

## Introduction to 1st German Edition

**O**STEOPATHY, FOR ME, IS AN art that involves the hands, the understanding, and the heart in equal measure. The most important principle is one I learned in particular from Alan Becker, who had the privilege of being introduced to cranial osteopathy in one of William Garner Sutherland's first courses: wait with gentle attentiveness until the tissue begins to speak, to listen, to allow processes to happen, and simply to be there. It is not a matter of doing something but one of attuning to the patient and learning to understand that person's own particular story.

During my training, or, rather, my initiation, I was introduced to fluid palpation, the palpation of energy and the sensing of embryological motion impulses. The means of looking behind the structures of the body was opened up to me—the capacity to see the heart or the still point of the patient and to sense the potential source of the health in each individual patient. What the old masters and teachers understood by palpation was more an act of attuning to what Sutherland called the “Breath of Life.” This is a very conscious, gentle, and respectful approach to the wholeness of the patient. These teachers did not simply palpate with their hands but opened all their senses, their understanding, and their heart to perceive how the universal breath of the cosmos found its echo and individual expression in the patient and every other form of existence. They used this endeavor to listen to the unique stories of the tissue and to sense the subtle motions, rhythms, and tensions of the tissue. Alan Becker would often walk through the woods in the evening to palpate the oscillations of the colors of petals in the darkness.

The therapeutic impulse consists more in attuning to these rhythms and energies revealed in and beyond the anatomical structures than in some mechanically executed technique. The practitioner should approach the patient by retreating and becoming receptive to such a degree that it becomes possible to trace back to the original mesenchymal ocean, the potential and *meaning*. Here, the body, the person, is able to orient itself anew in immediate experience and to transfer from the fulcrum of disease to the fulcrum of health.

Many cranial teachers today lay claim to these insights. Yet, in all fairness, it must be said that this was the daily practice of Sutherland—especially in his later years—and of his students, though it was an approach that he only shared with a small circle of students. When I asked

Anne Wales, when she was 92 years old, what was the special quality that distinguished an osteopath, she answered: "As an osteopath you examine the patient's body through your hands. You study anatomy so that you can find out how the body works and what the problem is that your patient brings to you. You want to understand the problem before you administer any kind of a treatment. You want to know what their complaint is. You want to know the history of their complaint, and then you want to find out what the problem behind their complaint is."<sup>1</sup>

It is in this spirit that this book is conceived. It provides the necessary basic embryological and anatomical information that create the vital map to guide the practitioner's approach to their patients. Our guide is the healthy individual, healthy living tissue and physiology, so that we can help our patients in the task of self-healing. Today, the use cranial techniques is spreading far beyond the bounds of osteopathy, complementing the tools available to other therapists and types of treatment. Perhaps this book will be able to help clarify questions, provide principles, new insights, and impulses, as well as serve as a reference work, so that this form of treatment can be successfully integrated into clinical practice. In presenting the results to date of scientific studies affecting the wide field of cranial osteopathy, the author of this book also hopes that this will stimulate others to engage in investigating the many questions that still remain unanswered. Perhaps something of the original spirit of those wise early teachers can also be found between its lines. Those teachers all stressed that cranial osteopathy could only be learned from a well-grounded, trained teacher and not from a book.

This book also seeks to arouse curiosity, to encourage readers to set out on a journey that is by no means concluded, and to trust their own hands and perceptions. The final part of the book presents cranial techniques as well as diagnostic and treatment principles. Dr. Still, the founder of osteopathy, generally avoided passing on techniques to his pupils, believing it more important to help them understand the principles of the body's organization. Dr. Sutherland only taught his students three techniques in his first two-week course. The techniques are like ripe fruit: as the practitioner's ability to visualize the structures involved and understand their interactions, mastery of the principles of diagnosis and treatment, and manual sensitivity all increase, the ripe fruits fall into the hand. These maturing abilities will enable practitioners to develop their own techniques and adapt them to a given patient. It is a task that calls for a consciousness of the energies of the individual body and loving attention to the patient.

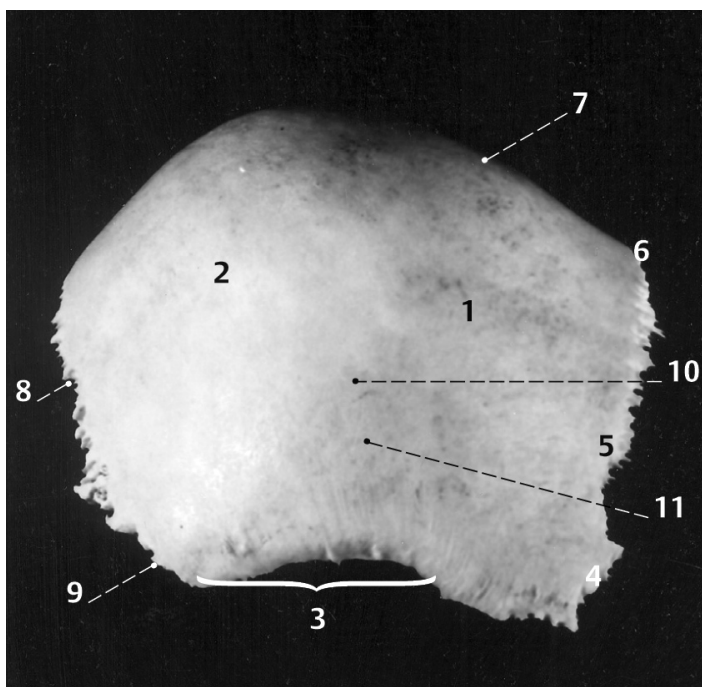
One of my own teacher's teachers repeatedly said at the end of his lectures that he was sure that fifty percent of what he had said was correct; he was simply not sure which fifty percent. With this remark in mind, I wish each of my readers much pleasure in their reading.

— Torsten Liem  
Hamburg, Spring 1997

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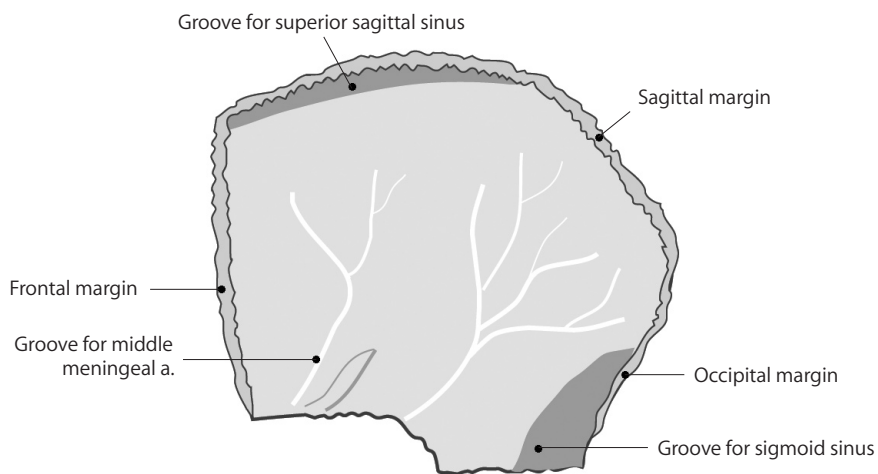
1. Anne Wales in personal conversation with the author, February 5, 1996. Quotation published by permission of Dr. Wales.

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- |                      |                            |
|----------------------|----------------------------|
| 1. External surface  | 7. Sagittal margin         |
| 2. Parietal eminence | 8. Occipital margin        |
| 3. Temporal margin   | 9. Occipital angle         |
| 4. Sphenoidal angle  | 10. Superior temporal line |
| 5. Frontal margin    | 11. Inferior temporal line |
| 6. Frontal angle     |                            |

► **Fig. 5.41** Parietal bone (external view)



► **Fig. 5.42** Parietal bone (internal aspect)

## THE MORPHOLOGY OF THE PARIETAL BONES AND CRANIAL VAULT

The parietals, like the rest of the cranial vault, undergo ossification from the outside in a similar way to the compact substance of the long bones. The difference is that the process begins from an ossification center in the vault bones, rather than as a surrounding “sleeve” of the bone. Rays of bone spread outward, linking the ossification centers in the shape of a pentagon, which Rohen sees as expressing dominating strength of form.<sup>30</sup>

Whereas in the limbs, the will expresses itself in movement, in the case of the head, this expression is in the power of thought. These powers of the will can be found on the skull’s exterior and are reflected in the brain within, which Rohen sees as a complete reversal from the limbs to the head region. Stone sees the parietal bone as exhibiting the energetic polar reflexes of the sides of the body.<sup>31</sup>

### OSSIFICATION

The parietal bone is membranous in origin. There is one ossification center each at the level of the parietal eminence, and ossification begins from the second fetal month.

### ATTACHMENT OF THE MUSCLES

Temporalis muscle	From the inferior temporal line and the squamal border
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### ATTACHMENT OF THE FASCIAE

Superficial layer via the temporal fascia	Between the inferior and superior temporal lines
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### INTRACRANIAL MEMBRANES

Falx cerebri	At the margins of the groove for the superior sagittal sinus
Tentorium cerebelli	Over a short distance, with its upper layer inserting on the lower, posterior angle of the parietal bone and the inferior insertion on the mastoid process of the temporal bone

A very important area! Sutural fixations are capable of impairing the venous backflow within the sigmoid sinus.

### RELATIONSHIP TO THE CRANIAL NERVES AND CEREBRUM

Parietal lobe	
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### VASCULAR CONNECTIONS

Middle meningeal artery	From the foramen spinosum along the internal surface of the parietal bone
Superior sagittal sinus	On the sagittal suture



Sigmoid sinus	In the groove for the sigmoid sinus on the mastoid border
Middle meningeal veins	On the internal surface

### Dysfunctions

Tensions at the foramen spinosum or at the sphenoparietal and sphenosquamous sutures can affect the middle meningeal artery, resulting in migraines and increased intracranial pressure.

Simultaneously occurring restrictions of movement affecting the parietal bone and thoracic cage are not infrequently observed!

## Maxilla

The paired, highly irregularly-shaped maxilla is the central bone in the upper part of the face. It plays a role in the formation of the lateral wall of the nasal cavity, the largest section of the nasal cavity floor, and the hard palate. It also forms the greater portion of the inferior orbital floor. The alveolar process is important in the act of chewing. Together with the tongue, the maxilla is necessary for speech. It is therefore involved in the nasal cavities, the oral cavity, and the orbit, and in their respective functions.

Dysfunctions of the maxilla are believed frequently to be caused by localized trauma and dental surgery, and lead to disturbances in the nasal, postnasal, and pharyngeal regions.<sup>22</sup>

### BORDERS

Superior	Frontal bone
Superior-medial	Ethmoid bone
Lateral	Zygomatic bone
Superior-posterior	Lacrimal bone
Posterior	Palatine bone
Superior-anterior	Nasal bone
Superior	Vomer
Medial	Maxilla on the opposite side and inferior nasal concha

### PARTS

The parts are the body and three processes: the frontal, zygomatic, and palatine (Figs. 5.43–5.45).

#### Body

The body is the largest component of the maxilla. With the nasal (medial) surface, it forms part of the lateral nasal wall, and with the triangular orbital surface, it forms the greater part of the orbital floor. The anterior (molar) surface forms the anterior surface of the bone and the base of the cheek: the infraorbital foramen on the anterior surface of the maxilla. Below the foramen is the canine fossa, surface of attachment of the levator anguli oris muscle. Anteriorly,

## CRANIAL SUTURE DYSFUNCTION

As far back as the ancient world, medical writers paid attention to the effects of sutural dysfunction. For example, both Hippocrates and Galen considered cranial deformities to be constitutional anomalies. Writing in 1839, Somering described parallels between cranial deformities and fusion of the cranial sutures. Virchow also held that reduced, irregular, and abnormal growth of the cranial bones was caused by premature ossification of the cranial sutures. In 1851, he classified various mental disorders in relation to the extent of premature ossification. Therefore, more than a century ago, he recognized the importance of the cranial sutures for the normal functioning of the nervous system.<sup>36</sup> In 1924, while investigating the causes of birth trauma, Ehrenfest concluded that these stemmed from problems with the maternal pelvic bones, and as long ago as 1843, Little noted the increased incidence of brain disease when the birth process had been particularly prolonged and difficult.

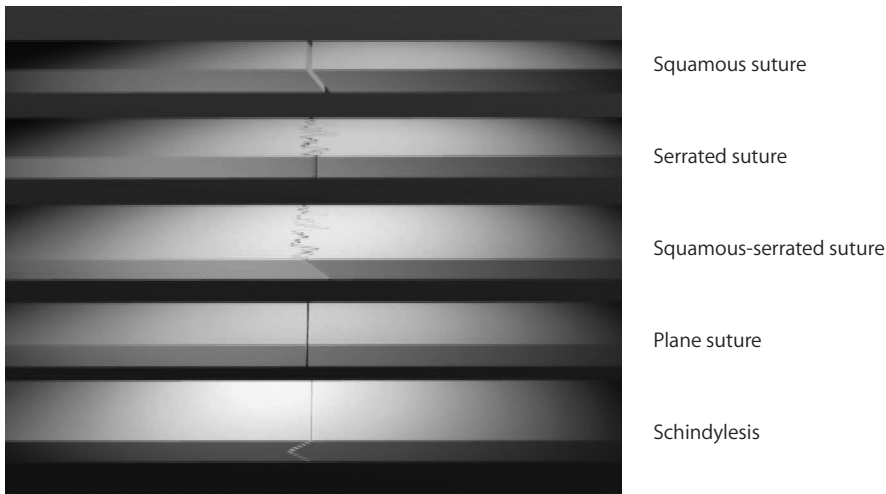
Mechanical stress has short-term and long-term repercussions on the cranial sutures. Short-term stress application produces an alteration in intersutural tissues, which also persists when the stress is no longer present. While type I collagen is synthesized in normal, nonstressed sutures, type II collagen is produced in response to mechanical stress and protein synthesis is stimulated within 6 hours. Mechanical stress appears to modulate biosynthesis.<sup>72</sup>

Stress also inhibits the enzymes responsible for collagen-specific hydrolysis (i.e., catabolism).<sup>73</sup> An interrelationship exists between cranial sutures and structures that transmit mechanical forces. According to Blum,<sup>74</sup> this relationship appears to be organized as a holographic matrix. Mechanical stress to cranial bones and sutures is able to produce piezoelectric effects. These are sufficient to provoke changes in enzyme production, osteoblast-osteoclast activity, and neuroelectrical dynamics in associated bones and soft tissue.<sup>74</sup>

On the basis of their extensive research, Retzlaff et al. concluded that cranial dysfunctions cause compression of the intrasutural blood vessels, nerve fibers, and nerve endings. Accordingly, sutural compression invariably also leads to sutural ischemia, and this in turn provokes pain via unmyelinated nerve fibers. They further suspect that intrasutural compression and tissue ischemia impairs endorphin production and endorphin activity in the suture, which in turn has implications for pain perception. They also believe that the function of the brain regions supplied by the sutural vessels and nerve fibers may be disturbed.<sup>75</sup> It is further possible that nerve fibers with an as yet undefined purpose may contribute to functional impairment of the central nervous system, with ensuing behavioral and emotional disturbances.

To summarize, it may therefore be assumed that pain as well as other physical and psychological symptoms may arise as a consequence of suture compression. Whereas the rigidity of the cranium is necessary on the one hand for venous return, Farasyn<sup>76</sup> has conjectured that it could be conceivable for local restrictions of the cranial bones to impair the circulation of venous blood. This would in turn lead to a compensatory increase in the circulation elsewhere. Some of the successes of cranial techniques resulting in decompression of the cranial sutures are perhaps explicable in terms of the changes in arteriolar vasomotor tone and of the regulation of pain perception emanating from this venous part of the cerebrovascular system.<sup>12</sup>

Manipulation of the facial bones is also thought to have repercussions in the cervical spine. A change in the position of facial bones (the maxilla) is reported to have led to a palpable homolateral tension increase at the level of C1; this can be resolved again by inserting wax between the molars and swallowing simultaneously.<sup>77</sup> Furthermore, manipulation of the maxilla,



► **Fig. 6.4** Cranial suture morphology

zygomatic bone, and temporal bone is reported to have resulted in sutural expansions of a few millimeters.

Certain to be of interest as far as osteopathic manipulation is concerned is one laser holography study in which complex intraosseous reactions were recorded in the maxilla and in all the surrounding bones following application of extremely low-magnitude forces to the maxilla.<sup>27</sup> It becomes clear here that even the tiniest manipulation of a bone may also affect all the other neighboring bones.

## CRANIAL SUTURE MORPHOLOGY

Cranial sutures show marked variations in their morphology and structure (Fig. 6.4). In all probability, their function is to permit specific minimal movement between cranial bones, based on differences in suture morphology, and to facilitate the domed development of the cranial bones during growth.

### Synchondrosis

A cartilaginous union between two bones; examples include the sphenobasilar synchondrosis and the petrojugular suture.

### Syndesmosis

A form of articulation in which closely apposed bony surfaces are bound together by an interosseous ligament.

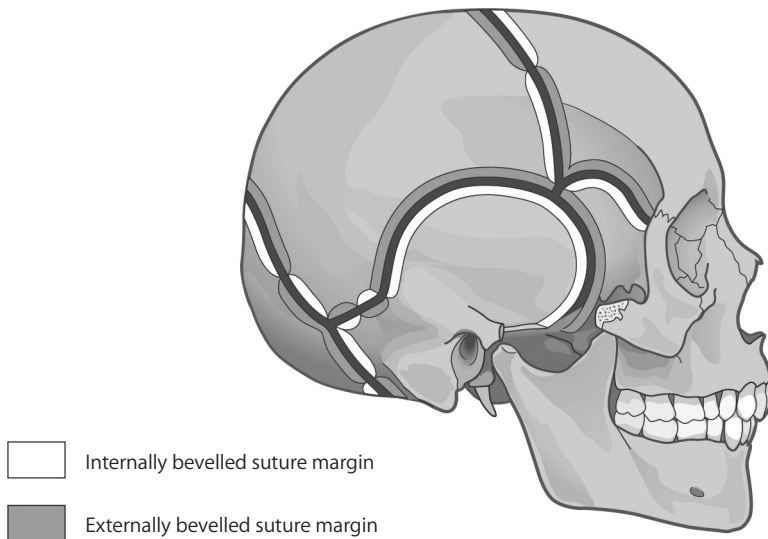
— *Squamous sutures*: These sutures are characterized by overlapping of the broad beveled edges of the participating bones. In response to pressure or compression, they permit a gliding, scissor-like movement as one sutural surface slides over the other, for example, the squamoparietal suture. Unlike a nonbeveled suture, a beveled suture is better able to withstand tensile and compressive forces.



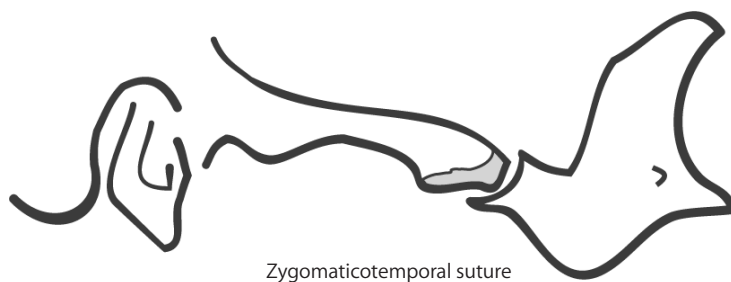
- *Serrated sutures or denticulate sutures*: These sutures are noted for their sawtooth projections. Those sutures with the largest projections represent the zones of most active growth. This growth activity appears to be related to the mobility of the sutures, because the larger the projections at the interlocking surfaces, the greater the potential for movement. According to Retzlaff,<sup>44</sup> this type of suture may permit a slight flexion movement, as with a hinged joint, for example, the sagittal and zygomaticotemporal sutures. Some authors describe denticulate sutures as sawtooth sutures; however, denticulate sutures differ from serrated sutures in that their serrated projections widen at their terminal end, thus achieving even more efficient interlocking of the participating bones, for example, the lambdoid suture.
- *Limbus sutures = squamous-serrated sutures*: These sutures interlock with beveled articular surfaces, with the result that the participating bones not only interlock but also overlap, for example, the lambdoid and coronal sutures.
- *Schindylesis*: A schindylesis is characterized by a ridged bone that fits into a groove on the neighboring element, for example, the sphenovomerine suture.
- *Plane sutures (harmonic sutures)*: These are smooth sutures and, like squamous sutures, they permit a type of gliding and spreading movement, for example, the nasomaxillary suture.
- *Syndesmosis in the strict sense*: A specialized ligamentous articulated union, for example, the sphenopetrosal synchondrosis.
- *Gomphosis*: A peg-and-socket articulation in which a conical bone ending fits into a socket in the neighboring cranial bone, for example, the dental attachment in the alveolar processes and the original intrauterine union of the styloid process and temporal bone.

### Pivot points

Pivot points are those places where the internally and externally beveled articular borders



► **Fig. 6.5** Direction of suture bevels



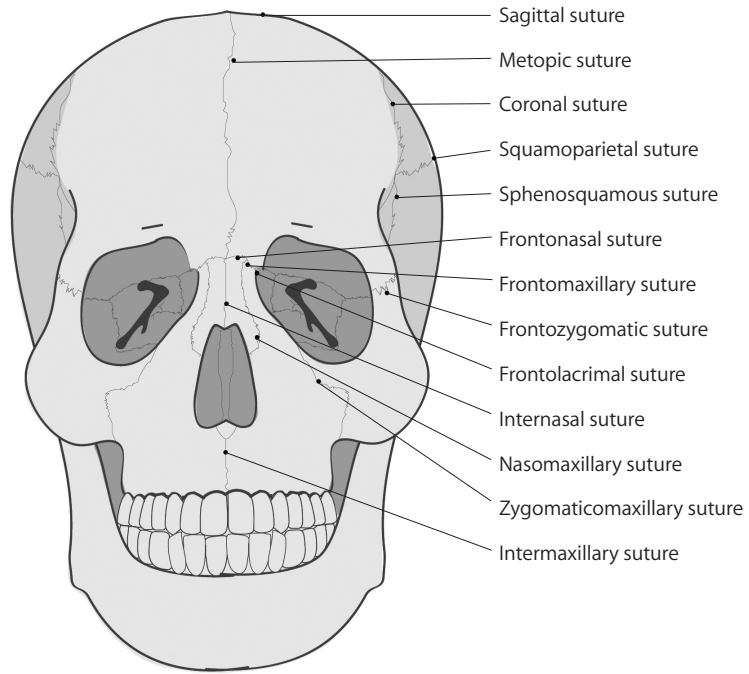
► **Fig. 6.6** Direction of suture bevels

meet, or those points where the bevel of the articular margins changes direction. These points are possible axes for movement of the cranial bones. For example, in the sphenosquamous pivot (SSP) point, the horizontal part of the squamosal margin of the greater wing of the sphenoid bone is internally beveled, while the vertical anterior part is externally beveled. This articular transition in the suture margins finds its correspondence at the sphenoidal margin, which forms the anterior border of the temporal bone. The point where the bevel of the suture margins changes direction is known as the *sphenosquamous pivot point*.

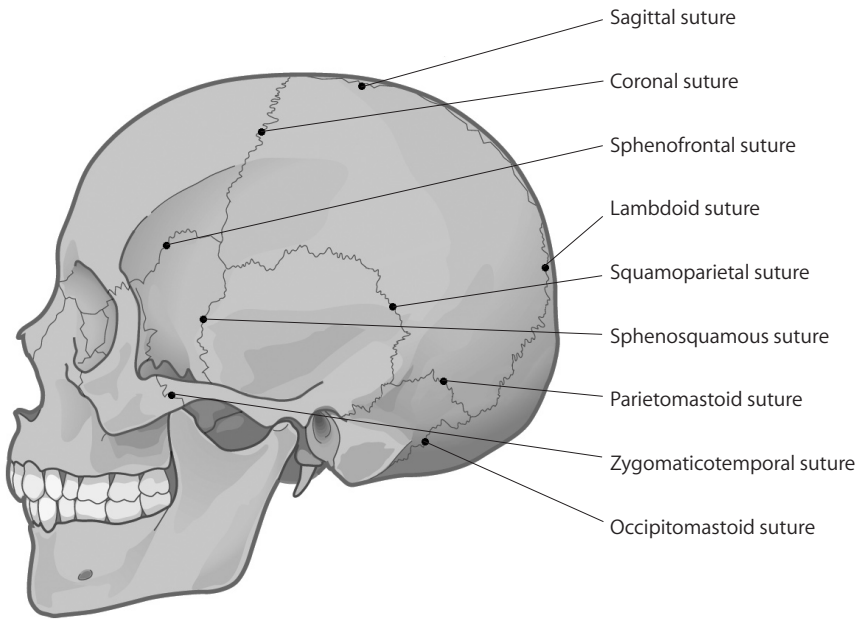
An understanding of how the suture margins are beveled is of the utmost importance for the application of cranial techniques. If the beveling of the suture margins is not taken into account, the cranial bones cannot be disengaged from each other; in the same way, it is impossible successfully to use the cranial bones as levers to release intracranial membrane tensions (Figs. 6.5 and 6.6).

The most important cranial sutures, especially those that are accessible to external palpation, are listed here (Figs. 6.7–6.10):

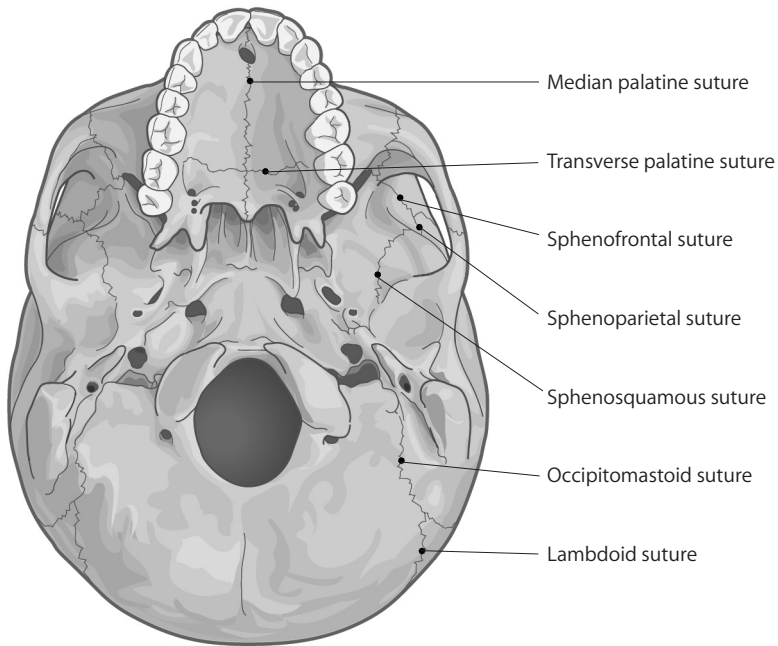
Sphenobasilar synchondrosis (SBS)	The suture between the sphenoid and occipital bones; type: synchondrosis, becoming a synostosis from about the age of 16
Coronal suture	The suture between the frontal and parietal bones; type: squamous-serrated suture
Sagittal suture	In the midline between the two parietal bones; type: serrated or denticulate suture
Lambdoid suture	The suture between the occipital and parietal bones; type: squamous-serrated suture
Squamoparietal suture	The suture between the parietal bone and the squamous part of the temporal bone; type: squamous suture
Parietomastoid suture	The suture between the parietal bone and the mastoid process of the temporal bone; type: irregular, primarily squamous
Occipitomastoid suture	The suture between the occipital bone and the temporal bone; type: irregular
Metopic suture	The suture between the right and left halves of the frontal bone; type: serrated suture



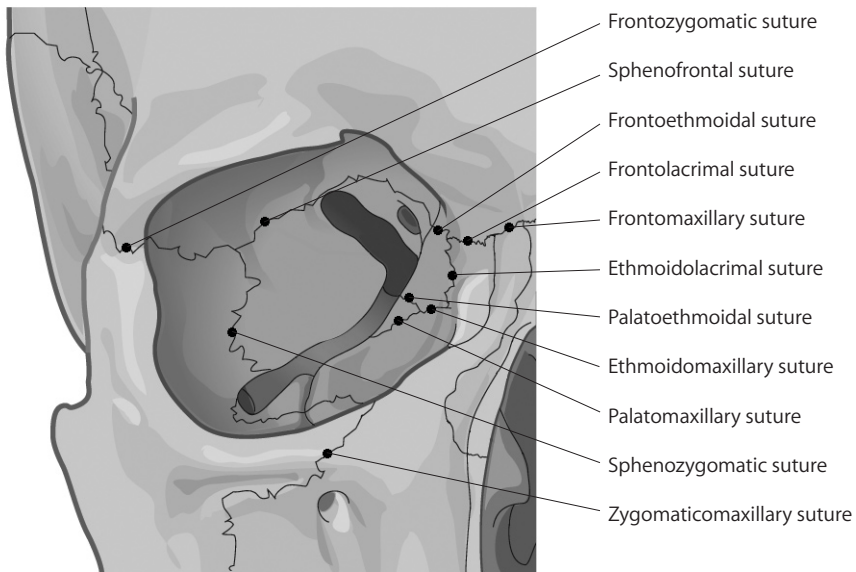
► **Fig. 6.7** Cranial sutures, anterior aspect



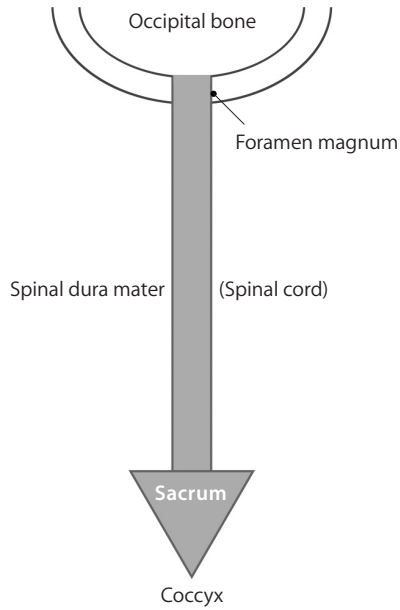
► **Fig. 6.8** Cranial sutures, lateral aspect



► **Fig. 6.9** Cranial sutures, inferior aspect



► **Fig. 6.10** Right orbit and sutures, anterior aspect



► **Figure 7.13** Continuity of the intracranial and intraspinal dural membranes



Spinal dura mater (posterior aspect) showing its attachment to the occipital bone, C2 and C3, and the second sacral segment and as a downward prolongation of the terminal filament in the coccyx.

► **Figure 7.14** Continuity of the intracranial and intraspinal dural membranes (specimen supplied by Dr. Louis Philippe Dombard).

layer (the dural border cell layer) characterized by multiple interdigitating cell processes, no extracellular collagen, significant extracellular spaces, and few cell junctions.<sup>25</sup> Further studies dealing with the ultrastructure of the cerebral and spinal membranes are listed in the references.<sup>26-39</sup> There is no absolute consensus regarding the structure of human dura mater, especially regarding the orientation of the collagen fibers that are responsible for biomechanical function.

### *Attachments of the spinal dura mater*

The spinal dura mater has a longitudinal orientation that is composed of longitudinal lamellae of collagen and elastin fibers.<sup>40,41</sup> Tensile strength and stiffness are clearly greater longitudinally than transversely. Longitudinal tensions, which arise as a result of longitudinal displacements due to movement in the vertebral column, are absorbed by the primarily longitudinally oriented collagen fibers and transmitted cranially and caudally to neighboring structures. In the high cervical region, however, the connective tissue displays primarily transverse orientation.<sup>42</sup> Collagen fibers (of canine spinal dura mater) are organized in longitudinal bundles, which are straight when stretched and wavy when unstretched.<sup>43</sup> Elastic fibers form a delicate network coursing in many directions. The elastin content of the spinal dura mater is 13.8 percent in the dorsal aspect and 7.1 percent in the ventral aspect. In the thoracic region, the elastin content is higher than in any other region.<sup>44</sup>

The spinal dura mater is thickest at the level of the craniocervical junction and at the level of the lumbar vertebral column.<sup>45</sup> With the exception of its cranial and caudal attachments, the spinal dura mater is only very loosely attached to the vertebral canal, with the result that mutual displacement of the dura mater is possible relative to the vertebral canal.<sup>22,46</sup> As a result, it is believed to be capable of transmitting the fine movements of the cranial rhythmic impulse from the cranium to the sacrum. As a continuation of the falx cerebelli and the intracranial dura, the spinal dura mater is firmly attached at the foramen magnum. According to Lanz,<sup>42</sup> the dura is particularly well attached to the following structures:

Anteriorly	To the basilar part of the occipital bone (traversing the tectorial membrane) To the transverse ligament of the atlas To the posterior longitudinal ligament
Posteriorly	To the periosteum of the occipital squama at the arch of the atlas and axis
Laterally	To the atlanto-occipital and atlantoaxial joints

The dura mater also has firm attachments to the third cervical vertebra,<sup>47,48</sup> although our own investigations suggest that this attachment is not always present.<sup>49</sup>

Munkacsy<sup>50</sup> examined twelve 6-millimeter crown-rump-length fetuses and established that the epidural space is occupied by an ubiquitous connective tissue. As fetal growth increases, this connective tissue becomes reduced to topographical structures. Posterior, lateral, and anterior ligaments can be identified. Atlantodural and sacral ligaments appear to be permanent features and serve to anchor the dural sac. These anchoring points may be responsible for compressing the nerve roots following disk protrusion. By contrast, most of the dorsal ligaments are resorbed during fetal development.

### **Cranial ligament of the spinal dura mater**

Lanz<sup>51,52</sup> designated the attachment to the occipital bone and to the periosteum of the upper cervical vertebrae as the cranial ligament of the spinal dura mater; this is formed by fibers connecting the spinal dura mater and the posterior border of the atlanto-occipital joints, part of the foramen magnum, the posterior arch of the atlas, and the arch of the axis. Rutten et al.<sup>53</sup> were also able to identify further fibers arising primarily from the flaval ligaments between C1/C2 and C2/C3, and they occasionally detected fibers between the arch of C2 and C3 running to the dura. None of these connective tissue bridges have been found caudal to C3.

The fibers of the cranial ligament of the spinal dura mater travel caudally for a few millimeters and form a supportive apparatus for the dural sac. Medial fibers from the cranial ligament of the spinal dura mater extend deep into the nuchal ligament.<sup>53</sup> The fibers of the cranial ligament of the spinal dura mater are stronger than the connective tissue bridge between the rectus capitis posterior minor muscle and the dura. Rutten et al. suspect that the function of parts of the cranial ligament of the spinal dura mater is to support the upper cervical vertebral column during movement. They also posit that the rectus capitis posterior minor muscle (with its very numerous muscle spindles) registers tension in the dura mater and that the cranial ligament of the spinal dura mater with its elastic and collagen fibers regulates folding. Furthermore, they believe that this mechanism helps to prevent dural folding. Hack et al.<sup>54</sup> support this hypothesis and note that trauma causes atrophy of the rectus capitis posterior minor muscle with subsequent failure of the antifolding mechanism. Furthermore, the spinal dura mater is attached to the posterior ligaments between the atlas and occipital bone, to the ligaments and membranes between the atlas and axis, and to the occipital bone and axis.<sup>47</sup>

### **Rectus capitis posterior minor muscle (and inferior oblique muscle)**

It is only recently that a connective tissue bridge has been identified between the rectus capitis posterior minor muscle and the dorsal part of the spinal dura mater via the posterior atlanto-occipital membrane at the atlanto-occipital joint.<sup>49, 53-55</sup> According to Kahn et al.,<sup>55</sup> connective tissue in the atlanto-occipital space extends between the anterior fascia of the rectus capitis posterior minor muscle and passes the anterior side of the posterior arch of the atlas to reach the spinal dura mater. In the atlantoaxial space, the anterior fascia of the rectus capitis posterior minor muscle and of the inferior oblique muscle, as well as the periosteum of the posterior arch of the atlas, extends to reach the spinal dura mater.

Some of the fibers of the connective tissue bridge from the rectus capitis posterior minor muscle to the dura mater are oriented perpendicularly to the dura mater. The connective tissue bridge to the dura mater may prevent infolding of the dorsal spinal dura mater toward the spinal canal during neck extension;<sup>54, 56</sup> according to von Lüdinghausen,<sup>57</sup> this occurs via the bridge between the rectus capitis posterior minor muscle and the dura mater at the posterior arch of the atlas. By contrast, atrophy of the rectus capitis posterior minor muscle may lead to infolding of the dorsal spinal dura mater toward the spinal cord, possibly accompanied by compression, on head and neck extension.<sup>54, 58</sup> Suboccipital headache might also be explicable in terms of this connection.

### **Continuity with the nuchal ligament**

In the upper cervical region, there is continuity in the midline between the nuchal ligament and the cervical posterior spinal dura mater, and, similarly, continuity has been observed at the first and second cervical vertebral levels between the posterior spinal dura mater and the

nuchal ligament at the midline.<sup>53,56,59,60</sup> According to Mitchell et al.,<sup>59</sup> this continuity is of special significance for understanding the biomechanics of the cervical spine, particularly for rotation movements of the head in sagittal or transverse planes.

### Interspinal ligaments of the dura mater

The interspinal ligaments of the dura mater, which extend from the vertebral canal to the dura mater, are located laterally in the upper cervical vertebrae. It is believed that rotational movements of the cervical vertebrae are transmitted directly to the dural tube via these ligaments.<sup>59</sup>

### Attachment to the flaval ligaments

There is a median fold in the dura mater at the lumbar spine level, sometimes known as the *plica mediana dorsalis durae matris*, that forms an attachment between the dura mater and the flaval ligaments and at the posterior vertebral arch.<sup>61,62</sup> Its structure varies from strands of connective tissue to a complete membrane. Fibers also travel to the dura mater from the flaval ligaments between C1/C2 and C2/C3<sup>53</sup> and at the cervicothoracic junction.<sup>63,64</sup> The posterior cervical epidural ligaments anchor the posterior spinal dura mater at the level of the cervical spine to the flaval ligaments.<sup>65</sup> Loss of the posterior cervical epidural ligaments allows anterior displacement of the posterior dura mater on vertebral flexion, possibly leading to flexion myelopathy.

### Posterior longitudinal ligament

This is a single midline fibrous band attached to the dorsal surfaces of the bodies of the vertebrae and linking the intervertebral disks. Its superficial layer is attached to the spinal dura mater (by structures known as the dorsolateral dural ligaments).<sup>66</sup> These attachments are irregular and are strengthened caudally in the form of the anterior sacrodural ligament. It has been suggested that the superficial layer of the posterior longitudinal ligament might be regarded as a protective membrane for the soft tissues inside the vertebral canal rather than as a conventional ligament.<sup>67</sup> Sinuvertebral nerves course between the spinal dura mater and the posterior longitudinal ligament.<sup>68</sup>

### Anterior sacrodural ligaments

These structures form a strong sagittal septum with lateral fascial branches (Fig. 7.15).<sup>69</sup> These are sometimes referred to as Trolard's ligaments. (See also the Meningovertebral ligaments below.)

### Hofman's ligaments

These ligaments course between the spinal dura mater and the superficial layer of the posterior longitudinal ligament, and are often referred to as *Hofman's ligaments*.<sup>70-73</sup> At the level of L5, these ligaments are very narrow, and they are sometimes absent at the level of S1. Generally, one ligament per segment is found on each side. Cranially, the ligaments become thicker, achieving a width of about 1 centimeter at the level of L2.<sup>74</sup> According to Wiltse et al.,<sup>74</sup> the function of these ligaments in children is to maintain the caudal position of the dura mater during growth. They also hold the dura mater anteriorly against the vertebral column. The posterolateral ligaments and the anterior sacrodural ligaments are also referred to collectively as the *meningovertebral ligaments*.<sup>75</sup>



## CHAPTER 10

# Cranial Bone Mobility and Flexibility

## *Some Observations from the Perspectives of Biomechanics and Developmental Dynamics*

Primary respiration and/or the cranial rhythm are believed to occur locally, in a particular tissue, and also in the body or organism as a whole. Their cyclical expression is called *inhalation* and *exhalation* (not to be confused with the phases of pulmonary breathing, which we refer to as inspiration and expiration). The phenomenon makes its appearance in the form of rhythmic changes in density, tension, or motion. Several rhythms have been described (see also Chapter 1 and page 31):

Cranial rhythmic impulse (CRI)	10 to 14 times/min; 6-12 or 8-12 times/min; 2 to 3 times/min
"Long tide"	6 to 10 times/10 min; once/5min

These rhythms are held to be present in the entire body. Some writers have utilized the terms "flexion" and "extension" to describe these rhythmic motions. However, we do not agree with these descriptions because they reduce the processes that occur in the inhalation and exhalation phases to purely axial motions and do not take full account of the expansive and retractive aspects of the CRI.

Differing views are found in the literature as to the nature of these expressions of motion or tension, and the ontology and interpretation of different frequencies. This chapter presents current views and new hypotheses from the biomechanical point of view and from the perspective of developmental dynamics. While there is some overlap between this chapter and Chapters 2 and 3, here the focus is specifically on the motion of the cranial bones.

The practitioner tries to sense when, in terms of the stage in the cyclical pattern, motion restrictions or abnormal tensions become evident. Knowledge of all the tissues involved as well as the sutural surfaces enables the practitioner to palpate motion restrictions and/or modifications and to assess and treat them in the context of inherent oscillating patterns. The practitioner can also attempt to judge whether the predominant direction of flow of the vital force is inward or outward, although it must be said that such findings are a highly subjective matter.

## FACTORS INFLUENCING THE MOBILITY OF CRANIAL BONES

There are four main factors that determine the normal mobility of the individual cranial bones relative to each other: (1) the flexibility of the individual bones, (2) sutural mobility, (3) mobility of the dura, and (4) extracranial tensions of the fasciae, tendons, and ligaments.

### **The flexibility of the individual bones**

This quality also includes the fluid aspect of the bone. A high proportion of the composition of each bone is fluid, and it is possible to sense the bone to a greater or lesser degree (depending on one's own sensitivity) as a fluid entity; in the case of the cranium, the fluid medium is the cerebrospinal fluid (CSF). If intraosseous distortions occur before ossification of the bone is complete, the capacity of the bone to adapt to the cranial rhythm may be restricted. Trauma to the head, caused by falls, blows, automobile accidents, etc., can reduce the flexibility of individual cranial bones. A single cranial bone can affect the free mobility of others via the sutures and the reciprocal tension membrane.

### **Sutural mobility**

The mobility of the sutures must be adequate to enable the physiological motion of the cranial bones relative to each other.

### **Mobility of the dura**

There should be no adhesions of the dura so as to permit the normal motion of the individual bones. Furthermore, the structures to which the dura is attached, that is, the cranial bones, the foramen magnum, the first and second cervical vertebrae, the sacrum and coccyx, and the intervertebral foramina, should not impede its ability to glide.

### **Extracranial tensions of the fasciae, tendons, and ligaments**

Structural disturbances can extend via the fascial system into the dural system in the form of abnormal tensions. Chronic tension of the muscles or hypertonic ligaments can cause considerable restriction to the mobility of the cranial bones or the sacrum. Examples are tension of the trapezius muscle at the occiput or of the piriformis muscle at the sacrum. All of the muscles, ligaments, and fasciae with direct attachments to the cranial bones or to the sacrococcygeal complex are particularly liable to impair the cranial system as a result of abnormal tensions.

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## **Analogy of the cranium to the vertebral column**

The cranium can be viewed as a modified extension of the vertebral column. The German universal genius Goethe gave a detailed account of the analogy between the skull and the vertebral column in a letter dating from the year 1790. In 1807, Professor Oken of the University of Jena gave a lecture in which he pointed out the resemblance of the skull structure to a vertebra. The osteopath R. Richard wrote, "Since the encephalon is an extension of the spinal cord, it is perfectly natural to think that the cranium cavity enclosing it is in the same way the continuation of the vertebral column."<sup>1</sup> A continuum therefore exists from the cranium to the vertebral column. To begin with, Oken distinguished three cranial vertebrae:

Occiput	An occipital vertebra
Posterior part of the sphenoid and parietal bone	Middle or sphenoparietal vertebra
Anterior part of the sphenoid and frontal bone	Anterior or sphenofrontal vertebra

He later added a fourth, the nasoethmoid vertebra. Careful observation of the cranial structures and their embryonic development led Weaver<sup>2</sup> to the conclusion that the cranium is made up of three vertebrae, altered and distributed in an irregular way. To him, the foramina of the cranial base could be seen in the wider sense as corresponding to the intervertebral foramina and transverse foramina. The vault would then correspond to the costal margin.

### *Open questions related to cranial bone motion*

Over the years, many studies have demonstrated the mobility of the cranial bones, even in adulthood. Little verified knowledge is yet available as to the clinical relevance or the nature of this mobility. The classical descriptions of the mobility are therefore largely based on hypothetical suppositions. Many questions remain unresolved:

1. Where do the inherent motions originate? It is assumed on the one hand that the “motions” of the primary respiratory mechanism (PRM) structures occur simultaneously; on the other hand, the forces responsible for their origin are variously attributed to the nervous system, the fluctuations of the CSF, to arterial or venous pulsations, or rhythmic variations in the pulse pressure (Traube-Hering-Mayer [THM] oscillations), etc., individually or in combination (see also page 48).
2. Is there a center governing the inherent motions? Is that center located in the middle of the cranium, at the straight sinus, the third ventricle, the choroid plexus, or the lamina terminalis? Or are these oscillations that are present in all tissues, transmitted by THM oscillations in the vessels or perhaps entering the body from outside?
3. How or by what medium is this rhythm transmitted to the tissues?
4. To what extent is there a “core link” between the cranium and the sacrum? Are motions transmitted from the cranium to the sacrum (and the reverse) via the spinal dura mater?
5. Is it in fact possible for the rhythm to be transmitted by means of continuities of fasciae and fluids from the structures of the PRM to the rest of the body and out to the extremities?
6. Do the classical osteopathic biomechanical models of the rhythmic mobility and malleability of the cranial bones in fact correspond to reality?
7. How even and symmetrical are these motions in normal situations? Given that the tissues, for example, the intrasutural or intraosseous structures, have differing hardness and elasticity, an even and symmetrical expression of the PRM rhythm seems rather unlikely.
8. Is motion still possible in the sphenobasilar synchondrosis (SBS) of an adult? (Ossification is complete from the thirteenth to seventeenth years of life.)
9. Bearing this in mind, to what extent can the transmission of motion from the jugular process of the occipital bone to the temporal bone, or from the sphenoid to the facial bones, be assumed to occur in an adult?

10. The SBS of a 30-year old will always offer more resistance to any rhythmic expression than that of a 4-year old. So, when considering the motions of the structures, the dimension of time ought also to be considered, along with the three dimensions of space.
11. How helpful are the classical osteopathic biomechanical descriptions of the axes of motion of the individual cranial bones when palpating cranial structures?
12. If—as appears to be the case—there is no interrater reliability in the palpation of these rhythmic phenomena, how should we assess the diagnostic value of this palpation?
13. Does applying the model of primary respiration in clinical practice improve the health of the patient?

The following is an account of relevant classical osteopathic biomechanical models. These are concepts based on the developmental dynamics involved in the motions of the cranial bones during growth, along with additional remarks on further perspectives. *Note:* These are hypothetical observations with a didactic purpose, designed to assist in the palpation of individual osseous elements of the cranium. Their limitations should be borne in mind, and further research is called for.

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## **Biomechanical observations on the mobility and flexibility of the cranial bones (including that of other parts of the body)**

### **INHALATION PHASE**

The inhalation phase is also described as an expansion phase (Figs. 10.1 and 10.2). The body is thought to perform flexion and external rotation: midline structures undergo flexion and bilateral structures perform external rotation. The cranium becomes broader and flatter.

### **EXHALATION PHASE**

The exhalation phase is described as one of contraction (Figs. 10.3 and 10.4). The body is thought to perform a motion of extension and internal rotation: midline structures undergo extension and bilateral structures perform internal rotation. The cranium becomes narrower and higher.

The cranial aspect of the SBS exhibits a slight convexity (Figs. 10.5 and 10.6). In the cranial inhalation phase, this convexity is believed to increase; this adaptation in shape is described as flexion. In the exhalation phase, the convexity is believed to decrease; the SBS is tending toward extension.

#### *Classical description of cranial bone mobility*

*Note:* Another way of looking at this phenomenon is to see it as a general expansion during the inhalation phase and a general retraction during the exhalation phase; that is, during the inhalation phase there is enlargement of the transverse and anteroposterior diameter and rise of the vault and during the exhalation phase there is reduction of the transverse and anteroposterior diameter and flattening of the vault.

At this point it is helpful to list some of the possible visible changes. Head shape can be used to assess the course of treatment, especially in infants.

General outline	Examples of shapes to note are a rhomboid shape in the case of lateral strain, and a banana shape in the case of sidebending-rotation.
Frontal bone	Metopic suture retracted: external rotation (ER) of the frontal bone; metopic suture prominent: internal rotation (IR) of the frontal bone; flattened, sloping forehead: ER of the frontal bone; prominent forehead: IR of the frontal bone; intensified vertical supranasal fold (ophryon): IR of the affected side
Orbits	Focus on the eyeballs themselves as well as the cross diameter of the orbits running from the superior medial aspects to the inferior lateral; in the case of a prominent eyeball, need to exclude the possibility of a space-occupying lesion, etc.; increased diameter and prominent eyeball: flexion/ER of the sphenobasilar synchondrosis (SBS); decreased diameter and retraction of eyeball: extension/IR of the SBS; unilateral, asymmetric change: torsion or sidebending-rotation of the SBS; unilateral increase and prominence of eyeball: greater wing of sphenoid on this side positioned anterior-inferior (ER); unilateral decrease and reduction in size of eyeball: greater wing of sphenoid on this side positioned posterior-superior (IR); external orbital margin turned outward: ER of the zygomatic bone; bilateral: flexion of the SBS; unilateral: torsion or sidebending-rotation of the SBS
Ears	Ear sticking out: ER of the temporal bone; ear lying close: IR of the temporal bone; unilaterally sticking-out or close-lying ears: torsion or sidebending-rotation of the SBS
Nasolabial fold	Deep: ER of the maxilla; absent: IR of the maxilla
Nose	Wide or narrow nostrils: may be a consequence of trauma or disturbance of the maxilla
Palatine bone	Palate low, flat: ER of the maxilla and palatine bone; high palate: IR of the maxilla and palatine bone; unilaterally low or high palate: torsion or sidebending-rotation of the SBS
Maxilla	Incisors displaced posteriorly and separated, while rest of upper teeth slant sideways: ER of the maxilla; incisor teeth displaced anteriorly and closely placed, while rest of teeth slant inward: IR of the maxilla; prominent front teeth: possible intraosseous internal rotation of the premaxilla
Mandible	Retracted: ER of the temporal bones; bulging forward: IR of the temporal bones
Occipital bone	Angled squama of occipital bone: occiput in flexion; flat squama of occipital bone: occiput in extension

## Palpation

At the beginning of the palpatory examination, the first step should always be to adopt an inner attitude of defocusing, that is, you consciously avoid focusing in any way to allow a contact with the tissue and the body that is completely free of prejudice or intent. Then the palpation of the patient's tissues can be carried out as far as possible without any preconceived ideas. The

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“Osteopathic medicine:  
The science of medicine  
The art of caring  
The power of touch”

— M.L. Kuchera, D.O.

## CHAPTER 14

# The Treatment Sequence and Reactions to Treatment

### TREATMENT SEQUENCE

There are no immutable rules as to the sequence of techniques or the structures to be treated. The decision as to which regions should be treated first is part of the osteopath's art, and the practitioner decides or is led to the place where treatment should begin. This calls for contact to be taken up with the tissue in an empathetic and noninvasive way as well as the skillful taking of a history and visual examination.

A key feature of prime importance is the act and attitude of listening with sympathetic understanding to the way the body as a whole is organized and being synchronized with the inherent homeodynamic forces that are at work. It is this that determines the therapeutic interaction, rather than any specific manipulation of a tissue. Therefore, the decision as to which structure to treat first should always consider the entire body: The body and being of the person is a functional unity. Any subdivision of osteopathy into separate categories is simply theoretical and done only for the purposes of instruction.

Different models are used. The aim here is not to describe all the models that are found in osteopathy, and it does not mean that other approaches cannot also be used successfully. A *possible* treatment sequence is given here:

1. The first contact is directed at seeking the health in the patient, which in this case means the health that is always present, however sick the person. For Jealous, one of the most important steps is to establish a neutral state.<sup>1</sup> This comes before any more specific diagnosis or treatment because, without it, the inherent motions in the patient would be no more than an expression of the reaction to external stimuli and demands. According to this view, it is only once this neutral state has been achieved that a relatively

constant rhythmic expression of primary respiration appears. The practitioner should synchronize with the homeodynamic forces in the body as a whole, which we call *primary respiration*.

2. A number of options may follow, for example:

a) *Locate the regions where vitality is good.* Palpation begins by taking up contact with the homeodynamic forces and with those regions and levels in the body where a good vitality and flow of energy can be sensed. Particular attention is paid to these regions, and taking up contact with them by palpation strengthens their presence in the body.

b) *Locate the regions or systems in the body where the homeodynamic forces or primary respiration are combating pathogenic forces (i.e., biokinetic energy), that is, where has treatment already started in the body?* Through the palpatory hand contact, the practitioner is led, without intervening, by primary respiration to the region where it is most active, the site of dynamic interaction of involuntary motion. These homeodynamic forces are credited with targeted activity in cranial osteopathy, and the practitioner must respect that activity and assist it by synchronizing with it. In this region, the practitioner's hands and whole being support the homeodynamic processes by listening to the processes and gently strengthening the inherent motion as necessary during the inhalation phase.

c) *Alternatively, begin the treatment at those regions and levels where the free flow of energy and vitality is hindered, but still strong enough to soften this resistance.* The practitioner's hands should be placed on these regions and synchronized with the homeodynamic forces at work there.

3. Other questions that are important for the therapeutic interaction have to do with the flow of energy in the body: Is it more strongly directed inward or outward? Is the body taking in more energy than it gives out? Is this leading to signs of congestion in the body? Or is the body continually giving out too much energy? Is the body becoming exhausted by the predominance of catabolic processes? The treatment given should take account of the predominant pattern. The therapy applied to an utterly exhausted body is different from that given to a body suffering from a congestion of energy. The practitioner also has to judge whether the patient's body is able to integrate the therapeutic interactions.

4. The next stage in the therapeutic process is to seek the primary dysfunction complex. Treatment can then proceed at the point of strongest or most pronounced motion (or mobility) restriction, change in density, or elasticity or energy, or at the key locations/primary dysfunction complexes. These locations are not necessarily the same as those where the patient's symptoms are occurring. The contrary is usually true: the location of the symptoms often does not coincide with that of most pronounced motion restriction.

a) Barral's general listening test<sup>2</sup> is one that can be used to look for the primary dysfunction (location of the most evident dysfunction). This is followed by a regional examination (e.g., of the viscerocranium) and a local or segmental one (e.g., of the frontozygomatic suture). There are more detailed accounts of the procedure in the osteopathic literature.



b) Another route is to identify the primary dysfunction from among all the dysfunctions found by Chauffour's inhibitory balance testing<sup>3</sup> or other methods of palpatory differential diagnosis.

c) The different areas of dysfunction also need to be differentiated, for example, differentiation in principle into osseous, membranous/ligamentous, fluid, visceral, and electromagnetic. It is also important to detect the emotional components and determine the part they play in the dysfunctional patterns.

d) Is the dysfunction complex characterized by an increase in dysfunction or a reduction in relative autonomy with respect to its surroundings and the body as a whole?

e) The traditional approach in cranial osteopathy has been to pay particular attention in the first instance to compression of the cranial base, the atlanto-occipital joint, and lumbosacral joint. In the case of severe, longstanding compression, it was considered important to perform preliminary techniques (such as the venous sinus technique) and to free certain abnormal tension patterns of the periphery. There are, however, no hard and fast rules about the order in which structures are treated. One of the arts of osteopathy lies in deciding where and how to apply treatment.

The model of the primary dysfunction can be extended to include psychological, social, and spiritual aspects and questions of hygiene, depending on the areas in which the individual practitioner has been trained. The interaction between these aspects and the body tissues reveals the particular therapeutic information. In addition, the model of the primary dysfunction is not universally applicable. Other models of dysfunction patterns and complexes may more accurately describe the reality.

The possible combinations and sequences of dysfunction are endless: viscerosomatic, somatovisceral, viscerovisceral, psychoneuroimmunological, somatosomatic, fascial, articular, fluid, endocrinoautonomic, endocrinovisceral, etc.; they result from the functional and structural interrelationships and the functional unity of the body. These interactions are expressed in different tissue qualities. It is these qualities of the tissue as detected by palpation that determine the order in which structures should be treated. The treatment order that is chosen depends on the practitioner's understanding of the underlying dysfunction patterns. Social, nutritional, and other factors should of course also be considered.

## THE NATURAL END POINT OF A TREATMENT SESSION

The fundamental concern here is a noninvasive attitude. This approach does not try to force the body in a certain direction but rather tries to synchronize with the homeodynamic forces in the body. Jealous<sup>4</sup> has set out the following list of points as the best way of enabling the practitioner to perceive when the end of a treatment session has been reached:

- Establishment of a neutral state; the many advantages of this include avoidance of side effects
- The ability and patience to perceive the "automatic shifting" in the body of the patient as a whole and so allow the natural end point of treatment to come about
- The ability to treat without going to the motion barrier of the tissue
- A consciousness that rests in the present

- Synchronization with the health in the patient, the free inherent motions, and the dynamic stillness in the patient
- The ability to detect at the end of treatment whether the patient is rebalanced
- The ability to detect the appearance of a longitudinal fluctuation with a good, even amplitude and frequency that lasts for at least three cycles (one sign of the end of treatment)

## REACTIONS TO TREATMENT

The therapeutic process continues after the treatment session has finished. In fact, some osteopaths believe that it only really begins at the end of the treatment session. A process of integration takes place after the treatment. Changes that occurred during the treatment are integrated into the body as a whole, the relationship between various parts changes on several levels (e.g., endocrine, vascular, autonomic, fascial, and postural), and altered relationships may find expression in everyday life or may bring about unwinding of further dysfunctional, bound energies. Changes that take place in the period following the treatment are, therefore, very informative for the practitioner, and their interpretation is important for the rest of the treatment and for the prognosis.

### Treatment complications

No methodological studies of complications following cranial treatment exist. There have been isolated reports of the following complications, most of which were transitory and resolved by rest or by the CV-4 technique:<sup>5</sup>

Nausea <sup>6</sup>	Psychological disturbances <sup>6</sup>
Vertigo <sup>7</sup>	Cases of depression
Confusion <sup>7</sup>	Diplopia
Headache	Loss of consciousness
Loss of appetite	Trigeminal symptoms
Sleep disturbances	Brainstem dysfunctions
Diarrhea	Opisthotonus
Vomiting	Tonic-clonic seizures
A case of aggravation of traumatic brain injury	Possible miscarriage of a 12-week pregnancy <sup>7</sup>
Heart palpitations	

A case of pituitary dysfunction was described following treatment by a therapist who was not a qualified member of the profession. This was resolved by further cranial and hormonal treatment. It is also thought that headaches following cranial treatment may be attributable to an uncorrected dysfunction of the atlas or axis.<sup>8</sup> Finally, a number of other side effects have been described, especially those associated with cranial nerve function.<sup>4</sup>

### **Possible causes of treatment complications**

- Contact and intention too forceful, forced, invasive, or unsuitable in some other way
- Manual traction wrongly directed
- Wrong hand positioning by the practitioner
- Nontreatment of associated tension patterns in other regions
- Excessive demands placed on the body's capacity for integration by, for example, failure to respect the natural end point of a treatment session, release of dysfunctions without achieving resonance with the patient's body as a whole, or overtreatment
- Destabilization by removing compensatory areas of function
- Desynchronization of the patient
- Guiding the tissues too forcibly to the motion barrier or performing manipulations in the direction of the motion barrier<sup>4</sup>
- Potency/vitality held fixedly in the midline during therapeutic processes<sup>4</sup>

### **Marked improvement or resolution of symptoms**

A marked improvement or a resolution of the symptoms on treatment of the site where the symptoms were experienced or of the segment to which they belong indicates that, in this case, the primary dysfunction coincides with the site of symptoms.

### **Symptom-free period or reduction of symptoms**

As long as the improvement increases after each subsequent treatment session, this is usually a positive sign. It is all the more a sign that healing is progressing well if it is accompanied by improved general well-being, a clearing away of confusion, and a sense of meaning for the patient.

### **Temporary deterioration**

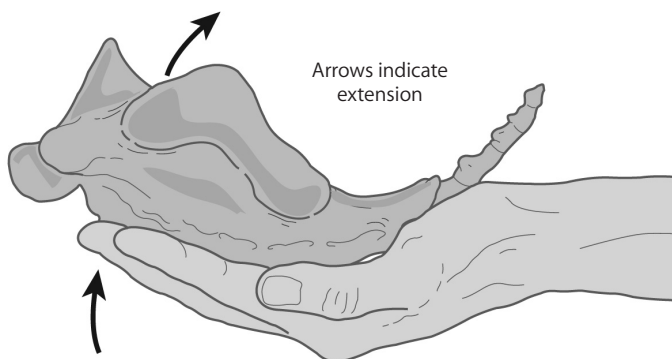
In rare cases, the patient may complain of tiredness, slight tensions in the head, or of a slight, diffuse soreness one to two days after the treatment.<sup>9</sup> As noted above, it is also thought that headaches following cranial treatment may be attributable to an uncorrected dysfunction of the atlas or axis.<sup>8</sup> It is important for the practitioner to warn the patient of the possibility that there might be a slight deterioration and to advise against taking any medication without consulting the practitioner first.

### **Temporary deterioration with no improvement**

A temporary deterioration after the treatment and a return to the original state a few days later usually means that the primary dysfunction complex was not located and released. Deterioration or other symptoms such as headache, dizziness, and nausea can also be caused by contact being too forceful, forced, or invasive, or by contact and intention that are in some other way unsuitable, wrongly directed traction, wrong hand positioning by the practitioner, or failure to treat associated tension patterns in other regions. Manipulation performed in the direction of

## SACRAL STILL POINT INDUCTION

Practitioner	Take up a position beside the supine patient, level with the sacrum.
Hand position	Place the palm of your hand under the patient's sacrum with your fingertips pointing cranially (Fig. 16.3). Place the spinous processes of the sacrum between your middle and ring fingers while supporting your elbow on the treatment table (Fig. 16.4).
Method	Preferably, the still point should be induced in the phase that is characterized by the greater excursion at the palpated structure; for example, where extension motion of the sacrum is more pronounced, induce the still point with the sacrum in the extension phase. Follow the extension motion by going anteriorly with the base of the sacrum and posteriorly with the apex of the sacrum. In the inhalation phase, offer posterior resistance to the flexion motion of the base of the sacrum. Continue as described for still point induction, using the feet as described above.



► **Fig. 16.3**  
Sacral still point induction



► **Fig. 16.4** Hand position on the sacrum

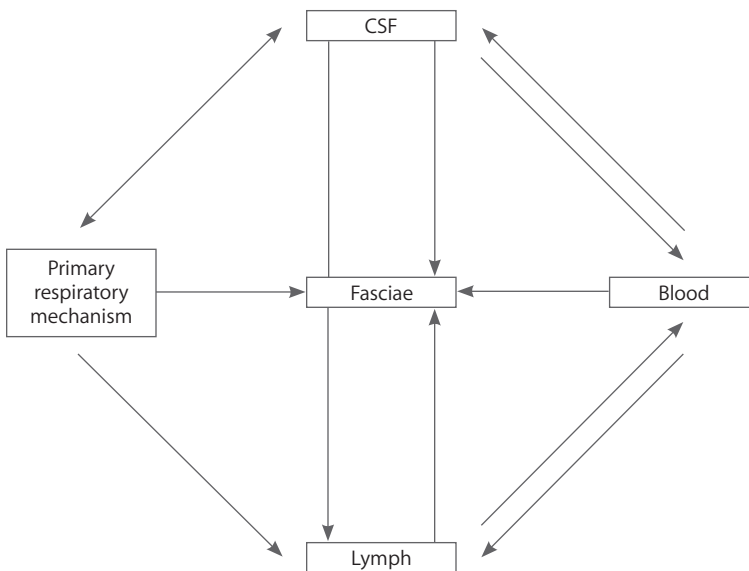
- b) Impairment of the free flow of intercellular fluid and lymph fluid
- c) Impairment of the immune system

This prepares the ground for the potential development of local and generalized dysfunctions and symptoms.

- 8. *Adaptation to mechanical forces.* Collagen, fibrin, and reticulin align themselves with the orientation of the prevailing forces. Increased tissue tension stimulates the arrangement of collagen and fibrin. The fascia alters its elasticity, plasticity, and viscosity as it adapts to the action of external and internal forces.
- 9. *Bioelectrical properties.* The fasciae are sensitive to piezoelectric impulses. Traumas as well as therapeutic impulses also act via the bioelectrical properties of the fascia.

### RELATIONSHIPS BETWEEN FASCIAE AND BODY FLUIDS

A schematic diagram illustrating the relationships between fasciae and body fluids is presented in Fig. 17.1, which is modified from B. Gabarel and M. Roques.<sup>7</sup>



► **Fig. 17.1** Schematic diagram illustrating the relationships between fasciae and body fluids (modified from B. Gabarel and M. Roques)

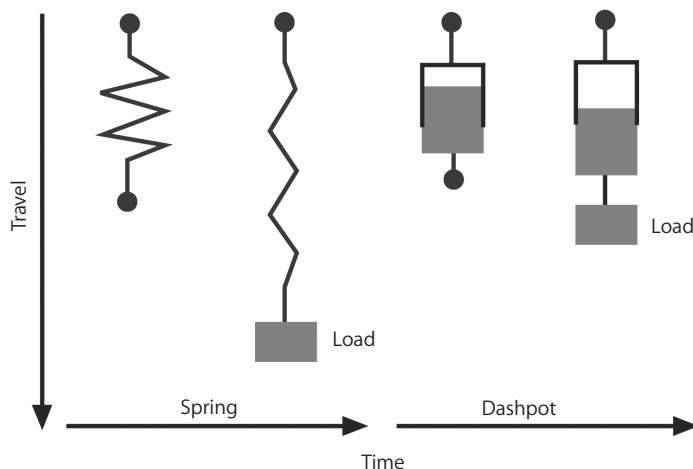
CSF	<p>CSF enters the bloodstream via the choroid plexuses.</p> <p>CSF travels via collagen microtubules to reach the fascial structures as well as the lymphatic system.</p> <p>CSF is in direct contact with the lymph via the dural sheaths.</p>
Lymph	<p>Lymph is transported back from the tissue fluid into the venous bloodstream via the lymphatic vessels.</p>

Blood	<p>A blood filtrate is secreted into the cerebral ventricles via the choroid plexuses.</p> <p>The blood supplies the fasciae with nutrients and oxygen and removes its metabolites.</p> <p>Via the arterioles and capillaries, plasma enters the fascial system, and approximately 10% of this is transported away again in the lymph.</p>
Fasciae	<p>Plasma, lymph, and CSF come into contact with each other in the tissue fluid of the fasciae/connective tissue.</p>

The PRM is believed to influence the drainage of the fascial tissues and cells. In addition, the rhythm of the PRM is thought to be transmitted via the fascial structures to all the organ structures of the body.

## SPRING AND DASHPOT MODEL

The spring and dashpot model developed by Little will be described at this point in order to illustrate the organization of connective tissue structure dysfunctions and their treatment (Fig. 17.2).<sup>8</sup> This theoretical model is based on first-hand experience in fascial techniques gained by osteopaths. It seeks to provide a clearer explanation of how tissues “store” traumatic and dysfunctional influences as well as psychological trauma. The fundamental starting point for this model are the elastic and collagen fiber structures ubiquitously found in tissues. The elastic



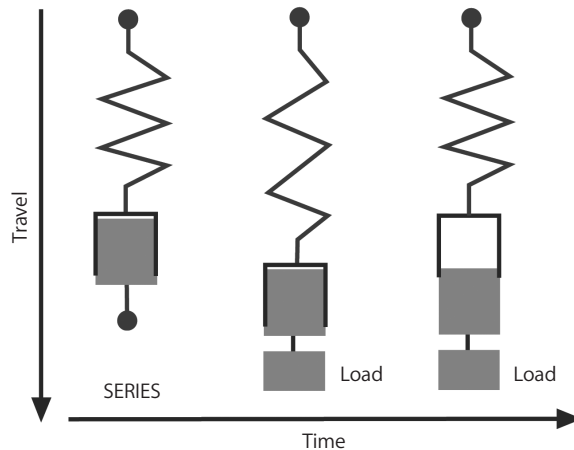
► **Fig. 17.2** Spring and dashpot model (according to Little)

tissue fibers react in accordance with the spring model. The amount of deformation relates directly to the amount of the load applied. By contrast, the collagen fibers behave in accordance with the dashpot model. In this case, deformation is determined by the rate of application of the imposed load.

Connective tissue structures behave like an elastocollagenous complex in which combinations of the spring and dashpot model occur. According to Little, structures such as fascia, ligament, and muscle behave as though the spring and dashpot were in series, whereas bone behaves as though the elements in the model were in parallel.<sup>9</sup>

*Series model*

After the force or load has been imposed for a period of time, the fascial tissues undergo lasting deformation. This even persists long after the load has been removed (Fig. 17.3), which can be explained as follows: When a force or load is applied, the elastic fibers (spring) are stretched initially. After a certain period of force or load application, the viscous dashpot function of the collagen fibers will compensate for the stretch effect, with the result that the elastic fibers (spring) return to their original position. Thus, a permanent change takes place because the elastic strength of the spring, which would have returned the fascial tissue to its original position, is no longer available.

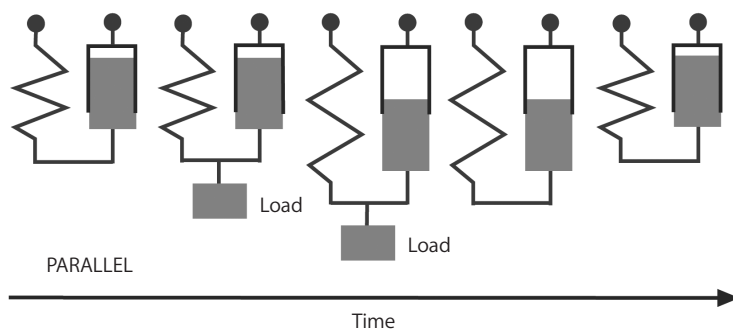


► **Fig. 17.3** Spring and dashpot model: arranged in series (according to Little)

*Parallel model*

When the force or load is removed after a certain period of time, the tissues return to their original state (Fig. 17.4), which can be explained as follows: A certain period of time is required before the dashpot undergoes deformation. Once deformation of the dashpot has finally occurred, the spring will also respond by deforming. Once the entire load has been transferred to the spring, and the force or load is then removed, the spring will return to its original position because of its elastic properties.

According to Gabarel and Roques,<sup>10</sup> deformation has varying effects on fascial structures, depending on whether the original length of the tissue has altered by more than 30%. If fascial tissue deforms by less than 30% of its original length, it behaves as if the spring and dashpot were connected in series, that is, after a load has been imposed for a certain time, the collagen fibers will remain in their altered state. If fascial tissue deforms by more than 30% of its original length and if strong tension is imposed, it behaves as if the spring and dashpot were connected in parallel, that is, because of the short-term exposure to the load, the tissue usually returns to its original position due to the action of the elastic fibers. According to Gabarel and Roques, however, prolonged exposure leads to irritation and inflammation accompanied by physiochemical changes in the fibers and their surrounding ground substance, the consequence of which is a permanent change in both the elastic and the collagen fibers.



► **Fig. 17.4** Spring and dashpot model: arranged in parallel (according to Little)

In the context of therapy, it is important to pay attention to the different properties of the fibers. The practitioner will be able to influence the elastic fibers more rapidly, whereas modification or normalization of collagen fibers is usually more time-consuming. By applying gentle continuous traction in the form of the direct or indirect technique, the practitioner is able to normalize the chemical structure of the collagen fibers and thus to free the cellular “memory” from traumatic influences. This applies equally to intracranial as well as to extracranial fascial structures. According to Scott,<sup>11</sup> the fiber structures confer protection against tensile forces, whereas the ground substance offers resistance against compressive forces. Like the fiber structures, this rather fluid property of connective tissue also merits attention in the context of diagnosis and therapy. In this connection, reference should be made to a hypothesis developed by Gabarel and Roques<sup>12</sup> concerning the interplay between the fluid components of connective tissue and the primary respiratory mechanism.

## INFLUENCE OF THE PRM ON CONNECTIVE TISSUE

Gabarel and Roques<sup>13</sup> suspect that the rhythmic inhalation and exhalation phase results in a phasic increase and reduction, respectively, in tissue permeability and in ground substance viscosity in connective tissue. This means that there is a rhythmic pattern of increased fluid and electrolyte flow into the cells and lymphatic system during the inhalation phase, and of fluid and solutes leaving the cells again during the exhalation phase (see Appendix 2, page 733). In addition, see page 56 in Chapter 3 for a discussion of research results published by Kostopoulos and Keramidas<sup>14</sup> and by Hubbard and Sacks<sup>15</sup> on the reaction to stresses by fascial tissue.

## FASCIAL ORGANIZATION

Fascial organization in the human body primarily displays a *longitudinal* orientation. Within this longitudinally organized fascial system there are *transverse* horizontal fascial planes. While the transverse horizontal fascial planes serve to support the longitudinal system, they may very easily interfere with the subtle mobility of the longitudinal fasciae in the event of disorders such as hypertonus or adhesions.

Even though the transverse fascial planes do not directly form part of the craniosacral system, they should be included in the examination and, where necessary, the treatment of all functional disorders of the craniosacral system. The most important transverse planes are:



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## 1. TECHNIQUE

Practitioner	Take up a position at the head of the patient.
Hand position	Place your left hand on the patient's thorax (Fig. 17.39) and let your right hand span the occipital bone.
Method	<p>With your left hand on the thorax, exert light caudal traction while your cranial hand rotates the patient's head to the left.</p> <p>Permit all tissue movements without reducing the gentle traction.</p> <p>At each tissue release, seek the new limit of motion by further head rotation or sidebending, and then treat the opposite side.</p>



► **Fig. 17.39** Technique for the cervical fasciae

## 2. TECHNIQUE FOR PLATYSMA TENSION RELEASE

Patient	Lay supine with the head in slight extension.
Practitioner	Take up a position at the head of the patient.
Hand position	<p>Place both hands on the upper thoracic region or at the transition between the neck and thorax (Fig. 17.40).</p> <p><i>Test:</i> Instruct the patient to inhale deeply and hold his/her breath. During this time, exert caudal traction and examine for platysmal restrictions.</p>
Method	Instruct the patient to tense the mouth or grimace, then use your hands to exert gentle caudal traction on the upper thorax to fix the platysma caudally.



► **Fig. 17.40** Technique for the platysma release

## 2. TECHNIQUE FOR PLATYSMA TENSION RELEASE (VARIATION)

Practitioner	Take up a position at the head of the patient.
Hand position	Place your hands bilaterally on the patient's cervical region with your fingers directed caudally.
Method	With your hands on the patient, exert gentle pressure posteriorly until the platysma beneath the skin starts to move. With your hands, go with the platysmal movements, as in the technique of unwinding (see page 525).

## 3. F. BUSET'S TECHNIQUE FOR SUPERFICIAL LAMINA TENSION RELEASE

Practitioner	Take up a position at the head of the patient.
Hand position	Take hold of both sternocleidomastoid muscles (Fig. 17.41-1).
Method	Move the sternocleidomastoid muscle together with the superficial lamina laterally and medially, and mobilize in relation to the pretracheal lamina and the hyoid muscles. <sup>30</sup>



► Fig. 17.41-1 Technique for superficial lamina mobilization

#### 4. F. BUSET'S TECHNIQUE FOR MOBILIZING THE ANTERIOR CERVICAL MUSCLES AND THE VISCERAL COMPARTMENT IN RELATION TO THE PREVERTEBRAL LAMINA

Practitioner	Take up a position beside the patient's head.
Hand position	Position your thumbs on one side and your other fingers on the other side of the patient's neck, as far cranially as possible (Fig. 17.41-2). In this way, both your hands will grasp the hyoid muscles together with the visceral compartment. <i>Caution:</i> Avoid compressing the carotid artery.
Method	Use both hands to exert gentle anterior traction, and, in addition, mobilize the anterior cervical muscles and the visceral compartment transversely in relation to the nuchal muscles (prevertebral lamina). Then reposition your hands slightly caudally and treat the rest of the cervical region. Perform this technique for about 30 seconds only.