Current problems in fracture treatment: what the surgeon wants

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Results of fracture treatment have continuously improved since the AO started to study and to teach operative fracture treatment 50 years ago. During the last decade this evolution was characterized by the development of new intramedullary nails and locking screw-plate constructs which can be applied with less damage to the blood supply of the bone and which also allow safer fixation in osteopenic bone. Today there are plates and nails available specifically designed for almost any given fracture of the skeleton. Despite the impressive improvement of our armamentarium there remain however still some challenges for the surgeon.

Fracture fixation in osteoporotic bone: Osteoporotic bone remains a problem despite the new implants mentioned above. These implants initially are getting much better purchase in the bone. However, since the constructs are quite stiff they tend to cut through the bone in severe osteoporosis. This could be solved with fixation devices with a "softer" interface between implant and bone, most likely manufactured of materials or composites other than metals currently used. Another approach to avoid cutting through would be augmentation of the bone. The only material used for this purpose is currently PMMA which however is far from being ideal. The surgeon would wish a material that can be applied almost immediately, that augments a big volume of bone without the need to first create a cavity, that can be kept on the back table for hours and still "freezes" in seconds after its application or - even better - at the moment the surgeon wishes. It should however not do any harm, neither in the bone nor if it leaks out of the fracture site or into a joint. Of course it should dissolve over reasonable time without however leaving a void but healthy bone. At the end it should be affordable particularly because of the still increasing number of elderly patients.

Non-unions: Classic teaching tells that non-unions are either the result of lacking stability at the fracture site or of impaired blood supply of the bone. In many cases however the reason remains unclear. Fracture healing can be enhanced with locally applied BMP's or other mediators. If a delayed union is noticed or a non-union established there are many therapeutic options on the marked of which the proven efficacy is unclear. Research in this field should therefore answer the question which patients are prone to develop a non-union. Patients at risk should then get some sort of prophylactic treatment. Research should also focus on the different modes of non-surgical treatment of delayed and non-unions. One of the interesting questions in this regard is what makes fibrous tissue in a non-union transform into bone.

Large bone defects: Bone loss occurs after debridement of open fractures, resection of bone for osteitis or tumors. Segmental bone loss of some centimeters in diaphyseal bone inevitably results in non-unions. However, in addition to the treatment of the non-union the missing bone needs to be replaced. The surgeon would wish a product with which the defect could be bridged or filled immediately. Ideally this "bone filler" would have the same mechanical properties as bone. It would not only fill the defect, but lead to new bone formation and eventually be replaced completely by new diaphyseal bone. The new product should be ready to use immediately and storage should be simple.

Bone infections: Despite new antibiotics, better antisepsis, more aggressive debridement in open fractures and less invasive operative techniques for fracture fixation, infections and particularly implant related infections of the bone remain a unsolved problem. There exists no reliable method to early diagnose or rule out infection. In the treatment the mainstay today is debridement. Here the problem is to differentiate living from dead tissue particularly in the bone. Debridement leaves defects. Thus other treatment methods would be desirable which would cure the infection without resection. Contaminated implants, particularly with bacteria that form biofilms can not be cleaned. Therefore methods to sterilize such implants in situ without damaging the surrounding tissues would be a huge step particularly in joint prosthesis. Prevention would be even better. In this regard implants that are more resistant to infections or local antiseptic substances would help. The methods or substances used should however avoid the selection of resistant germs.

Conclusion: To address the current needs of the clinician research has to change its focus almost completely from traditional biomechanics and new implant design to a variety of new fields.