An alternative to Spenobasilar Synchondrosis (SBS) Motion

This paper is a very brief and simplified summary of the main points contained in *"The mechanics of cranial motion - the sphenobasilar synchondrosis (SBS) revisited"* Andrew Cook - Journal of Bodywork and Movement Therapies, Volume 9, Issue 3, July 2005, Pages 177-188

Introduction

The reason this work came about was in my attempt to find a plausible physiological mechanism for the craniosacral rhythm (CSR). In particular, I was interested in the CSR with a frequency of 5-12 seconds/cycle, also called the Cranial Rhythmic Impulse (CRI). Whilst looking at the results of scientific medical research carried out over the past 20 years, I came across a host of different possibilities and combinations of medically recognised phenomena as possible candidates. In order to identify the most likely (or most likely combination) of these, I felt that I had to understand the mechanics of the CSR much better. I found myself trying to identify the relative inputs of membranous (tensile) as opposed to fluid (pressure) driving forces - with the intention of then applying that understanding analyse the palpatory experiences. This led to looking at the cranium from a biomechanical perspective - using my knowledge as an engineer in addition to 10 years of palpatory experience as a craniosacral therapist.

This "project" looking at the CSR has taken about 4 years so far, and this analysis of SBS motion came out of it by accident, as a rather surprising (but satifying) sideline.

All motions described below are the stage of Flexion, beginning at the peak of Extension. I have used capital letters to distinguish Flexion (as in CSR) from flexion (as in bending).

A simplified argument for the immobility of the SBS

It is possible to feel ("palpate") that the cranium goes through a repeating cycle of Flexion and Extension. Although different cranial schools and practitioners differ on the rate at which this normally occurs (anything from 3 seconds to 100 seconds), the whole phenomenon is called the Craniosacral Rhythm (CSR).

The most direct and simple way to describe the CSR (ignoring the details of individual bony motions) is that the skull becomes more spherical (wider) during Flexion, and more elongated like a rugby ball (narrower) during Extension.

It is usual in Cranial textbooks to say that the motion of the skull during Flexion and Extension is possible because the sutures are mobile - especially the Spenobasilar Synchondrosis (SBS). The "Sutherland lesions" are used to describe a method of assessment and treatment of the cranial bowl, dividing motion into three planes of shear (compression/decompression, vertical lateral) and three axes of rotation (sidebending, rotation, Flexion-Extension).

However, movement along suture lines is only part of the story. Some cranial bones are very thin, and the skull is able to change shape mainly because of this flexibility. Particularly thin bones include the ethmoid, the cribriform plate and superior orbital plates (frontal), and the wings and body of the sphenoid.

In addition, there is one suture which is permanently open, and which is crucial to the ability of the cranium to change shape - this suture is the superior orbital fissure(SOF) - the gap between the lesser and greater wings of the sphenoid.The absolute position of the sutures is important because this defines how and where blood vessels can safely pass along the inner surface of the skull. If you inspect a moulded or disarticulated skull, you will find that the vascular channels avoid areas of particularly high mobility -e.g. the suture line between the temporal squama and the parietals.

In summary so far - cranial motion takes place because

a) sutures act like zones of slightly increased flexibility (they are lines of preferential motion, exactly like pre-folded marks on a cardboard model);

b) cranial bones bend - the thinner they are, and the more they bend; and

c) the SOF provides some “give”.

If only one of those three elements were not present, there would be much less ability for the skull to change shape with the CSR. If only the sutures were available, and there were no flexibility, the skull would be locked solid by an impossibly complex set of intermeshing “gears”. If the sutures were not present, the skull might change shape by “folding” anywhere, and this could lead to motion directly over the top of blood vessels.

If sutures are relegated to this “folded cardboard” model instead of being totally responsible for cranial motion, then there is no need for sutures to remain open and membranous throughout life. They can partially ossify, and - because they are lines of slight thinning - they remain lines of preferential folding. This is important - because it removes the need for any argument between cranial practitioners and medical anatomists.

Another interesting factor to bear in mind is how the skull distributes internal stresses across areas of foramena without these becoming closed. The answer is that stress is distributed through thicker areas of bone. Particularly thick bony ridges are present because they take the stress from adjacent thin bones, or even holes (foramina). The thickest bony ridges in the skull are a) the SBS b) the temporal body, c) the zygomatic body, and d) the meeting point of the tips of the greater wings of the sphenoid with the lateral angle of the frontal. The latter two transmit stress round the eye sockets.

The SBS is the only way in which anterior-posterior (A-P) stress can be transmitted through the cranial base. If one inspects the SBS, then unlike the other mobile sutures, it looks like something designed to be very rigid. It has many small triangular projections which intermesh across a large flat surface. This structure cannot possibly bend or flex. It is very strong and rigid.

The above leads to the conclusion that SBS motion is largely illusory. This illusion is caused by a very familiar phenomenon - “arcing”. The bones of the cranium are mostly thinner than the SBS, therefore they bend (flex) more easily, and this motion rotates around the more stable SBS.

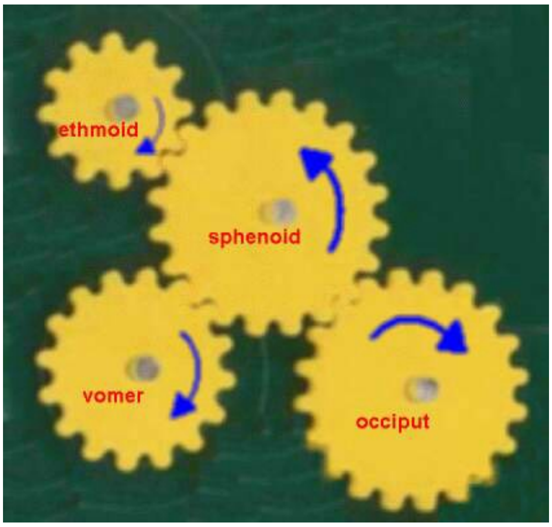
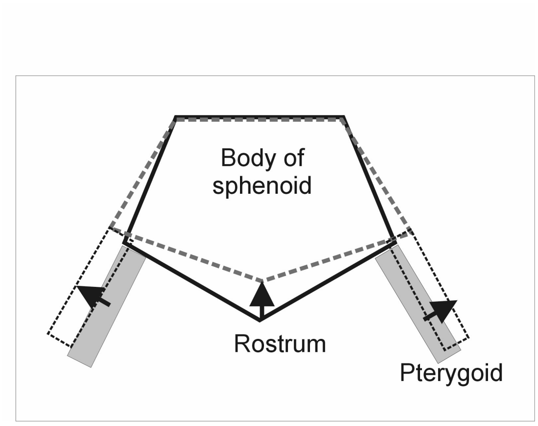


Figure 1 : the traditional description of cranial motion using four intermeshing gears

An alternative to the "four gear train" model

Again, looking at traditional cranial textbooks, the relative motions of the sphenoid, vomer, ethmoid and occiput are described using a "four gear" model (Figure 1). Everyone knows that there are not four gears, but nobody has actually been able to say why these bones move in the way that they do.



Firstly, motion of the superior half of the sphenoid. The sphenoid bends around the SBS. The greater wings bend, and the body of the sphenoid changes shape. As the sphenoid bends, the anterior tips of greater wings flex inwards, and the posterior surfaces flex outwards. This latter motion follows the frontal bone in its lateral motion, which in turn follows the widening of the parietal bones.

Figure 2 : squashing of the body of the sphenoid during Flexion

The posterior surface of the occiput flexes to follow the parietals. This flexing of the occiput can only take place in one line, because the occiput is elsewhere reinforced by bony ridges. So, the posterior half of the occiput folds anteriorly and widens to follow the parietals. At the same time, the anterior part of the occiput (including the foramen magnum and basilium) remains rigid against the body of the sphenoid. And so we have now described the two "gears" of the sphenoid and occiput. During past descriptions of palpated motion, the widening of the occiput has been taken to be posterior motion. In fact, the midlines of the occiput and frontal bone move *towards* each other during Flexion!

As the sphenoid flexes, the body of the sphenoid changes shape - see Figure 2. This shape change is a flattening of the anterior body, which causes the pterygoid wings to move laterally, and so the maxilla also widens.

The anterior body of the sphenoid is thin and can change shape easily. However, the posterior body of the sphenoid is made up by the solid SBS, and so cannot change shape. Therefore, as the body of the sphenoid flattens, its rostrum (inferior surface) changes its angle, resulting in an apparent forwards motion of the Vomer. Similarly, the ethmoid sits on the front of the body of the sphenoid, and so also appears to rotate. See Figure 3

The motion which does still occur at the SBS is compression-decompression, and in fact the SBS is largely a joint/structure which alternates between stages of compression and decompression during the Flexion-Extension cycle. It is in greatest compression during Flexion.

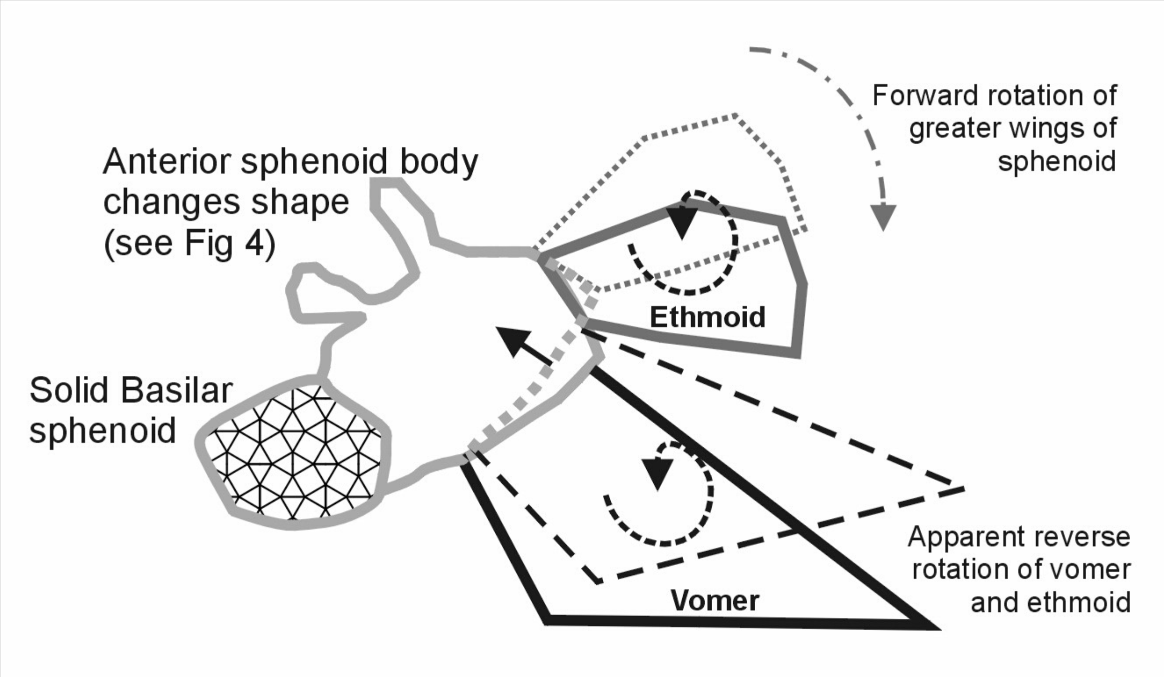


Figure 3 : The big picture. It looks complicated because it is complicated. The total motion is mainly achieved by flexing of thin bones in the sphenoid instead of simple hinging around sutures.

Q. Why hasn't this been noticed before?

Its quite simple, and is very well explained in the new film "What the Bleep..." (see http://www.whatthebleep.com) .

The use of a mechanical description of sutural motion "explained" cranial motion, and so nobody looked any further. This is the danger of explanations,and of words. If I call something by its noun/name, then to some degree I cease to see the thing, but rather have a concept of what it is based on the word. This is the strength and also the failing of a brain which largely makes up "reality" inside itself.

The use of mechanical words also subliminally conveyed the impression of a simple hinging motion at the sutures, by bones which were immobile. "Fulcrum", "Hinging", "Axis of Rotation" all give the subliminal impression of solid inflexible objects.

I really encourage you to NOT take what I say at face value, but rather to get hold of a flexible moulding of a disarticulated skull, and try it out for yourself. You can assume with reasonable accuracy that pieces of plastic of varying thicknesses will bend in the same way that bones will bend provided that the thicknesses of the bones has been well reproduced. Of course, there are no mouldings which reproduce the internal hollow of the sphenoid body. But all the other motions I have described, and more, can be checked out using your hands.

Also, if you actually feel the motion of the cranial bones without "knowing" that the SBS moves, it is quite apparent that there are movements taking place which could not possibly happen if all this was emanating from the SBS. It is necessary to trust your hands more than your knowledge. The step of linking back from hands to knowledge as a "reality check" then gives you a means to test the models you use to determine your treatments.

Q. What are the implications for treatment?

Actually, the "Sutherland Lesions" are still valid methods of addressing a restricted sphenoid. However, only compression-decompresison occurs in reality at the SBS, and the other five motion patterns (vertical shear, lateral shear, sidebending, rotation and Flexion-Extension) occur by deformation of the sphenoid body and wings and their adjacent structures.

When tuning into the SBS without expecting motion, it very quickly becomes clear that the SBS retains a far more "energetic" charge. Keith Farvis described this to me as a "capacitance" - like the two surfaces retain some kind of charge. My personal experience is that there is a ring of "charge" held round the outside surface of the SBS. You might like to explore this further - I would be very interested in your experiences.

The physical motion of the sphenoid is now seen as being far more integrated into the whole motion of its adjacent bones/structures, including the tentorium and falx (the "reciprocal tension membrane"). The picture is not so simple, but actually, if you follow your hands, this flexible bone model will be found to be far closer to palpatory experience. It is still possible to work on individual sutures, or to work with the entire structure.

The flexibility of the sphenoid body is also important, since recent research indicates that most CSF drains from the brain through the cribriform plate, and NOT through the arachnoid villi. A flexible sphenoid body implies lots of motion at the cribriform plate - so improving sphenoid mobility improves CSF drainage (amongst many other things).

There are lots of other implications - undoubtedly some which I haven't identified. I suggest that you read the full original article in JBMT for more detail, *think* about it yourself - and compare the model in your head with the movements your hands are detecting. If the two dont correspond, trust your hands.

Further reading

The concept of Tensegrity has been central to helping me to understand the bony motions and the reciprocal tension membranes in more detail. There are lots oftensegrity resouces on the web. I suggest you start at the beautiful images and sculptures on http://www.kennethsnelson.net/

In particular, note that the solid compression-bearing struts ONLY touch the tension bearing cables at their ends, and each strut is in NO contact with any other strut (think about it). If you're not astonished, its likely that you havent really grasped the implications of this little piece of architectural engineering.

Donald Ingber did grasp its implications - particularly for biological structures. There are papers at http://spaceresearch.nasa.gov/general_info/19jun_cytoskeletons.htmland particularly at the Ingber Laboratory http://web1.tch.harvard.edu/research/ingber/research.html.

It is possible that tensegrity structures provide the (an?) interface between mechanical, chemical and quantum events at all levels of the biological organism, *including* consciousness. See Stuart Hameroff and Roger Penrose's papers on microtubules at http://www.quantumconsciousness.org/