RESEARCH ARTICLE

Solitary plasmacytoma of maxillofacial bones: correlation of CT features with pathological findings

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Objective: To explore the CT features of solitary plasmacytoma (SP) of maxillofacial bones and correlation with pathological findings.

Methods and materials: We retrospectively reviewed the clinical, CT and pathological features of SP in the maxillofacial bones. 16 patients with clinically and histologically proven SP of maxillofacial bones were involved. They were aged from 27 to 79 years old (median 55.5 years old), and included 12 males and 4 females (males vs females: 3:1). All patients performed CT examination, in whom 13 patients underwent enhanced scanning and 3 plain scanning. The CT images were assessed for lesion location, size (maximum diameter), shape (round, oval and irregular), boundary (defined and illdefined), bone changes (bone destruction, residual bone, sclerotic margin and periosteal reaction), density of soft tissue mass and enhancement manifestations, and invasion of adjacent structures.

Results: 13 patients suffered from SP in the mandible, 2 in the zygoma, and 1 in the maxilla and hard palate. The maximum diameter of lesions ranged from 2.4 to 8.2 cm (mean 3.93 ± 1.435 cm). Most lesions were founded as a solitary osteolytic lesions (15/16, 93.75%) with round or ovoid shape (13/16, 81.25%), smooth margin (16/16, 100%) and defined boundary (16/16, 100%) in bone marrow. They destroyed bone cortex (15/16, 93.75%) and had residual bone (10/16, 62.5%), without sclerosis margin (15/16, 93.75%) and periosteal reaction (14/16, 87.5%). They easily formed soft tissue masses (16/16, 100%) and invade adjacent anatomical structures (15/16, 93.75%). The density of lesions was usually uniform (12/16, 75%) with strong enhancement. There was a significant difference in CT values between plain and enhanced scanning [50.75 ± 9.140 Hounsfield unit (HU) vs 101.0 ± 28.830 HU; $p < 0.001$), with the mean difference of CT values 50.25 HU.

Conclusions: SP is predominant in the mandible of elderly male patients. A solitary, round or ovoid, well-defined, osteolytic, invasive mass in bone marrow, which destroys bone cortex, has residual bone, no sclerosis margin and periosteal reaction, and shows strong enhancement, is suggestive of this diagnosis.

Dentomaxillofacial Radiology (2020) 49, 20190277. doi: [10.1259/dmfr.20190277](https://doi.org/10.1259/dmfr.20190277)

Cite this article as: Liu Y, Li K. Solitary plasmacytoma of maxillofacial bones: correlation of CT features with pathological findings. *Dentomaxillofac Radiol* 2020; 49: 20190277.

Keywords: Solitary Plasmacytoma; Maxillofacial Bones; Computed tomography; Orthopantomography; Pathology

Introduction

Solitary plasmacytoma (SP) is a solitary plasma cell neoplasm characterized by the lymphoid neoplastic proliferation of B cells.¹ SP is rare compared with multiple myeloma (MM), accounting for less than

5% of plasma cell neoplasms.² SP can be divided into two subtypes according to its occurrence in bone or soft tissue. Solitary bone plasmacytoma (SBP) is developing within marrow-rich bones, mainly in the axial skeleton and pelvic bones.² Solitary extramedullary plasmacytoma (EMP) is developing within soft tissue, especially in the upper respiratory tract.² SP of

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Received 14 July 2019; revised 21 September 2019; accepted 24 September 2019

maxillofacial bones is a relatively rare condition. It is reported that the incidence of SP in mandible is 4.4% within the maxillofacial regions.³ The incidence of SP in maxillofacial bone is low and its clinical symptoms are not specific. So the clinical diagnosis of SP in maxillofacial bones is quite difficult and often leads to misdiagnosis.

Pre-treatment imaging diagnosis of SP in maxillofacial bones is of great significance. Many imaging modalities can be used, such as skeletal survey, CT, MR and positron emission tomography (PET)/CT.⁴ SP of maxillofacial bones is usually treated with maxillofacial discomfort in the department of oral and maxillofacial oncology. Oral and maxillofacial surgeons firstly recommend patients orthopantomography examination. On the one hand, the density resolution and sensitivity of radiography are poor and make it difficult to diagnose early lesions. On the other hand, the anatomical structure of the maxillofacial bones is complex and lesions may be occluded in radiography.⁴ CT examination just makes up for these shortcomings and makes it an important tool for diagnosis of SBP.⁵ MRI has a good soft tissue resolution and has a certain value in improving the staging of tumors. But the sensitivity of MRI for bone change is inferior to CT.⁶ ¹⁸F-FDG PET/CT can cover the whole body and identify tumor sites with high sensitivity. So for the SBP, ¹⁸F-FDG PET/CT is mainly used to identify whether SBP is progressing to MM or not.⁷

The published literature of CT findings of SP in maxillofacial bones is very little. And there were only little case reports about cone beam CT findings of SP in maxillofacial bones.⁸ The enhanced imaging features of SP in maxillofacial bones nearly have not been reported thus far. Thus, the objective of this study was to characterize the CT findings of SP in maxillofacial bones, especially enhanced CT, and correlate these findings with pathology.

Methods and materials

The study was approved by the Institutional Research Ethics Committee of the local hospital.

Patients

We have retrospectively reviewed the SP of maxillofacial bones confirmed by pathological, imaging and clinical data from January 2005 to December 2018. 16 patients with CT scanning were involved, including 12 males and four females, aged from 27 to 79 years old (median 55.5 years old). We reviewed the imaging exams, clinical records and pathological reports of these patients. The imaging modalities and findings, clinical signs and pathological characteristics were analyzed.

Radiological examinations

CT scanning

All the 16 patients underwent CT plain scanning, in whom 13 patients underwent enhanced scanning. The CT examinations were performed with 64-slice (Philips Healthcare, Best, The Netherlands) or 16-slice/64-slice multidetector CT scanner (GE Healthcare, Milwaukee, WI). The scanning parameters were as follows: 120 kV, 240 mA, 5 mm slice thickness with 1 mm reconstructions, 22 cm field of view (FOV) and 256 × 256 matrix. The enhanced scanning was performed after 40 s delay of injection of contrast media. The nonionic contrast agent (iopamidol, 300 mgI ml⁻¹, Bracco, Milan, Italy) was injected through antecubital vein with 70 ml dose at a rate of 2.5–3 ml s⁻¹.

Orthopantomography

9 of the 16 patients underwent orthopantomography. Panoramic radiography was obtained using a Vera-viewepocs 3D unit (J. MORITA MFG.CORP., Kyoto, Japan). It was operating at 60 kVp, 2 mA and exposure time of 17.2 s.

MRI

Only 1 of the 16 patients underwent MRI. MRI was performed using a Ingenia 3.0 T unit (Philips Healthcare, Best, The Netherlands) with a sense head/neck coil. Scanning protocols included axial T_1 weighted image (T_1 WI), T_2 weighted image with fat saturation (T_2 Wifs), coronal T_2 weighted image (T_2 WI), axial diffusion-weighted imaging (DWI), dynamic contrast enhanced (DCE) T_1 WI with fat saturation (T_1 Wifs), and axial and coronal delayed phase enhanced T_1 Wifs. The main scanning parameters were as follows: T_1 WI [repetition time/echo time (TR/TE), 615/18 ms], T_2 WI (TR/TE, 2692/85 ms), DWI (TR/TE, 2255/68 ms with b -factor of 0 and 1,000 s/mm²), and DCE- T_1 WI (TR/TE, 580/15 ms). Images were obtained with 22 cm FOV, 256 × 256 matrix, 5 mm section thicknesses, and 5.6 mm spaces. The contrast-enhanced MRI was obtained using contrast agent Gadolinium-DTPA (Magnevist; Schering) with a dose of 0.1 mmol/kg at a rate of 1.5–2 ml s⁻¹.

Image analysis

Two radiologists reviewed all CT, orthopantomography and MR images in consensus, mainly the CT images. The images were assessed by lesion location, size (maximum diameter), shape (round, oval and irregular), boundary (defined and ill-defined), bone changes (bone destruction, cortical destruction, residual bone, sclerotic margin and periosteal reaction), density/signal intensity of soft tissue mass, enhancement manifestations, and invasion of adjacent structures.

Table 1 The clinical data of the patients

Case	Sex	Age	Symptom	Time interval from onset to consultation (month)	Treatment
1	F	79	Preauricular repeated swelling and pain	8	Resection and radiotherapy
2	M	41	Facial swelling	6	Resection and radiotherapy
3	M	41	Suborbital swelling	4	Resection and radiotherapy
4	F	60	Facial swelling	6	Resection and radiotherapy
5	M	27	Facial swelling	2	Resection and radiotherapy
6	M	70	Mandibular pain	12	Biopsy and radiotherapy
7	M	51	Numbness of lower lip	1	Biopsy and radiotherapy
8	M	64	Toothache and loosening	2	Resection and radiotherapy
9	F	74	Facial swelling and numbness of lower lip	12	Resection and radiotherapy
10	M	62	Numbness of lower lip and chin	4	Biopsy and radiotherapy
11	M	45	Mandibular swelling with numbness	7	Biopsy and radiotherapy
12	M	44	Painless swelling of earlobe	3	Resection and radiotherapy
13	M	43	Infraorbital swelling and pain	3	Biopsy and radiotherapy
14	M	48	Symptomless	1	Resection and radiotherapy
15	F	76	Facial swelling with numbness	2	Resection and radiotherapy
16	M	65	Numbness of lower lip	1	Resection and radiotherapy

Pathological examination

All lesions specimens were fixed with 4% paraformaldehyde, decalcified with 8% formic acid, embedded in paraffin, sectioned, stained with hematoxylin eosin (H&E) and observed under light microscope. Immunohistochemistry was labeled and stained by avidin–biotin–peroxidase conjugated method.

Statistical analysis

IBM SPSS Statistics19.0 software package was used for statistical analysis. The lesion location, shape, boundary and bone changes were expressed by percentage and composition ratio. The lesion maximum diameters and CT values were described by mean $\pm$ standard deviation. The difference of CT values between the before and after contrast enhancement were compared by paired sample *t*-test. The difference was statistically significant with a *p* < 0.05.

Results

The clinical presentation

The clinical data of all patients were summarized in Table 1. From the table we could see that the patients with SP in maxillofacial bones usually suffered from the swelling, pain and numbness (14/16, 87.5%). Only one patient presented with toothache and loosening, and one patient had no clinical symptoms. Time interval from onset to consultation was from 1 to 12 months (median months: 3.5 months). 5 patients underwent tumor biopsy and radiotherapy, and 11 patients underwent tumor resection and radiotherapy.

Radiological findings

The CT findings of all patients were summarized in Tables 2 and 3. 13 patients suffered from SP in the

mandible, 2 in the zygoma, and 1 in the maxilla and hard palate. The maximum diameter of lesions ranged from 2.4 to 8.2 cm (mean 3.93 ± 1.435 cm). Most lesions were founded as a solitary osteolytic lesion (15/16, 93.75%) with round or ovoid shape (13/16, 81.25%), smooth margin (16/16, 100%) and defined boundary (16/16, 100%) in bone marrow. They destroyed bone cortex (15/16, 93.75%) and had residual bone (10/16, 62.5%), without sclerosis margin (15/16, 93.75%) and periosteal reaction (14/16, 87.5%). They easily formed soft tissue masses (16/16, 100%) and invade adjacent anatomical structures (15/16, 93.75%). The density of lesions was usually uniform (12/16, 75%) with strong enhancement (Figure 1). There was a significant difference in CT values between plain and enhanced scanning [50.75 ± 9.140 Hounsfield unit (HU) vs 101.0 ± 28.830 HU; *p* < 0.001], with the mean difference of CT values 50.25 HU. Figure 1 was the classical CT findings of SP in the mandible.

Orthopantomography revealed defined, unilocular, and expansive radiolucent lesion in bone marrow for all nine patients. The lesions usually destroyed bone cortex (8/9, 88.89%), without sclerosis margin (8/9, 88.89%) and periosteal reaction (8/9, 88.89%). Figure 2 was the classical orthopantomography findings of SP in the mandible.

MRI findings revealed expansive bone destruction in the right zygomatic–maxillary complex. The bone cortex signal was discontinuous. Compared with muscle tissue, the lesion showed iso-signal on T_1 WI, slightly high signal on T_2 WI, high signal on T_2 WIs, and obvious enhancement after enhancement. The lesion diffusion was limited on DWI and apparent diffusion coefficient (ADC) value was $0.6 \times 10^{-3} \text{ mm}^2 \text{ s}^{-1}$. And DCE- T_1 WIs showed that the time signal curve of the lesion was fast-in and wash-out. Figure 3 was the classical CT and MRI findings of SP in the zygomatic–maxillary complex.

Table 2 The CT findings of the patients

Case	Location	Size (cm)	Shape	Margin	Boundary	Density	CT value (HU)	CT value enhancement (HU)
1	L; condyle	2.8	Round	Smooth	Defined	Uniform	60	120
2	R; mandibular angle	2.8	Oval	Smooth	Defined	Uniform	34	/
3	R; zygoma	3	Oval	Smooth	Defined	Uniform	55	130
4	R; condyle	3.5	Round	Smooth	Defined	Uniform	64	154
5	L; zygoma	5.4	Irregular	Smooth	Defined	Non-uniform	45	85
6	R; mandibular body and angle	4.2	Oval	Smooth	Defined	Uniform	61	151
7	L; mandibular ramus	3.1	Oval	Smooth	Defined	Uniform	59	92
8	R; mandibular chin and body	2.4	Round	Smooth	Defined	Uniform	50	87
9	L; mandibular angle and ramus	4.1	Round	Smooth	Defined	Uniform	44	103
10	L; mandibular angle and ramus	3.3	Oval	Smooth	Defined	Uniform	52	79
11	R; mandibular body	8.2	Oval	Smooth	Defined	Uniform	55	/
12	R; mandibular ramus	4.8	Round	Smooth	Defined	Non-uniform	49	82
13	L; maxilla and hard palate	4.9	Irregular	Smooth	Defined	Non-uniform	32	/
14	L; mandibular ramus	2.7	Irregular	Smooth	Defined	Uniform	54	87
15	R; mandibular body and ramus	4.1	Round	Smooth	Defined	Non-uniform	44	80
16	R; mandibular body	3.6	Round	Smooth	Defined	Uniform	54	63

HU, Hounsfield unit.

Pathologic findings

On the naked eye, the neoplasm was nodular, gray-white, brittle, easy to bleed, and had few necrotic tissue. Microscopically, the tumor cells showed patchy distribution with various degrees of differentiation. Well-differentiated tumor cells resembled normal plasma cells, which were round or oval, rich in cytoplasm, basophilic, nuclear deviation, wheel-like arrangement of chromatin and obvious light-stained halo around nucleus. The poorly differentiated tumor cells were difficult to distinguish their cytoplasmic plasma characteristics. They had obvious atypia, large and irregular nuclei, large proportion of nucleoplast, thick nuclear membrane, no wheel-like arrangement of chromatin, large nucleoli, binuclear

or polynuclear giant cells and common mitotic figures. Tumor tissue had little stromal and necrotic content, but rich blood vessels. The Immunohistochemical findings of all patients were summarized in Table 4. Immunohistochemical results were absent in five cases. The remaining 11 immunohistochemical examination showed CD138 positive (11/11, 100%), CD38 positive (7/7, 100%), 3 cases of κ positive / λ negative, 6 cases of κ negative / λ positive, CD79a positive (9/9, 100%), CD56 positive (5/7, 71.4%), EMA positive (5/6, 83.3%), CD3 negative (8/9, 88.9%) and CD20 negative (8/8, 100%). And Ki67 positive expression level in most cases (8/9, 88.9%) was lower than or equal to 30%. Figure 4 showed the H&E and Immunohistochemical staining of SP.

Table 3 The CT findings of the patients in bone changes

Case	Bone destruction	Bone cortex	Residual bone	Sclerotic borders	Periosteal reaction	Soft tissue mass	Invasion of adjacent structures
1	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes
2	Osteolytic lesion	Interruption	No	Yes	No	Yes	Yes
3	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes
4	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes
5	Osteogenic bone lesion	Interruption	No	No	Radial	Yes	Yes
6	Osteolytic lesion	Interruption	No	No	No	Yes	Yes
7	Osteolytic lesion	Interruption	No	No	No	Yes	Yes
8	Osteolytic lesion	Interruption	No	No	No	Yes	Yes
9	Osteolytic lesion	Interruption	Yes	No	Radial	Yes	Yes
10	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes
11	Osteolytic lesion	Interruption	No	No	No	Yes	Yes
12	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes
13	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes
14	Osteolytic lesion	Continuity	Yes	No	No	Yes	No
15	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes
16	Osteolytic lesion	Interruption	Yes	No	No	Yes	Yes

Figure 1 A representative case of SP of mandible in a patient (female, 60 years old) on CT images. (a) A single osteolytic lesion is found in the right mandibular ramus and condyle. (b) The soft tissue mass is formed in the bone destruction region. (c) After enhancement, the lesion is uniformly and obviously enhanced. SP, solitary plasmacytoma.

Discussion

SBP is a malignant tumor that is caused by abnormal proliferation of plasma cells. It originates from bone marrow and causes single osteolytic lesions. In addition to the tumor localization in bone tissue and the phenotype of plasma cell differentiation, the clinical diagnosis of SBP must also exclude systemic plasma cell diseases

Figure 3 A representative case of SP of maxillary in a patient (male, 40 years old) on CT images and MRI. (a) A single osteolytic lesion is found in the right zygomatic-maxillary complex. (b) The soft tissue mass is formed in the bone destruction region. (c) After enhancement, the lesion is uniformly and obviously enhanced. (d) On axial T_1 WI, the lesion shows iso-signal compared with muscle tissue. (e) On axial T_2 WIFs, the lesion shows uneven high signal intensity compared with muscle tissue. (f) After enhancement, the lesion is obviously enhanced. (g) On axial DWI, the lesion shows high signal intensity. (h) On ADC map, the lesion shows low signal intensity and the ADC value is $0.6 \times 10^{-3} \text{mm}^2 \text{s}^{-1}$. (i) The time signal curve of the lesion is fast-in and wash-out. ADC, apparent diffusion coefficient; SP, solitary plasmacytoma; T_1 WI, T_1 weighted image; T_2 WIFs, T_2 weighted image with fat saturation.

such as MM. The SBP diagnostic criteria was recommended by the International Myeloma Working Group in 2014.⁹ All 16 patients in this group met the above criteria. Its etiology and pathogenesis have not yet been

Figure 2 The same patient with Figure 1. Orthopantomography reveals defined, unilocular, and expansive radiolucent lesion in the right mandibular ramus and condyle.

Table 4 The Immunohistochemical findings

Case	CD138	CD38	κ	λ	CD79a	CD56	CD20	CD3	EMA	Ki67
1	+	+	-	+	+	+	-	-	/	10–20%+
2	+	+	-	+	/	/	-	-	+	5%+
3	+	/	-	+	+	+	-	-	/	10%+
4	+	+	+	-	+	-	-	-	/	5%+
5	+	+	-	+	+	-	-	-	/	20%+
6	+	+	+	-	+	+	-	+/-	+/-	10%+
7	+	+	-	+	+	/	-	/	+	40–50%+
8	+	+	-	+	+	+	-	-	-	/
9	+	/	/	/	/	+	/	-	+	20–30%+
10	+	/	/	/	+	/	/	-	+	30%+
11	+	/	+	-	+	/	/	/	/	/

+positive; -negative; ± partially positive;/ undo

clarified. It occurs mostly in males aged 40–60 years.⁸ The ratio of males to females is 2:1.² In this group, the age was ranged from 27 to 79 years (median 55.5 years) and the ratio of males to females was 3:1, which was basically consistent with the literature reports. It usually occurs in the central axis bone, and spine is the most common site. It can also involve pelvis, humerus, femur and skull.^{10,11} It is rare to occur in the maxillofacial bones. The clinical symptoms of SBP are lack of specificity. It mainly manifests as local pain, lumps or tenderness. If it occurs in the maxillofacial bones, it can also show pain or looseness of the teeth and numbness of the lips. In this group, the patients with SP in maxillofacial bones usually suffered from the swelling, pain and numbness. The relationship between SBP and MM is still controversial. Most scholars believe that SBP is a clinical disease different from MM, because there are great differences in clinical manifestations, course and prognosis.² Some scholars believe that SBP should belong to the early stage of MM.² The average age of onset of SBP is about 10 years earlier than MM. Although a few patients have stable lesions for a long time, many patients (about 10–60%) will eventually progress to MM within 3 years.⁹ Progression to MM is the main factor affecting the survival of patients with

SBP. Many scholars advocate local radiotherapy for the recommended treatment of SBP.^{12,13} If the destruction of bone is serious and affects the stability of bone structure, surgery plus radiotherapy can be considered.¹⁴

Histologically, SBP has a large difference in cell morphology, from mature plasmacytes to highly atypical cells completely different from plasmacytes. SBP is classified into three grades according to the differentiation degree of tumor cells.¹⁰ Grade I tumor cells resemble normal plasmacytes without obvious atypia. Grade II tumor cells have obvious atypia and nuclear division can be seen. Grade III tumor cells are highly atypical and nuclear division is common. Immunophenotypes, such as CD38, CD138, and monoclonal λ or κ light chain globulin were expressed, but plasmacytes whole B-cell antigen (CD20) were not expressed.¹⁵ Ki-67 was generally low in typical plasmacytoma (10%–30%). In anaplastic plasmacytoma and plasmoblastoma, Ki-67 was generally more than 50%.¹⁵ The positive expression of CD38, CD138, λ or κ in this group indicated that the tumor cells had plasma cell differentiation phenotype. The number of Ki-67 positive cells in most cases was less than 30%, suggesting that the pathological tumor cells were well differentiated.

Skeletal radiography is a routine conventional imaging method for the diagnosis of SBP. And orthopantomography is used for maxillofacial lesions. But the density resolution or soft tissue resolution of X-rays is inferior to that of CT and MRI. CT has a high density resolution, and CT can show the destruction of bone fine structure earlier than X-rays.⁴ CT scanning combined with various reconstruction techniques can clearly show the destruction mode, characteristics, degree and extent of bone destruction of maxillofacial SBP. And it can show the residual bone ridge in the bone destruction area, the proliferation and sclerosis of surrounding cortex, and the multiple ruptures of tumors through the cortex. Although the above findings can also be displayed on MRI, CT can more clearly show the bone changes. So CT is an important imaging diagnostic method for maxillofacial SBP. In recent years, PET/CT has been gradually used to evaluate the therapy efficacy

Figure 4 Histopathological images of SP of mandible in a patient (female, 60 years old). (a) H&E-stained section shows a sheet-like pattern of atypical plasma cells (40×). (b) Immunohistochemical stain for CD38 shows positive reaction (40×). H&E, hematoxylin and eosin; SP, solitary plasmacytoma.

of SBP and differentiate it from MM.⁶ But it is seldom used in the diagnosis of SBP because of high false positive. In addition, the cost and radiation dose of PET/CT are high. The authors believe that the combination of X-rays and CT can greatly improve the diagnostic accuracy of patients with suspected maxillofacial SBP, from the consideration of diagnostic cost and diagnostic effect.

The imaging findings of SBP are mostly concentrated in the spine and skull in the literature. There is no complete and systematic report on the imaging findings of SP in maxillofacial bones, and only a few cases have been reported. Moreover, case reports mainly focused on orthopantomography or CBCT, without describing the CT enhancement features of the lesions. This paper summarized 16 cases of maxillofacial SBP imaging findings, mainly focused on CT plain scan and enhancement features. The typical X-ray and CT features of maxillofacial SBP were as follows. (1) Single, expansive and osteolytic bone destruction was found in bone marrow, and often broke through bone cortex to form soft tissue mass. (2) Most of the lesions had intermittent residual bone in or around them. In the literature, SBP of spine could show curved trabeculae with hypertrophic sclerosis, forming “gyri-like impression sign,” which had certain characteristics.¹⁶ But in our cases, no similar signs were found in maxillofacial SBP. (3) Most of the lesions had define margins and no sclerotic margins. Most of the cases had no obvious periosteal reaction. Only two patients in this group were accompanied by a small amount of radial bone needles. (4) Hardening and mixed lesions were rare. In this group, 14 cases were osteolytic type and 2 cases were mixed type. (5) On contrast-enhanced scanning, most tumors showed obvious homogeneous enhancement, which was related to the rich vascular content in the pathological lesions. (6) Mandibular SBP was predominant in the mandibular ascending branches, body and angle. MR findings were as follows: soft tissue mass was formed in bone destruction area of bone marrow. Soft tissue mass showed iso-signal on T_1 WI and slightly hypersignal on T_2 WI, and enhanced significantly and uniformly. Diffusion of lesions was limited on DWI, which was related to the morphology and arrangement of tumor cells. On one hand, SBP tumor cell lines are small round cells, and small round cells have a larger proportion of nuclear plasma and less intracellular fluid. On the other hand, the tumor cells are closely arranged and less extracellular fluid. The decrease of intra- and extracellular fluids leads to the limitation of Brownian motion of water molecules. Documents reported that DWI had certain value in the differential diagnosis of SBP.⁶ The dynamic enhancement curve showed a fast-in and wash-out pattern, indicating that the blood supply of the tumor tissue was rich and the blood flow velocity was faster.

SP in maxillofacial bones needs to be differentiated from a variety of single destructive osteolytic tumors,

such as ameloblastoma, odontogenic keratocyst, primary intraosseous squamous cell carcinoma of the jaw and osteosarcoma.³ Ameloblastoma occurs mostly in young adults aged 20–40 years, with no gender difference. Ameloblastoma usually occurs in the mandibular molar region and the ramus of the mandible. The typical CT findings of ameloblastoma are as follows: expansive bone destruction with obvious buccal swelling, osseous or fibrous septation and multilocular changes, uneven density with mixed cystic and solid changes, defined boundary, sclerotic margin, and no periosteal reaction.¹⁷ After enhancement, the solid part is obviously enhanced, but the cystic part is not enhanced. And tooth root resorption is usually found adjacent to the lesion. Odontogenic keratocysts usually occurs in the posterior mandible and the mandibular ramus. The CT findings are as follows: osteolytic bone destruction, unilocular or multilocular, no obvious bone expansion, growth along the long axis of the mandible, defined boundary, sclerotic margin, and no periosteal reaction.¹⁸ The lesion shows cystic density with no enhancement or mild peripheral rim enhancement after enhancement. Primary intraosseous squamous cell carcinoma of the jaw has three main clinical symptoms: toothache, non-healing after tooth extraction and numbness of the lower lip. It predominantly occurs in the mandibular molar region. The CT findings are osteolytic bone destruction developed from the center of jaw to the marginal cortex, with “small mouth and large floor” change and irregular margins. And it is moderately enhanced after enhancement. Osteosarcoma of the jaw is most common in young adults aged 30–40 years. Most of the jaw osteosarcoma on CT showed mixed density changes. Tumorous osteogenesis and radial periosteal reaction are seen in the bone destruction area, with Codman triangle and soft mass formation.¹⁹

There are some limitations in this paper. Firstly, this paper is a retrospective study. So on one hand, the sample size of the study is small. On the other hand, there may be some selection bias. In the future, we will use the current conclusions to carry out prospective research, further verify the reliability of the conclusions, and make up for the deficiencies of retrospective research. Secondly, two authors in consensus analyze the imaging signs without observer consistency study.

SP of maxillofacial bones is predominant in the mandible of elderly male patients. Its CT features have certain characteristics. A solitary, round or ovoid, well-defined, osteolytic, invasive mass in bone marrow, which destroys bone cortex, has residual bone, no sclerosis margin and periosteal reaction, and shows strong enhancement, is suggestive of this diagnosis.

Acknowledgment

This work was supported by grants from National Natural Science Foundation of China (81401455).

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