A new surgical technique to perform guided multiplanar complex resections in bone tumours: an exemplification case of low-grade chondrosarcoma of distal femur.

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Abstract

Background: in muscular skeletal oncology aiming to achieve wide surgical margin is one of the main factors influencing patient prognosis. In cases where lesions are either a meta or epiphyseal surgery most often compromises joint integrity and stability because muscles, tendons and ligaments are involved in wide resection. When lesions are well circumscribed they can be completely resected by performing multi-planar osteotomies guided by computer-assisted navigation. Our aim is to describe a simple technique useful to perform complex multiplanar osteotomies also when a computed-assisted navigation is not available. An exemplificative case is reported.

Methods: A 57 year-old caucasian female was referred to our department for the presence of a distal femur chondrosarcoma. A resection with presenting technique was scheduled. The first step consists in inserting several K-wires under CT-scan control to delimitate the tumor; the second step consists in tumor removal: in operative theatre, after surgical access, k-wires are used as guide positioning scalpels externally to them to perform a safe osteotomy.

Results: a minimal wide resection is safely gained.

Conclusion: computed assisted resections can be considered the most advantageous in reaching the surgical outcome but unfortunately navigation systems are only available in specialized centres. The present technique allows to perform a multiplanar complex resection also where navigation systems are not available. This technique can be applied in low-grade tumours where a minimal wide margin can be considered sufficient.

Keywords: tumour resection, osteotomy, low-grade bone tumour, wide margin, navigation computer assisted
Background

In muscular skeletal oncology aiming to achieve wide surgical margin is one of the main factors influencing patient prognosis [1]. In cases where lesions are either a meta or epiphyseal surgery most often compromises joint integrity and stability because muscles, tendons and ligaments are involved in wide resection. Moreover, prosthesis reconstruction is necessary in most cases but not sufficient to maintain preoperative activity levels [2].

When lesions are well circumscribed they can be completely and safely resected by performing multi-planar osteotomies guided by computer-assisted navigation. This technique was recently applied in select patients with sarcomas however, the costs limit the procedure to be carried out in highly specialized centres where computer assisted navigation systems are available [3].

We propose a new safe surgical technique able to permit a minimally extended wide resection also in a non-specialized centre where computer assisted navigation is not available. An exemplification case is also reported, where it allowed to spare joint integrity, reducing the need of prosthesis reconstruction and assuring improved functional outcome.

Methods

A 57 year-old Caucasian female was referred to our department complaining of a pain in her right knee for the last six months. Radiology exams showed a non-homogeneous sclerotic lesion located in the medial aspect of the distal femur without cortical erosion resembling a benign chondroma (Fig.1). Due to local pain, a CT guided core biopsy was performed by medial access. The histology allowed to diagnose a low-grade chondrosarcoma. Given that the tumor did not compromise the joint surface, we decided to program a complex osteotomy to preserve joint stability. Computerized tomography (CT) was used to plan the cutting planes to facilitate minimal wide resection (Fig.2).
The day before surgery, K-wires were inserted to delimit the tumor defining the resections planes, sparing joint surface and intra-articular space (Fig.2). The K-wires were then cut under the skin.

The next day, in the operating theatre, the patient was placed in supine position; to access the surgical area the medial approach was used; the residual K-wires were identified and isolated externally until the bone surface (Fig.3). The scalpels were put externally to them and used as guide to perform a wedge shape resection removing biopsy track with the mass (Fig.4). Reconstruction was performed by morcellized bone allograft.

The study was authorized by the local ethics committee and was performed in accordance with the Ethical standards of the 1964 Declaration of Helsinki as revised in 2000. The patient gave permission for her case and imaging to be published.

**Results and Discussion**

A minimal wide resection was easily performed, allowing to spare joint stability. At two year follow-up the X-ray shows a quite complete osteointegration (Fig.5), the patient is free from disease and able to walk normally with a modest patellar lateral instability. The Musculoskeletal Tumor Society score is 25; the patient is particularly satisfied to have maintained joint integrity.

The main objective in oncological surgical orthopaedics is achieving a wide surgical margin because it is one of the most important prognostic factors [4]. Wide surgery can cause an important loss of function due to ligaments, muscles, tendons and neurovascular bundles that can be involved in resection.

In low grade tumours obtaining minimal wide resection can allow the patient to maintain a satisfying quality of life. Computed assisted resections can be considered the most advantageous in reaching the surgical outcome but unfortunately navigation systems are only available in specialized centres.
The present technique allows to perform a multiplanar complex resection also where navigation systems are not available. In our case the technique allowed to resect the mass sparing the joint and collateral ligaments, sacrificing just medial patellar retinaculum. This technique can be applied in low-grade tumours where a minimal wide margin can be considered sufficient.

The surgical treatment of low-grade chondrosarcoma of the appendicular skeleton remains controversial. Some authors prefer wide resection margins, while others consider intralesional curettage sufficient for adequate local control (5-6). This discordance is probably caused by interobserver variability in the histological diagnosis of cartilaginous tumours. Etchebehere et al. reported that biopsies yielded the correct diagnosis in 96% of chondrosarcoma cases, but in actual fact the correct grade was identified in only 46% of the time. This suggests that some chondrosarcomas may be undertreated using intralesional methods based on biopsy grading [7].

Our group sustains wide resection for low-grade chondrosarcoma as well as minimizing the risk of local recurrence. We also maintain that to reduce the risk of undertreating a lesion could be higher than expected at histology.

**Conclusions**

The present technique allows to safely perform a multiplanar complex resection also where navigation systems are not available. It can be applied in low-grade tumours where a minimal wide margin can be considered sufficient. More studies are advocated to verify its reliability.

**Competing interests**

The authors declare that they have no competing interests.

**Authors' contributions**
ZC devised the technique, performed the surgery and have given final approval of the version to be published;

RB participated to surgery and cared the patient follow-up;

FV supervised the draft and cared the patient follow-up;

AV performed the CT-guided K-wires insertion;

RA wrote the manuscript;
References


Figure Legends

Fig.1: Preoperative imaging showing a sclerotic lesion located in the medial aspect of the medial condyle.
Fig. 2: *CT scan showing the position of K-wires to define surgical margins.* In the upper left square the K-wire is inserted proximally to the lesion; in the upper right square two K-wires delimit the lesion laterally in the proximal part; in the lower left square two K-wires delimit the lesion laterally in the distal part; in the lower right the k-wire is inserted distally to the lesion.

Fig. 3: *An intraoperative image showing the isolated mass delimited by the K-wires.*

Fig. 4: *The scalpels were placed externally to the K-wires to perform multiplanar osteotomy; in the square the surgical specimen after resection with a k-wire resected en-bloc.*

Fig. 5: *At two years follow-up, X-rays showing rather normal distal femurs; in the left square an immediate post-operative CT scan evidencing the wedge shaped osteotomy and rearrangement after a two year period.*