HALO FIXATION IN CHILDREN:

Anatomical Considerations and Thickness at the Pin Insertion Site

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Introduction / Aim

The HALO skeletal fixation provides immobilization that stabilizes the cervical spine, and can correct with traction spinal deformities and traumas. Sometimes the pin penetrates bone of the skull and enters the intracranial space, resulting in potential complications such as brain injury, infection, hematoma, and loss of cerebrospinal fluid. There is lack of relevant literature concerning pin insertion considerations in children.

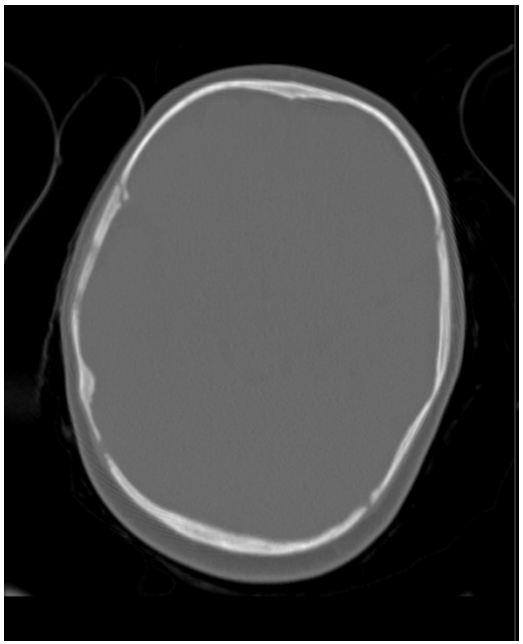
The aim of this study is to evaluate the skull thickness of the children to use the halo fixation safely.

Materials and Methods

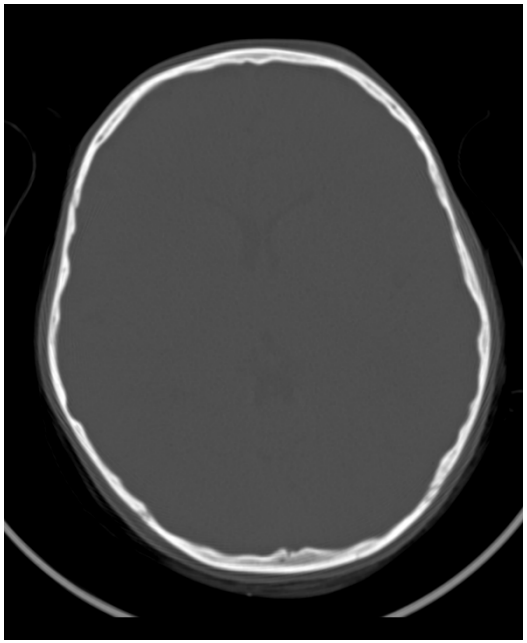
Subject

15 cases / age from 1 to 16 years old (y/o) ,
15 babies (0 y/o < 6 months old) and 15 babies (6 months old < 0.5 y/o < 1 y/o)
(Total ; 270 children (male139, female 131))

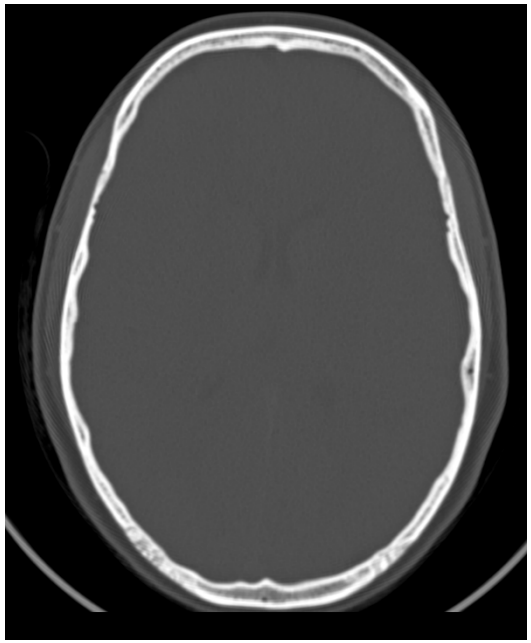
All cases were attended in the emergency unit by accident in Barcelona, Spain and their head **Computed Tomography scans (CT scan)** were performed (**Exclusion criteria**: Fractures, concomitant head or bone diseases)



0 y/o (4 months old)



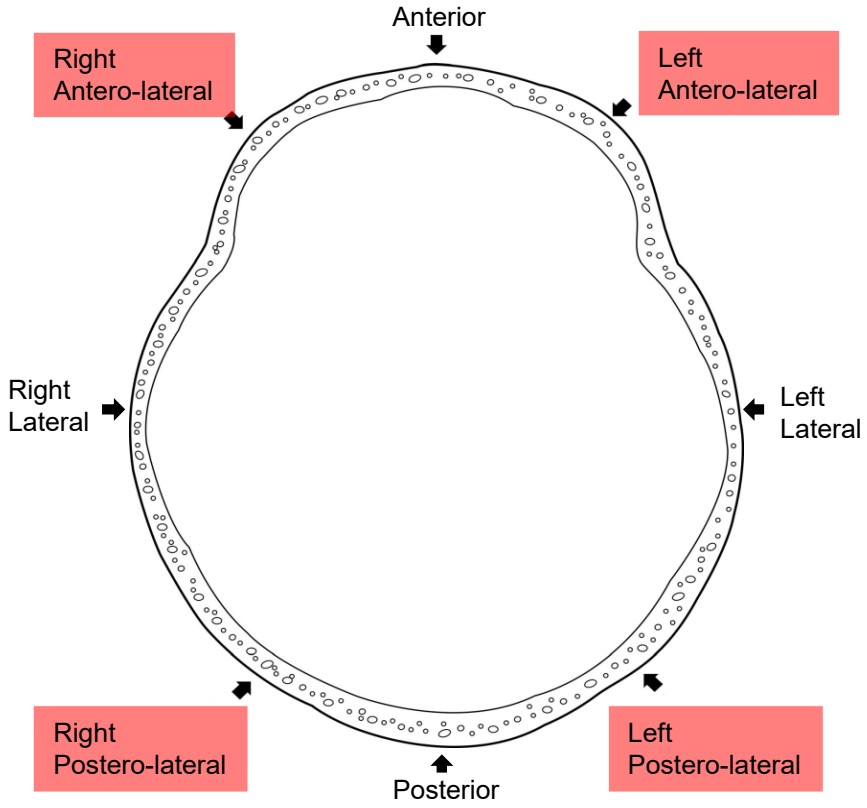
5 y/o

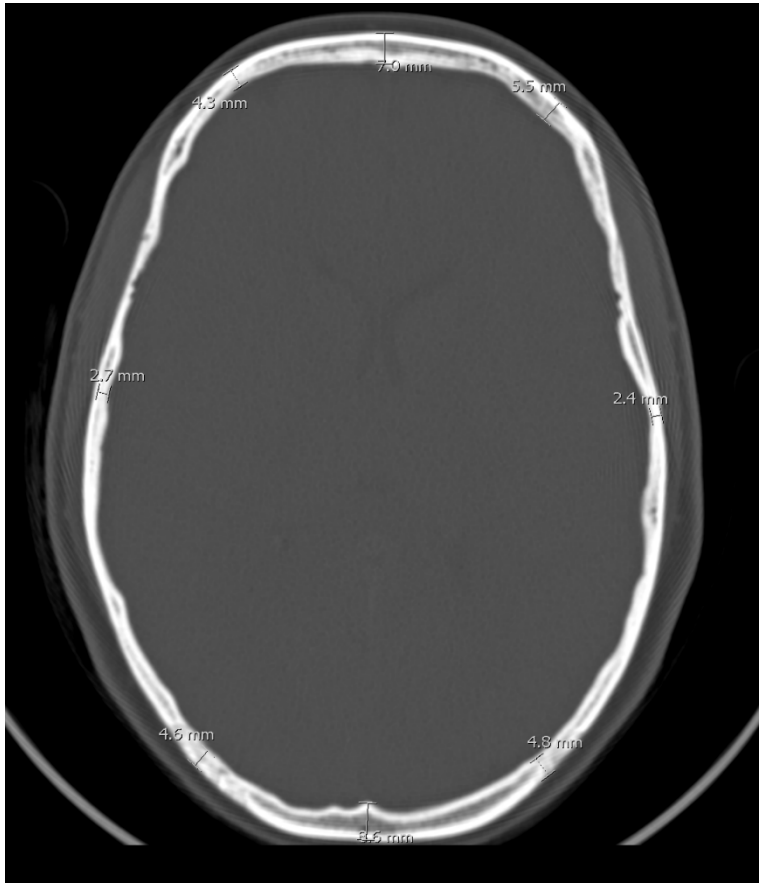


14 y/o

The thickness of the skull at the pin insertion sites and some reference points of each case were measured on axial plane of CT scan

(Software; IMPAX Client)





Pin insertion site

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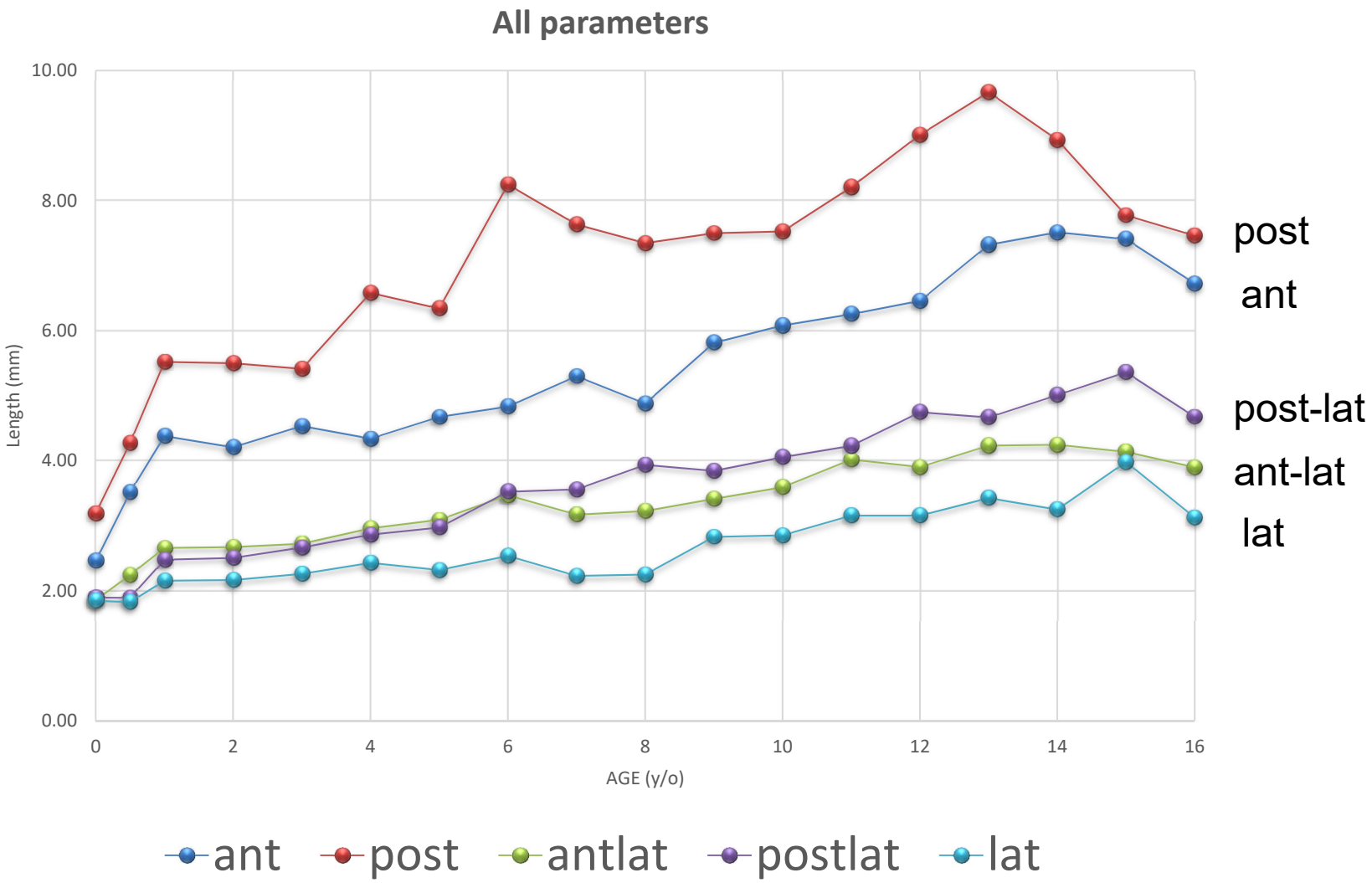
Results



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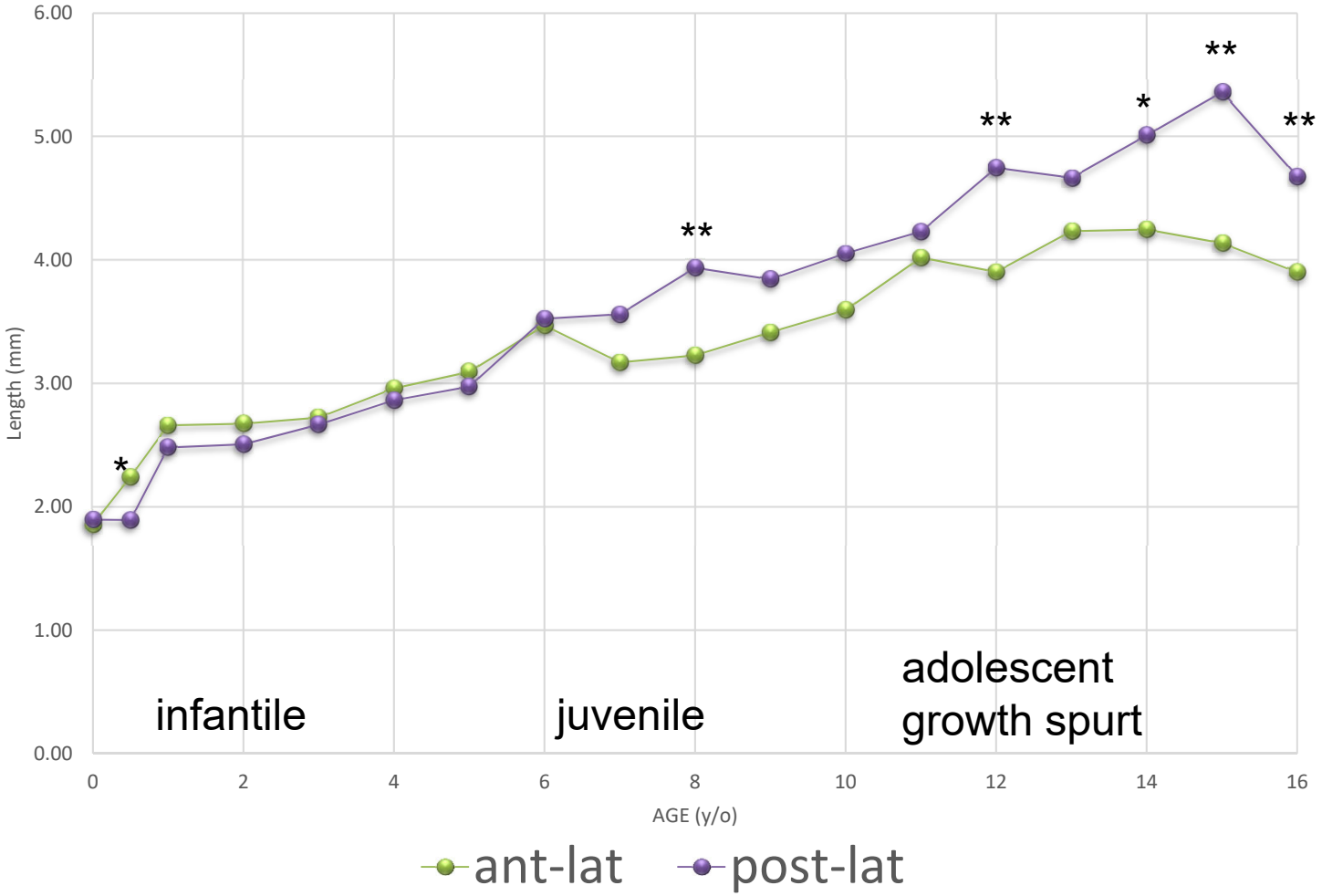
Pin insertion site



* p<0.05 ** p<0.01

post-lat

ant-lat

Pearson correlation
Antero-lateral
R=0.742 (p<0.001)

Postero-lateral
R=0.836 (p<0.001)

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Discussion

Halo fixation

Perry J, Nickel VL. Total cervical-spine fusion for neck paralysis. *J Bone Joint Surg Am.* 1959;41:37-60.

What complications are there associated with Halo fixation?

pin loosening
pin infections
pin discomfort
pin site bleeding
pressure sores
nerve injury
dysphagia
severe scars

dural puncture
cranial osteomyelitis
cerebral abscess formation
pin penetrating into the skull
halo dislodgement
loss of fracture alignment or reduction

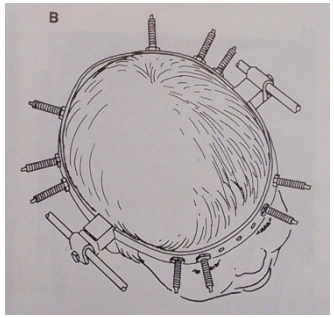
to avoid complications

meticulous pin-site care and frequent follow-up

How old can we use the Halo fixation for children minimally?

Halo Application in the Infant

Mubarak SJ. et al, J. Pediatr Orthop 1989



-3 children (**7** - 24 **months old**) were applied Halo fixation.
-**Multiple pins** (10 pins)
-Significantly **less torque**
(finger tightness in 7 months infant with bone defect, 2 in-lb in other infant)

Complications and Problems in Halo Treatment of Toddlers

Limited Ambulation is Recommended

Caird MS. et al, J. Pediatr Orthop 2006

-13 children (16 - 43 months old) were applied to Halo fixation.
-**Custom or modified ring and vest** are used.
-**Complications rate were similar to older children**.
(6 pin infections, 3 falls and 1 respiratory difficulty)
-There is no skull deformity after using Halo fixation.
-Toddlers may be more prone to fall than older children,
so **limited ambulation is recommended**.

Analysis of halo-orthoses application in children less than three years old

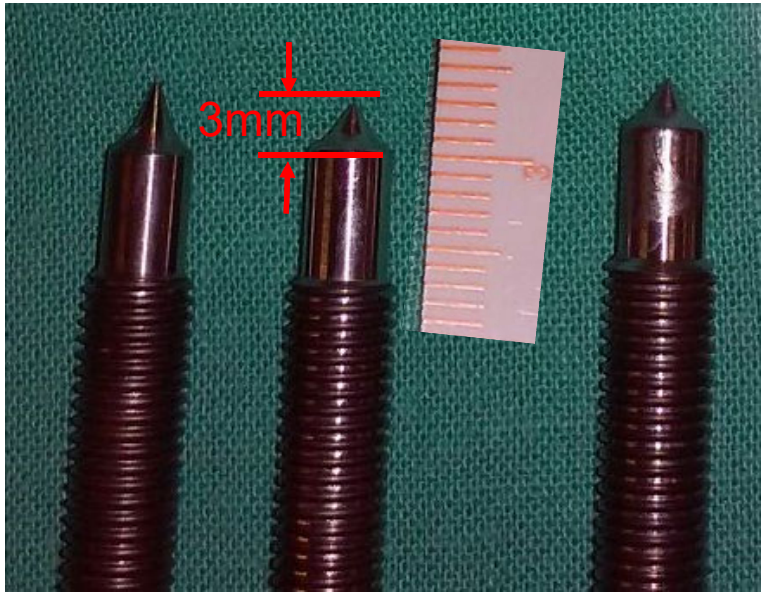
Arkader A. et al, J. Child Orthop 2007

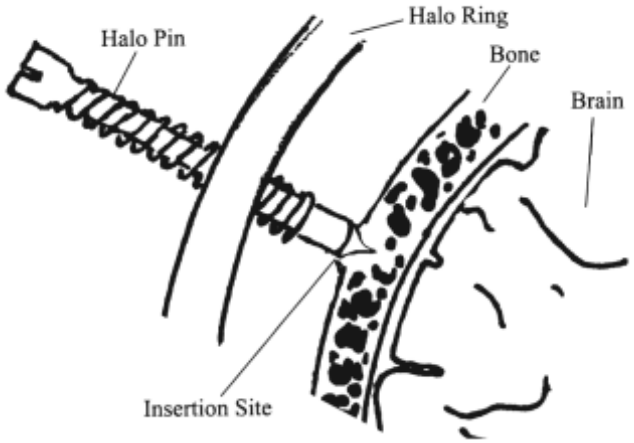
-10 children (10 - 34 months old) were applied Halo fixation. (F/U 5Y2M; 1-12 years)
-Halo-related complications were only 1 pin infections and 1 pin loosening.

What differences are there between adult and children?

	ADULT	CHILDREN
Number of pin	**4** pins	**6-12** pins
Torque of tightening the pin	**6-8** in-lb (0.68-0.96 N-m)	**1-5** in-lb (0.11-0.56 N-m)
Complication rate	**36%** (Gonfin et. al. 1986 JBJS)	**68%** (Dormans et. al. 1995 JBJS) **53%** (Limpaphayom et.al. 2009 Spine)

In this study, some cases less than 3 y/o had the thickness only less than 2mm.
The tapered tip of the pin is usually more than 2mm, thus care must be taken when used.
CT scans are recommended before applying to the patients less than 3 y/o to know the thickness at the pin insertion site.





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Conclusion

Halo fixation is relatively safe and reliable device for cervical immobilization in children as same as adult.

Care must be taken when Halo fixation is applied to the children, especially less than three years old. CT scan is helpful in pin placement. Special pins had better be used according to the skull thickness at each age, in order to avoid complications.

Thanks !
Gracias !

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