Objective
To evaluate the clinical efficacy of percutaneous cementoplasty with respect to pain relief in patients with refractory painful bone metastases.

Design
Case series.

Setting
Regional hospital, Hong Kong.

Patients
All oncological patients with painful bone metastases despite conventional treatment seen between October 2006 and May 2010 were recruited.

Interventions
Cementoplasty with or without radiofrequency ablation.

Main outcome measures
Pain score before and after the procedure.

Results
In all, 12 patients with 13 lesions received cementoplasty. Two patients were excluded from the analysis because of inadequate documentation of pain score due to rapid disease progression. For the remaining 10 patients with 11 metastases, the primary sites were the lung (n=3), renal cell carcinoma (n=2), rectum (n=2), pancreas (n=1), multiple myeloma (n=1), and soft tissue sarcoma (n=1). The locations of the metastatic lesions were scapula (n=1), thoracic vertebrae (n=1), lumbar vertebrae (n=3), and pelvic bones (n=6). Eight lesions were treated by cementoplasty alone, whereas the other three associated with large soft tissue components had radiofrequency ablation followed by cementoplasty in a single setting. Immediate or near-immediate pain relief after treatment was achieved in 10 out of 11 lesions; the median pain score was 5 before treatment and decreased to 2 a week after treatment (P=0.039). In all lesions for which the pain was successfully controlled in the first week, the palliation effect persisted at subsequent follow-ups. The median follow-up period for these patients was 16 weeks, and the longest pain-relieving effect was at least 9 months.

Conclusion
In our experience, cementoplasty with or without radiofrequency ablation achieves satisfactory and long-lasting pain control in oncological patients with bone metastases. This is the first local study to describe the effect of cementoplasty for pain relief. Patients with painful bone metastases that are refractory to conventional treatments can benefit from cementoplasty, which should therefore be considered when conservative treatments fail.

Key words
Bone neoplasms; Cementoplasty; Pain management

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Introduction
Bone metastases are detected in 30 to 70% of oncological patients, and are more likely to be found if the disease is advanced. For patients with terminal disease and multiple sites of metastases, preserving quality of life is one of the main concerns. However, their...
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The quality of life can be greatly impaired by debilitating pain, especially if the symptom arises from weight-bearing regions. Traditionally, such pain could be alleviated by various kinds of systemic and local treatments. However, many treatment modalities achieve suboptimal palliation, and use of some of these treatments is often limited by their side-effects. Around 20% of the patients suffering from cancer pain had inadequate pain control by analgesic ladder.

In recent years, the development of percutaneous interventional radiological procedures, including cementoplasty, radiofrequency ablation (RFA), alcohol injection, cryotherapy and others, provide alternatives to patients when the pain related to bone metastases cannot be adequately controlled by conventional methods. Our study aimed to assess the effectiveness of pain control in patients with refractory painful bone metastases by means of percutaneous cementoplasty and if indicated, RFA.

Methods

Subject selection

Between October 2006 and May 2010, 13 consecutive patients who had persistent and debilitating painful bone metastases, despite conventional therapies and undergoing cementoplasty and/or RFA under fluoroscopic and computed tomography (CT) guidance, were recruited. One patient was recruited in 2006, while others were recruited in 2009 to 2010. All the patients were under the care of a dedicated palliative care team in the Oncology Department. Pain was considered refractory when oral or parenteral analgesia was maximised, with radiotherapy given to the painful lesion still failed to adequately control the pain.

Pain score assessment and statistical analysis

Assessment of pain related to the site of metastases was performed just before the interventional procedures, and monitored serially afterwards until the last follow-up in the oncology clinic or when the patient died. The pain scores were retrospectively reviewed. Each score entailed a visual analogue scale, an instrument measuring a characteristic or an attitude that ranges across a continuum of values but cannot be objectively measured. Patients were asked to quantify the severity of pain from 0 to 10, with a score of 0 being completely pain-free and that of 10 meaning extremely painful. Pain scores were assessed immediately before and after the procedure, then weekly up to 4 weeks, and every month thereafter until the last follow-up or when the patient died.

FIG 1. An axial computed tomographic image of the pelvis showing an osteolytic bone lesion with soft tissue component at the left acetabulum.
Percutaneous cementoplasty of osteolytic metastases

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As the sample size was small and the pain score was an ordinal variable, the two-tailed sign test was employed for statistical analysis. Statistical significance was set at the 5% level.

Interventional techniques

During cementoplasty with or without RFA, the location of the lytic bone lesion was first located by fluoroscopy or CT as shown in Figure 1. For lesions with significant soft tissue component, RFA was given before cementoplasty. For RFA, an ablation needle was first inserted into the bone lesion under image guidance; ablation was then performed according to the manufacturer’s protocol. After ablation of the lesion, the ablation needle was removed and replaced by a bone biopsy needle, which was then inserted along the same tract (Fig 2). Bone cement was injected into the bone lesion under real-time fluoroscopic control until the whole lesion was filled with cement. For patients who did not receive RFA, the bone biopsy needle was introduced into the lesion directly under fluoroscopic or CT guidance, and cement injection was performed as described before. Post-treatment CT was performed to confirm the location, the amount of cement injection (Fig 3), and to look for extralesional cement leakage.

Results

In this study, the age of the patients ranged from 28 to 72 years. All 12 patients had intolerable pain despite conventional treatments; 10 of them also received radiotherapy for pain control weeks or months before the interventional procedure. These 12 patients had 13 lesions treated by cementoplasty; three of these lesions were treated by RFA before cementoplasty at the same setting, while the rest were treated by cementoplasty alone.

TABLE 1. Summary of patient characteristics, type of primary malignancy, and site of painful metastases for the 11 procedures analysed in this study

<table>
<thead>
<tr>
<th>Lesion No.</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Primary site</th>
<th>Site of metastatic lesion</th>
<th>Date</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>69</td>
<td>RCC</td>
<td>Acetabulum</td>
<td>October 2006</td>
<td>RFA/cementoplasty</td>
</tr>
<tr>
<td>2†</td>
<td>M</td>
<td>49</td>
<td>Lung</td>
<td>Ischium</td>
<td>January 2009</td>
<td>RFA/cementoplasty</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>72</td>
<td>Rectum</td>
<td>Pubic ramus</td>
<td>May 2009</td>
<td>Cementoplasty</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>62</td>
<td>Multiple myeloma</td>
<td>Thoracic spine</td>
<td>September 2009</td>
<td>Cementoplasty</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>59</td>
<td>RCC</td>
<td>Lumbar spine</td>
<td>September 2009</td>
<td>RFA/cementoplasty</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>28</td>
<td>Sarcoma</td>
<td>Acetabulum</td>
<td>January 2010</td>
<td>Cementoplasty</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>72</td>
<td>Rectum</td>
<td>Acetabulum</td>
<td>February 2010</td>
<td>Cementoplasty</td>
</tr>
<tr>
<td>8†</td>
<td>M</td>
<td>49</td>
<td>Lung</td>
<td>Lumbar spine</td>
<td>February 2010</td>
<td>Cementoplasty</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>46</td>
<td>Pancreas</td>
<td>Lumbar spine</td>
<td>February 2010</td>
<td>Cementoplasty</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>64</td>
<td>Lung</td>
<td>Pelvis</td>
<td>April 2010</td>
<td>Cementoplasty</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>51</td>
<td>Lung</td>
<td>Scapula</td>
<td>May 2010</td>
<td>Cementoplasty</td>
</tr>
</tbody>
</table>

* RCC denotes renal cell carcinoma, and RFA radiofrequency ablation
† Lesion No. 2 and 8 are of the same patient
only treated by cementoplasty. Two patients were excluded from further study because of inadequate documentation of pain scores due to rapid disease progression. Among the remaining 10 patients with 11 metastases, the primary sites were lung (n=3), renal cell carcinoma (n=2), rectum (n=2), pancreas (n=1), multiple myeloma (n=1), and soft tissue sarcoma (n=1). The location of metastatic lesions were scapula (n=1), thoracic vertebrae (n=1), lumbar vertebrae (n=3), and pelvic bones (n=6) [Table 1]. In all, there were eight lesions treated by cementoplasty alone while three had both RFA and cementoplasty in a single setting. The latter three patients had large soft tissue components associated with the lytic lesions.

Immediate or near-immediate pain relief after treatment was observed for 10 lesions, with the median pain score of 5 before treatment and decreased to 2 a week later (P=0.039) [Table 2 and Fig 4]. In these 10 lesions for which the pain was successfully controlled in the first week, the palliative effect was noted to be lasting in subsequent follow-ups. The median follow-up period for these patients was 16 weeks, and the longest pain-relieving effect was at least 9 months. One patient who had a metastasis at L1 vertebra and received combined RFA and cementoplasty developed irreversible left lower limb paralysis after the treatment. Post-procedural magnetic resonance imaging and CT scans demonstrated no cement leakage into the epidural space, no evidence of cord compression, and the needle tract was shown to be totally transpedicular and had not entered the spinal canal.

<table>
<thead>
<tr>
<th>TABLE 2. Pain scores of patients recorded before and after treatment until last follow-up or death*</th>
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<tr>
<td>Lesion No.</td>
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<tr>
<td>1</td>
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<td>9</td>
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<td>10</td>
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<td>11</td>
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</tbody>
</table>

* D denotes day, Wk week, and M month

**FIG 4. Median pain score of patients before and after treatment**
**Discussion**

The primary aim of this study was to evaluate the pain-relieving effect of cementoplasty with or without RFA in bone metastases over time. Oncological patients with bone metastases could suffer from debilitating pain, especially in weight-bearing regions. Thus, pain control is one of the major steps in improving the quality of life in these terminal patients.

Analgesics, in form of the enteral or parenteral agents, and radiation therapy are traditional means of controlling pain related to bone metastases. In recent years, the development of percutaneous interventional radiological procedures, including cementoplasty, RFA, alcohol injection, cryotherapy and others provide alternative strategies for patients with bone metastases causing pain that cannot be adequately controlled by conventional methods.

Different studies have demonstrated improvement in pain and walking ability after percutaneous radiological interventions that have also been shown to be safe. However, their potential complications include local wound infection or inflammation, leakage of cement outside the bone into adjacent soft tissue or joint spaces, all of which could be prevented by delayed instillation of cement and close monitoring by fluoroscopy during the injection. In our study, one patient developed left lower limb paralysis after the procedure, which was attributed to thermal injury of the nerve roots during RFA. The complication was uncommon, even in patients with vertebral tumours associated with a posterior wall defect.

Among all of the percutaneous interventional radiological procedures, cementoplasty and RFA have demonstrated more promising results in pain control, both of which can be used separately or together in the same setting (depending on the nature of the lesions). However, there is no large-scale randomised study appears warranted. In our study, most of the sites with painful metastases that received treatment were at weight-bearing regions; the sites involved included the thoracic and lumbar spine, the pelvis, and the scapula. Regarding the 11 evaluated lesions, 10 enjoyed pain-relief effect within the first week and the median pain score decreased from 5 to 2 within this period (P=0.039). The pain scores were documented until the last follow-up or death of the patients. Looking at the changes of pain score over time, we demonstrated that in most of the patients, pain relief after cementoplasty with or without RFA was evident in the first 2 to 3 weeks after treatment. In addition, the effect could last until the patient died, disease progression, or was lost to follow-up.

The limitations of this study included its retrospective nature, and the small number of patients studied. Nevertheless, the pain scores were recorded prospectively during the course of treatment and follow-up, thus avoiding recall bias. We also limited selection bias by including consecutive patients treated during the study period. The pain-relieving effect was nevertheless shown to be promising, and therefore a large-scale randomised study appears warranted.

**Conclusion**

In our experience, cementoplasty with or without RFA shows satisfactory, long-lasting pain control effects in oncological patients with bone metastases. The use of cementoplasty in painful bone metastases that are refractory to conventional treatments can be beneficial. However, the addition of RFA in treating vertebral metastases should be considered with caution, as it might give rise to neurological damage.

**References**