CASE REPORT

Distant metastasis of intraosseous dentinogenic ghost cell tumour to the donor site of a bone graft

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A dentinogenic ghost cell tumour (DGCT) is an extremely rare odontogenic tumour which is considered as a solid, neoplastic variant of calcifying odontogenic cyst. Intraosseous DGCTs are more aggressive than extraosseous DGCTs and have a high propensity for local recurrence. This report describes a case of a diagnosis of recurrent DGCT at the primary site and a distant donor site. A 25-year-old female patient visited a dental hospital for a complaint of facial swelling for the previous month. Incisional biopsy was performed and the specimen was diagnosed as DGCT. Partial mandibulectomy for tumour resection and iliac bone graft was performed. 2 years later, the tumour recurred on the mandible and iliac bone. The recurrent lesion on the donor site was diagnosed as metastasized DGCT. This report highlights the possibility of distant metastasis occurring at a graft donor site.

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Case report

A 25-year-old female patient visited a dental hospital with a chief complaint of left facial swelling. She had a history of pain in the left molar region for 1 month. Her medical history was non-contributory. Extraoral examination revealed a non-tender diffuse left facial swelling. Intraoral examination revealed a swelling on the left mandibular area. The left premolar and molars were dislocated and showed severe mobility. On the plain radiographs including the periapical and occlusal radiographs, a well-circumscribed multilocular radiolucent lesion was found extending from the apical area of the left first premolar to the anterior border of mandibular ramus. The root resorption of the left first molar had been observed (Figure 1). The contrast-enhanced CT scan revealed a well-defined heterogeneous enhanced soft-tissue mass with cortical expansion on the left mandibular

body (Figure 2). The cystic component was found at the inferior aspect of the soft-tissue mass. The incisional biopsy and extraction of the left mandibular first molar were performed. The specimen was diagnosed as a dentinogenic ghost cell tumour (DGCT). A partial mandibulectomy for tumour resection and iliac bone graft were performed under general anesthesia.

2 years later, the patient visited our department owing to a huge recurrent mass on the mandible. The patient complained of a facial swelling and spontaneous pain on the mandible. The lesion was first noticed about 4 months earlier and had grown slowly. A panoramic radiograph showed a recurrent lesion with bony destruction on the mandibular body from the right first molar to the left mandibular angle. Root resorption and displacement of the adjacent teeth were observed (Figure 3). CT images showed a huge multilocular soft-tissue mass with bony destruction of the mandible from the right first molar to the left mandibular angle (Figure 4). MRI scan revealed a tumour that had invaded the right mandible and extrinsic muscles of the

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Figure 1 The plain radiographs taken initially are seen. The periapical and mandibular cross-sectional occlusal radiographs show root resorption of left first molar and displacement of left second and third molar

tongue. The lesion consisted of a cystic and a solid portion. The cystic portion showed a homogeneous intermediate intensity signal on a T_1 weighted image (WI), homogeneous high-intensity signal on T_2 WI and no enhancement on Gadolinium (Gd)- T_1 WI. The solid portions showed a heterogeneous intermediate-low signal on T_1 WI, a heterogeneous high signal on T_2 WI and intermediate enhancement on Gd- T_1 WI (Figure 5).

Mass resection with partial mandibulectomy was performed and the mandible was immediately reconstructed with the left fibular myo-osseous free flap. Histopathological examination revealed a solid tumour with a thin fibrous capsule. The tumour cells were made

up of anastomosing broad cords, reminiscent of the plexiform type of ameloblastoma (Figure 6a). Peripheral columnar cells with a distinct reverse polarity were arranged in palisaded pattern, and the inner cells were similar to the stellate reticulum of the enamel organ. In contrast to ameloblastoma, the stellate reticulum-like cells had not transformed to squamous, granular or basal cells, but nests of eosinophilic ghost cells were sporadically observed in the stellate reticulum area (Figures 6a,b). Dysplastic dentin was also formed in between the tumour cells (Figure 6c). The specimen was diagnosed with recurrent DGCT.

The patient was referred to the Department of Orthopedics of the Seoul National University Hospital, Seoul, Republic of Korea, for the evaluation of the left ilium that was the donor site of bone graft at the first surgery. The lesion on the left ilium was discovered accidentally on the bone scan and angiography that had been taken for planning the second surgery. A bone scan showed a photon defect on the left ilium, and angiography showed an enhancing lesion about 6 cm in diameter.

A pelvic MRI showed a multilocular soft-tissue mass, similar to the primary lesion in the mandible (Figure 7). Ultrasonography-guided biopsy was performed on the left ilium. Histopathological examination revealed similar findings to those of the initial tumour of the

Figure 2 A contrast enhanced CT image taken initially shows a heterogeneous enhanced soft-tissue mass with cortical expansion on the left mandibular body

Figure 3 Panoramic radiograph shows a recurrent lesion with bony destruction on mandibular body from the right first molar to the left mandibular angle. Root resorption and displacement of the adjacent tooth are observed

Figure 4 CT images show a huge multiseptated soft-tissue mass with bony destruction on the mandibular body from right first molar to left mandibular angle

mandible, and there was no evidence of malignant transformation. The specimen was diagnosed as metastasized DGCT. Wide excision was performed on the left ilium. There has been no evidence of recurrence or metastasis in the 3 years since the operation.

Discussion

The DGCT is an extremely rare odontogenic tumour, which is considered to be a solid, neoplastic clinicopathological variant of a calcifying odontogenic cyst (COC).¹ Since first described by Gorlin *et al*,² the COC represents a heterogeneous group of lesions that exhibit a variety of clinicopathological features. In 2005, the World Health Organization reclassified this entity as a calcifying cystic odontogenic tumour (CCOT), a DGCT and a ghost cell odontogenic carcinoma (GCOC). A CCOT is a benign cystic odontogenic neoplasm, characterized by local invasiveness and rare recurrence following enucleation. A DGCT is a locally invasive neoplasm characterized by ameloblastoma-like islands in a mature connective tissue stroma associated with the presence of aberrant keratinization in the form of ghost cells and varying amounts of dysplastic dentin. A GCOC is a malignant odontogenic epithelial tumour with highly aggressive and recurrent features.^{3,4}

DGCTs occur as intraosseous and, less commonly, as extraosseous variants.⁵ Intraosseous DGCTs are more aggressive than extraosseous DGCTs and have a high propensity for local recurrence.⁶⁻⁸ According to previous reports, patients ranged in age from 12 years to 75 years, with a mean age of 40.3 years old, and there was no gender predilection.⁶ In our case, the patient was a 25-year-old female, much younger than the reported patients with occurrence of DGCT.

Radiographically, DGCT shows a well-defined, mostly unilocular lesion that varies from a radiolucent to a mixed radiolucent/radio-opaque appearance depending on the amount of calcification.^{4,6} Root resorption of adjacent tooth is not uncommon.⁵ In the present case, the plain radiographs showed a multilocular radiolucent lesion with a bone destruction. CT and MRI of the recurrent lesion showed a mixed lesion that consisted of a cystic portion and a solid portion. Displacement and root resorption of the adjacent tooth were characteristic findings. Although the mitotic figures were not found among the cells from the initial tumour, there was evidence of tumour invasion of the surrounding cortical bone and soft tissue.

DGCT may have an infiltrative growth pattern and a high rate of recurrence after resection.^{9,10} Consistent with the previous reports, this case indicated that intraosseous DGCT should be treated by resection with an adequate safety margin, as recommended.⁶

Tumour recurrence at the bone graft donor site is rare but several cases of osteosarcoma, giant cell tumour and histiocytoma have been reported.¹¹⁻¹⁶ However, there has been no report about the metastasis of an odontogenic benign tumour to the bone graft site in the English literature. This report might be the first report about a metastasizing DGCT that was diagnosed at the distant donor site as well as the primary site. Implantation metastasis is defined as metastasizing tumour by seeding tumour cells into a wound or tissue.¹⁵ The exact mechanism of seeding of the primary tumour to the graft donor site is unclear and controversial.¹³ There are two theories for implantation metastasis in our case. First, the lesion might have originated from the contamination of the initial donor site. This theory arises from the possibility of the presence of free tumour cells on surgical instruments and gloves.¹⁷ Second, the tumour might have

Figure 5 MR images reveal a tumour that invades the right mandible and extrinsic muscles of the tongue. (a) Axial T_2 weighted image (WI) shows a huge mass of heterogeneous high signal intensity. (b) Sagittal enhanced T_1 WI demonstrates superior intermediate enhancement of the solid portion and inferior large cystic portion. Note: no enhancement of the homogeneous cystic portion. (c) Axial enhanced T_1 WI demonstrates intermediate enhancement of the solid portion. (d) Sagittal enhanced T_1 WI shows an inferior large cystic portion. Note: no enhancement of the homogeneous cystic portion

Figure 6 Histopathological specimen [haematoxylin and eosin stain, original magnification, (a) $\times 40$, (b) $\times 200$ and (c) $\times 200$]. (a and b) The tumour cells were made up of anastomosing broad cords, reminiscent of the plexiform type of ameloblastoma. Peripheral columnar cells with a distinct reverse polarity are arranged in a palisaded pattern, and the inner cells are similar to the stellate reticulum of the enamel organ. The nests of eosinophilic ghost cells are sporadically observed in the stellate reticulum area, and multinucleated giant cell lesions in the fibrous stroma. (c) Dysplastic dentin between the tumour cells is observed

Figure 7 Axial enhanced T_1 weighted MR images of pelvis show an enhanced multilocular soft-tissue mass on left ilium

originated from the direct haematogenous spreading to the pelvic area. Although direct contamination was more likely, seeding also could be attributable to the altered

circulation at the healing donor site, possibly leading to haematogenous spread of tumour seeds.¹³

The risk of tumour implantation can be minimized by the surgeon using new surgical instruments for bone graft harvesting. Also, changing the gloves and gown would be recommended. The harvest site could be treated additionally with sterilizing solutions. Preferably, the choice of the bone harvest site should be more distant from the site of the tumour surgery, reducing the risk of any direct exposure of the donor area to the tumour tissue.¹⁴ Dias *et al*¹³ suggested that the tumour should be removed first and then the graft bone should be harvested to prevent haematogenous spreading of tumour seeds. Standard precautions and careful techniques are important for surgeons to avoid iatrogenic metastasis.

In conclusion, this report highlighted the possibility of distant metastasis occurring at a graft donor site. Standard precautions should be taken to avoid iatrogenic metastasis.

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