

Tissue reaction around implants – the histological view

[S Milz](#)

AO Research Institute, AO Foundation, Davos, CH,

Tissue reaction around implants has been in the focus of scientific interest for many decades. Here it is attempted to provide some insight how evaluation strategies for the assessment of tissue reaction around different types of implants can be selected and adapted to the individual demands. Evaluation usually is driven by a relatively uniform set of questions which are commonly raised when the clinical value of an implant has to be assessed.

Independent of the type of implant the first concern always is that an adverse reaction can be provoked in the host organism. Despite the fact that in most cases already extensive *in vitro* tests have been performed, the first *in vivo* application should always be designed in such a way that an adverse reaction can be assessed. In such a case local signs of inflammation and high macrophage activity (Fig.1) can be expected around the implant. It is not the presence but the severity of the condition that in most cases determines whether an implant is suitable for clinical use or not. The time to reaction often is modulated by the type of the surrounding tissue. In bone the inflammatory response, especially in chronic cases, may occur with some delay but nevertheless will lead to increased resorption and subsequently osteolysis.

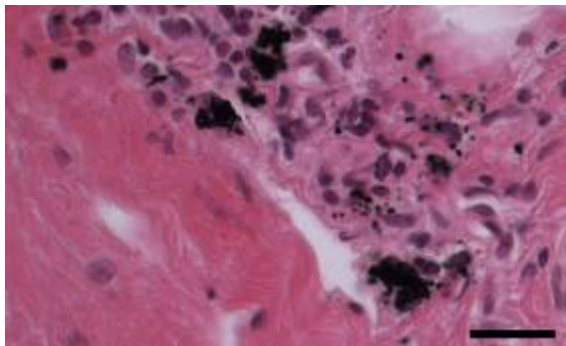


Fig. 1 Corrosion products in the vicinity of a metallic implant. Note the macrophages containing dark debris. H&E, scale bar = 50µm.

Depending on the type of implant (e.g. inert, osteoconductive, osteoinductive) and on the material properties (e.g. resorbable, non resorbable, corroding, dissolving) the next most important concern relates to whether the desired purpose is fulfilled by the implant. In metallic

implants, as commonly used in the locomotor system, it often is the stabilisation and/or replacement of mechanical function that is desired. In such cases the interface between bone and implant usually attracts considerable attention. Scientific experience however has shown that histological assessment of bone implant contact is not always suitable to conclude on the mechanical stability of the entire implant bone interface. This is mainly due to the fact that it is not possible to assess the mechanical quality of a bone implant interface based on histological observation alone. It is also often a problem to conclude from a randomly sampled 2D view (i.e. the histological section, Fig.2) on a 3D situation.



Fig. 2 Ceramic implant with surrounding bone. Note the newly formed bone within the threads. Giemsa/Eosin, scale bar = 600µm.

In implant materials designed to fill bone voids it usually is important to know how (and if) the material is replaced during remodelling. Here different phases (early bone ongrowth, bone integration, long term remodelling) have to be taken into account, since histology always only can assess one moment in time in an otherwise continuously changing biological situation. The situation is even more complicated if composite implants which consist of vital and avital parts are used. Although currently only a clinical issue in human arterial stent application, drug eluting capabilities are a feature that will demand for even more sophisticated evaluation designs in the future. The same is true for the increasing number of non-metallic implant materials which are based on composite structures often involving 3 or more different materials.