

CHAPTER 4

DISCUSSIONS

The aim of this study was to determine the biochemical effect between using NiTi closed coil spring (NT) and elastic c-chain (CH) during canine retraction by investigating 2 potent cytokines, IL-1 β and IL-8, in gingival crevicular fluid (GCF) at pressure sides. These orthodontic materials are known to provide different type of force. The orthodontic force induces tissue reactions and tooth movement. NiTi closed coil spring gives continuous force while elastic c-chain gives intermittent force. However, there are studies reported that NiTi closed coil springs have the force loss.^(8, 62) Therefore, we would measure the force exerted from NiTi closed coil springs after one month of activation. We found that NiTi closed coil springs still exerted continuous force throughout our study. The results clearly demonstrated that the levels of IL-1 β and IL-8 were higher in the GCF of NiTi closed coil spring group. In addition, the rate of tooth movement was greater when using NiTi closed coil spring.

Before bracket placement or pre-treatment, we found low levels of IL-1 β and IL-8 in GCF which were similar to the recent study in periodontally healthy sites.⁽⁷⁰⁾ After bracket placement, the force exerted to the teeth and periodontium for leveling and aligning. The levels of IL-1 β and IL-8 were slightly increased at 0h (before canine retraction) which were used as the baseline levels. It should be noted that, the baseline levels of IL-1 β and IL-8 in both NT and CH groups were not significant difference. After canine retraction with force about 6 ounces, the levels of IL-1 β and IL-8 were increased and highest at 24 hours in the pressure sides of both NT and CH groups which were correspond to previous studies.^(10, 22, 24) This finding indicated that the cells within periodontal tissue were responsible to the mechanical force within 24 hours. These evoked an acute inflammatory reaction in the stressed PDL and released neurotransmitters and cytokines, such as IL-1 β , IL-8, etc. from inflammatory cells.⁽⁷¹⁾ This might be the reason why the levels of IL-1 β and IL-8 were increased and highest at 24 hours. Then the levels of IL-1 β and IL-8 were decreased after 24 hours canine retraction in both groups. The period of osteoclast differentiation along the alveolar bone wall is 30 to 40 hours after force application in young human being.⁽⁷²⁾ Furthermore, there has been reported that it took 24 hours for osteoclasts to

differentiate after stimulation (Fig.29).⁽⁴³⁾ There might also be feedback mechanisms that prevent these mediators from increasing excessively.⁽²⁴⁾ This result indicated that continuous force did not induce continuous IL-1 β release from inflammatory cells. Besides, Iwasaki (2001) reported that IL-1 β levels have a 28-day fluctuated cycle when a continuous orthodontic force was applied.⁽²³⁾

In CH group, the IL-1 β and IL-8 levels were decreased to the baseline levels within one month of canine retraction, while the IL-1 β and IL-8 levels of NT group were still higher than the baseline. This inferred that elastic c-chain had large force decay and the remained force was not enough for cellular response and canine movement. Force generated by NiTi closed coil spring remained for a long period and might provide continuous force for canine movement. After 1 month of canine retraction, we changed a new elastic c-chain or reactivated with the same magnitude of force (6 ounces) while NiTi closed coil spring still exerted the same force (6 ounces). We found that the levels of both mediators at 1 month and 2 months of canine retraction were not significant difference. Although, we did not investigate the levels of IL-1 β and IL-8 at 24 hours after reactivation but we expected that they might have the same cycle of the first month of canine retraction which are increased and highest at the 24th hour and then declined. And the levels of IL-1 β and IL-8 in the second month may be lower than in the first month of canine retraction because the PDL space in the second month is wider than before canine retraction.

The levels of both cytokines were found to be higher in NiTi closed coil spring (continuous force) than elastic c-chain (intermittent force) throughout the period of investigation. It can be explained that NiTi closed coil spring still exerted continuous force throughout the study period whereas elastic c-chain had large force decay after 24 hours of load. Bishara *et al.* (1970) found that elastic c-chains lost 74 % capability of force delivery after 24 hours of load.⁽²⁾ Lu *et al.* (1993) showed that the force decay of the elastic c-chains was 41 % after 24 hours and approximately 67% after the fourth week of force application.⁽⁶³⁾ This result demonstrated that a continuous force may have greater effects when cellular activity is considered than the intermittent force and implied that alveolar bone resorption may be greater at pressure side in NT group than in CH group. Iwasaki (2001) found the velocity of human tooth movement positively

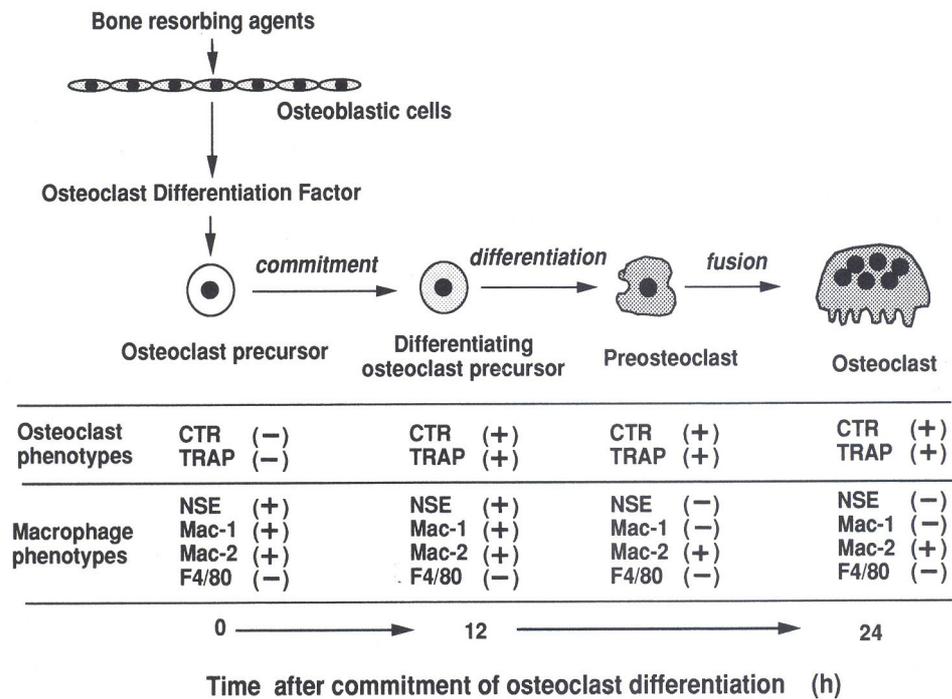


Fig.29: Expression of osteoclast-macrophage-associated phenotypes during differentiation of postmitotic osteoclast precursors into osteoclasts. Postmitotic osteoclast precursors expressed macrophage-associated phenotypes such as nonspecific esterase (NSE) and antigens to Mac-1 and Mac-2. When postmitotic osteoclast precursors began to differentiate into the committed osteoclast precursors, they expressed osteoclast associated phenotypes such as TRAP and calcitonin receptors almost simultaneously. By contrast, some macrophage-associated phenotypes such as NSE and Mac-1 rapidly disappeared in osteoclast precursors during differentiation. After the differentiation of the precursors into mononuclear preosteoclast was completed, they began to fuse resulting in multinucleated cells.⁽⁴³⁾

correlated with the concentration of IL-1 β and the correlation was stronger on the pressure site than the tension site.⁽²³⁾ There has been reported that the life span of human osteoclast is 21 days and then osteoclast apoptosis will occur.⁽⁷³⁾ The cytokines which induced by orthodontic force, as in our study; IL-1 β and IL-8 can stimulate osteoclastogenesis.^(13, 14) They might need for osteoclast formation during tooth movement.

Furthermore, we found that the rate of maxillary canine retraction in NT group was significantly higher than in CH group. Dixon *et al.* (2002) compared the rate of space closure among active ligature, elastic c-chain and NiTi closed coil spring. They found that NiTi closed coil spring gave the most rapid rate of space closure. In addition, the mean rate of tooth movement with NiTi closed coil spring (0.81 mm/month) was higher than with elastic c-chain (0.58 mm/month). However the rate of tooth movement in their study was not statistically different. They did not use a split mouth study design, therefore, it might be individual variation which affected the rate of tooth movement.⁽⁷⁾ Besides, Nightingale and Jones (2003) found that the force loss and the mean rate of space closure of NiTi closed coil spring were similar to elastic c-chain.⁽⁸⁾ However, in our study the force provided by NiTi closed coil springs differed from provided by elastic c-chain. This might be because of the brand used in our study differed from the brand used in their study.

Our study implies that the light continuous force (6 ounces) produced may give better effects on tooth movement than intermittent force (6 ounces) correlating to the levels of IL-1 β and IL-8. This implication was supported by the previous studies.^(6, 74, 75) They found that the light continuous force gives the better effects on tooth movement and no adverse tissue reaction. The light continuous forces have been suggested for more ideal physiologic tooth movement and to conserve anchorage.⁽⁷⁶⁾ Conversely, Lee *et al.* (2004) evaluated the effects of 100g continuous force with NiTi closed coil spring and heavy interrupted force with a screw-attached retractor on IL-1 β and PGE₂.⁽²⁴⁾ They found that the heavy interrupted force and the light continuous force provided similar rate of tooth movement and similar biochemical effects on the tooth movement. This might be due to the magnitude of continuous force used was less than the optimum force (150 cN), whereas the interrupted force was heavy and weekly reactivated.

In this study, IL-1 β and IL-8 levels were found to be positively correlated with the rate of tooth movement. The level of mediators in GCF can be used as parameters of the tooth movement and periodontal status. For clinical application, IL-1 β and IL-8 can be used to accelerate tooth movement during orthodontic treatment. However, we need further research to examine doses and side effects of these mediators.

In our study, NiTi closed coil spring gave higher rate of tooth movement than elastic c-chain for canine retraction which may be correlating to the levels of IL-1 β and IL-8. However, the result obtained from our study might be not enough to absolutely assess the efficacy of elastic c-chain and the NiTi closed coil spring. This study also needs to be improved upon by future work to include more frequent GCF collection such as 168 hours after canine retraction, 24 hours and 168 hours after reactivation and measured the remained force in elastic c-chain at the same period of GCF collection and the amount of maxillary canine movement after 1 month of canine retraction.