Growth of the PetroMastoid V and its application in the cranial deformations without synostosis

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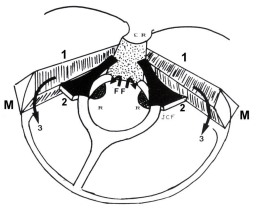
Introduction

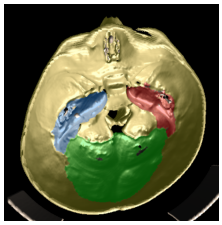
- The **PetroMastoid V** (**PMV**) is a biomechanical unit of the posterior cranial fossa fundamental to absorb the muscular constraints of vertebral origin.
- It also determines the scale of the **skull base**.

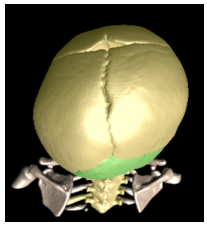


The Petromastoid « V » (**PMV**)
1 petromastoid part (**PP**)of temporal bone
2 clivoforaminal part
3 squamous part of the occipital bone

Ferre. J. C.. C. Chevalier. et l. (1989)

- The growth of the **PMV** and petromastoid part (**PP**) from the fetus to adulthood were modeled and compared to cranial deformations (**plagiocephaly** and **brachycephaly**)
- Hypothesis : the **PMV** and **PP** are deformed in the cranial deformation without synostosis

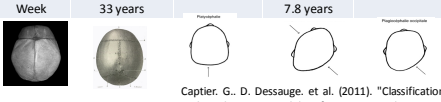




Materials and methods

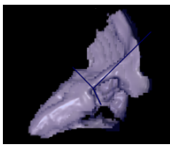
1: CT-Scan Data base

	Fetus (dry bone)	Control (patient without deformation)	Posterior Brachycephaly (PB)	Fronto Occipital Plagiocephaly (FOP)	Occipital Plagiocephaly (OP)
Male(n=)	?	21	8	13	20
Female (n=)	?	11	3	7	8
Total (n=)	7	32	11	20	28
Age	15-27 Gestational Week	1 day to 33 years	6-18 months	4 months to 7.8 years	5-29 months

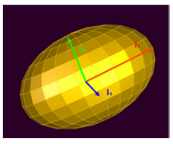


Captier. G.. D. Dessauge. et al. (2011). "Classification and pathogenic models of unintentional postural cranial deformities in infants: plagiocephalies and brachycephalies." J Craniofac Surg

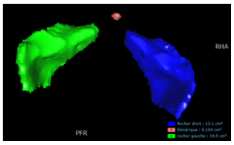
2: Segmentation and modelling



The **PP** of the temporal bone was segmented in two regions of interest (**ROI** left and right).

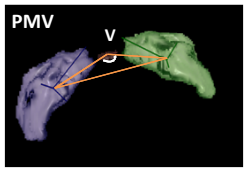


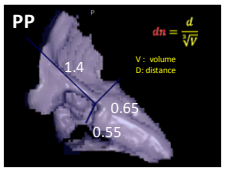
The coordinate of the centroid of the **ROI** and the three inertia axes was calculated (Myrian® Montpellier)



The sella turciqua was used as median reference of the **PMV**

3: Data and parameters studied





Distance inter ROI (normalized)
1. SPL: Sella turcica-PP left
2. SPR: Sella turcica-PP right
3. PLPR: PP left-PP right
4. V: V Angle

Distance intra ROI (normalized)
1. Axe 1
2. Axe 2
3. Axe 3

Volume of the PP (cm3)

In the **FOP** and **OP** the occipital bossing side was compared to the occipital flat side (SPB. SPF. PBPF)

Results: fetal and control group

Fig 1: PMV angle (degre)

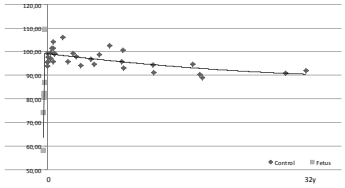


Fig 2: PMV, Distance inter ROI (cm)

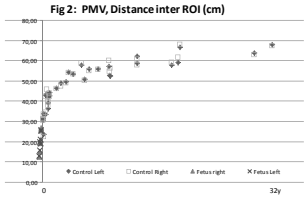


Fig 3: PP Volume (cm3)

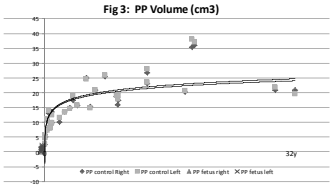
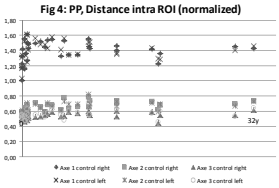


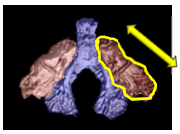
Fig 4: PP, Distance intra ROI (normalized)



- The **PMV** angle, between the two **PP** centroid and the sella turcica centroid, increase slightly in prenatal period stay around 100° from birth to 5 years and decrease slightly to aldulthood (Fig 1)
- The posterior displacement of the **PMV** (Fig 2) and volumic growth of the **PP** (Fig 3) are very fast up to 5 years to reach 90% of the adult growth. It was not highlighted of asymmetry between the two sides in fetal and control group.

Fig 5 : prenatal change of the PP

Fetus 17 gestational week



Fetus 27 gestational week

- The shape of the **PP** changed during prenatal period (Fig 5) then, it is unchanged in the postnatal period (Fig 4). Noted the variability of the axe 1 under 6 month

Results: cranial deformation

PMV		Mean	SD
Control (n=32)	V angle	**98°**	σ=4.5
	SPR/SPL	**1/1**	σ=0.01
	PLPR	**1.5**	σ=0.05
PB (n=11)	**V angle**	**105°***	σ=3.3
	SPB/SPF	**1/1**	σ=0.02
	PBPF	**1.6**	σ=0.03
FOP (n=20)	V angle	**101°**	σ=5
	SPB/SPF	**1.04/0.96**	σ=0.3/0.2
	PBPF	**1.53**	σ=0.06
OP (n=27)	V angle	**100°**	σ=5
	SPB/SPF	**1.03/0.97***	σ=0.01
	PBPF	**1.53**	σ=0.06

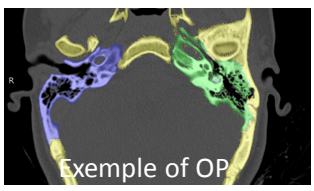
* p<0.01 (ANOVA)

PP		Mean	SD
Control (n=32)	Axe 1	**1,40**	σ=0,15
	Axe 2	**0,65**	σ=0,12
	Axe 3	**0,55**	σ=0,05
PB (n=11)	Axe 1	**1,48**	σ=0,07
	Axe 2	**0,63**	σ=0,06
	Axe 3	**0,55**	σ=0,06
FOP (n=20)	Axe 1	**1,48/1,37§**	σ=0,08/0,09
	Axe 2	**0,63/0,63**	σ=0,04/0,03
	Axe 3	**0,52/0,55**	σ=0,03/0,04
OP (n=27)	Axe 1	**1,50/1,37§**	σ=0,09/0,09
	Axe 2	**0,64/0,63**	σ=0,04/0,03
	Axe 3	**0,51/0,55**	σ=0,03/0,02

§ p=0.19, § p=0.05 (Student paired test)

- **PB**: increase of the angle V
- **FOP** and **OP:** the PMV are asymmetric
  - increase of the PMV on the bossing side
  - reduction of the PMV on the flat side

FOP and **OP** : the axe 1 is reduced on flat side and not affected in bossing side



The modeling of the **PMV** shows that there exists an asymmetric structural deformation of **PP** in the **FOP** and **OP** especially on the flat side.

In the **BP** there exists only an architectural deformation : increase of the V angle