**BUNDLE**

**GEDDES PAPER**

To add to the note on SBS

**FORENSIC NEUROPATHOLOGY THIRD EDITION JAN LEESTMA**

*“The immature skull is equipped to undergo potentially large deformations associated with vaginal childbirth and thus possess flexible cartilaginous bones and hinge like membranous joints between the bones formed by the periosteum. The mechanical properties of the bones and sutures vary greatly over the first few years of life as the infant brain grows and develops. With growth and development the bones of the skull increase in thickness and differentiate into their sandwich construction of the dense inner and outer tables surrounding the diploe.*

***The parietal bone for example increases in thickness from approximately 1-2 mm at birth to approximately 10 mm at maturity. The prominences of the parietal bones (parietal eminences) are the growth centres from which the bone growth emanates radially forming a mechanical structure whose properties vary according to the anatomical loading direction (loading oriented parallel to the radial fibres versus across the radial fibres). This mechanical behaviour is analogous to the behaviour of corrugated card board, a structure that carries bending loads more effectively along the direction of the corrugations than in the direction across the corrugations….”***

*“In contrast the sandwich composite into which the bones typically develop at maturity provides a stiff light weight structure that is capable of carrying external eg impact crush loads effectively in bending and shear. The cortical inner and outer tables of the bones provide bending and shear strength to the structure, whereas the diploe core provides space for intracranial channels as well as a lightweight energy absorbing cancellous bone core, much like engineered sandwich structures as in aircraft wing panels, architectural building skins etc. The skull bones are a structural composite that achieves an optimum balance of weight, stiffness and energy absorbing ability.*

***The curved sandwich structure of the skull acts like an architectural dome receiving an external load at a point along the curvature and distributing that load across the bone. The load is carried by the bone to its margins, where the load is shared and transmitted to the other skull bones via the sutures. In the immature skull the membranes are incapable of supporting a bending load and possess little ability to absorb energy (eg from an impact). As the skull matures the joints between the bony plates of the skull begin to achieve their typical interdigitated conformation with the joint between bones possessing a network of collagenous connective tissue. The interdigitation of the bones provides a large surface area over which the joints form and the connective tissue present in the joint in concert with the increased surface area, forms an effective means of absorbing energy transmitted between bones during impact loading of the skull for example.***

**MORITZ “THE PATHOLOGY OF TRAUMA 2ND ED PHILADELPHIA LEA& FEBIGER 1954 REFERRED TO IN KRANIOTI “FORENSIC INVESTIGATION OF CRANIAL INJURIES DIE TO BLUNT FOCE TRAUMA: CURRENT BEST PRACTICE”**

 *“Moritz notes that if the head is free to move with the impact the fractures tend to be linear or completely depressed whereas if the head is immobilised (ie against a solid surface) heavy blows will result in comminuted fractures with inward displacement”*

**IBRAHIM “PHYSIOLOGICAL AND PATHOLOGICAL RESPONSES TO HEAD ROTATIONS IN TODDLER PIGLETS J NEUROTRAUMA 2010 JUNE 27(6) 1021-1035**

The introduction re myelination and “*Clinical evidence suggests that even within the pediatric population age significantly affects the response of the immature brain to trauma…Overall children less than 4 years of age exhibit worse outcomes compared to older children and adults with head injuries (****KOSKIMIEMI 1995; LUERSSEN 1988)*** *Even among children < 4 years of age we demonstrated differences in head injuries between infants and toddlers after the same event (****IBRAHIM)****. We presented a cohort study of infants and toddlers with accidental head injuries and found that infants sustain significantly more skull fractures after accidents whereas toddlers presented with significantly more neurological signs suggesting that development plays a role in the head injury response of the immature brain”*