Internal fixation systems for improved genetic and for biomechanical studies in mice and rats

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Introduction
Genetic studies with knockout technology require the use of mice. Exactly defined, reproducible mechanical conditions are a must for experimental studies of fracture healing. Goal of developing the new technology for use in mice was to provide several standardized osteotomy and fracture models with a fixation that avoided mechanical artefacts and provided well standardized conditions.
Requirements to be met:
- standardized, selectable flexibility
- simple surgery, minimal tissue damage
- minimal mass and for free ambulation
- available as research kit

Materials and Methods: Made of medical grade titanium, PEEK or 316L.
The internal fixator plates consist of a plate body including holes for application of solidly locked screws. The stable connection between screw and plate forgoes the need of pressing the plate onto bone for transmission of the load between bone fragments and plate. The intramedullary nail consists of a rod with a threaded tip, two transversal locking holes at the middle and a distal cone shaped end. The external fixator consists of two clamps to connect the four pins with the invivo exchangeable rods.
The external distractor, with its main concept similar to the external fixator, includes the option of distraction.
The method uses a miniature set of instruments to create an osteotomy and achieve standardized fixation of it. The techniques are designed to allow for flexible internal as well as external fixator splinting with variable gap widths as well as compression plating of osteotomy or fracture fragments that are in contact. Special care was taken to design of the instruments, implants and procedures to minimize surgical damage. Watch maker technology was applied.

Results so far:
Micro surgical techniques are demanding but the results obtained so far bay different institutions indicate that no major problems were encountered after initial training. The majority of the more than 1450 cases done at different institutions with the implant systems so far were performed using flexible splinting. Compression technology, bridging of large defects and applications to porotic bone were also achieved.

The goal of developing the new technologies for use in mice and rats was namely providing several technologies of fracture or osteotomy fixation similar to the technologies used in humans was achieved.
Methods presented here allow the selection of different degrees of flexibility of fixation and, at the same time, the creation of different gap widths.
Absolute stability or different degrees of reversible instability should permit investigation of the effects of defined fixation stability on fracture healing and non unions under different genetic conditions achieved by knockout technology.

The differnet technologies are available as research kits.

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