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| **Name:** |
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| 6B-2 |
| **Basic Science Question:** |
| How do orthodontic forces influence bone formation and resorption? |
| **Report:** |
| Orthodontic forces are typically exerted by the orthodontic appliance on the crown of the tooth and ultimately transferred to the surrounding periodontal tissues, most notably the periodontal ligament (PDL). The PDL is responsible for providing a vascular supply and nutrients to the cementum and alveolar bone, as well as absorbing mechanical stresses and anchoring the tooth into the alveolar bone. In the context of orthodontia, the PDL is significant due to its pivotal role in regulating and inducing bone formation and resorption, along with associated tooth movement, in response to the orthodontic forces acting upon the tooth. (Jiang et al., 2016)  The process by which the PDL responds to orthodontic forces is often described using a “pressure-tension theory”. Within the first 1-2 days (the “initial phase”), the applied forces cause the tooth to be displaced within the surrounding periodontal space, constricting the PDL on the leading or “compression” side of the tooth, while the trailing or “tension” side is stretched. The compression side exhibits a disruption of blood flow, which causes cell death (hyalinization), followed by resorption of this hyalinized tissue by macrophages and adjacent bone structure by osteoclasts. Almost no tooth movement occurs for the first 20-30 days (the “lag phase”) of this resorption process until the necrotic tissue has been completely removed, paving the way for subsequent tooth movement. As the tooth moves (“post-lag phase”), the newly created space on the tension side is filled by the remodeling of the PDL, alveolar bone, and cementum. In this case, osteoblasts facilitate new bone formation by producing a type I collagen matrix, which is then mineralized into bone tissue. Much of the newly formed bone structure consists of “osteocytes”, which are simply osteoblasts that became trapped inside the matrix during its formation. (Zainal Ariffin et al., 2011)  With these mechanisms in mind, it is also important to consider how various characteristics of the orthodontic forces such as magnitude and duration are related to tooth movement and overall treatment outcomes. While the amount of strain on the PDL is linearly related to the rate of tooth movement, there needs to be enough force applied to disrupt vascularity and blood supply on the compression side of the tooth in order to effectively promote the hyalinization/resorption process. The total duration of orthodontic treatment may be extended if force is insufficient since tooth movement may not occur or the rate of movement may be significantly decreased. On the other hand, if the magnitude of force is too high, root resorption can occur, along with tooth loss in some severe cases. Therefore, it is important for the provider to carefully consider the appropriate amount of force to be applied when preparing the orthodontic appliance in order to facilitate the most efficient and successful orthodontic treatment. (Wu et al., 2018) |
| **References:** |
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