International Journal of Osteopathic Medicine 14 (2011) 10–16

Contents lists available at ScienceDirect

International Journal of Osteopathic Medicine

journal homepage: www.elsevier.com/ijos

Research report

The palpated cranial rhythmic impulse (CRI): Its normative rate and examiner experience

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ARTICLE INFO

Article history:
Received 10 March 2009
Received in revised form
12 November 2009
Accepted 25 November 2010

Keywords:
Osteopathic Medicine
Osteopathic Manipulative Medicine
Osteopathy in the Cranial Field
Cranial Osteopathy
Medical education
Teaching psychomotor skills
Cranial rhythmic impulse
CRI rate
Primary Respiratory Mechanism

ABSTRACT

This retrospective review study aims to contribute data regarding the normal range of the palpated cranial rhythmic impulse (CRI) rate from a population of 734 healthy subjects, each determined by a different examiner. Experience levels ranged from 1 to 25 years training/practice in cranial osteopathy. This study reports an overall CRI rate range (mean ± SD) of 6.88 ± 4.45 cpm for all subjects (valid $N = 727$). The examiner population was subdivided into three groups based upon the level of examiner experience. The rates obtained from each subgroup, from least experienced to most experienced, are as follows: Level 1 (one year of experience), 7.39 ± 4.70; Level 2 (two years of experience), 6.46 ± 4.10; Level 3 (three-twenty five years of experience), 4.78 ± 2.57. Both group mean values of the reported palpated CRI rates and their standard deviations showed an inverse relationship with the level of examiner experience, i.e., as experience increases, the mean CRI rate and its deviation decreases. In the light of the findings of this study, the currently accepted range of the palpated CRI, 8–14 cycles/minute, should be reconsidered to be as low as 2–7 cycles/minute.

Précis: CRI rate means and ranges as assessed by experienced examiners are, respectively, lower and narrower.

1. Introduction

In the paradigm of cranial osteopathy, a controversial rhythmicity, the cranial rhythmic impulse (CRI), has been described, discussed, and debated.[1–5] It is defined in the Glossary of Osteopathic Terminology[6] as "a palpable rhythmic fluctuation believed to be synchronous with the primary respiratory mechanism." The fact that the CRI is debatable and incompletely understood makes it subject to question and, therefore, of interest for corroboration of its normative parameters.

In 1939, William G. Sutherland first proposed cranial osteopathy and, what he suggested was a means of holistically coordinating the approach to patient care, the primary respiratory mechanism (PRM).[7] He described it as a biphasic phenomenon, independent of pulmonary respiration, with an "inspiratory" and an "expiratory" phase. It is interesting to note that nowhere in the early descriptions of the cyclic PRM is there specific mention of its rate or normative range. In fact, it wasn't until 1961, well after Sutherland's death, that Woods and Woods first published the term cranial rhythmic impulse and a normative rate for it (10–14 cpm).[8]

The establishment of normative parameters for the rate of the CRI subsequently has been controversial due to: (1) the lack of an accepted objective approach, (2) the esoteric nature of the phenomenon, (3) the subjective nature of the CRI's detection through palpation, (4) the relatively low number of researchers experimentally measuring the rate, and (5) the comparatively low subject population numbers in many of the published studies. Recognized osteopathic textbooks[5,9,10] cite the rate in the range of 8–14 cpm, consistent with the original, 1961, Woods and Woods study.[8] This range still is often cited as definitive even though a much lower range has been reported repeatedly.[11–18] Past reported measured rates for the palpated rate of the CRI are presented for comparison in Table 1, along with the values from this study.

The aims of this study were (1) to define the normative rate of the CRI and (2) to compare palpated CRI rates obtained by practitioners at three experience levels.

2. Methods

The study was organized around the teaching activities of one of the authors (NS) in compliance with the legal requirements of the Commission Nationale de l'Informatique et des Libertés (CRIL) and

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doi:10.1016/j.ijosm.2010.11.006

Table 1
Reported cranial rhythmic impulse (CRI) rate ranges.

Authors	CRI Rate (Range or Values)	Subjects in Study (N)	Year Reported
Woods and Woods[8]	10–14	62	1961
Norton et al.[11]	3.2–4.1	24	1992
Wirth-Pattullo and Hayes[12]	3–9	12	1994
McAdoo and Kuchera[13]	6.63–9.37	128	1995
Hanten et al.[14]	3.6 & 4.2	40	1998
Rogers et al.[15]	3.28 & 4.83	28	1998
Sommerfeld[16]	2.3–3.6	49	2004
Moran and Gibbons[17]	2.92–4.17	11	2004
Nelson et al.[18]	2.46–6.62	44	2006
This Study	(mean ± SD)		2009
All subjects	2.43–11.33	727	
1 year experience	2.69–12.09	463	
2 years experience	2.36–10.56	190	
3–25 years experience	2.21–7.35	74	

the Helsinki Accord. Students who participated in the academic program were taught to palpate the CRI and tested to establish their ability to monitor it. The data for this study were taken from these evaluations.

The participants of this study ($N = 734$) were practicing clinicians (predominantly physical therapists, with some nurses, midwives and medical doctors). They were undergraduate and postgraduate students of osteopathy. Most were studying at, or graduates of, La Maison de la Thérapie Manuelle, an osteopathic school that holds classes in different European cities. Their formal two year course of study in cranial osteopathy consisted of 225 contact hours, including 150 h of didactic and 75 h of laboratory work. It was presented within an extensive academic osteopathic curriculum, typically after two years of general osteopathic studies. The Level 1 individuals participated at the end of their first year of cranial osteopathic study. The Level 2 individuals participated upon completion of the course at the end of their second year of study. The Level 3 individuals, having successfully completed the two year cranial program, participated as attendees of postgraduate courses in cranial osteopathy. The demographics of the study population, with respect to the city and year in which the course was given, the level of participants, and their number at that site and year, are as follows: 60.2% (of the total enrolment) at Biscarrosse, France: [2001] Level 1, 86; [2002] Level 1, 50, Level 2, 32, Level 3, 35; [2003] Level 1, 48, Level 2, 31; [2004] Level 2, 52; [2005] Level 1, 59, Level 2, 49. 29.3% at Paris, France: [2002] Level 1, 42; [2003] Level 1, 15, [2004] Level 1, 74, [2006] Level 1, 58, Level 2, 26. 5.2% at Lyon, France: [2003] Level 1, 16, [2004] Level 1, 22. 5.3% at Padova, Italy: [2003] Level 3, 39. The % of the total number of subject/examiners at each level were 64.0% level 1, 25.9% level 2, 10.1% level 3.

Data collection occurred at the end of the course at the same time in the academic schedule of each program. The time of day was variable depending upon each separate program's schedule. The data were collected in the teaching laboratory with the subjects always being examined in the same position, supine upon the examination table. The data were collected in each instance by the same individual (NS).

All participants palpated CRI rates on each other (734 different healthy individuals) within the controlled environment of the teaching laboratory. The groups were divided in half, with half of the group being examiners and the other half subjects. Upon completion of the protocol, the pairing was maintained and the individuals changed places, with the examiners becoming subjects and the subjects becoming examiners. With this structure, every participant was an examiner one time and a subject one time. At no time during and between both sessions was any communication between participating individuals permitted. The examiners were asked to begin palpating the CRI using the classically described vault hold[5,9] and given enough time, *ca.* 2 min, to sense the oscillation. Following this acclimatisation period, they were told when to start and when to stop counting the CRI. They were not told how long they would be palpating, only to count the number of complete biphasic CRI cycles that they palpated during the acquisition period. They were timed, using a wristwatch with a sweep second hand for a predetermined number of minutes (all trials, 3 min) known only to the individual conducting the protocol. It was determined by our previous work[18–20] that this relatively brief time measurement window is sufficient to provide a good CRI sampling number without introducing error that could come with longer measurement periods. Following the data acquisition period, the investigator passed among the examiners and had them silently record their measured rate on a roll of paper after which that section of paper was torn from the roll and placed into an envelope. The reported number-of-cycles were kept private, and palpating participants were not aware of the rates that other participants reported. The investigator then moved to the next examiner and repeated the process until the rates acquired from all examiners had been gathered. Following this, the pairs exchanged positions, and the protocol was repeated. The numbers recorded on the paper fragments were tabulated on a spreadsheet identifying the experiential group and site. The CRI rate was then calculated in cycles/min for each recorded value by dividing the total number of CRI cycles counted per subject by 3, the time in minutes allowed at each measurement session.

3. Statistical analysis

Palpating participants were analyzed in three groups based upon their level of training and clinical experience: Level 1 ($N = 463$) consisted of students with 1 year of experience who successfully palpated the CRI; Level 2 ($N = 190$), 2 years of experience; Level 3 ($N = 74$), 3–25 years of experience. Although 734 individuals participated in the study, seven Level 1 students did not palpate a CRI rate, yielding a valid subject population of 727 volunteers. Data frequencies and descriptive statistics were computed using the SPSS statistical package (SPSS, Inc., SPSS 10.1).[21] The One-Way Analysis of Variance (one-way ANOVA) was used to assess whether a significant difference existed among the three experimental groups. In addition, pair-wise comparisons (of means) were performed among the three groups using both the Scheffé and the Least-Significant Difference range tests, with an alpha of .05 accepted as significant. Formal tests of normality were computed using the Shapiro–Wilk and the Kolmogrov–Smirnov tests. The distributions obtained (histograms) were analyzed further for their deviations from normality using Normal Q–Q plots and Detrended Normal Q–Q plots.

4. Results

Seven Level I participants (1.5%) were unable to perform the CRI rate determination, while all participants in Levels 2 and 3 successfully performed the CRI rate determination. The valid examiner/subject population of the 734 potential pairings, therefore, was 727.

The mean reported CRI rate ($N = 727$) was (mean ± SD) 6.88 ± 4.45 cycles per minute (Fig. 1 and Tables 2 and 3). Skewness (2.510 ± .091) and Kurtosis (11.389 ± .181) provide measures of the distribution (Table 2). (Skewness, or third moment, will take on the value of zero when the distribution is a completely symmetric bell-shaped curve. Kurtosis, or fourth moment, is a measure of relative peakedness or flatness of the curve. A normal distribution will have a kurtosis of zero.[21])

The mean (±SD) for each subgroup (Tables 1 and 3) is as follows: Level 1, 7.39 ± 4.70; Level 2, 6.46 ± 4.10; Level 3, 4.78 ± 2.57 (Fig. 2).