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Thumb-to-finger method of percussion: a novel, modified technique that is less painful and more productive than the conventional method

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INTRODUCTION

Inspection, palpation, percussion and auscultation are the four main foundation techniques of clinical examination. Percussion, as a clinical technique, was introduced by Leopold von Auenbrugger, an Austrian physician, in 1761, who described the method in his Latin book “Inventum Novum”. He introduced the direct method of percussion, where the thorax is tapped directly with points of the fingers.⁽¹⁾ Later, Nicolas Corvisart, a French physician, translated Auenbrugger’s book from Latin to French in 1808 and further modified his technique by tapping the thorax directly with the palmar surface of the extended fingers.⁽²⁾ In 1826, Pierre Adolphe Piorry, a French physician, introduced the indirect technique of percussion by inventing a pleximeter and in 1828, published his famous work in the book “Le plessimetre ou de la Percussion Mediate”. Piorry tried many materials and finally chose a small ivory plate, 5 cm in diameter, as the pleximeter.⁽²⁾ William Stokes and James Hope, who assisted Piorry, further modified this technique by using the left middle finger as a pleximeter.⁽³⁾ The currently practised finger-to-finger method has the advantage of providing an additional ‘feel’ to percussion.⁽²⁾ Even a fifth technique, called insonation, was proposed to be included in physical examination.⁽⁴⁾

As fingertips are sensitive to pain, our practice of percussing with the tip of the middle finger (plexor) on a pleximeter can cause undue discomfort to the percussing fingers of examining clinicians. Because of the pain and discomfort, the intensity with which successive percussions are performed decreases, at times even precluding the clinician from further examination. To minimise this pain and discomfort associated with the current finger-to-finger method of percussion, this article presents a novel, modified technique for percussion.

TECHNIQUE

In the currently practised and conventional finger-to-finger method of percussion,⁽⁵⁾ the middle finger of the left hand is placed on the part to be percussed and pressed firmly against it, with slight hyperextension of the distal interphalangeal joint. The back of this joint is then struck with the tip of the middle finger of the right hand (and vice versa, if left handed). The movement should be at the wrist and not at the elbow. The movement is alternate flexion and extension at the wrist joint. The percussing finger is bent, so that its terminal phalanx is at right angles and it strikes the other finger perpendicularly. As soon as the blow has been given, the striking finger is raised: the action is a tapping movement.

In the novel, modified thumb-to-finger method of percussion, the middle finger of the non-dominant hand (pleximeter) is firmly placed on the part to be percussed, with slight hyperextension of the distal interphalangeal joint, as in the finger-to-finger method. The back of this joint is then struck with the radial border of the proximal portion of the distal phalanx of the thumb (plexor) of the dominant hand. The movement, in this technique, is alternate pronation and supination at the proximal and distal radioulnar joint of the forearm. The dominant hand should be in the semipronated position, with all digits in extension. The hands should be placed in such a way that, while doing pronation and supination movements, the radial border of the proximal portion of the distal phalanx of the thumb of the dominant hand (plexor) taps the middle finger of the non-dominant hand (pleximeter). It should be noted that during percussion, the thumb should be in extension and there shall be no movement at the joints of the thumb (Fig. 1).

The differences between the two techniques are presented in Table I and Fig. 2.

DISCUSSION

Percussion is an important clinical method used to examine the chest and abdomen. If performed properly, it can be lifesaving in diagnosing emergency conditions, such as massive pleural effusion, pneumothorax, massive ascites, distended bladder due to bladder outlet obstruction, pneumoperitoneum secondary to hollow viscous perforation and rebound tenderness in peritonitis. For patients, necessary intervention can be done immediately in an emergency without waiting for other investigations. However, despite having such a valuable technique on hand, clinicians nowadays tend to order investigations without proper clinical examination.⁽⁶⁾

The principles of percussion and ultrasonography are more or less the same. In ultrasonography, a transducer emits ultrasonic waves (inaudible sound with high frequency for humans), which are reflected differently by different tissues. Those reflected waves are received by the transducer and are projected onto a monitor as an image.^(7,8) Similarly, in clinical percussion, an audible sound is produced by tapping of plexor over the pleximeter and this sound is reflected by solids, liquids and gaseous medium differently. This reflected sound is felt by the pleximeter and heard by the examiner. Depending on the type of reflected sound, it is said to be resonant, tympanic, dull or stony dull.⁽⁹⁾

Accordingly, I opine that percussion can also be termed as ‘clinical sonogram’. Although the term is a misnomer – as a virtual image is not visualised similar to that seen in ultrasonography – it does denote a similitude between a clinical examination technique (percussion) and a sonological investigation (ultrasonography). A comparison of percussion and ultrasonography is provided in Table II.

To the best of my knowledge, no previously published study in the literature has concluded that percussion is painful to the examining clinician. The current technique of percussion was modified by me in my final year of medical school in 2011. As a general

surgeon by specialisation, I have found this modified technique of percussion more productive than the conventional technique in clinical practice, the basis for which is explained below.

The movement in the thumb-to-finger percussion technique is alternate pronation and supination at the radioulnar joints of the forearm, whereas, in the finger-to-finger method, it is flexion and extension at the wrist joint. It is possible that, beginners, while learning the finger-to-finger method of percussion, may sometimes flex and extend the elbow joint instead of the wrist joint, which is not desired. In comparison, in the thumb-to-finger method, there is no flexion and extension movement at the elbow joint during percussion.

Percussion is a combination of biomechanics, vibration and acoustics. Biomechanics is defined as the study of the mechanical aspects of the structure and function of biological systems;⁽¹⁰⁾ it deals with the movement at joints. Acoustics is defined as the study of sound.⁽¹¹⁾ In percussion, during tapping, the force of flexion movement at the wrist or pronation movement at the forearm (biomechanics) of the dominant hand sets vibrations in the pleximeter and body wall, and the reflected sound (acoustics) thus produced is heard and felt by the examiner. It is beyond doubt that the character of the resonant note depends on the condition of the body wall and the underlying organs,⁽⁹⁾ but it is to be noted that the intensity (loudness) of the resonant note depends on the force with which the plexor taps the pleximeter.⁽¹²⁾ This aspect of wrist and forearm movements during percussion in the conventional and modified techniques, respectively, is dealt by biomechanics. The capability of a force to produce rotation is known as torque and is measured in Newton-meters (Nm).⁽¹³⁾ In simple terms, greater the torque, higher the force of movement at a joint. The mean peak torque generated at the wrist joint during flexion, with the forearm in pronation, is 8.3 ± 3.1 Nm,⁽¹⁴⁾ whereas the mean peak torque for pronation, with the wrist in neutral position, is 12.6 ± 4.2 Nm.⁽¹⁵⁾ This implies that the strength of forearm pronation, with the wrist in neutral position (the joint positions adopted during tapping in the modified technique), is greater than the wrist flexion, with the forearm in

pronation (the joint positions adopted during tapping in the conventional technique). As the force of percussion is more in the modified method than the conventional one, the resonant note heard is louder in the former than the latter. The normal range of motion of forearm pronation is 80° – 100° ⁽¹⁶⁾ and is greater than wrist flexion, which is 70° – 90° .⁽¹⁷⁾ This contributes to the torque of the respective joint movements.⁽¹³⁾

An untrimmed fingernail of the middle finger (plexor), in the conventional method, can injure the pleximeter finger, which can cause pain and redness, but an untrimmed fingernail of the thumb (plexor), in the modified technique, does not interfere with percussion. Hence, the level of pain and discomfort is minimal in the modified technique when compared to the conventional technique. The accuracy of the plexor finger to tap on the desired surface of the pleximeter is high for the modified technique than the conventional technique. This is because the forearm pronation movement is more accurate than the wrist flexion movement.⁽¹⁸⁾

In the finger-to-finger method, while tapping, the plexor can sometimes deviate from the path and may not hit the desired pleximeter surface, and can even miss the pleximeter due to less surface area of the plexor, but this is not seen frequently with the modified technique. Fig. 3 compares the accuracy of the plexor to hit the pleximeter in both the techniques.

In the conventional technique, the middle finger (plexor) can tap the pleximeter in both parallel and perpendicular directions with ease, whereas, in the modified method, the thumb (plexor) can tap the pleximeter more effectively in the perpendicular direction than the parallel direction. Due to this, the modified technique is difficult to perform on patients in certain positions. The overall technical difficulty is minimal in the modified method. Considering the above-described factors, such as pain, discomfort, strength of percussion and intensity of the reflected wave, the overall productivity of the thumb-to-finger method of percussion is better than the conventional technique of finger-to-finger percussion.

In conclusion, this report puts forth that the novel, modified thumb-to-finger method for percussion presented here is an acceptable and worthy alternative to the conventional finger-to-finger method of percussion. Clinicians can explore this modified technique in their clinical practice to better appreciate the differences between the two techniques.

REFERENCES

1. Smith JJ. The Inventum Novum of Joseph Leopold Auenbrugger. *Bull N Y Acad Med* 1962; 38:691-701.
2. Sakula A. Pierre Adolphe Piorry (1794-1879): pioneer of percussion and pleximetry. *Thorax* 1979; 34:575-81.
3. McCarthy OR. Getting a feel for percussion. *Vesalius* 1999; 5:3-10.
4. Narula J, Chandrashekar Y, Braunwald E. Time to add a fifth pillar to bedside physical examination: inspection, palpation, percussion, auscultation, and insonation. *JAMA Cardiol* 2018; 3:346-50.
5. White VLC. Respiratory system. In: Glynn M, Drake WM. *Hutchison's Clinical Methods*. 24th ed. Edinburgh: WB Saunders, 2018: 175-6.
6. Feddock CA. The lost art of clinical skills. *Am J Med* 2007; 120:374-8.
7. Hassani S. Principles of ultrasonography. *J Natl Med Assoc* 1974; 66:205-7, 231.
8. Carovac A, Smajlovic F, Junuzovic D. Application of ultrasound in medicine. *Acta Inform Med* 2011; 19:168-71.
9. Yernault JC, Bohadana AB. Chest percussion. *Eur Respir J* 1995; 8:1756-60.
10. Hatze H. Letter: The meaning of the term "biomechanics". *J Biomech* 1974; 7:189-90.
11. Raphael LJ, Borden GJ, Harris KS. *Speech Science Primer Physiology, Acoustics, and Perception of Speech*. 6th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2011.

12. Jarvis C. *Physical Examination and Health Assessment*. 7th ed. Canada: Elsevier, 2016.
13. Enoka RM. *Neuromechanics of Human Movement*. 4th ed. Champaign, IL: Human Kinetics, 2008.
14. Yoshii Y, Yuine H, Kazuki O, Tung WL, Ishii T. Measurement of wrist flexion and extension torques in different forearm positions. *Biomed Eng Online* 2015; 14:115.
15. O'Sullivan LW, Gallwey TJ. Forearm torque strengths and discomfort profiles in pronation and supination. *Ergonomics* 2005; 48:703-21.
16. Shaaban H, Pereira C, Williams R, Lees VC. The effect of elbow position on the range of supination and pronation of the forearm. *J Hand Surg Eur Vol* 2008; 33:3-8.
17. Ryu JY, Cooney WP 3rd, Askew LJ, An KN, Chao EY. Functional ranges of motion of the wrist joint. *J Hand Surg Am* 1991; 16:409-19.
18. Luria S, Apt E, Kandel L, Bdolah-Abram T, Zinger G. Visual estimation of pro-supination angle is superior to wrist or elbow angles. *Phys Sportsmed* 2015; 43:155-60.

FIGURES

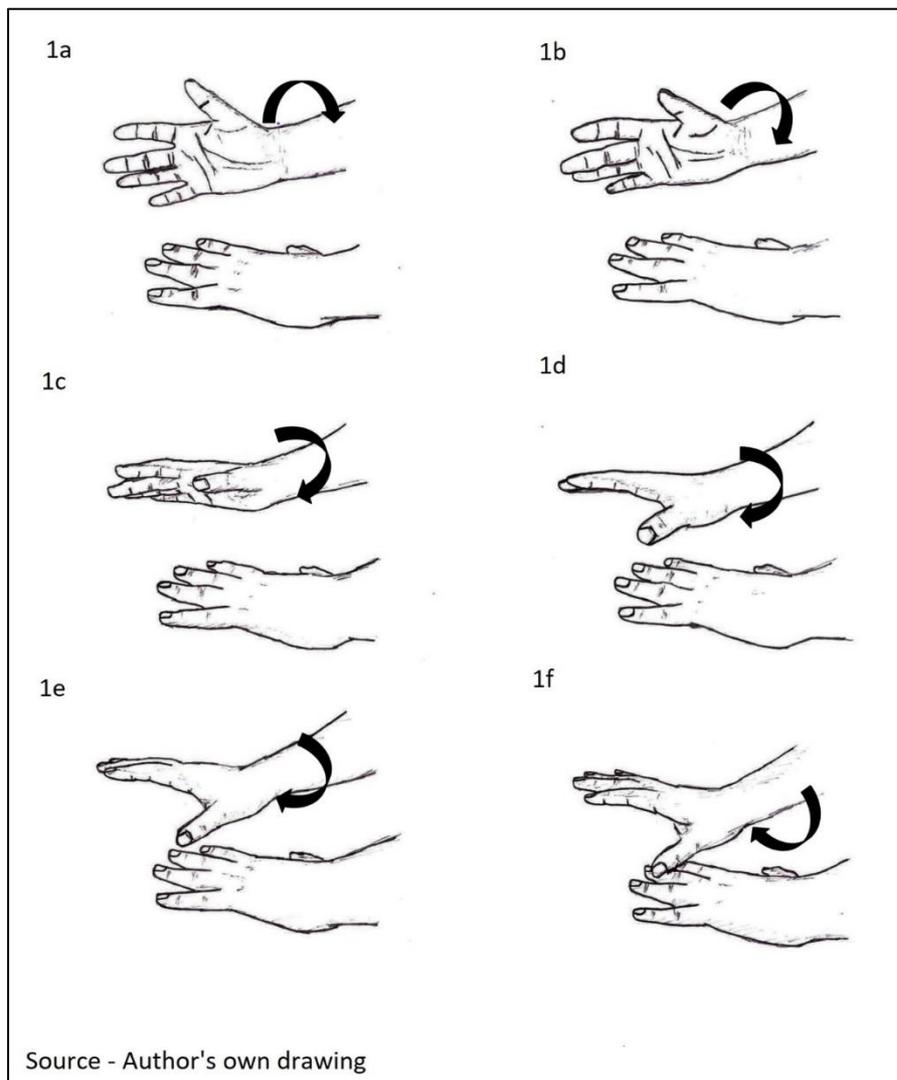


Fig. 1 Illustrations show modified thumb-to-finger method of percussion, with (a) semipronated dominant hand and (b-f) movement of hand from semipronation to complete pronation, as indicated by the curved arrows. After tapping, the hand will supinate to semiprone position once again.

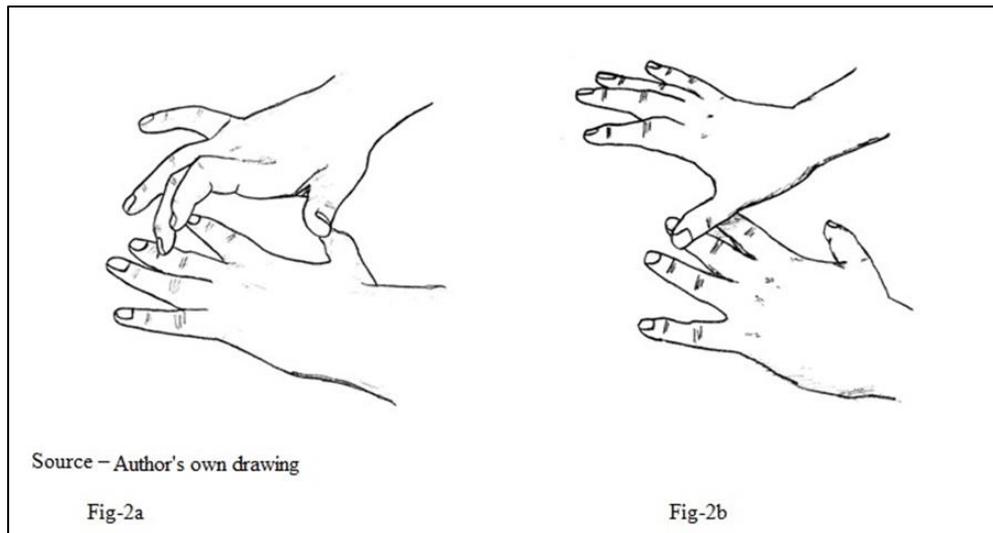


Fig. 2 Illustrations show end positions of fingers after tapping in the (a) conventional finger-to-finger and (b) modified thumb-to-finger methods of percussion.

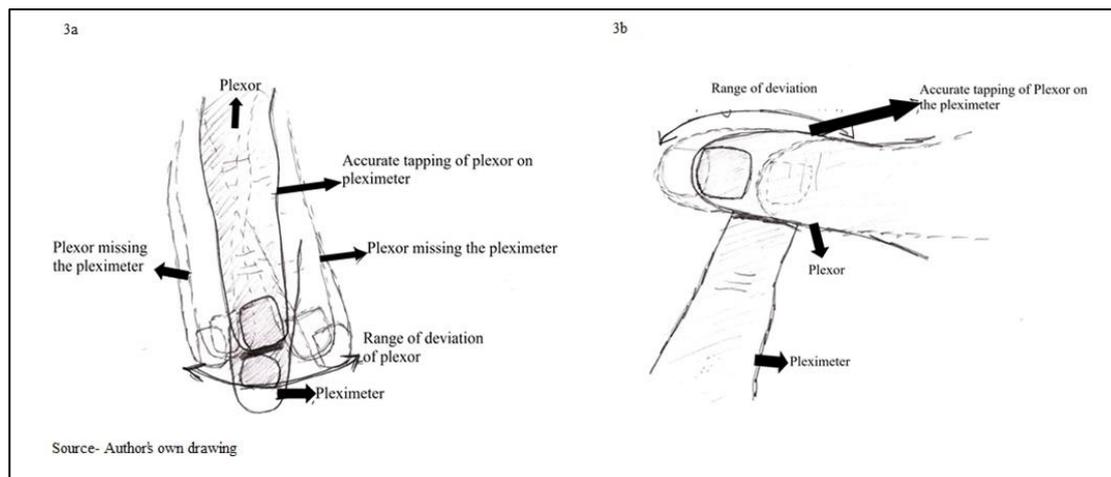


Fig. 3 Illustrations show comparison of the accuracy of plexor in tapping the pleximeter in the (a) conventional finger-to-finger and (b) modified thumb-to-finger methods of percussion.

Table I. Comparison of modified thumb-to-finger and conventional finger-to-finger methods of percussion.

Feature	Thumb-to-finger method (modified technique)	Finger-to-finger method (conventional technique)
Pleximeter	Middle finger of non-dominant hand	Middle finger of non-dominant hand
Plexor	Radial border of proximal portion of the distal phalanx of the thumb of the dominant hand	Tip of the middle finger of the dominant hand
Movement and joint involved	Pronation and supination at the radioulnar joints of forearm	Flexion and extension at the wrist joint
Avoid movement at	Thumb joints	Elbow joint
Strength of percussion	Stronger than conventional technique	Average
Mean peak torque of joint movement involved	12.6 ± 4.2 Nm (pronation)	8.3 ± 3.1 Nm (flexion)
Normal range of motion of joint involved	80°–100°	70°–90°
Loudness of resonant sound audible and vibration felt after tapping	Louder than conventional technique	Average
Effect of untrimmed fingernail of plexor on percussion	No effect	Traumatizes the pleximeter finger, and causes pain and redness
Level of discomfort on repeated percussions	Minimal	High
Surface area of plexor	More	Less
Accuracy of plexor tapping the pleximeter	Very accurate when compared to conventional technique	Moderately accurate
Ease of performing in parallel and perpendicular directions	Easy to perform in perpendicular direction but limited in parallel direction	Easy to perform in both parallel and perpendicular directions
Technical difficulty	Minimal	Average
Overall productivity of technique	Better than conventional technique	Average

Table II. Comparison of percussion and ultrasonography.

Characteristic	Percussion⁽⁹⁾	Ultrasonography⁽⁸⁾
Sound frequency	Audible (range 20 Hz to 20 kHz)	Inaudible (range 2–18 MHz)
Source of sound	Tapping of plexor on pleximeter	Transducer
Reflected sound character depends on	Acoustic impedance of tissue containing solid, liquid and gas	Tissue impedance, which is different for different tissues and mediums
Reflected sound sensed by	Pleximeter	Transducer
Reflected sound interpreted by	Feel of vibration on pleximeter and sound heard by ears of examiner	Projected as image onto a monitor that is visually interpreted by examiner
Type of examination	Clinical	Non-invasive sonological