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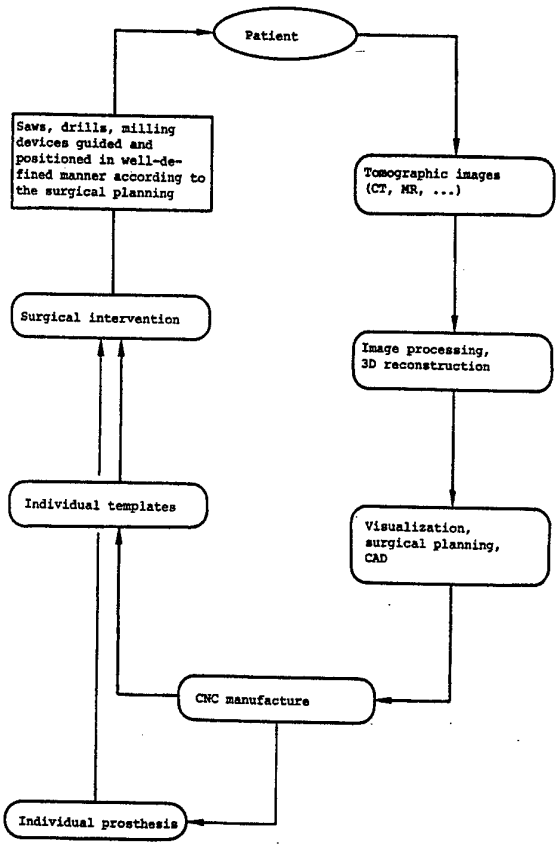
(54) Title: TEMPLATE FOR TREATMENT TOOLS AND METHOD FOR THE TREATMENT OF OSSEOUS STRUCTURES

(57) Abstract

Of an osseous structure to be treated, a reconstruction is produced. On the basis of the contact points of this reconstruction, abutment points are defined for a template for guidance, alignment and positioning of a treatment tool. The contact points are defined in such a manner that the template can be mounted on the osseous structure in form-closed manner in exactly one spatially uniquely defined position. On such a template, the treatment tool is fastened and guided in such a manner that the treatment of the osseous structure can be performed corresponding to the previous planning of the surgical intervention.



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Template for treatment tools and method for the treatment of osseous structures

The invention is directed to a template for treatment tools for the treatment of osseous structures and a method for the definition and reproduction of the positional relationship of a treatment tool relative to an osseous structure.

Using image producing methods such as computertomography and computer-based image-processing systems, it is possible to record osseous structures of the living organism in slices by a non-invasive technique, to reconstruct them three-dimensionally and to visualize them through an output medium. Further, such systems frequently permit already a three-dimensional planning of surgical interventions with regard to incisions, drilling, puncture, positioning of individual implants or other surgical interventions. Intraoperatively, i.e. during the actual sur-

gical procedure, there often occur orientation problems because no adequate technical means exist for a consequent, exact three-dimensional transfer of the steps of the intervention which have been planned with a waste of technical support. Therefore, the accuracy of execution depends exclusively on the experience, the three-dimensional perceptivity and the technical skill of the surgeon, which, depending on the type and the anatomical site of the intervention can involve extreme risks even with experienced surgeons. Generally, only freehand-guided instruments, two-dimensional tomographic images and pre- or intraoperative X-ray images are available.

For some interventions, standard tool guides have been provided. These are mostly cutting, boring or sinking templates for preparing and/or fixing the seat of a knee or hip joint prosthesis (as e.g. US 4,567,885, US 4,703,751, US 4,822,362, US 4,721,104, DE-33 39 259, EP 380 451, EP 415 837, EP 231 885, EP 228 339, DE 39 25 488, DE 79 14 280) or for repositioning osteotomies in the region of the proximal head of the femur or tibia (e.g. US 4,565,191, DE 38 42 645, DE 32 11 153). The intraoperative positioning of these templates relative to the bone is performed free-handed and even in case of special solutions allowing limited adaptation to the anatomical conditions, as e.g. in US 4,846,161, DE 34 47 163 or DE 40 16 704, can generally not be carried out exactly and clearly according to the planning of the intervention. In some approaches, intraoperative measurement and positioning under X-ray control are provided. This causes an increased expo-

sure to radiation for the patient and the medical staff, prolongs the duration of the surgical intervention and again is just an indirect and not clearly defined transfer of the treatment strategy defined in the surgical planning.

There also exist devices for stereotactical interventions. Principally, these devices can be divided into two categories. The first category comprises devices which, designed as rigid frames, are attached directly (e.g. by screws) on/in the bone and are adapted for rigid mechanical coupling to a positioning or coordinate measuring system with the reference points of said devices being reproduced in a tomographic image (e.g. stereotaxic apparatuses as described in Riechert et al.: Beschreibung und Anwendung eines Zielgerätes für stereotaktische Hirnoperationen, Acta neurochir., Vienna, Austria, Suppl. III (1955), 308; and in DE 37 17 871, DE 39 02 249 and EP 312 568). The second category comprises methods wherein individual reference bodies (marking elements, at least three of them) are fixed in or on the bone or the overlying skin surface already prior to tomographic scanning of the respective part of the body and subsequently are imaged in the tomographic pictures. These reference bodies und markers are then detected, as to their position and orientation, through a mechanically rigid construction or 3D coordinate measurement and evaluation for detection of the transformation relation between the coordinate systems of the bone structure, the tomographic images and the environment (Adams et al.: A navigation support for surgery. In: Höhne et al.:

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