

Computer-assisted to personalized resection of bone tumor and precise bone reconstruction

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Objective: In the past 2 decades, the effect of treating bone tumors has significantly improved with the promotion and application of neo-adjuvant chemotherapy technology, as well as the rate of limb salvage and survival. The reservation of limb has great advantages for patients, especially for their psychology. The main problem, which limb-salvage-surgery is facing to, is how to fix bone defect and recover limb function. For treatment of therioma, the key procedure is resection of the lesions, and the purpose of the surgery is to decrease the rate of recurrence and systemic metastases. This study is focus on the new approach of computer-assisted to personalized resection and accurate reconstruction of bone malignant tumor, and to investigate the value of computer-assisted designing in the treatment of bone malignant tumor.

Method: Computed tomography and Magnatic Resonance Imaging is used in 13 clinic cases with bone malignant tumor to get 2-dimensional data of diseased area, the data is imported into the Mimics software (product of Materialise), and calculate 3D objects including 3-dimensional bone and joint objects from CT and 3-dimensional objects of lesions areas from MRI. The Reconstruction of 3-dimensional anatomical model, resection range of bone, designing of individual surgical template and personalized prosthesis were accomplished preoperatively by computers. And then, the resection template, allografts bone pruning template were made by liquid photopolymer resin with the technology of rapid photography (RP). Based on computer-assisted-design (CAD) proposal, we cut the tumor accurately with the help of tumor resection templates, and used allografts bone combined personalized prosthesis to reconstruct the bone defect after tumor resection. It is concluded that we can design resection range of bone easily, cut them accurately, reconstruct bone defect of diseased area precisely with the CAD technology.

Result: Bone malignant tumors in all 13 cases were accurately and completely cut, and allografts bones in matching shape with personalized prosthesis were used to reconstruct bone defect of diseased area, the effect of bone defect repairing is satisfied, and all patients begin walk in 3-6 months after operation. The Postoperation X-ray showed that the effect of reconstruction in bone defect was good, and the surgery reconstructs the anatomic structure of the bone defect. The X-ray shows that the conformation of limb is satisfying and consistent with the contralateral limb. The structure is stabilized and good at load-carrying, so it is possible to recover physical activity for patients.

Conclusion: Computer-assisted technology in analyzing and limiting the range of tumor resection is accurate and novel. How to ensure that we can cut the tumor in the surgery accurately according the preoperative plan comes to be very important. It will cause deviation if we cut the tumor in the surgery by our eyes or rulers, sometimes the deviation cannot be accepted. Personalized prosthesis added allogeneic bone used to treat bone tumor achieved satisfactory results and provide a new way of thinking to solve this problem. Such surgical procedures solve the traditional problems encountered in surgery: personalized prosthesis and residual bone is well matched, mechanical strength of integrated prosthesis is guaranteed, preoperative prosthesis installation and each screw's position are designed and the procedure of prosthesis installation is simulated. This method makes the treatment of bone tumors promote to individual stages, so the surgery is more accurate, more reliable, more convenient and better efficacy.