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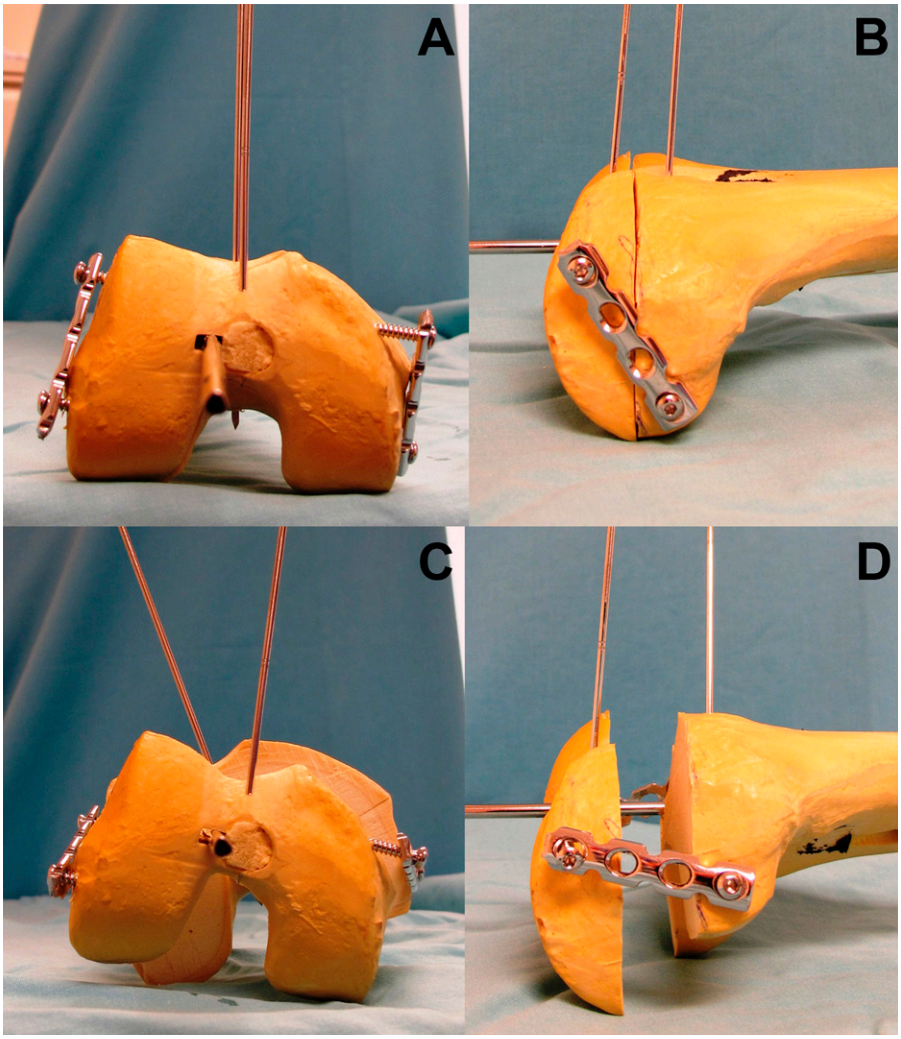

Fig. E-1

Figs. E-1A through E-1D Bone model. **Figs. E-1A and E-1B** Initial position. **Figs. E-1C and E-1D** Position at the end of correction, showing the rotational change.

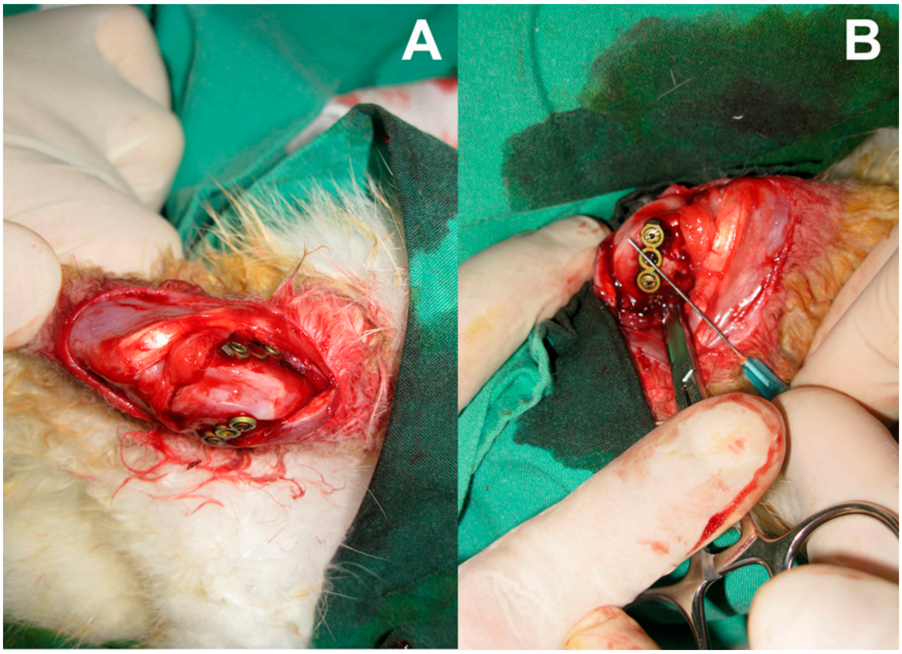

Fig. E-2

Figs. E-2A and E-2B Intraoperative photographs. **Fig. E-2A** Anterior view at the completion of the procedure. Two plates have been inserted across the physis, in an oblique fashion relative to the physis and opposite to each other. **Fig. E-2B** Lateral view of the medial aspect of the knee. The needle marks the line of the physis. A plate is positioned in an oblique fashion relative to the physis.

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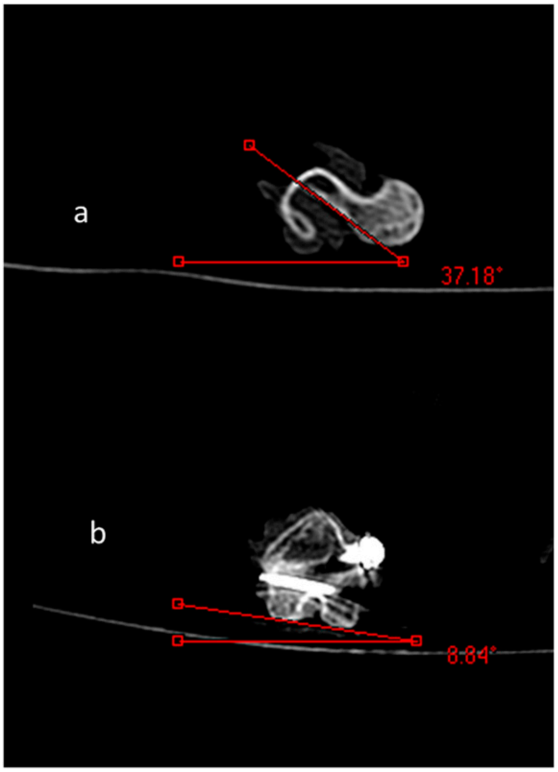

Fig. E-3

Rotational profile measurement. On transverse-plane CT images, two measurements were made on the extracted femora: the angle between the posterior cervical line of the proximal aspect of the femur relative to a horizontal line (**Fig. E-3A**) and the angle between the posterior aspect of the femoral neck and a horizontal line (**Fig. E-3B**). The difference between the angles denotes the angle between the femoral neck and the distal femoral condyles.

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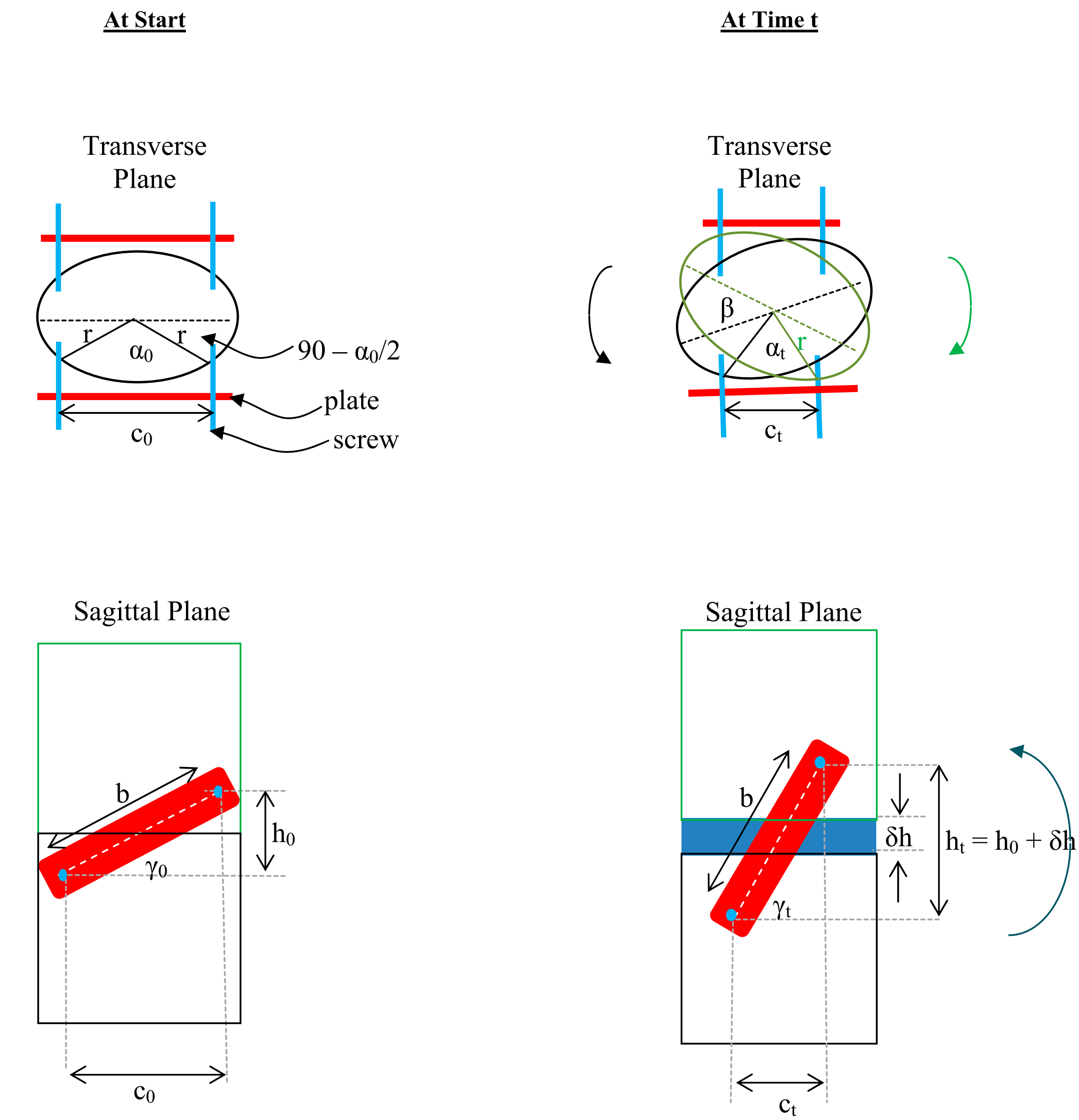
The Mathematical Model



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Legend

α: the angle between the radii (r) connecting the screws and the center of rotation
β: the induced rotation angle
γ: the sagittal plane angle between the plate and the physis
b: the distance between the two screws on the plate
c: the projection of the distance between the two screws along the physis
h: the projection of the distance between the two screws perpendicular to the physis
δh: the difference in h (linear growth)
Subscripts $_0$ and $_t$ denote, respectively, the variable "At Start" and "At Time t"

Relationships in the Model

1. α = the angle between the radii connecting the screws to the center of rotation
2. β = the induced rotation angle at time t
3. $\beta_t = \alpha_0 - \alpha_t$ [$= 180 - 2(90 - \alpha/2) - \alpha_t$; see top view]
4. $\sin(\alpha/2) = (b/2)/r = b/(2r)$ [see top view]
5. $b^2 = c^2 - h^2$ [see side view]
6. $\Rightarrow \sin(\alpha/2) = (c^2 - h^2)^{1/2}/(2r)$
7. $\Rightarrow \alpha = 2 \arcsin[(c^2 - h^2)^{1/2}/(2r)]$
8. $\Rightarrow d\alpha/dh = 2[1 - (c^2 - h^2)/(4r^2)][(1/2)\ (c^2 - h^2)^{-1/2}(-2h)/(2r)] = -[h/(br)] \cos^2(\alpha/2)$
9. $\Rightarrow d\alpha/dh < 0$
10. $\Rightarrow d\beta/dh = -d\alpha/dh > 0$

Conclusion #1: The Induced Rotation Angle Increases with Bone Growth

11. $b = c \cos(\gamma)$ [see side view]
12. $\Rightarrow \sin(\alpha/2) = c \cos(\gamma)/(2r)$
13. $\Rightarrow \alpha = 2 \arcsin[c \cos(\gamma)/(2r)]$
14. $\Rightarrow d\alpha/dc = 2[1 - (c/(2r))^2 \cos^2(\gamma)]^{-1/2} \cos(\gamma)/(2r)$
15. and: $d\alpha/d\gamma = 2[1 - (c/(2r))^2 \cos^2(\gamma)]^{-1/2} (c/2r) [-\sin(\gamma)]$
16. $0 < \gamma < 90°$
17. $\Rightarrow d\alpha/dc > 0$
18. and: $d\alpha/d\gamma < 0$

Conclusion #2: The Longer the Plate, and the More Parallel the Plates Are to the Growth Plate Initially, the Higher the Final Induced Rotation Angle

19. as above [2]: $\beta_t = \alpha_0 - \alpha_t$
20. and [3]: $\sin(\alpha_t/2) = b_t/(2r)$
21. thus, as $b_t \rightarrow 0$ (i.e., as the plate approaches the vertical, due to growth):
22. $\alpha_t \rightarrow 0$
23. and: $\beta_t \rightarrow \alpha_0$

Conclusion #3: If Growth Continues Until the Plates are Parallel, the Final Induced Rotation Angle Will Be the Initial Angle [α_0] Between the Radii Connecting the Two Screws and the Center of Rotation