Section IV Prosthetic Considerations During Implant Treatment Planning

Once an implant is well integrated with the surrounding bone, its long-term success is heavily dependent on restorative biomechanical factors. Success depends on how the stresses imposed on a functioning implant or the prosthetic unit or units attached to the implant will be distributed to preserve the osseointegration of the implant. Similar to natural teeth, the load-bearing capacity of an integrated implant must be greater than the anticipated occlusal loading. Loads that are greater than the load-bearing capacity are likely to lead to mechanical and/or biologic failure. Therefore, prosthetic considerations must be accounted for during the treatment planning phase before performing the surgery to place the implants.

Biologic implant failures occur when the functional load exceeds the load-bearing capacity of the implant–bone interface while integration is still occurring or after it has been achieved. This initially presents as bone loss around the coronal portion of the implant. With time, if the load is severe enough, the bone loss can progress around enough of the entire implant to cause it to loosen and become useless. Dentists working with implants must remember that implants lack the "shock absorbing" property provided by the periodontal ligaments of natural teeth. The periodontal ligament allows a slight physiologic movement of teeth; thus, in the absence of microbe-induced inflammation, natural teeth can move and adapt to the forces without pathologic bone loss. This, however, cannot occur with an osseointegrated implant.

Similar in several ways to natural teeth, the load-bearing capacity of implants is qualified by several factors. These factors include the number and size of the implants, the arrangement and angulation of the implants, and the volume and quality of the bone–implant interface. Much of load-bearing capacity relates to the amount of the implant surface area to which high-quality bone has attached. The same factors that maximize unloaded implant stability in hard tissue continue to be important after the attachment of a prosthesis. Thick cortical and dense cancellous bone surrounding a long, wide-diameter implant positioned in line with the functional load offers the greatest load-bearing capacity, providing the best prognosis for long-term success. In contrast, a short, narrow-diameter implant placed in an area of thin cortical bone, with less dense cancellous bone and an off-axis angulation, will have compromised load-bearing capacity and a poorer prognosis. The angulation of the implants as it relates to the occlusal plane and the direction of the occlusal forces is important in optimizing the translation of the forces to the implants and the surrounding bone (Fig IV-1). Loads directed through the long axis of the implants are well-tolerated. Slightly off-axis loads are usually not clinically detrimental; however, loads applied at angles greater than 20° off the long axis result in load magnification and tend to initiate bone loss at the implant–bone interface. Again, if excessive loads persist, the bone loss will continue and likely lead to implant failure.

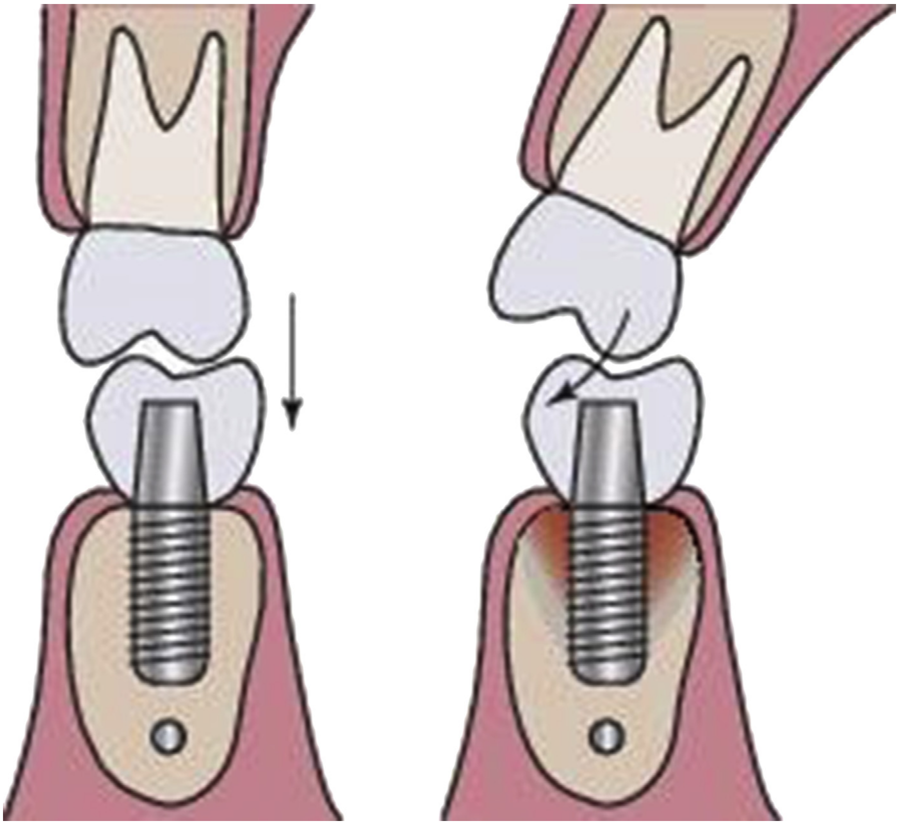

FIGURE IV-1. Off-axis loading can result in unfavorable forces on the implant, jeopardizing the long-term success because of excessive lateral loads.[1]

Similar again to natural teeth, the number of implants placed in edentulous spans affects the load-bearing capacity of the implant-borne prosthesis. If a 3-tooth edentulous span is present, the fixed prosthetic options would be to place 3 implants with 3 splinted crowns, 3 implants with 3 single-unit crowns, 2 implants as terminal abutments for a 3-unit fixed partial denture, or 2 adjacent implants with a fixed partial denture with a cantilevered pontic. Of these 3 alternatives, the load-bearing capacity decreases with each successive option.