Osteopathic Evaluation of Somatic Dysfunction and Craniosacral Strain Pattern Among Preterm and Term Newborns

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Context: Palpatory skills are a central part of osteopathic manipulative treatment and palpatory diagnosis. The aim of osteopathic structural examination is to locate somatic dysfunction and cranial strain pattern, which are the hallmarks that form the basis for treatment decisions and strategy. In the osteopathic literature, there is a lack of studies evaluating preterm or term newborns during hospitalization.

Objective: To determine the prevalence of somatic dysfunction and cranial strain pattern in a population of preterm and term newborns who were treated in a neonatal intensive care unit (NICU).

Methods: During a period of 6 months—November 2009 through April 2010—the authors performed a retrospective review of data on consecutive preterm and term newborns who were admitted to the NICU of the Spirito Santo Public Hospital. Osteopathic evaluation was performed once on each newborn, and somatic dysfunction and cranial strain pattern were identified. Descriptive analysis and test of association based on the χ^2 test were performed.

Results: One hundred fifty-five preterm and term newborns met the study's eligibility criteria. The highest rate of somatic dysfunction was found in the pelvic area of 63 newborns (40.7%). The sacroiliac joints were compressed unilaterally or bilaterally in 82 newborns (52.9%); the lumbosacral junction was restricted in 61 newborns (39.4%), and intraosseous lesions of the sacral bone were diagnosed in 57 newborns (36.8%). The spine accounted for somatic dysfunction in 38 newborns (24.5%), with the middle thoracic and lower thoracic areas restricted in 29 (18.7%) and 21 (16.8%) newborns, respectively. Sphenobasilar synchondrosis compression and lateral-vertical strain were diagnosed in 57 newborns (36.8%), with the sagittal and the coronal sutures found restricted in 35 (22.6%) and 30 (19.4%) newborns, respectively. The occipital bone presented the highest rate of intraosseous lesions, with the left condyle compressed in 48 newborns (31%), the right condyle in 46 newborns (29.7%), and the squama in 38 newborns (24.5%).

Conclusion: Results showed that osteopathic findings are not secondary to gestational age and weight at birth.

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Highly developed palpatory skills are necessary in the use of osteopathic manipulative treatment (OMT) and palpatory diagnosis. One essential component of OMT is the diagnosis of somatic dysfunction, defined in the osteopathic literature as "impaired or altered function of related components of the somatic (body framework) system: skeletal, arthrodial and myofascial structures, and their related vascular, lymphatic, and neural elements."[1] Diagnosis of somatic dysfunction is based on the TART criteria (tissue texture changes, asymmetry of structure, restriction of motion, and tenderness to palpation).[1] Diagnosing, ameliorating, and relieving somatic dysfunction enables the physician to promote health whether a patient has acute symptoms or is asymptomatic.[2,3]

The term *somatic dysfunction* is coded under the *ICD-9-CM 2012 Expert for Physicians* with the codes 739.0 through 739.9,[4] corresponding to the area of the body in which the changes are palpated. More specifically, these codes are 739.0—head (including the occipitoatlantal joint), 739.1—cervical, 739.2—thoracic, 739.3—lumbar, 739.4—sacral/sacroiliac, 739.5—hip/pelvic, 739.6—lower extremity, 739.7—upper extremity, 739.8—rib, and 739.9—abdomen.

Somatic dysfunction of the head, also called cranial strain pattern, is a membranous articular strain resulting from abnormal dural membrane tension.[1] Restriction of the physiologic membranous articular motion resulting from cranial strain pattern can alter cerebrospinal fluid motion, as well as arterial, venous, and lymphatic flow in the human skull.[5]

To our knowledge, little research has been conducted on the prevalence of somatic dysfunction and cranial strain pattern in both the general population[6,7] and in adult patients referred to osteopathic physicians.[8] Several studies,[9-12] however, report somatic dysfunction and cranial strain pattern findings in relation to specific clinical conditions. Frymann[13] and Carreiro[14] were, to our knowledge, the only researchers to explore osteopathic findings in large neonatal populations of newborns by evaluating groups of 1250 and 1600, respectively. Furthermore, hospital-based electronic databases with prevalence data of somatic dysfunction in preterm or term newborns are scarce.

In the present study, we performed a retrospective review of data of preterm and term newborns who were admitted to a neonatal intensive care unit (NICU) to determine the prevalence of somatic dysfunction and cranial strain pattern findings after osteopathic structural examinations. The aim of our study was to determine the prevalence of somatic dysfunction and cranial strain pattern in newborns at the first osteopathic structural examination.

Methods

Study Population

All newborns entering the study were consecutive preterm or term newborns who at birth were directly admitted to the NICU at the Spirito Santo Public Hospital in Pescara, Italy. Exclusion criteria were neurologic abnormality, necrotizing enterocolitis or gastrointestinal perforation, any congenital abnormality, gastrointestinal obstruction, cardiovascular disease, genetic disorders, having a mother with human immunodeficiency virus or drug addiction, pneumoperitoneum, and atelectasis. Any newborns who met the exclusion criteria were disqualified from osteopathic structural examination during the first 2 weeks after birth.

Data Collection and Osteopathic Structural Examination

Data were collected by osteopathic physicians (G.P., F.C., M.D., P.T.) who were certified by the Registro degli Osteopati d'Italia and trained in cranial and pediatric osteopathic medicine.

Somatic dysfunction and cranial strain pattern findings were recorded on a form the authors developed to document the following characteristics: date of birth; gestational age; weight at birth; and presence of somatic dysfunction in the spine (cervical; upper, middle, and lower thoracic; and lumbar), rib cage (ribs, sternum, and diaphragm), pelvis (sacrum, lumbosacral junction, sacroiliac joints, pubis), and extremities.

Data regarding cranial strain pattern, cranial bones, and sutures included compression, flexion, extension, torsion, sidebending, lateral/vertical strain of the sphenobasilar synchondrosis, bony motion restriction, and suture compression of the viscerocranium and neurocranium. Data concerning the presence of intraosseous lesions of the cranial and sacral bones were also collected on the form.

Osteopathic structural examinations were performed twice weekly, on Tuesdays and Fridays, with the newborn lying supine or prone in an open crib or an incubator. Somatic dysfunction was evaluated by means of TART criteria, which focused on tissue texture abnormalities, areas of asymmetry, and misalignment of bony landmarks. We also evaluated bony landmarks for motion, balance and organization.

Diagnosis of cranial strain pattern, which is extensively described in the literature,[15-17] was determined by using the "vault hold" or the "fronto-occipital hold."

Statistical Analysis

Descriptive analysis was performed using frequencies, median (range), mean (standard deviation), and percentage for each dysfunction. Univariate analysis for test of association based on the χ^2 test was performed for each group of dysfunctions. The level of statistical significance was defined as $P<.05$. Results were expressed in point estimates. The univariate statistical test was used to evaluate the difference among somatic dysfunction, gestational age, and weight at birth. All analysis was performed using R software (version 2.10, R Foundation for Statistical Computing).

Results

Newborns were recruited from November 2009 through April 2010. Of the 205 newborns whose medical records were studied, 50 presented with severe medical conditions and thus were excluded on the basis of the following criteria, listed in order of prevalence: 11 for neurologic abnormality, 7 for necrotizing enterocolitis or gastrointestinal perforation, 7 for congenital abnormality, 7 for gastrointestinal obstruction, 6 for cardiovascular disease, 5 for genetic disorders, 4 for having a mother with human immunodeficiency virus or drug addiction, 2 for pneumoperitoneum, and 1 for atelectasis. Thus, 155 newborns—85 boys (54.8%) and 70 girls (45.2%)—met the study criteria. Mean (standard deviation) gestational age was 35.5 (3.4) weeks, and mean (standard deviation) birth weight was 2513 (724.9) g.

Results for somatic dysfunction are shown in *Table 1*. After dividing the entire body into 4 anatomic regions (spine, rib cage, pelvis, and extremities), the area with the highest rate of somatic dysfunction was the pelvis, with 63 newborns (40.7%) having 1 or more dysfunctions at this level. In addition, the sacroiliac joints were compressed unilaterally or bilaterally in 82 newborns (52.9%); the lumbosacral junction was restricted in 61 newborns (39.4%), and lesions at the intraosseous level were found in 57 newborns (36.8%).

The spine—divided into cervical; upper (T1-T4), middle (T5-T8), and lower (T9-T12) thoracic; and lumbar—accounted for somatic dysfunction in 38 newborns (24.5%). The spinal segments with high numbers of somatic dysfunction were the upper thoracic (18 [11.6%]), middle thoracic (29 [18.7%]), lower thoracic (21 [13.5%]), and lumbar (21 [13.5%]) segments.

Furthermore, the motion of the diaphragm was restricted in 26 newborns (16.8%), whereas the pubis, the extremities, and the cervical column were found to move freely in almost all newborns.

Results for cranial strain pattern, suture compression, and bony motion restriction are shown in *Table 2*. Sphenobasilar synchondrosis compression and lateral-vertical

Table 1.
Prevalence of Somatic Dysfunction in Spine, Rib Cage, Pelvis, and Extremities in Newborns (N=155)

Anatomic Region	Newborns With Somatic Dysfunction, No. (%)	Somatic Dysfunctions per Infant, Median (Range)
Spine	38 (24.5)	1 (0-6)
Cervical	3 (1.9)	
Upper thoracic[a]	18 (11.6)	
Middle thoracic[a]	29 (18.7)	
Lower thoracic[a]	21 (13.5)	
Lumbar	21 (13.5)	
Rib Cage	38 (24.5)	0 (0-2)
Rib/sternum	23 (14.8)	
Diaphragm	26 (16.8)	
Pelvis	63 (40.7)	1 (0-5)
Sacrum—intraosseus	57 (36.8)	
Lumbosacral junction	61 (39.4)	
Sacroiliac joints	82 (52.9)	
Pubis	3 (1.9)	
Extremities	3 (1.9)	0 (0-3)

[a] The vertebral segments for the upper, middle, and lower thoracic spine were T1 through T4, T5 through T8, and T9 through T12, respectively.

strain were diagnosed in 57 (36.8%) and 57 (36.8%) newborns, respectively, altogether accounting for 73.6% of all instances of cranial strain pattern. Among all sutures, the sagittal sutures were found to be compressed or overlapped in 35 newborns (22.6%) and the coronal sutures were found to be compressed or overlapped in 30 newborns (19.4%). The cranial bones that presented more intraosseous lesions were the occipital bones: the left condyle (48 newborns [31.0%]), the right condyle (46 newborns [29.7%]), and the intersquamous (38 newborns [24.5%]). The pelvis and sacroiliac joints were restricted in half of the newborns studied, whereas the lumbosacral junction and intraosseous strain were found in 61 (39.4%) and 56 (36.0%) newborns, respectively.

After univariate statistical tests were performed, no associations were found among somatic dysfunction, gestational age, and weight at birth.

Comment

The results of the present study are difficult to interpret given the absence of additional data on the population under study and the lack of studies evaluating preterm or term newborns during hospitalization. The present study was, to our knowledge, the first to examine somatic dysfunction and cranial strain pattern in newborns who were admitted to a single NICU. Frymann (1966)[13] and Carreiro (1994)[14] were, to our knowledge, the only

Table 2.
Prevalence of Cranial Strain Pattern, Suture Compressions, and Intraosseus Lesions in Newborns With Somatic Dysfunction (N=155)

Areas of the Body	No. (%)
Sphenobasilar Synchondrosis	
Compression	57 (36.8)
Torsion	22 (14.2)
Flexion-extension	1 (0.6)
Sidebending rotation	6 (3.9)
Lateral-vertical strain	57 (36.8)
Sutures	
Metopic	6 (3.9)
Coronal	30 (19.4)
Lambdoid	16 (10.3)
Interparietal	35 (22.6)
Other findings	12 (7.7)
Bones	
Occiput	
Left condyle	48 (31.0)
Right condyle	46 (29.7)
Intersquamous	38 (24.5)
Temporal	
Right petrotympanic	2 (1.3)
Right petrosquamous	2 (1.3)
Right tympanosquamous	2 (1.3)
Left petrosquamous	1 (0.6)
Left petrotympanic	1 (0.6)
Left tympanosquamous	1 (0.6)
Sphenoid	1 (0.6)

researchers who explored the prevalence of osteopathic findings in newborns, but their data do not compare readily with ours due to the lack of published results by Carreiro and different characteristics (ie, Frymann did not evaluate preterm newborns) of the samples under study. In the present report, sphenobasilar synchondrosis compression and lateral-vertical strain patterns were diagnosed in 36.8% and 36.8% of preterm newborns, respectively, as opposed to 17% and 7% diagnosed by Frymann, suggesting that severe cranial restrictions may be secondary to unstable clinical conditions of newborns in the NICU.

Findings from the present study also showed that somatic dysfunction at the level of the pelvis and spine occurred frequently. Moreover, the segment of the spine with the highest prevalence of somatic dysfunction was the middle thoracic area (18.7%), in line with the osteopathic observations on 1600 newborns by Carreiro.[13] Additionally, dysfunctions of the rib cage were shown to be in relation to dysfunctions of the diaphragm (16.8%), ribs, and sternum.

We can speculate on clinical interpretation of these results. Licciardone et al[10] demonstrated that tissue changes at the T11-L2 levels were a consistent osteopathic palpatory finding in patients affected by type 2 diabetes mellitus. Evidence from 2 longitudinal studies by Johnston et al[18,19] confirms the association between upper thoracic somatic dysfunction and hypertension. Sergueef et al[11] found that cranial strain pattern and somatic dysfunction at the level of the cervical spine can predispose a newborn to assume a preferential head position, leading to plagiocephaly.

Building on the data from these studies, the pathogenesis of somatic dysfunction and cranial strain pattern in newborns may occur on the basis of several factors. These factors include maternal age and body mass index, parity, pregnancies obtained via assisted reproductive technologies, ovulation induction therapy, gestational diabetes, hypertension, preterm labor, preterm uterine contractions, use of tocolytic drugs, use of oxytocin, duration of labor, route of delivery, and immaturity of the preterm newborn systems. Such speculations, however, cannot be verified within the framework of the current study, as more ad hoc studies looking at specific clinical conditions and osteopathic findings are needed.

Several limitations of the present study need to be addressed. Grades of severity for somatic dysfunction and cranial strain pattern were not reported and lack of data of the study population did not allow for further association with clinical symptoms. Because of the limited sample size, it was not possible to perform subgroup analysis of somatic dysfunction and cranial strain pattern occurrence in different classes of gestational ages and to compare the preterm and term newborn groups. Moreover, the absence of data regarding route of delivery prevented a more detailed analysis for correlation. Finally, these findings lack in reliability because neither interoperator nor intraoperator agreement was evaluated.

Conclusion

The results showed that osteopathic findings are not secondary to gestational age and weight at birth. Further research on a larger population to create a somatic dysfunction and cranial strain pattern database for newborns is needed.

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