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PLANNING IN TRAUMATOLOGY AND ORTHOPEDICS USING THREE-DIMENSIONAL COMPUTER RECONSTRUCTION TECHNOLOGY

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Abstract: Planning for surgical intervention is an important and integral stage in traumatology and orthopedics, which allows you to focus on the features of the clinical case and identify possible problems during the operation. However, the use of classical methods of preoperative examination is not able to fully provide the surgeon with all the necessary information about the operation at the preparation stage.

Keywords: Preoperative planning, method, three-dimensional computer reconstruction of CT scans (computed tomograms).

INTRODUCTION

Planning for surgical intervention is an important and integral stage in traumatology and orthopedics, which allows you to focus on the features of the clinical case and identify possible problems during the operation. At this stage, it is possible to assess existing changes in the musculoskeletal system, determine the stages of the operation, and select the required implant.

Today, the leading method for diagnosing the vast majority of skeletal bone diseases is radiography [1; 4]. This study is quite routine and consists, in the standard version, of taking X-ray photographs of the area of interest of the skeleton in two projections: frontal and lateral [2]. However, despite the simplicity and speed of this study, it also has some disadvantages: a standard radiographic analog image does not provide the full spatial location of bone fragments [3; 6; 10], since it is planar, two-dimensional, does not give an idea of the "depth" of the studied area of the skeleton. On a scale of three-dimensional coordinates, where X is the width, Y is the height, and Z is the depth of the object, an X-ray image can only provide information on the X and Y scales. Using such two-dimensional X-ray images, it is impossible to fully create, visualize and predict the stages of the upcoming surgical treatment. Particular attention should be paid to the technique of radiography: images must be taken in strictly defined projections. Unfortunately, this requirement is often not met for a number of reasons and, as a result, results in low-quality, uninformative images that are unsuitable for applying existing planning methods: taking measurements, using implant templates.

MATERIALS AND METHODS

The purpose of this study was to develop a methodology for preoperative planning in patients with injuries and post-traumatic deformities of the skeletal system, taking into account individual characteristics of changes in the musculoskeletal system, calculation of the necessary parameters for correction of deformity (if any), selection of a suitable implant and its correct location and drawing up on this the basis of a comprehensive plan for precision surgical intervention.

RESULTS AND DISCUSSION

As a "template," a model of an identical zone of the contralateral limb, mirrored in the sagittal plane, was used, in relation to which the deformity was corrected. The possibility of using a

three-dimensional model of the bone of the opposite limb is due to the high correlation of the structure of similar left- and right-sided anatomical structures [3]. The model of the healthy bone was layered onto the model of the affected bone structure in such a way as to ensure maximum coincidence of the image points not affected by the deformation, starting from the intact articular end. After the correction, a virtual model of the implant was superimposed on the three-dimensional image of the injured bone formed in this way, its correct location was made, the correct direction and angles of insertion of the screws were determined, and their length was measured. In the absence of a three-dimensional model of the required plate, absolute geometric calculations of the dimensions of the required implant were made. Based on the data obtained as a result of the above actions, a protocol was compiled and placed in the operating room.

On control radiographs in all patients, the position of bone fragments and metal fixators was satisfactory and corresponded to that calculated at the preoperative stage, and the anatomical osteoarticular relationships were as close as possible to those of the healthy, contralateral limb. Good and excellent immediate clinical results were achieved: the previous level of physical activity was restored in all operated patients. Of the working patients, all returned to their previous professional activities.

An important positive point is that the work on planning and calculations for the upcoming operation was carried out directly by the operating surgeon, who had an understanding of the specific clinical case, which also influenced the accuracy and speed of the calculations. The planning work did not require much time and was carried out the day before the upcoming surgical intervention.

Long-term treatment results were not assessed in depth, since this technique does not involve the introduction of new treatment methods, but is intended to increase the accuracy and speed of existing surgical techniques and techniques. Assessment of the quality of preoperative planning is possible directly at the time of the operation and when performing control instrumental studies. Thus, we can say that there is no correlation between the proposed algorithm and the methodology of preoperative planning and the possible development of postoperative complications in the long-term postoperative period.

CONCLUSION

Preoperative planning using three-dimensional computer reconstruction and modeling increases the accuracy of surgical interventions in patients with limb fractures and post-traumatic deformities of the skeletal system, provides the opportunity for a more detailed study of a specific clinical case, facilitating the adoption of the most appropriate decision on further treatment tactics. The described technique reduces time costs, reduces intraoperative trauma and exposure to an open wound, and also promotes more accurate placement of implants, taking into account the individual characteristics of each clinical case. The possibilities of “virtual” surgical interventions can also be used in the training process, helping to improve the level of training of specialists.

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