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| **Name:** |
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| **Basic Science Question:** |
| What is involved in the process of osseointegration? |
| **Report:** |
| Osseointegration is crucial to the long term success rate of an implant, ensuring that the implant is firmly placed in the alveolar bone. Without proper osseointegration, the implant will not maintain stability. Osseointegration can be defined as a structural and functional connection between newly formed bone and the surface of the load-carrying implant. It involves interlocking between the bone and implant surface and then continuous bone remodeling toward the implant.  Osseointegration can be broken down into three steps: early immune-inflammatory response, angiogenesis, and osteogenesis. When the implant is placed into bone, there will be an early immune response within 24 hours. Neutrophils will dominate the area from a result of broken blood vessels surrounding the implant initiating an immune response. Within two to four days, macrophages and monocytes will migrate to the implant site. These immune cells remove debris as well as secrete cytokines and growth factors. Cytokines and growth factors will recruit mesenchymal cells and contribute to angiogenesis.  After the initial immune response to the implant placement, angiogenesis increases. However, the immune response and angiogenesis are occurring simultaneously after the implant is placed into the alveolar bone. After the first day of implantation, a blood clot will form next to the implant surface. New blood vessels begin to form within 24 hours. With the help of macrophages and monocytes influxing to the area within two to four days, neovascularization is increased. These cells help recruit mesenchymal cells from the bone marrow around the newly formed blood vessels. Mesenchymal cells will differentiate into osteoblasts and begin to attach to the implant surface.  The last step of osseointegration is the formation of new bone through a process called osteogenesis. Within five to seven days, new woven bone will form in the gap between the implant and host bone. By four weeks, new bone will continue to grow on the implant surface which is referred to as contact osteogenesis and start to connect with new bone forming on the host bone which is distant osteogenesis. After eight to twelve weeks, the interface between the periodontium and the implant surface will be completely replaced by mature lamellar bone. The regular parallel alignment of collagen fibers within lamellar bone makes it mechanically strong. At this point, the implant is secured and stable within the alveolar bone. The bone structure will undergo constant remodeling in order to adapt to the load of the implant which will prevent failure. All of these steps of osseointegration are crucial in determining long term success of the dental implant. |
| **References:** |
| Parithimarkalaignan, S., & Padmanabhan, T. V. (2013). Osseointegration: an update. *Journal of*  *Indian Prosthodontic Society*, *13*(1), 2–6.  Wang, Y., Zhang, Y., & Miron, R. J. (2016). Health, Maintenance, and Recovery of Soft Tissues  around Implants. *Clinical implant dentistry and related research*, *18*(3), 618–634. |