Can Zometa Lines be Used to Study Growth in Patients with Congenital Pseudarthrosis of the Tibia?

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What was the question?
What is the effect of reconstructive surgery on lower extremity growth in patients with congenital pseudarthrosis of the tibia?

How did you answer the question?
A retrospective chart and radiographic review was performed for all patients with a diagnosis of congenital pseudoarthrosis of the tibia (CPT) who underwent surgical reconstruction at our clinic from 2013 – 2022. Patients were included in the study if they had received at least one dose of Zometa prior to reconstruction. If the Zometa infusion date was unknown or if a patient did not have postoperative radiographs available for review, they were excluded. When available, radiographs from the 3, 6, 12, 18 and 24 month postoperative visits were analyzed. For each visible Zometa line (Z–line) in the operative and nonoperative femur and tibia, the distance from the center of the Z–line to the center of the physis was measured. A two–way, random effects, absolute agreement, single rate intraclass correlation coefficient (ICC) was calculated for the measurement of the Z–lines. Growth rates were calculated for the distal femoral and proximal tibial growth plates, and the operative and nonoperative rates were compared. Comparisons were performed with Kruskall–Wallis test, and multiple comparisons were performed with Wilcoxon Rank Sum and Bonferroni correction. Significance was set at $p < 0.05$.

What are the results?
Fifty–one patients were included in the final analysis. The ICC for Z–line measurement was good to excellent at 0.92 (95% CI 0.88–0.94). The first table in Figure 1 shows the percentage of Z–lines that were visible and able to be measured at each physis and time period. The distal femoral Z–lines and proximal tibial Z–lines were consistently visible (over 60%); therefore, further analysis was limited to those physes. The second table in Figure 1 outlines the mean growth rates for the operative and nonoperative distal femoral and proximal tibial physes. On the operative side, the proximal tibia physis demonstrated a significantly higher growth rate at the 3, 6, and 12 month intervals compared to the 18 month interval ($p = 0.0100$, $p = 0.0059$, $p=0.0264$). There were no differences in growth rates between any two time points for the operative distal femur ($p = 0.2234$) , nonoperative distal femur ($p = 0.0742$) or nonoperative proximal tibia ($p = 0.7286$). When comparing the operative to the nonoperative physes, the operative proximal tibia had significantly higher growth rates at 3, 6 and 12 months ($p=0.0001$, 0.0026, 0.0011). The operative distal femur had a significantly higher growth rate at 3 months ($p=0.0115$).

What are your conclusions?
Measuring Z–line distance from its respective physis is a reproducible way to quantify growth at that physis as evident by the high inter–rater reliability in our study. Z–lines were most reliably seen at the distal femur and proximal tibia physes while Z–lines in the proximal femur were seen less than 30% of the time. Higher growth rates observed for the operative distal femur and proximal tibia physes compared to the nonoperative physes may represent temporary growth stimulation of the operative side. This growth stimulation effect is most evident in the first year after reconstructive surgery.

Percentage of Z-lines Identified

Month Followup	Nonop PF	Op PF	Nonop DF	Op DF	Nonop PT	Op PT	Nonop DT	Op DT
3	30	17	72	88	87	84	61	59
6	15	14	78	100	73	86	73	42
12	14	9	65	87	86	93	59	48
18	10	13	65	89	85	82	68	37
24	9	9	78	96	78	73	74	31

Mean Growth Rate for Distal Femur and Proximal Tibia Physes (mm/month)

Month Followup	Nonop DF	Op DF	Nonop PT	Op PT
3	1.42	1.8	0.91	1.41
6	1.83	1.49	0.95	1.43
12	1.73	1.78	0.97	1.27
18	1.32	1.61	0.85	0.88
24	1.37	1.43	1.1	1.04

PF= Proximal Femur
DF-Distal Femur
PT=Proximal Tibia
DT=Distal Tibia