Primary malignant bone tumor resection and joint-sparing surgery under computer navigation

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Background: With application of musculoskeletal oncology surgical staging system, we learned that malignant bone tumors by appropriate surgical margin resection can reduce the local recurrence rate. With CT/MRI imaging qualities improving, it’s possible to make preoperative planning for distinguish the boundary of the tumor in imagings. The limb-salvage surgery have become the main trend for the patients with bone tumors. Along with the development of the computer aided navigation surgery in spine, joint surgery and neurosurgery, it become possible that the patients have better postoperative function and lower local recurrence rate by precise resection of the tumor for joint-sparing according to the preoperative planning.

Objective: The aim of this study was to report our experience for the precision tumor resection and joint-sparing reconstruction in musculoskeletal tumor surgery using image-guided computer navigation.

Methods: Between August 2008 and December of 2012, surgical resections and joint-sparing reconstructions were performed for 19 patients with primary malignant bone tumors with the assistance of the image-guided computer navigation. There were 9 females and 10 males with an average age of 24 years (127 to 59 years old). Tumors were located at distal femur diaphysis in 14 and tibia diaphysis (proximal in 4 cases and distal in 1 cases). There were 13 osteosarcoma, 4 chodrosarcoma, 1 hemangioendothelioma and 1 spindle cell sarcoma. Pre-operative CT of each patient and bone models were performed. We made the pre-operation planning for each patient with the Navigation system software that included conforming the tumor surgical margin, designing resection, using 31.4 mins and designing reconstructions with custom-made joint-sparing prosthesis in 12 cases and large allograft bone in 7 cases. Intro-operation, we carried out the process of registration and match the operative anatomy to the virtual image generated by the Navigation System software. Then we performed these surgical processes according the pre-operation planning. The designed average length of cutting tumor bone is 180mm (80mm~280mm). The mean length from level of the cutting tumor bone to articular surface is 34.5mm (12mm~50mm).

Results: All cases were follow-up. The tumor precision resections of all cases were done as pre-operation planning and joint-sparing reconstructions with custom-made prosthesis in 12 cases and allograft in 7 cases. All the resection specimens showed a safe and clear margin. The average distance of tumors resection margin to the joint were 17.4mm (7.5mm~35 mm). In 19 patients, 1 patient with osteosarcoma located proximal tibia had soft tissue recurrence after 1 year, the other 18 cases no local recurrence, and the recurrence rate is 5.26%. No remote transfer had been found in all cases. 1 patient with osteosarcoma located proximal tibia and reconstruction with allograft bone were performed amputation for postoperative infection after operation 6 months. 14 patients with more than 12 months follow-up were evaluated according MSTS score. An average rate of the limb function recovery is 88.2% (76.7%~96.7%).

Conclusions: The adequate surgical margin is very important for tumor resection. The computer navigation system is very helpful for the precision tumor resection and realization joint-sparing reconstruction for the patients with malignant bone tumor near joints.