

Infantile bruising to the head in deliberate upper airway obstruction: using experimental modelling to identify common bruising patterns

de Gracia Hahn, D¹; Johnson, G²; Green, F³; Johnson, C.⁴

¹Homerton University Hospital NHS Trust, London UK; ²North Bristol NHS Trust, Bristol UK

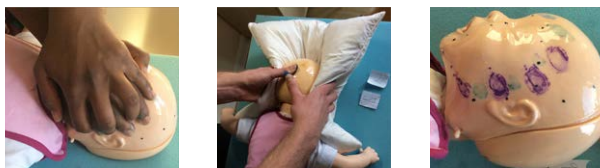
³Royal Free Hospital NHS Trust, London UK; ⁴Forensic Pathology Unit, Royal Liverpool University Hospital, Liverpool UK

Introduction

- Distinguishing between accidental and non-accidental injury at the paediatric autopsy poses several difficulties for the pathologist.
- Deliberate upper airway obstruction is a well recognised pattern of abuse¹, however the significance and distribution of bruising to the head it might create has not been extensively studied and is poorly described.
- In this project, we aimed to characterise any bruising patterns that more strongly suggest intentional upper airway obstruction.

Method

- We recruited 31 volunteers and asked them to undertake four trials of imposed airway obstruction on an infant resuscitation dummy and four equivalent trials on a child resuscitation dummy.
- The four trials were as follows:
 1. Use the pillow to obstruct the external airways with the infant dummy face-up.
 2. Force the dummy face-down into a pillow.
 3. Use one or both hands to obstruct the external airways with the dummy face up.
 4. Use one or both hands and the cloth provided to obstruct the external airways with the dummy face up.
- Chalk was applied to their fingertips and thumbs. Digital heat maps were created showing the patterns of fingerprints and therefore the location of potential bruise marks.

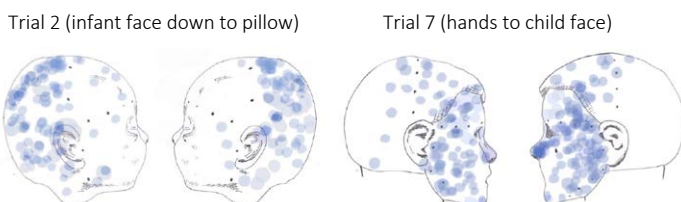


Examples of different techniques used and chalk marks created

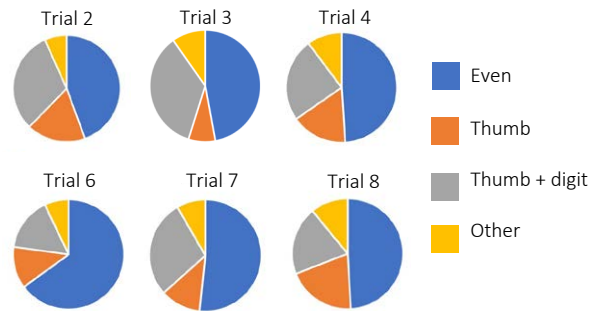
- Given that chalk marks allow visualisation of the location of the fingertips but does not distinguish between how much force is being applied, we carried out a questionnaire to gain an understanding of force distribution, in the participant's subjective view.
- Answers were compared using paired t-tests to identify any statistically significant differences (p value < 0.05) between trials.

Results

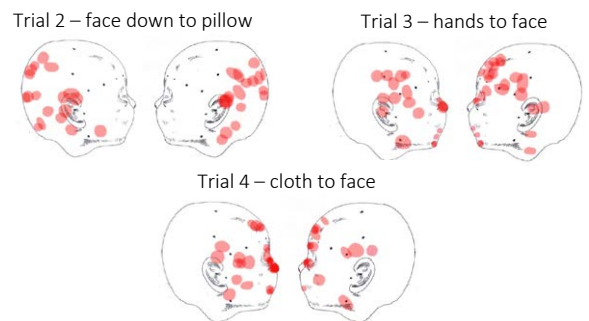
- Digital heat maps demonstrated a wide range of possible locations for fingertip bruising:



- Participants' impression of force distribution across the fingers:



- In many cases participants felt they were not applying force evenly across the digits, meaning not all fingerprints are equally likely to create a bruise.
- The single digit most mentioned through which they were applying the most force was the thumb. Specific thumb maps were created to identify possible locations of single bruises:



Thumb heat maps for the infant dummy in trials 2, 3 and 4

- Statistical analysis of the questionnaire revealed:
 - Participants felt they were using less force on the infant dummy than the child dummy.
 - Participants felt they were using less force when using adjuncts such as a pillow or cloth.

Conclusion

- Bruising anywhere on the head could be associated with deliberate upper airway obstruction.
- Force is not applied evenly across the fingers, and even a single bruise could be consistent with airway obstruction.
- If a single bruise is created, this is most likely to represent the thumb.
- In cases involving infants and the use of adjuncts participants felt they were using less force and therefore there is less likely to be visible bruising. It is important to examine for more subtle signs of asphyxiation such as petechial haemorrhages² and mucosal damage or focal bruising inside the lips. If these are found this should prompt crime scene investigators to consider the possible use of adjuncts.

References

¹Samuels MP, McCloughlin W. Fourteen cases of imposed upper airway obstruction. Arch Dis Child. 1992 Feb; 67(2): 162-170.
²Saukko P, Knight P. Knight's Forensic Pathology. 4th Ed. CRC Press; c2016. Chapter 14, The classical signs of 'asphyxia': p353-68.