HISTOLOGICAL AND HISTOMORPHOMETRIC ASSESSMENT OF TOOTH BORNE MANDIBULAR DISTRACTION OSTEOGENESIS

Francisco Vale[1], João Brochado[2], João Cavaleiro[3], Luísa Maló[4], Silvério Cabrita[5]

1 Specialist in Orthodontics; Coordinator of the Graduate Program in Orthodontics, Faculty of Medicine, University of Coimbra
2 Institute of Histology and Embryology, Faculty of Medicine, University of Coimbra
3 Graduate Student in Orthodontics, Faculty of Medicine, University of Coimbra
4 Specialist in Orthodontics; Co-coordinator of the Graduate Program in Orthodontics, Faculty of Medicine, University of Coimbra
5 Laboratory of Experimental Pathology, Faculty of Medicine, University of Coimbra

INTRODUTION

The distraction osteogenesis (DO) is the biological process of new bone formation between segments gradually separated by traction. The basic principles of this technique were suggested by Codvilla (1905) but it was Ilizarov in the 50s who widely applied this technique in long bones with predictability. In 1992, McCarthy used DO for mandibular lengthening in patients with congenital facial deformities and since then this technique has been accepted as an effective treatment option. Although the rate of DO can influence the whole process, there are few experimental studies on the effect of this parameter on the quality and quantity of new bone.

OBJECTIVES

To evaluate the histological and histomorphometric effects in new bone of two different rates of canine mandible distraction osteogenesis, using a tooth-borne distractor.

MATERIALS AND METHODS

10 Beagle dogs were used, weighing between 15-18kg, 7 were submitted to the protocol of distraction and 3 remained as a control group. Both hemi-mandibles were used for experimental purposes, forming the following groups: **Group A:** 6 mandible remained as control group, **Group B:** 7 were subjected to two daily activations of 0.5 mm, with an interval of twelve hours; **Group C:** 7 were subjected to a 1 mm single daily activation. After the distraction period, the distractors were blocked, and submitted to a consolidation period of 12 weeks. Histological and histomorphometric evaluation of bone tissue formed within distraction gap was performed.

RESULTS

Group A

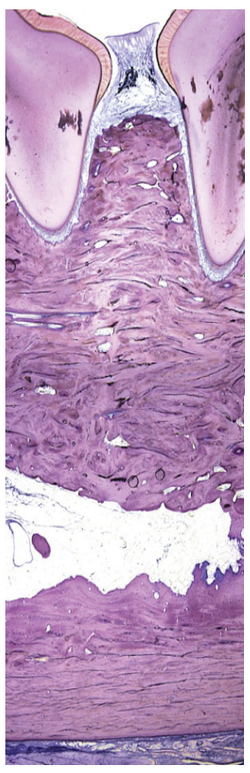
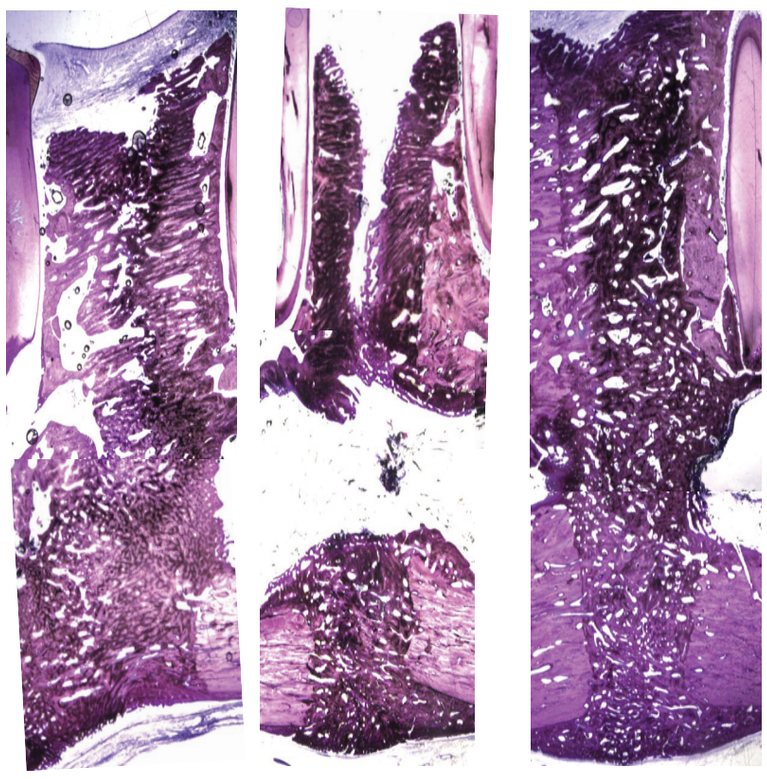


Figure 1– Histologic section of vestibular extent, showing the normal stucture of bone tissue in control group (7,5x).

Group B



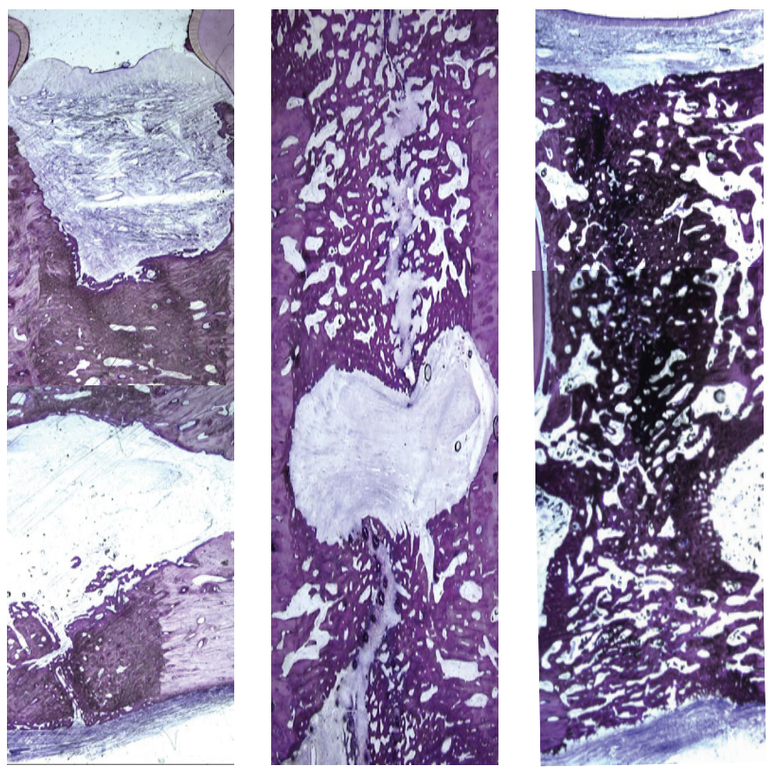
A B C

Figure 2– 8 week consolidation regenerate (7,5x). Histologic section of regenerate (distraction gap) with (A) vestibular aspect of bony trabeculae extending up to half of the total width of distraction gap; (B) new bone formation located at the host bone margins with fibrovascular tissue in the center of the gap up to alveolar canal; (C) lingual/cortical areas completely obliterated by bony trabeculae originating from the native bone. Note that newly synthesized woven bone is aligned parallel to the long axis of the native bone.

Histomorphometric analysis showed statistically significant differences between coefficient of variation of bone formation between:

- central and buccal areas ($F(1,44)=23.328$ $p<0.001$)
- lingual and buccal areas ($F(1,46)=17.131$ $p<0.001$)

Group C



A B C

Figure 3– 8 week consolidation regenerate (7,5x). Histologic aspect of the distraction gap showing discrepancies in regenerate bone consolidation in buccal-lingual direction. The fibrous interzone was usually wider and more extensive at the vestibular extent (A) than at the central (B) or lingual (C) extents of the regenerate. At the central aspect can be noted the presence of newly formed woven bone and some areas of cartilage/fibrocartilage tissue. However, the lingual aspect of distraction gap has been completely filled with new bone.

Histomorphometric analysis showed statistically significant differences between coefficient of variation of bone formation between:

- central and buccal areas ($F(1,41)=7.348$ $p=0.010$)
- lingual and buccal areas ($F(1,46)=17.131$ $p<0.001$)

CONCLUSION

The results show that increasing the rate of distraction of 1 to 2 daily activations produces changes in quantity and structural quality of newly formed bone, as evidenced by frequent situations of bone non-union and large areas of cartilage / fibrocartilage in group C, compared to group B. Moreover, the preservation of the lingual periosteum seems to be favorable for bone formation.

CLINICAL IMPLICATIONS

This study infers that DO can be effective for the correction of mandibular deficiencies and that continuous distraction seems to be more favorable for bone formation rather than a single daily activation.

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