Surgical management of skeletal metastases of the appendicular skeleton

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Abstract

Skeletal metastases are a common cause of morbidity in cancer patients through bone pain, pathological fracture and spinal cord compression. With advances in surgical and medical treatment, and a multidisciplinary approach, the outcome and survival for these patients has improved in recent years. The orthopaedic surgeon should be an integral part of the multidisciplinary team who provide high quality treatment to these patients to optimize outcome. They should be aware of the particular needs of these patients and the range of surgical and non-surgical treatments available. This article outlines the presentation, diagnosis and surgical management of patients with skeletal metastases. It summarizes the relevant best practice guidelines applicable to surgeons working in the UK but with worldwide relevance.

Keywords bone; fracture; metastases; multidisciplinary; surgery

Introduction

Over the last decade, incidence rates for all cancers combined have increased by 7% in the UK.[1] At the same time cancer survival is improving and has doubled in the last 40 years.[1] Skeletal metastases can occur in any cancer but most commonly in breast, prostate, renal, lung, multiple myeloma, and thyroid carcinomas. Accurate incidence is difficult to determine, but post-mortem studies have shown the presence of skeletal metastasis in 73% of patients with breast cancer and 68% of patients with prostate cancer.[2] Table 1 shows the incidence of skeletal metastases by cancer type in post-mortem and radio-isotope bone scan studies.[2,3] Skeletal metastases are most common in the axial skeleton in particular the spine (Table 2).[3]

The prognosis varies according to site of primary cancer. Survival time from diagnosis of bone metastases in prostate cancer or breast cancer is measurable in years in contrast to advanced lung cancer where it is typically measured in months. In recent years the prognosis for many patients with metastatic bone disease has significantly improved principally due to advances in medical therapy including hormonal treatment, bisphosphonates, chemotherapy, and biologically targeted agents (Table 3).[4]

Although patients with skeletal metastases are commonly encountered there is a lack of awareness in the primary and secondary care settings of what can be achieved with operative and non-operative treatment. Up to date guidelines on the management of skeletal metastases published by the British Orthopaedic Oncology Society and British Orthopaedic Association should be consulted to improve patient outcomes.[5] There is a need to highlight the possible positive outcomes of surgical intervention even in patients with advanced cancer.

Incidence of bone metastases by primary cancer at post mortem and using radio-isotope bone scanning[1,2]

Cancer	Post-mortem incidence of bone metastases (%)[1]	Incidence of bone metastases on bone scanning (%)[2]
Breast	73	32.7
Prostate	68	40.6
Thyroid	42	—
Renal	35	—
Lung	36	62.5
GI	5	38.5

Table 1

Involvement of the orthopaedic surgeon

Patients with skeletal metastases present in a variety of ways either with acute admission with a pathological fracture or spinal cord compression, via referral from the oncology team, or via referral to an orthopaedic clinic with musculoskeletal pain. Discovery of skeletal metastasis can be the first manifestation of malignancy.

The orthopaedic surgeon can play one of four roles; to:

- establish the diagnosis of a skeletal metastasis
- treat skeletal metastasis surgically to reduce pain and/or prevent fracture

Adapted from Kakhki et al. Frequency of anatomical distribution of bone metastases in 160 patients with prostate, breast, gastrointestinal, and lung cancers undergoing bone scan[2]

Anatomical site	Frequency of bone metastases (%)
Spine	30 (18.8%)
Ribs	23 (14.4%)
Pelvis	15 (9.4%)
Sternum	12 (7.5%)
Femur	8 (5%)
Scapula	6 (3.8%)
Skull	6 (3.8%)
Humerus	3 (1.9%)
Clavicle	2 (1.3%)
Tibia and fibula	1 (0.6%)

Table 2

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Mirels' scoring system for predicting risk of pathological fracture. Prophylactic fixation is recommended with a score of 9 or above[10]

Score	1	2	3
Site	Upper limb	Lower limb	Pertrochanteric
Pain	Mild	Moderate	Functional
Lesion	Blastic	Mixed	Lytic
Size[a]	<1/3	1/3	>2/3

[a] As seen on plain radiograph, maximum destruction of cortex in any view.

Table 3

- stabilize or reconstruct a bone following pathological fracture and restore function
- decompress the spinal cord and/or stabilize the spine.

The orthopaedic surgeon forms part of a multidisciplinary team required to give the best care to patients with metastatic bone disease including oncologists, radiologists, histopathologists, and specialist cancer nurses. In addition national guidelines advise that each hospital trust should have a designated lead orthopaedic surgeon for appendicular metastatic bone disease who can advise on management of patients requiring surgical intervention.[5] The designated metastatic bone disease lead should be adequately trained in diagnosing, investigating and co-ordinating the care of patients with metastatic bone disease and have a network of appropriate contacts in regional and supra-regional centres where advice on complex cases can be sought.[5]

Diagnosis

Appropriate investigations should be carried out to establish diagnosis, staging, and prognosis. This will allow a decision to be made as to whether surgery is indicated and what particular surgical intervention is most appropriate. There should be no rush to intervene surgically even in the case of pathological fracture. Pathological fractures are mostly low energy with minimal soft tissue injury and patients are often more comfortable once limb immobilization and good analgesia have been provided.

Any patient presenting to an orthopaedic surgeon with a new diagnosis of skeletal metastasis should be assessed with a full clinical history and examination and an extensive array of investigations. These should include full blood count, renal, liver and bone profiles, erythrocyte sedimentation rate, C-reactive protein, tumour markers and myeloma screen. Radiological investigations should include plain radiographs and MRI scan of the lesion to differentiate the lesion, assess size, and to assess the extent of bony and soft tissue invasion. CT of the chest abdomen and pelvis, and isotope bone scan should also be undertaken to assess for a primary tumour, to assess the number and distribution of other skeletal metastasis, and to assess the extent of visceral metastasis.

Role of biopsy

If a patient presents with skeletal metastasis in a previously diagnosed disseminated malignancy then biopsy is not necessary prior to surgical intervention. However if there is any doubt about the underlying pathology, for example when a patient presents with an isolated metastasis some time after curative treatment of a previously diagnosed carcinoma then biopsy is indicated. In addition biopsy is essential to establish a tissue diagnosis in the first presentation of a patient with a solitary bone lesion. This approach will avoid the risk of dissemination by the undertaking of inappropriate surgery.

Bone biopsies are usually performed percutaneously with image guidance by an adequately trained practitioner, following discussion with the surgical team or radiologists to avoid inappropriate biopsy tracts. The principles of biopsy must also be considered including:

- longitudinal incision
- confined to a single compartment
- haemostasis and drain if required
- no penetration of neurovascular structures
- exiting within the line of potential surgical incision.

Indications and aims for surgery

The orthopaedic surgeon should have an in depth discussion with the patient and family including what surgery involves, the perceived benefits and the perceived potential risks and complications. The orthopaedic surgeon should also consult with members of the multidisciplinary team including the treating oncologist regarding the appropriateness of a surgical intervention, the timing of the intervention and if non-surgical oncologic treatment would be preferable. This is particularly important in patients with poor performance status and life expectancy. It has been recommended that surgery should only be undertaken if life expectancy is at least 1 month for a weight bearing bone and 3 months for a non-weight bearing bone.[6]

Indications for surgical intervention fall broadly into two categories, to:

- improve survival
- alleviate symptoms and improve quality of life.

There is some evidence that appropriate and timely surgical treatment of metastatic bone disease can improve survival.[7] This is more likely in patients with better prognosis such as those with breast and renal cancers particularly with a solitary bone metastasis. In these cases endo-prosthetic replacement may be an appropriate surgical option.[5]

Where surgery is not curative, the role of surgery is to relieve pain and to maintain or restore mobility, function, and quality of life. Surgery should be undertaken prophylactically in patients with a significant risk of pathological fracture as this can be planned and is associated with less risk of complications, shorter operative time, and shorter hospital stay.[8] Non-surgical treatment should be considered as an alternative and/or adjunct to surgical intervention.

Pathological fracture risk assessment

A sudden increase in pain in an area of known metastasis should alert the patient and surgeon as to a potentially impending fracture. The presence of functional pain is thought to be the most important indication of an impending pathological fracture.[6] Classical criteria attributed to Harrington that suggest a high risk of impending pathological fracture are:[9]

- cortical bone destruction greater than 50%
- a lesion of more than 2.5 cm in the proximal femur