

TITANIUM AS AN IMPLANT MATERIAL, CLINICAL PERFORMANCE IN NEW TECHNOLOGIES.

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A fracture results in disruption of the continuity of bone stiffness. Bone loses its support function with loss of alignment i.e. loss of anatomical shape. Attempts to use the limb then generate pain and thus functional immobility results.

An implant used for internal fixation of fractures should provide a temporary mechanical scaffold to maintain restored anatomical shape with enough stability to allow free and painless mobility of the injured limb to exercise the soft tissues and thus to avoid the fracture disease. The mechanical requirements regarding the function of an implant material for internal fixation, therefore, are primarily stiffness and strength; both depend on material but even more so on design. In conventional technology the application of the implant requires ductility. The latter allows for shaping of the implant to correspond to the bone shape. In respect to the use of screws the ductility of the implant has an even more important aspect, it protects from overload and failure at application by providing feedback to the surgeon. Titanium is less ductile than steel. If the surgeon using conventional techniques tries to tighten the screws as much as possible failure of Titanium without pre-warning may occur.

The major complications of internal fixation are mechanical failures at implantation, fatigue failures during and after the bone healing and biological failures mainly infection. Today's implant materials are considered to be biocompatible. Still some important differences exist such as different influence on local resistance to infection. Such differences have been observed in recent experimental evaluations. The surgeon "knows" that bacterial contamination resulting in infection subsides only when the "foreign" body is removed. Recently the main focus of interest concerned the basic aspects of formation and avoidance of a dead space within an implant and around it. Beside biocompatibility and surface structure tissue strain seems to play an important role in respect to the mechanism of adherence of the soft tissues.

The interaction of surface contact of implants and bone blood supply brought about changes in the philosophy of application and function of the

implants. Today a basically different mechanical function of e.g. periosteally applied implants is achieved. These implants now function rather like fixators than like plates with a different mechanical loading of the screws especially at application. As a consequence, commercially pure titanium finds a wider application and offers more advantages than in conventional application. Using the new technology of internal fixation with PC-Fix made of commercially pure titanium out of more than 2000 fixators with an average of more than 5 screw-bolts no screw nor fixator breakage has been observed. It is fascinating to observe how material, design and application interact in the surgical treatment of fractures.

Implants and Infection, S. Arens (Ed.)

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Stephan M. Perren, Surgical aspects of implants and infection, Nova Acta Leopoldina (in press).