

# Finger Clubbing: Do We Require Digital Index Quantitator?

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## SUMMARY

Some diseases may underlie finger clubbing. However, there is a dearth of information about early stage of finger clubbing because only few researchers have shown interest in it. We determined the Digital Index of normal, healthy subjects by using thread and manual Vernier calipers, the time used for the procedure, and its interrater reliability. The value of Digital Index was  $8.86 \pm 0.29$  (Mean  $\pm$  SD) with a range of 8.15 to 9.41. Interrater reliability was excellent with Pearson's correlation coefficient of 0.966. Overall, the time taken to measure the Digital Index ranged from 21.93 to 68.80 minutes with an average of  $35.97 \pm 9.16$  (Mean  $\pm$  SD). Determining Digital Index need much time, but this can be overcome if we use Digital Index Quantitator (DIQ). Availability of DIQ in the hospital wards will be of much benefit. DIQ can also be used to accurately quantify the progression or regression of the clubbing process. This article proves that we need morphometry of digital clubbing as well as the correlation of the physical sign of clubbing with Digital Index.

## KEY WORDS:

*Hippocratic finger, digital clubbing, finger clubbing, drumstick finger, watchglass nails, pulmonary hypertrophic osteoarthropathy, primary hypertrophic osteoarthropathy, pachydermoperiostosis*

## INTRODUCTION

Clubbing or finger clubbing refers to enlargement of the distal segments of the fingers, reduction in the nail-fold angle, and sponginess of the nail beds. It can be graded into 5 stages i.e. Grade 1: fluctuation and softening of the nail bed, Grade 2: increase of the hyponychial angle, Grade 3: accentuated convexity of the nail, Grade 4: clubbed appearance of the fingertip, and Grade 5: development of a shiny or glossy change in nail and adjacent skin<sup>1</sup>. Clubbing is found in a wide variety of conditions including pulmonary, cardiovascular, hepatic, thyroid and gastrointestinal diseases<sup>2,3,4,5</sup>.

Clubbing is unmistakable when the patient presents with so-called "drumstick fingers", an advanced stage of clubbing. Identification of early stages of clubbing is difficult, and it is often a source of debate among medical students, residents, and even experienced specialists. Methods used to detect finger clubbing include Schamroth's sign (diamond window), hyponychial angle, profile angle or Lovibond's angle, the phalangeal depth ratio, and digital index<sup>4,6,7</sup>. Although the

presence of early clubbing is difficult to establish by subjective examination, objective measures were seldom undertaken at the bedside because they were deemed impractical and cumbersome<sup>8,9</sup>. Consequently the early stage of clubbing is often overlooked.

It is true that the objective assessment of clubbing is impractical as it is time consuming and requires much equipments<sup>10,11</sup>. It would be clinically advantageous if a simple means of recognising clubbing existed. Ideally, such a method should be utilisable at the bedside, provide reproducible readings, be able to study its dynamics, as well as grade the clubbing process. Finally, a device that accurately quantitates the clubbing phenomenon would clear the way for clinical studies designed to elucidate its cause.

The aim of the present study was to show that determining Digital Index needs much time, but no more, if the new device - Digital Index Quantitator - is used.

## MATERIALS AND METHODS

### Subjects

The participants in this study were medical students of Universiti Malaysia Sarawak, who were considered normal and in a good health, who did not suffer from any disease, especially those likely to cause clubbing. They were non-smokers, with no sponginess of nails, no increased nail curvature and no increased mass of soft tissue at the nails. They were studied for their Digital Index after verbal consent was obtained.

### Material

For Digital Index measurement, we used non-elastic thread, a stand device to stabilise the finger, firm and thin paper, a clamp, cellotape, scissors and Vernier calipers.

### Measurement of Digital Index

Digital Index (DI) is the sum of ratios of the circumference at the nail fold (NF) over the circumference at the distal interphalangeal joint (DIP) of the ten fingers. The procedure for measurement was as follows: the finger being measured was put on a firm rod stand (Fig.1). A non-elastic thread is circled twice around the finger at the nail-fold (NF). The two ends of the thread after circling were fixed using cellotape to the stiff paper. Half the length of the thread used to circle the finger twice was taken as the perimeter of the finger at the nail-fold. The same process was repeated at the distal-

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Table I: Male Subjects' Demography, Length of Time Taken to Perform Measurements, Digital Index

Name	G	A (min)	B (min)	C (min)	D (min)	DI
GWPK	M	37.75	15.38	3.63	56.76	9.3
ABAB	M	35.28	18.68	3.32	57.28	8.87
AFAH	M	33.55	22.02	2.27	57.84	9.36
AN	M	34.35	11.75	4.48	50.58	9.05
KAM	M	34.75	8.9	4.2	47.85	9.03
DESS	M	23.58	7.98	3.32	34.88	9.23
NA	M	23.82	11.75	4.08	39.65	8.54
MS	M	25.55	11.82	3.43	40.8	9.02
SH	M	21.9	7.93	3.75	33.58	8.8
MSZ	M	19.12	13.07	3.8	35.99	8.39
SKS	M	26.47	9.13	2.88	38.48	8.91
CKBL	M	18.52	8.87	9.03	36.42	8.38
MFSR	M	17.95	8.32	2.57	28.84	8.73
RUSH	M	17.87	9.92	2.5	30.29	9.16
CKC	M	18.4	9.15	2.37	29.92	9.37
CCP	M	20.75	8.43	2.38	31.56	8.5
LKC	M	15.95	7.8	2.2	25.95	8.83
SPM	M	18.13	8.63	2.27	29.03	8.66
CBK	M	19.37	7.33	2.28	28.98	8.94
FH	M	17.4	8.22	1.82	27.44	9
CCH	M	18.22	8.65	2.08	28.95	9.25
DAL	M	19.38	7.73	1.98	29.09	8.88
CHL	M	12.82	8.55	1.93	23.3	8.97
Average		23.08	10.44	3.16	36.67	8.92

## Abbreviations

A : Length of time to run the thread along NF and DIP      D : The sum of A, B and C      min: minute  
 B : Length of time for measuring the thread with calipers      DI : Digital Index value  
 C : Length of time for measuring off the NF/DIP ratio      G: Gender

Table II: Female Subjects' Demography, Length of Time Taken to Perform Measurements, Digital Index

Name	G	A (min)	B (min)	C (min)	D (min)	DI
NBAB	F	33.68	17.25	3.15	54.08	9.14
EIBI	F	30.63	15.13	3.08	48.84	9.05
SS	F	26.73	8.78	4.05	39.56	8.72
AI	F	30.37	9.23	3.73	43.33	8.9
SH	F	26.48	12.72	3.57	42.77	8.65
WNA	F	22.4	15.27	4.07	41.74	9.07
NAG	F	19.58	17.45	4.28	41.31	8.68
NOR	F	19.88	8.45	3.08	31.41	8.39
LMT	F	19.13	8.48	3.23	30.84	9.41
WNBA	F	22.75	8.67	2.8	34.22	8.15
NDWT	F	21.3	9.48	2.88	33.66	8.54
CM	F	16.55	9.52	2.6	28.67	8.58
LSV	F	19.32	7.35	2.73	29.4	9.04
NUA	F	17.32	7.5	2.45	27.27	8.58
HASL	F	22.95	8.38	1.83	33.16	8.73
SNOR	F	22.37	9.42	2.33	34.12	8.72
FAZ	F	15.82	8.52	2.16	26.5	9.04
RAFI	F	17.28	8.67	2.25	28.2	8.93
SHER	F	20.6	8.48	2.97	32.05	8.73
GSN	F	19.98	8.2	1.97	30.15	8.61
DIL	F	18.02	8.03	1.78	27.83	8.91
Average		22.05	10.24	2.9	35.2	8.79

## Abbreviations

A : Length of time to run the thread along NF and DIP      D : The sum of A, B and C      min: minute  
 B : Length of time for measuring the thread with calipers      DI : Digital Index value  
 C : Length of time for measuring off the NF/DIP ratio      G: Gender

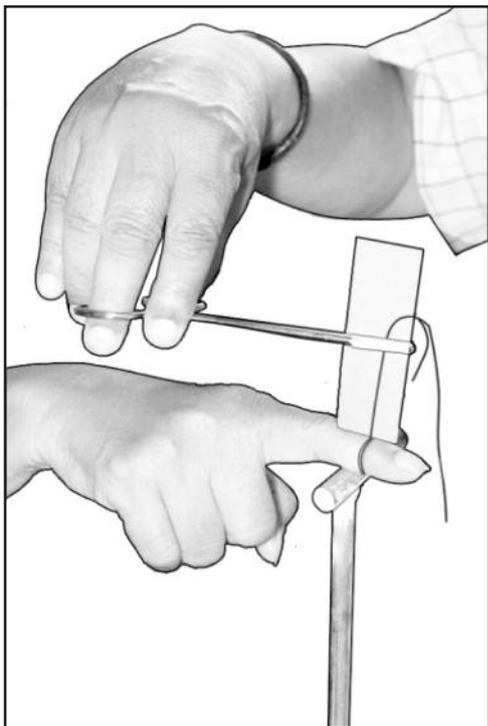


Fig. 1 : Rod stand, DIP, thread, stiff paper, and clamp

interphalangeal joint (DIP) to determine the perimeter there. We used red thread for the NF and white thread for the DIP. To determine the half-length of the thread after finishing the measurement of the circumferences of all the ten fingers a pair of manual calipers was used. The value of Digital Index was calculated as the sum of ratios of the circumference at NF and DIP of the ten fingers.

*Data analysis:* Participants were divided into two groups — male and female. All collected data were recorded and analysed using statistical package SPSS version 14 for Windows. The accuracy and reproducibility of the measurement of Digital Index (Inter-observer reliability) were determined by Pearson’s correlation coefficient.

**RESULTS**

Forty-four students, 23 males and 21 females, aged 21 to 26 years, who fulfilled the criteria, participated in the study. The values of Digital Index in this study were  $8.92 \pm 0.29$  (Mean  $\pm$  SD) for male and  $8.79 \pm 0.28$  (Mean  $\pm$  SD) for female subjects with a range of 8.38 to 9.37 and 8.15 to 9.41 respectively. The value of Digital Index for all subjects together is  $8.86 \pm 0.29$  (Mean  $\pm$  SD) with a range of 8.15 to 9.41.

*Time consumed to measure Digital Index*

The time taken to encircle all ten fingers ranged from 12.82 minutes to 37.75 minutes with an average of  $22.59 \pm 6.17$  (Mean  $\pm$  SD). The time taken to measure the threads with manual calipers was 7.33 to 22.02 minutes with an average of  $10.34 \pm 3.46$  (Mean  $\pm$  SD), and the time to calculate the circumference ratio was 1.78 to 9.03 minutes with an average of  $3.04 \pm 1.20$  (Mean  $\pm$  SD). Overall, the time taken to measure the Digital Index ranged from 21.93 to 68.80 minutes with an average of  $35.97 \pm 9.16$  (Mean  $\pm$  SD).

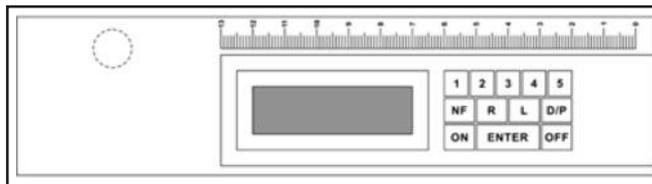


Fig. 2 : Digital Index Quantitator.

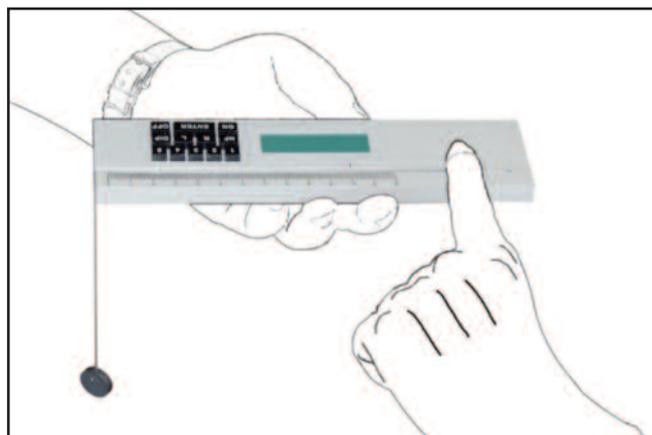


Fig. 3 : To operate a Digital Index Quantitator.

*Inter-rater reliability*

Three investigators (HM, KTK, RDD) independently measured 20 Digital Indices, inter-rater reliability was excellent with Pearson’s correlation coefficients of 0.966.

**DISCUSSION**

*Methods*

Objective observation of the fingernail for the diagnosis of finger clubbing has been tried by several techniques. Stavem (1959)<sup>11</sup> measured the longitudinal curvature of the nails by unguisometer (modified spherometer usually used to measure the power of lens). Shadow images had been used by Bentley (1970)<sup>12</sup>, Sinniah (1979) and lately Moreira (2004)<sup>4,13</sup>. The new method had been employed by Goyal et al (1998)<sup>14</sup> and by Husarik et al (2002)<sup>15</sup> by using digital photography and computerised analysis to obtain the value of the nail-fold angle. Most old methods of studying the morphology of terminal finger used positive finger cast<sup>3,7,8,16</sup> made with plaster of Paris which according to Waring<sup>8</sup> or Husarik<sup>15</sup> needs several hours, so much time is needed for doing the procedure. However, if hydrocolloid material (Jeltrate) is used the procedure takes three minutes only<sup>16</sup>. Eventually, all those techniques were not used as they were impracticable for a busy clinician. Decades of such efforts to establish accurate diagnosis of early finger clubbing has not produced satisfactory results. Some authors have described techniques of observing fingernail morphometry i.e. phalangeal depth ratio and Digital Index. Moreira (2004)<sup>13</sup> used the shadow of one live index finger without magnification to measure the nail-fold angle and the ratio of distal phalangeal depth over distal interphalangeal joint depth. Recently Roy et al (2013)<sup>17</sup> measured the soft tissue depth under the nail (SDUN), the distal phalangeal depth (DPD) and interphalangeal depth (IPD) by using high-frequency ultrasound imaging and finally calculated the DPD/IPD ratio, they reported that the

usage of ultrasound for the diagnosis of digital clubbing is easier and more convenient than other methods. In the present study we used live fingers, not finger cast or shadows for determining Digital Index. Between these two methods, phalangeal depth ratio<sup>3,4,5,8,9,13,18,19</sup> is preferred to Digital Index<sup>11,20</sup> because it is simpler and needs less time than Digital Index. However, to diagnose early clubbing we consider using all the ten fingers a better option than using an index finger alone.

#### Numbers that confirm absence or presence of clubbing

Vázquez-Abad *et al*<sup>20</sup> obtained the values of DI  $9.33 \pm 0.27$  (Mean  $\pm$  SD) in subjects without any clubbing and  $10.73 \pm 0.32$  (Mean  $\pm$  SD) in subjects with digital clubbing. Karnath<sup>21</sup> in his review of clubbing stated Digital Index of  $\geq 10.2$  indicates clubbing. This study stated  $8.86 \pm 0.29$  (Mean  $\pm$  SD) is DI of normal subjects,  $8.92 \pm 0.29$  (Mean  $\pm$  SD) for male and  $8.79 \pm 0.28$  (Mean  $\pm$  SD) for female. The participants in this study had fingers with smaller DI (8.86) compared to those in Vázquez-Abad's study (DI 9.33).

#### The time taken to measure fingernail morphometry

According to Baughman *et al*<sup>9</sup> the technique to perform Phalangeal Depth Ratio takes no longer than 1 minute. In this study the time taken to get digital index was  $35.97 \pm 9.16$  minutes (Mean  $\pm$  SD) with a range of 23.30 to 57.84 minutes. This large discrepancy of timing is simply because the measurement of Phalangeal Depth Ratio was done on one finger while the measurement of digital index was done on ten fingers. Digital index measurement by manual means will surely annoy the proposition as well as bore the examiner. The time taken to encircle all ten fingers ranged from 12.82 minutes to 37.75 minutes with an average of  $22.59 \pm 6.17$  (Mean  $\pm$  SD). The length of time taken to measure the thread with manual calipers was  $10.34 \pm 3.46$  minutes (Mean  $\pm$  SD). The time taken to do these measurements varied with a range of 7.33 to 22.02 minutes because it largely depended on the mood of the observers. The time to calculate the circumference ratio was 1.78 to 9.03 minutes with an average of  $3.04 \pm 1.20$  (Mean  $\pm$  SD). Overall, the time taken to measure the Digital Index ranged from 21.93 to 68.80 minutes with an average of  $35.97 \pm 9.16$  (Mean  $\pm$  SD).

Such a long time to perform a non-urgent procedure will make it impossible to implement in any hospital practice. We really need a handy and user-friendly device which can obtain this useful measurement and calculate the Digital Index in a shorter time.

#### Inter-rater reliability

Interobserver variation in this study showed Pearson's correlation coefficient of 0.966, while interobserver variation of DI done by Vázquez-Abad<sup>20</sup> had a coefficient of 0.999 and coefficient for intraobserver variation was 0.979. Although our interrater reliability was excellent, the technique used by Vázquez-Abad was more reliable.

#### Suggestion/Recommendation

In view of the significance of clubbing as a clinical sign, difficulty in its detection and the long time consumed to determine its absence or presence by manual methods, we propose the use of a new device — the Digital Index

Quantitator (DIQ) — to determine Digital Index (Fig.2). DIQ is a modification of electronic calipers equipped with a calculator to quantitate the Digital Index. An examiner familiar with DIQ can determine the Digital Index in ten minutes. Its dimensions are 200mm x 50mm x 11mm. It weighs around 120 grams.

#### Benefit

The availability of DIQ in the wards will be a boon for scientific minded clinicians and will generate passion for investigation and clinical studies on early stage clubbing. Diagnosis of conditions known to cause clubbing will be facilitated. DIQ can also be used to accurately quantify the progression or regression<sup>22</sup> of the clubbing process.

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