Creating a craniosynostosis protocol

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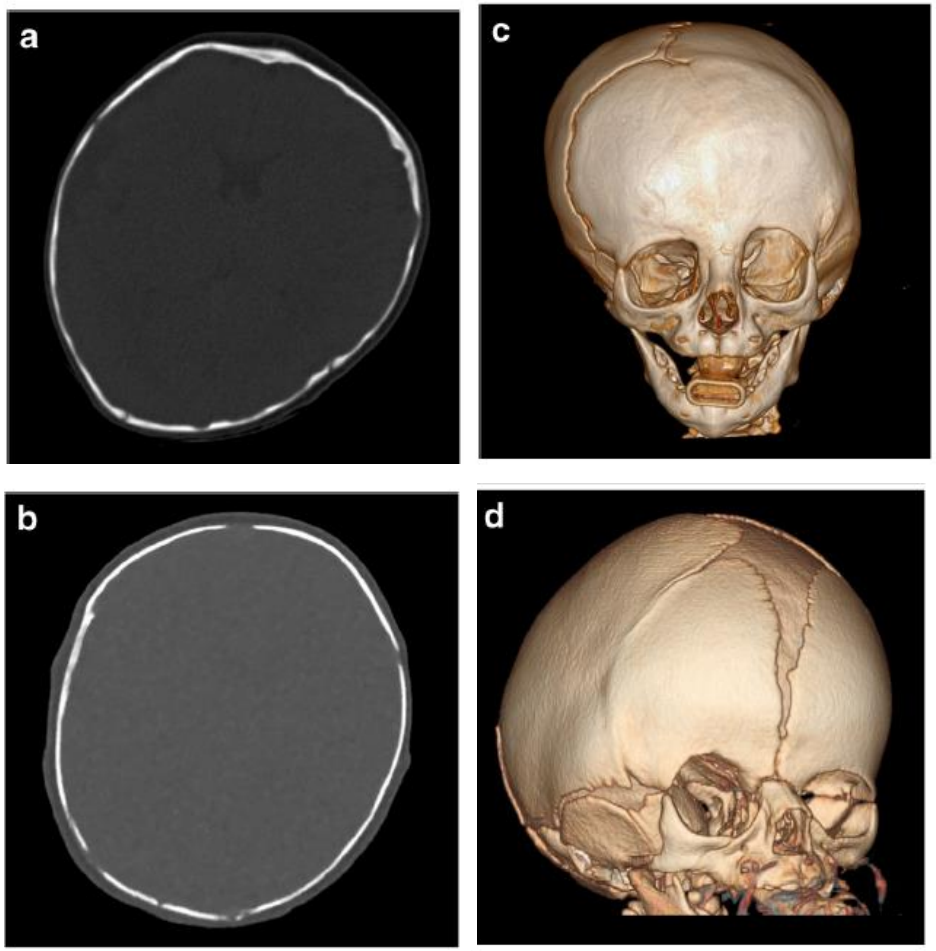
Introduction

- Craniosynostosis is the premature fusion of the skull sutures.
- The resulting asymmetric calvarial (skullcap) growth causes characteristic cranial deformities.
- The clinical outcome varies between minor cosmetic deformity to severe head growth restriction with mental retardation and cranial palsies

Introduction

A & C: axial plane and a 3D image in a patient suffering from right sided coronal craniosynostosis.

B & D show axial plane and a 3D image in a patient suffering from left sided coronal craniosynostosis



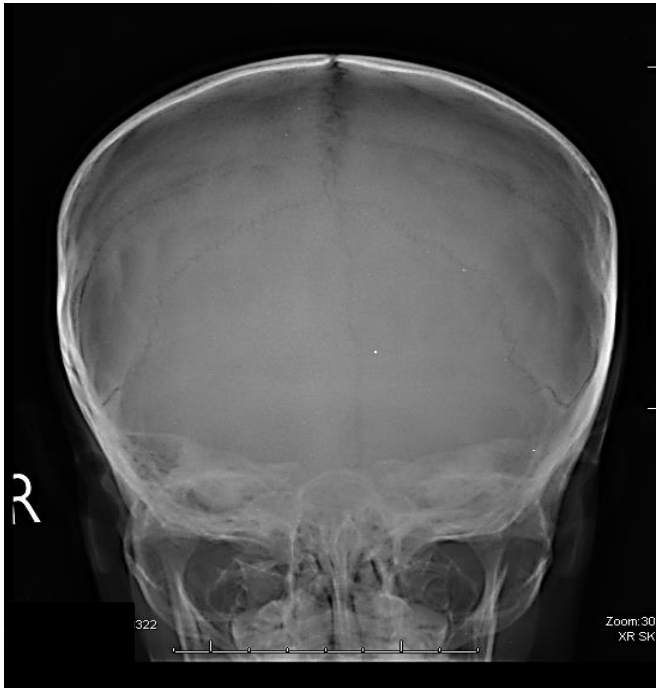
Introduction

- The overall goal is the early detection and characterisation to enable appropriate treatment.

- Delayed diagnosis and treatment may lead to:
  -deformity which may be difficult to correct
  -potentially irreversible neurological issues

- Specific imaging goals include detailed characterization of the number of sutures, extent of suture involvement, and complexity of 3D skullcap deformity.

CR-Xray Craniosynostosis protocol at RSCH



LAT and AP skull CR x-ray

Effective dose approximately **0.03mSv**

GE VCT XT CT craniosynostosis protocol

Vazquez Castelo et al (2012)

100 patients
3 dose level groups
DLP range 40-281 mGy.cm

Effective dose **0.40-2.6 mSv**

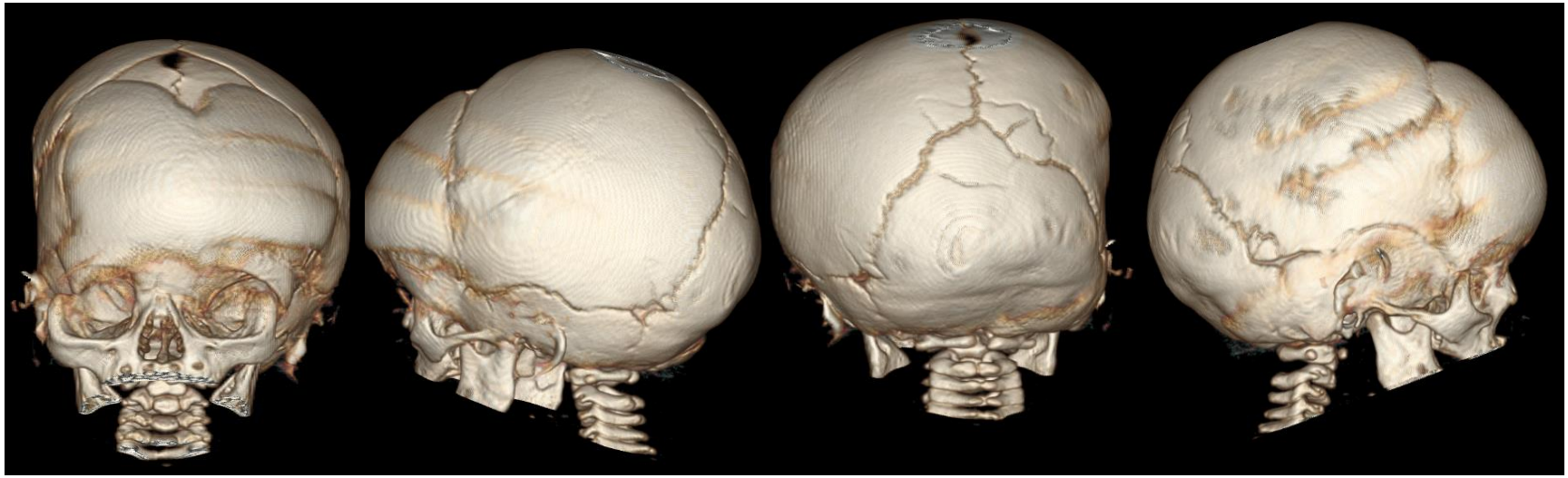
Dose conversion coefficient of 0.011mSv/mGy.cm

ICRP publication 102. Managing patient dose in multi-detector computed tomography. Chapter and Apendix A Annals of the ICRP . 2007; 37(1): 59-79

GE VCT XT CT craniosynostosis protocol

Technical Parameters	Protocol Head Group 1	Protocol Craniosynostosis Group 2	Group 3
Tube Voltage (kVp)	80/100/120	80/100	80
mA range	150-250	50-180	50-150
Noise Index	6,5	7,28	>7,28-23,22 ($\bar{X}$=18,6)
Length of study (cm)	12,7 ± 1,3	12,3 ± 1,6	12,6 ± 0,9
Number of images	204	197	202
FOV (cm)	16	16	16
Total collimation width (mm)	40	40	40
Rotation time (s)	0,4	0,4	0,4
Pitch	0,984	0,984	0,984
Table feed per rotation	39,37	39,37	39,37
Table speed (mm)	98,4	98,4	98,4
Acquisition width (mm)	1,25	1,25	1,25
Interval (mm)	0,625	0,625	0,625
Reconstruction algorithm	Soft tissue & bone	Soft tissue & bone	Soft tissue & bone

CT cranisynostosis protocol at RSCH



Low dose 3D reconstructed CT head scan 69.26 mGy.cm

Effective dose approximately **0.42mSv or 1.87mSv???**

CT cranisynostosis protocol at RSCH

The total lifetime cancer risks are as follows:

-CR x-ray (0.03mSv) = 1 in 200,000

-CT (0.42mSv) = Kursheed et al (2002) 1 in 47,000

-CT (1.87mSv) Chappel et al, (2002) = 1 in 10,000.

-Natural childhood cancer risk = 1 in 500 (Stiller, 2007)

Discussions

- Given the effective dose using a CT scan is approximately 10-60 times greater than CR X-ray and that patients may require sedation should the use of CT be justified for craniosynostosis?
- Do other centres use CT for craniosynostosis imaging and if so how was this justified?
- What do other centres use to calculate effective dose/risk for paediatric CT imaging?

Discussions

Khursheed A, Hillier MC, Shrimpton PC and Wall BF. Influence of patient age on normalized effective doses calculated for CT examinations. Br J Radiol 2002; 75:819-830

Or

Chapple.C.L., Willis.S., Frame.J (2002) Effective dose in paediatric computed tomography Phys. Med. Biol. 47 (2002) 107–115

Or

ICRP publication 102. Managing patient dose in multi-detector computed tomography. Chapter and Apendix A Annals of the ICRP . 2007; 37(1): 59-79

Which one is correct ??????????????

References

J. L. Vazquez Castelo, M. A. Pombar, J. M. Pumar, V. M. Del- Campo, J. Vieito (2012) Optimized low-dose MDCT protocol for children with cranial malformation. European Society of Radiology

Chapple.C.L., Willis.S., Frame.J (2002) Effective dose in paediatric computed tomography Phys. Med. Biol. 47 107–115

Khursheed. A., Hillier. M. C., Shrimpton. P. C., and Wall. B.F. (2002) Influence of patient age on normalized effective doses calculated for CT examinations The British Journal of Radiology, 75, pp.819–830.

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