

Catabolic Modeling of Trabecular Bone Following Selective Alveolar Decortication



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Introduction

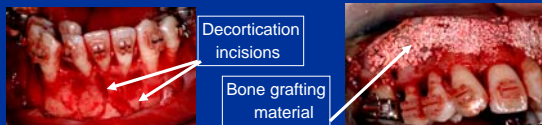
Selective Alveolar Decortication, when combined with orthodontic treatment, results in rapid resolution of malocclusion (Internat J Perio Restor Dent, 21:9-19, 2001). Decrowding and orthodontic finishing has been shown to be 3 to 4 times more rapid (Wilcko WM, et al. World J Ortho 4:197-205, 2003) than traditional orthodontic treatment alone.

(after: Wilcko WM, et al: World J Ortho 4:197-205, 2003)



Selective decortication means an incision is made into cortical bone. This minor out-patient surgery is done a few days after orthodontic appliances have been placed. The surgical incisions barely penetrate cortical bone and initiate a regional acceleratory phenomena (Frost HA, Orthop Clin of N Amer 12:725, 1981) and an increase in alveolar bone turnover, including increased osteoclasts or bone resorption.

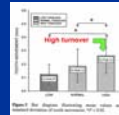
(after: Wilcko WM, et al: Internat J Perio Restor Dent 4:9-19, 2001)



Bogoch (J Orthop Res 11:285-291, 1993) demonstrated a dramatic increase in apposition and resorption of rabbit tibia spongiosa adjacent to decortication cuts with 5X bone turnover and diminished bone density. However, little is known about the effect of decortication on alveolar bone spongiosa.



Verna showed a significant increase in tooth movement when increased bone turnover was induced in rats. (EJO 22:343, 2000)



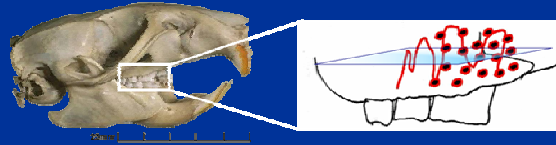
Objectives

The objectives were to evaluate catabolic modeling in 1) trabecular bone, 2) PDL, and 3) 1st versus 3rd molars as a function of time and proximity following alveolar decortication.

Methods & Materials

Selective Alveolar Decortication

The sample consisted of 9 adult male rats with a body weight of 400-450 grams. Under general anesthesia, maxillary buccal and lingual full thickness periosteal flaps were elevated adjacent to the upper left first molar and the selective decortication was performed with 5 palatal and 3 buccal bur marks (0.2mm) under sterile irrigation. The flaps were then repositioned with 6-0 sutures.



Tissue Preparation

The animals were sacrificed in groups of three at 3, 7, and 11 weeks, and maxillas were removed, stripped, and prepared for decalcified histology using TRAP or H&E stains. Bone modeling dynamics was histomorphometrically examined for osteoclast and/or precursor count (OC) within the geometric center defined by the 4 most distal 1st molar roots, the 2 mesial roots of the 3rd molar, and within the 1st molar PDL.

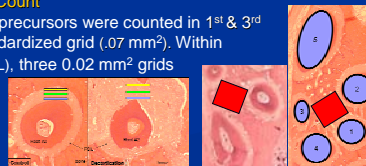
Data of Interest

Bone & PDL Surface

Transverse sections of 1st molars areas were analyzed using a standardized grid (15 mm²) and Olympus Micro Suite FIVE analysis software at 2.5 magnification.

Bone & PDL Osteoclast Count

Bone osteoclasts and/or precursors were counted in 1st & 3rd molar areas using a standardized grid (.07 mm²). Within each PDL region (M-D-B-L), three 0.02 mm² grids were used.

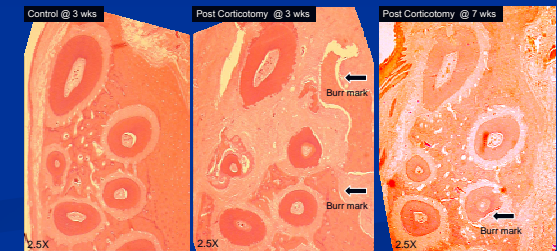


Results

3 Week Surgery Group was significantly different ($p < .05$) according to Oneway ANOVA and Krushal-Wallis testing for the following study variables:

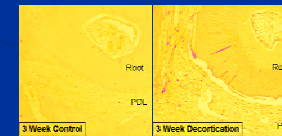
Bone Surface: less bone surface (4.40 mm²) than all other groups (7.35 to 9.04 mm²) except 7 week surgery (6.16 mm²).

PDL Surface: higher PDL surface (7.19 mm²) than all other groups (2.06 to 5.30 mm²)



Bone OC: higher OC (56.3) than control (26.3), 7 week surgery (29.7), and 3rd molars.

PDL OC: higher than control, all other 1st molar groups (see table), and 3rd molars



Group	Palatal n=45	Buccal n=45	Mesial n=45	Distal n=45
3 Week Surgery	16.9*	15.9*	16.6*	16.0*
3 Week Control	6.2	5.2	5.6	5.4
7 Week Surgery	5.3	4.7	4.7	4.9
7 Week Control	4.0	3.7	2.7	4.3
11 Week Surgery	5.2	4.6	4.2	4.3
11 Week Control	4.9	4.1	3.8	4.7

* = $p < .05$

Conclusion

Selective alveolar decortication resulted in a 2X increase in catabolic modeling (turnover) of spongiosa and a 4X increase in PDL osteoclast count. Moreover, the catabolic aspect of RAP was demonstrated in all study variables. Increased tissue turnover is a condition that favors rapid tooth movement.