A Simplified Guide Ruler for Rotational Corrective Osteotomy

Presented by

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BMC Musculoskeletal Disorders

A simplified guide ruler from numeric table method in doing rotational osteotomy

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# Rotational Corrective Osteotomy

- Used for treating rotational mal-alignment of bones.
- Femur: most common
- Tibia
- Humerus
  - Proximal: alternative to shoulder instability
  - Distal

Previous Methods

- Kirschner wires method

- Place two Kirschner wires.

- Correction angle is between the wires.

- Do the osteotomy.

- Rotate the two fragments until the two Kirschner wires are parallel.

- Fix the osteotomy.

- Lasserre G., Saint-Supery J.. *Ann Chir Infant*. 1966;7:165–170.
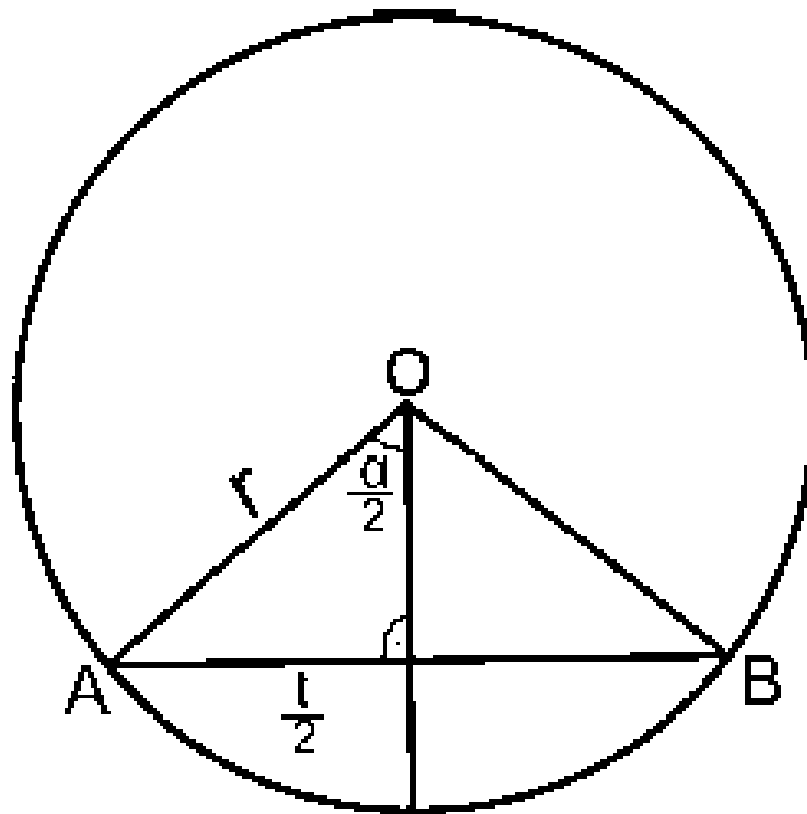
- Advantage: directly correct the angle.
- Disadvantages:
  - Additional trauma
  - Hard to place two Kirschner wires in correct angle.
  - Kirschner wires may interfere with fixation.
    - Hard to use in intra-medullary fixation method.

Lookup Table Method
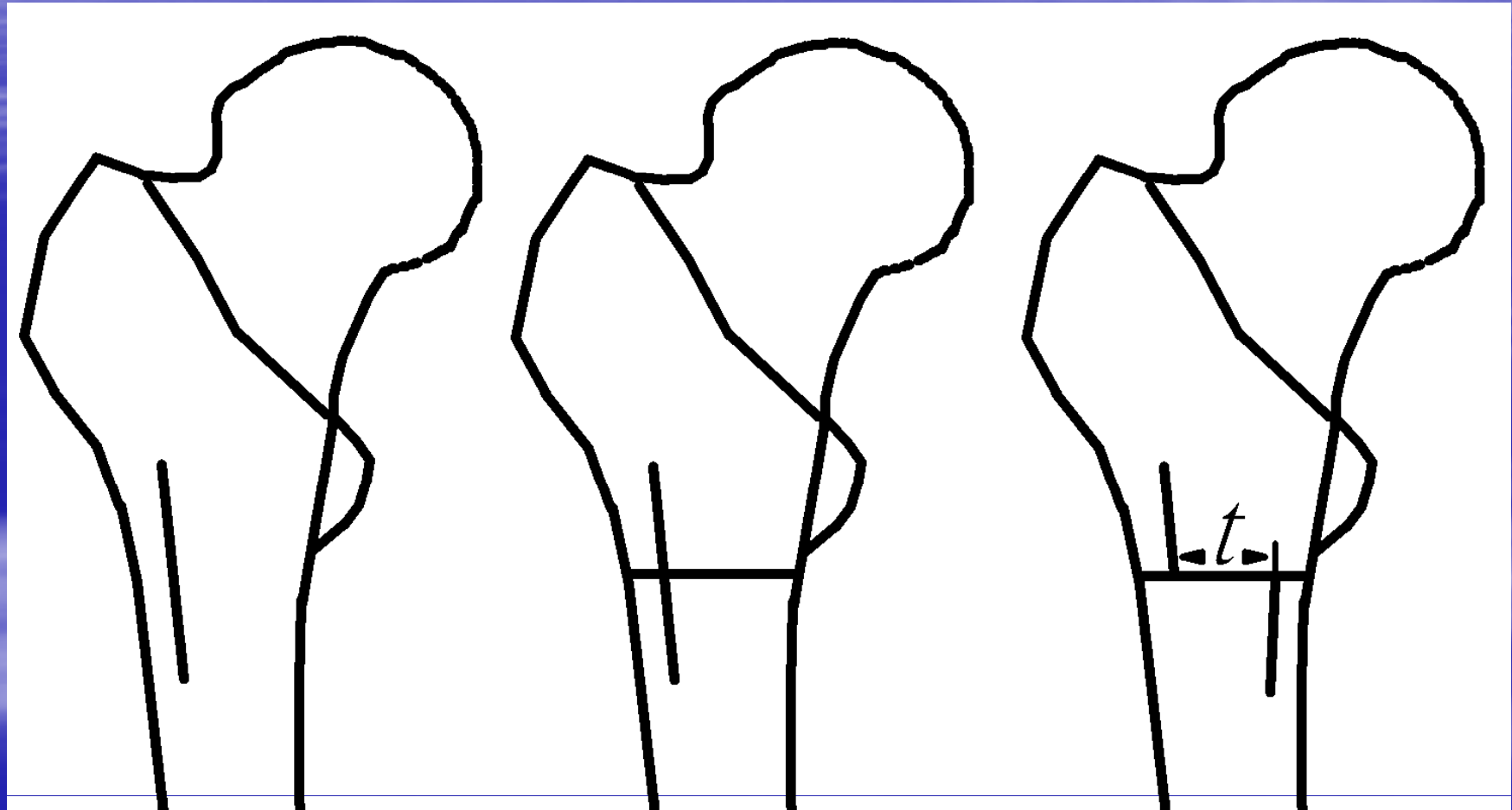
- Čobeljić et al.

Lookup Table Method

$$t = 2r\sin\frac{q}{2}$$

Lookup Table Method

- ## Part of the huge four-page-table

- Čobeljić et al. Femoral Derotation Osteotomy in Cerebral Palsy. *CORR* 2006:452,216–224.

TABLE 1. Value of Derotation Variables 2r = 10–29 mm and α = 1–45°

2r (mm) α angle (degree)	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
											t (mm)									
1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8
4	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0
5	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.3
6	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5
7	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.7	1.8
8	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.8	2.0	2.0
9	0.8	0.9	0.9	1.0	1.1	1.1	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.0	2.1	2.2	2.3
10	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.4	2.5
11	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
12	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
13	1.1	1.2	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.1	3.2	3.3
14	1.2	1.3	1.5	1.6	1.7	1.8	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.5
15	1.3	1.4	1.6	1.7	1.8	2.0	2.1	2.2	2.3	2.5	2.6	2.7	2.9	3.0	3.1	3.3	3.4	3.5	3.7	3.8
16	1.4	1.5	1.7	1.8	1.9	2.1	2.2	2.4	2.5	2.6	2.8	2.9	3.1	3.2	3.3	3.5	3.6	3.8	3.9	4.0

Developing Our Method

- The four-page-table is too large.
- Require 3 measurements (two lengths-to-number and one number-to-length).
- Need one calculation (average).
- We propose to do that in one step.

Our Method

$t = 0.5*(4r)\sin(\alpha/2)$
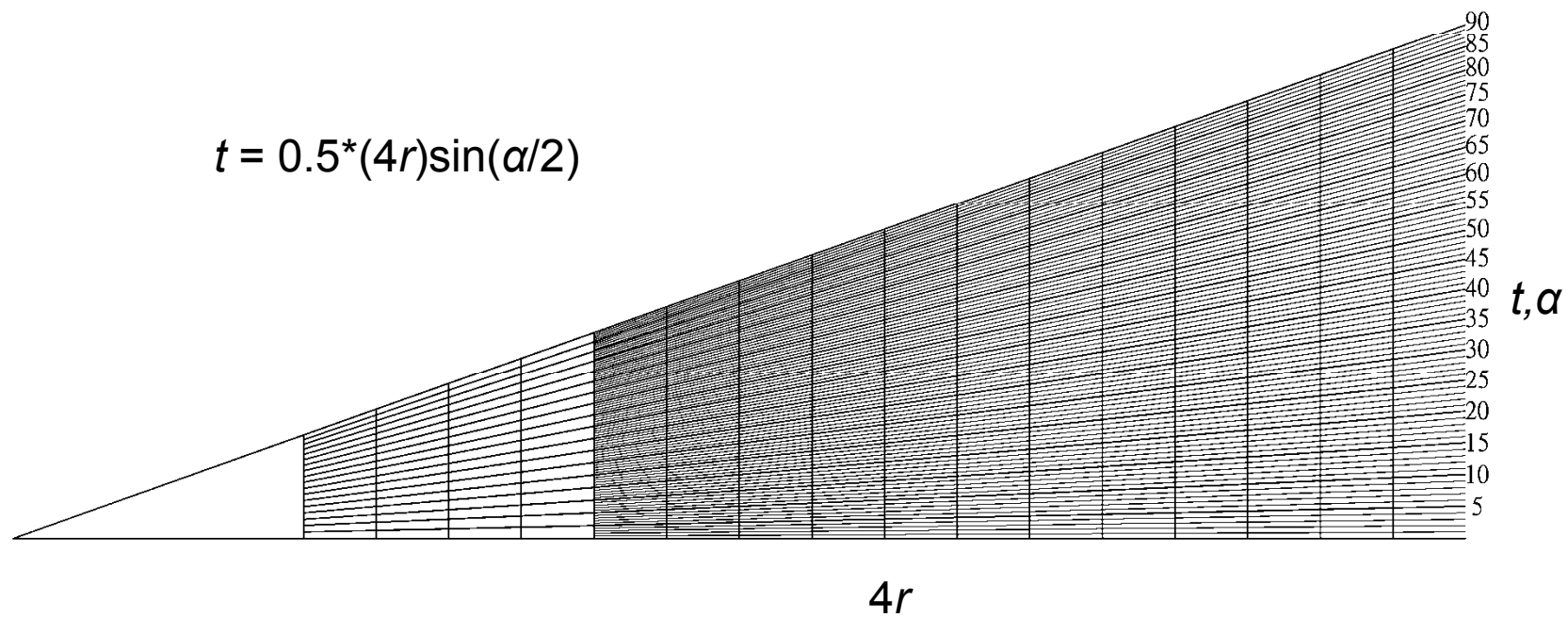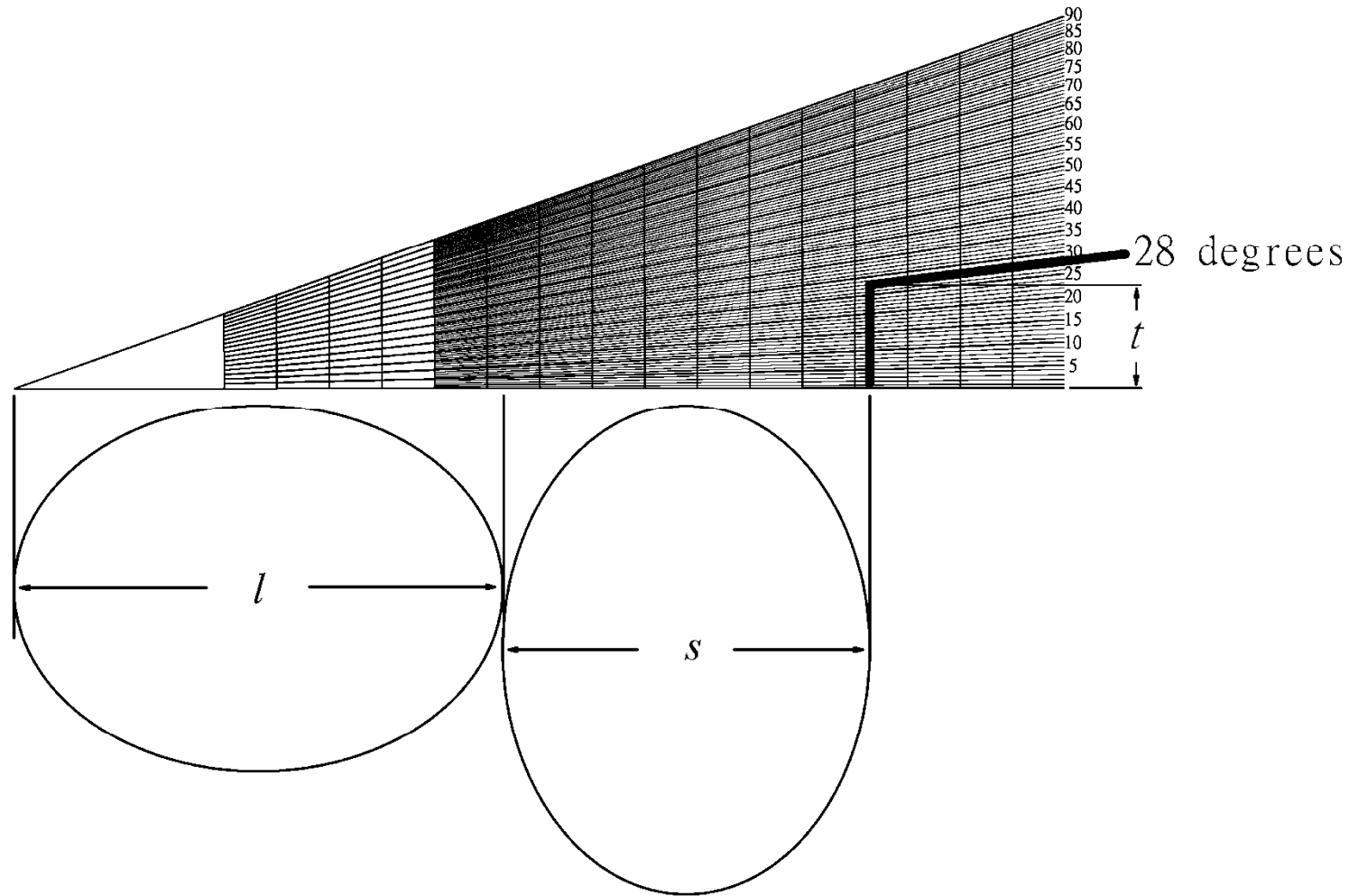
- *l* : long axis of bone cross section ellipse
- *s*: short axis of bone cross section ellipse

Our Method

- Is still a proposal.
  - No real experience.
- We planned to print it on water- and heat-proof material.
  - Stainless steel
  - Plastic

Disadvantages

- Correction angle in the ellipse is different from the circle.
- Hard to do such perfect correction in reality.

Results of Computer Model Verification

- 8 CT (Computer Tomography) slices
- Totally 1558 boundary points.
- Errors:
  - +17% to -33%
  - **mean $\pm$ SD: -6% $\pm$ 9%**
  - 2.5 percentile: -25%
  - 97.5 percentile: 13%
  - That is 0.75 to 1.13.
- SD: Standard Deviation

Goran's Result

- 21 patients received rotational corrective osteotomy
- Errors: (achieved-planned)/planned*100%
  - +80% to -50%
  - **mean $\pm$ SD: 6.7% $\pm$ 31.4%**
  - 2.5 percentile: -37%
  - 97.5 percentile: 57%
  - That is 0.63 to 1.57.

Discussion

- Accetable results in computer model
- In reality, may cause more error.
- The numeric-table-method and our guide ruler are the only two methods which can be used in rotational corrective osteotomy fixed with intra-medullary implants.

Conclusion

- We invented a guide ruler for rotational corrective osteotomy.

- The computer model showed acceptable result in comparison with previous published numeric-table-method.