CASE SERIES

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A New Digital Method Proposition for Depth Measurement in Patients with Pectus Excavatum

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Abstract

The follow-up of patients with minimal pectus excavatum is generally made by depth measurement of the concavity. The measurement is usually performed with a manual ruler extended to depth. Here we present a measurement method with a digital caliper to standardize and sensitize the assessment. This measurement technique is not intended to replace the radiologically measured pectus index. Our aim with this technique is to digitize the manual technique currently used. The device consists of a combination of a ruler and a digital caliper. The ruler was attached to the sternum at the level of the deepest part of the deformity, the tip of the caliper was pushed until the depth of the deformity was reached, and the value on the screen was recorded. Measurements were made by two surgeons unaware of each other's measurement results. We used this technique in 60 patients with pectus excavatum deformity. There were 17 females (28.3%) and 43 males (71.7%). Median age was 10 (range: 2-18) and median depth of deformity was 11.3 mm (range: 4-37.3 mm). There was no significant difference between the values recorded by 2 surgeons. As a result, we concluded that digital measurement can be safely used in the follow-up of patients with pectus excavatum.

Keywords: Pectus excavatum, funnel chest, vacuum bell, deformity

INTRODUCTION

Pectus excavatum (PE) has been reported to be the most common congenital chest deformity in many articles. Treatment decisions and follow-up of patients with PE are made using clinical and radiological measurements (1). Thoracic computed tomography is generally not required in patients with minimal deformity, and depth grade are used in patient follow-up. There are different methods in the literature for measuring pectus depth. The depth measurement of concavity, which is most widely used, is made with a ruler placed on the sternal edges and a measuring stick inserted from there to the depth of the deformity (2,3). The course of deformity in patients with PE who underwent vacuum bell therapy was determined by measuring the depth of concavity at each outpatient control. Standard, precise, and objective measurements are very important for follow-up. Here, we describe a digital measurement method using a device called a digital pectusmeter for measuring the depth of PE deformity.

Technique

The new method used in our technique consists of a ruler measuring 17x150 mm and 1.5 mm thick and a digital caliper adapted to measure depth. The caliper is made of carbon fiber raw material and has a 40x15 mm LCD screen. Measurement options are available in millimeters (mm) and inches. Measurement options are available in millimeters and inches. Its measurement accuracy is 0.1 millimeter (mm) and the device can be calibrated for every measurement. The part-measuring the depth by moving into the concavity is plastic and has a blunt tip, so it does not do any damage to the skin. The measurement technique has been described on the model. The wooden ruler is placed on both edges of the

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sternum transversely, and the LCD screen of the digital caliper is opened. The value 0.0 should be displayed on the screen, and if a different value is seen, it should be calibrated with the "zero" key (Figure 1A, B). The tip of the digital pectusmeter device is advanced toward the concavity of the deformity. When the end of the deformity is reached, the value on the LCD is recorded (Figure 2A, B). Measurements were made by 2 different surgeons who were unaware of each other.

CASE PRESENTATION

The records of patients whose depth of PE deformity was measured digitally between January 2022 and September 2022 were retrospectively reviewed. Data of the patients, including age, gender, and depth of pectus concavity were collected. Analyses were performed using SPSS 25 (IBM Corp., Armonk, NY, USA). Continuous variables are given as median with minimum maximum and mean with standard deviation according to the distribution of values. Categorical variables are given as n and percentage (%). Whether there was a difference between the measurement values of the 2 different surgeons was investigated using the paired sample t-test. A p value of <0.05 was considered statistically significant.

A total of 60 patients whose pectus deformity was assessed digitally were included in the study. There were 17 females (28.3%) and 43 males (71.7%). Median age was 10 (range: 2-18) and median depth of deformity was 11.3 mm (range: 4-37.3 mm). There was no significant difference between the values recorded by 2 surgeons.

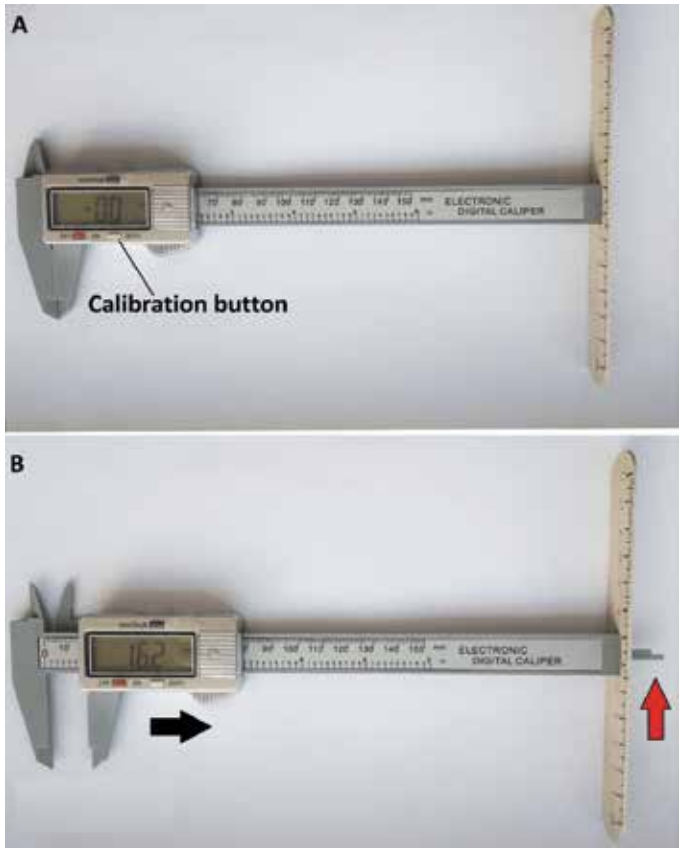

Figure 1. (A) Figure shows resetting the digital pectusmeter to prepare for measurement. (B) The black arrow indicates the direction of advancement of the tip of the device. The red arrow indicates the tip of the device advancing into the pectus concavity

DISCUSSION

Here, we describe a digital method for depth measurement of PE deformity. Depth measurement is very important in the follow-up of patients suffering from PE, especially in the evaluation of the effect of vacuum bell therapy. Toselli et al. emphasized the importance of the initial depth in PE deformity (4). We believe that making this measurement digitally will increase the sensitivity. Sesia et al. (5) developed a pressure-controlled vacuum bell device in the treatment of PE and evaluated the treatment effectiveness by measuring the depth of the pectus. For the evaluation of patients with PE to be optimal, depth measurement should be precise and standardized and should be performed in the same way at every outpatient control. Here, we propose to avoid subjectivity with digital measurement and standardize follow-ups with precise values (one-tenth of a

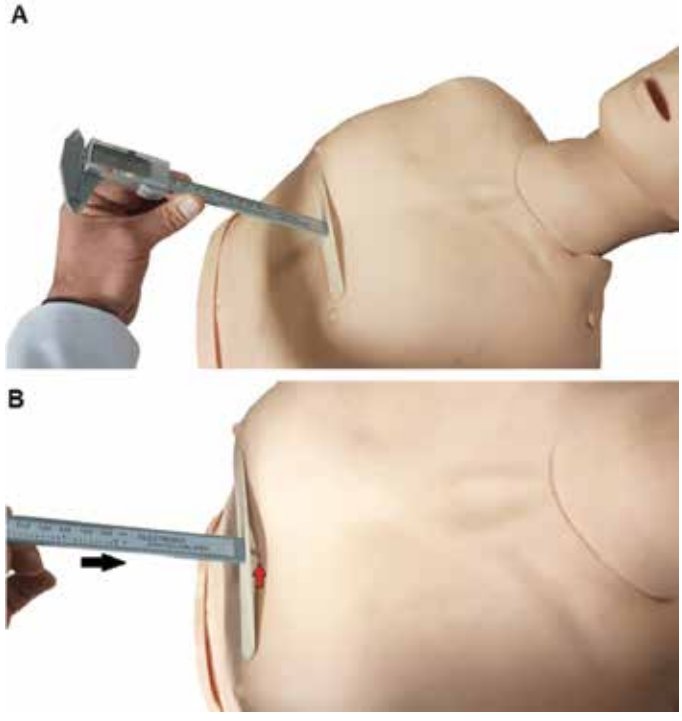

Figure 2. (A) The placement of the digital pectusmeter appears on the model. (B) The red arrow indicates the measurement of concavity of pectus excavatum deformity

millimeter) for each application. Surgical treatment is generally preferred for large deformities, and the Haller index is measured by tomography for treatment indication (6). However, thoracic computed tomography contains high-dose radiation and is not needed in small deformities that can be treated by non-surgical methods such as vacuum bell devices. The effectiveness of follow-up and treatment in these patients is determined by depth measurement. Liu et al. (7) defined the sternum index to calculate pectus severity and determine surgical indication using a radiation-free method. In their formula, a sagittal measurement is made from the deepest part of the cavity, and the distance between the sternum and vertebral body is divided by the patient's height. As a result of this study, the authors concluded that the sternum index can determine both pectus severity and surgical treatment efficacy (7). Our digital pectusmeter device, which is described here, does not claim to be an alternative to computed tomography for calculating the Haller index. It is recommended for the initial evaluation and follow-up of patients with relatively mild PE deformities.

CONCLUSION

As a result, the initial evaluation and follow-up of patients with PE can be made standard and more sensitive with the digital pectusmeter device proposed in this technical report. The feasibility of the digital pectusmeter device is that it is easy to apply, can measure small deformities, is suitable for all ages including infants, can be calibrated in every measurement, and is non-invasive. Although we applied this technique to a model, a clinical study comparing it with conventional measuring methods in the initial examination and follow-up of patients suffering from PE may show its usability.

Ethics

Informed Consent: Obtained.

Peer-review: Externally and internally peer reviewed.

Authorship Contributions

Surgical and Medical Practices: M.S., İ.T., M.T.A., A.K., G.A., A.Ç., Concept: M.S., İ.T., M.T.A., A.K., G.A., A.Ç., Design: M.S., İ.T., M.T.A., A.K., G.A., A.Ç., Data Collection or Processing: M.S., İ.T., A.Ç., Analysis or Interpretation: M.S., İ.T., A.K., A.Ç., Literature Search: M.S., M.T.A., A.K., G.A., Writing: M.S., İ.T., M.T.A., A.K., G.A., A.Ç.

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