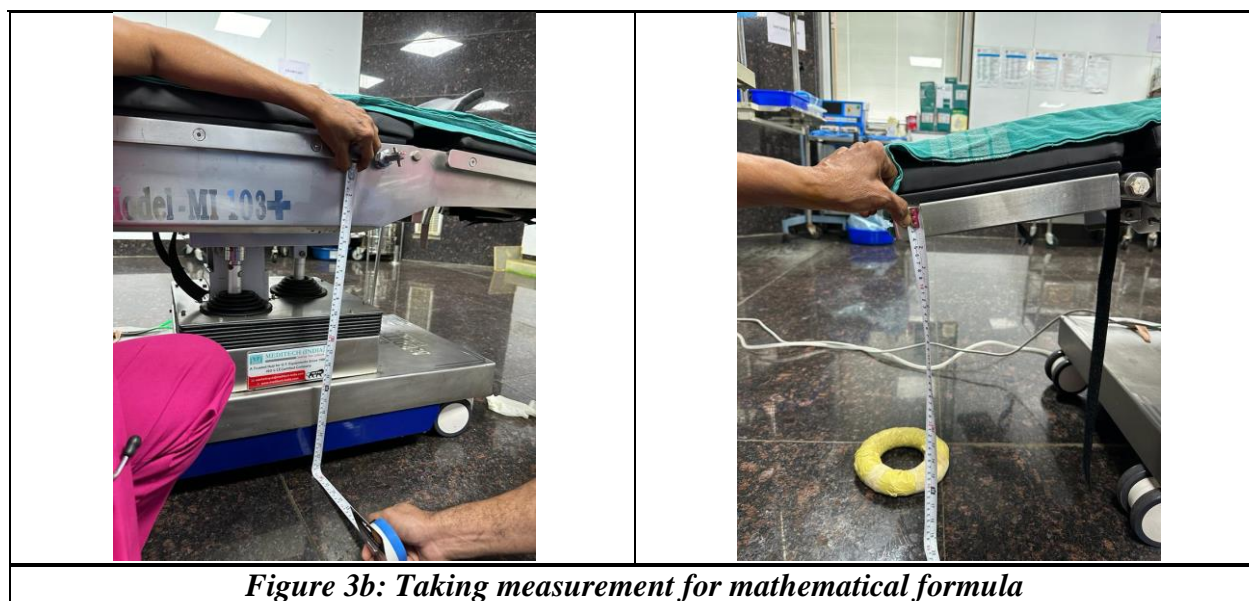
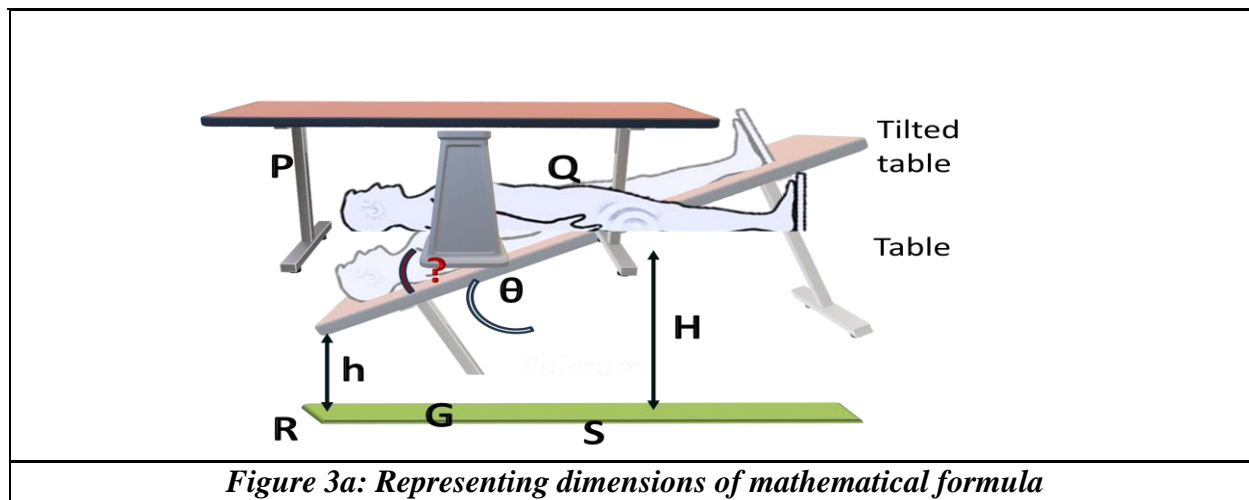
Mathematical formula- We used the following mathematical formula for our study (figure 3 a and b)

$$\theta = \tan^{-1} \frac{G}{H-h}$$

$$G = PQ = TQ = RS$$

$$90 - \theta = \angle PQT$$

Where H = Height of table at pivot, h = Height of patient to ground on positioning



Readings from all the three methods were noted for all the patients. Other than this comfort regarding the availability and use of methods was also noted.

The results were analyzed using SPSS version 25.0. The mean ± SD value of tilt was calculated for various methods used. Level of significance was kept at p less than 0.05.

RESULTS

The mean age of patients in our study was 37.8±5.9 years. Average weight was 58.98±7.5 kgs and height was 5.7±2.3 feet as shown in table 1.

Variable	Mean ±SD
Age	37.8±5.9 years
Weight	58.98±7.5 kgs
Height	5.7±2.3 feet

Table 1: Details of patient

The Mean \pm SD angle measured by three methods were 13.1 \pm 2.8 degree by inclinometer, 13.2 \pm 2.6 degree by bubble app and 13.1 \pm 2.6 degree by mathematical formula and results were significant with p value .000 as shown in table 2.

Tilt Measurement Method	Mean \pm SD (degree)	P value
Inclinometer	13.1 \pm 2.8	.000
Bubble app	13.2 \pm 2.6	
Mathematical formula	13.1 \pm 2.6	
<i>Table 2: Mean \pm SD angle measured by three methods</i>		

DISCUSSION

Surgeons are alchemists of drugs, methods, and technology. The patient's safety is so important that it cannot be stressed enough. Many new technology innovations have been made occasionally to protect patients' health and give surgeons enough time and space during operations.^[4]

TTT was originally used in clinical settings by Kenny et al. in 1986.^[1] It is now a crucial tool for examining syncope in the right patients. The test has multiple indications recommended by the ESC recommendations, wherein it can produce a high diagnostic yield. When a patient's history points to a vasomotor etiology and all baseline testing have come back negative, TTTs are typically conducted. Nevertheless, in spite of these recommendations, it is frequently observed that TTT requests are made as part of standard testing procedures for syncope patients, putting them through an unneeded and perhaps uncomfortable examination.^[5]

In present study we used three types of method to calculate the table tilt like inclinometer, bubble app and mathematical formula among patients undergoing pelvic surgery which was in head down tilt. The average angle found by three methods were almost equal and results of the study were significant showing no difference in calculation despite of using any method.

An inclinometer is a sensor used to measure the magnitude of the inclination angle or deformation of any structure. The bent is either depicted in percentage or degrees concerning gravity. Based on their fundamental working principle, tiltmeters can be classified as liquid, vertical pendulum, or horizontal pendulum. Depending on how the tilt is sensed (mechanical, with accelerometer transducer, with vibrating wire transducer, or with electrolytic transducer), Dunicliff^[6] offers a thorough analysis of tiltmeters and inclinometers. To improve the monitoring of sensitive structures and analyze deformations, comprehensive statistical trend analysis of temporal series, integrated analysis, and appropriate calibration testing and correction are required. The main disadvantages of this method are errors due to user holding, cannot be attached to C arm compatible tables and cumbersome in intra op when patient is draped in surgery.

Bubble level is an electronic device which is an easily available mobile application but is extremely sensitive. It measures any tilt provided from a neutral position or level by using the smartphone's sensor. Like spirit level, it can also measure any change in angle in horizontal level. It is quite simple to use; all we need to do is launch the application, place it horizontally on a table, and observe the precise tilt given in two decimal places. There won't ever be a problem finding a smart phone thanks to technological improvements and falling costs.^[7] Once more, we

are able to take a screen grab of every patient and provide a caption with their registration number, date, etc., so we will have proof of every case.

This tilt may be helpful in medicolegal situations and recorded in the file. Due to the digital nature of the record, it may be transferred and stored on several devices or a central server, greatly expanding the reach and utility of the data collected for research and documentation.

We have the ability to watch surgeons at work and then communicate our findings with them, giving them an opportunity to refine their procedures. With the use of this application, patients may be positioned at the precise angles and tilts needed to receive different types of operation for pain treatment, improving procedure accuracy and raising the likelihood of successful therapeutic outcomes.^[8,9]

In a study by Haleem et al.,^[10] the effects of pelvic tilt position versus table tilt position on intrauterine resuscitation following caesarian section spinal anesthesia are compared. Even though they did not explain in their materials and procedures how they achieved a 15° lateral table tilt, our results will enable researchers and medical professionals to perform similar operations on tables without tilt measurement accessories.

Ramamoorthy and Bailey, Letterkenny General Hospital, Letterkenny, Ireland,^[11] responded to an article by sharing their experience using a similar Apple iPhone "multimeasure" application to measure left lateral tilt of 15° to be given to a patient undergoing LSCS under spinal anesthesia in order to prevent supine hypotension syndrome. They consider using the application to be a "reliable and easy way." A significant tool for studying the human organism is mathematical modeling, as human experimental studies often present intractable problems. The possibility of endangering the subjects' health limits the experiment's design, and budgetary and technological constraints frequently prevent direct physiological data acquisition.

The substantial nonstationarity of biological systems frequently complicates the interpretation of the results.^[12-15] The mathematical formula used in our study gives almost the same results but had chances of having human error in calculation.

Our study is the first of its kind of research comparing three methods for measuring table tilt hence not much data is present in past to compare our results. The main limitation of our study is small sample size and a single centre which limits the results to be generalized.

CONCLUSION

We come to the conclusion that the inclinometer, bubble app, and mathematical formula are the three effective ways to get nearly identical results. It improves the procedure's objectivity, ease of documentation, patient safety, and surgeons' efficiency and stress level.

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