

# Transcutaneous Skin Perforation by a Protruding Xiphoid Process in a Bedbound Patient With Post-Traumatic Cervical Myelopathy: A Case Report and Review of the Literature

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## Case Report

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# Abstract

## Background

The xiphoid process is the smallest and most morphologically variable component of the sternum, and anterior (ventral) deviation is a recognized anatomical variant. Symptomatic xiphoid disease typically presents as localized pain (xiphodynia). Cutaneous complications are exceedingly uncommon, and only a single previous report describing an ischemic xiphisternal ulcer associated with a protruding xiphoid has been published. To the best of our knowledge, we identified no previous English-language report describing complete transcutaneous perforation of the skin by a protruding xiphoid process associated with chronic sinus formation and secondary infection.

## Case presentation

A 71-year-old bedbound man with type 2 diabetes mellitus, hypertension, and post-traumatic cervical myelopathy with spastic weakness developed progressive protrusion of the xiphoid process. The angulated xiphoid tip gradually eroded through the overlying skin, producing a chronic midline ulcer with sinus tract formation and superimposed infection. Lateral radiography demonstrated marked anterior angulation of the xiphoid process with prominent ventral protrusion and irregularity of the distal tip. The patient underwent xiphoidectomy with en-bloc excision of the ulcer and debridement of devitalized soft tissue. Intraoperative culture of the resected xiphoid specimen yielded extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli*, and culture-directed carbapenem therapy was administered. Histopathological examination revealed extensive ulceration with inflamed granulation tissue and a sinus tract, accompanied by reactive squamous epithelial hyperplasia (pseudoepitheliomatous hyperplasia), whereas the underlying bone was unremarkable and showed no evidence of malignancy.

## Conclusions

A protruding xiphoid process can rarely progress beyond pain and superficial ulceration to cutaneous breach with sinus tract formation and secondary infection, particularly in debilitated patients with chronic immobility, diabetes mellitus, and reduced soft-tissue padding. This process appears mechanistically analogous to a pressure ulcer developing over an atypical bony prominence. Xiphoidectomy combined with debridement and culture-directed antimicrobial therapy appears to provide definitive treatment. Histopathological examination is essential because reactive pseudoepitheliomatous hyperplasia at the ulcer margin may mimic cutaneous malignancy.

## Introduction

The xiphoid process (xiphisternum or ensiform process) is the smallest, most caudal, and most morphologically variable component of the sternum. Initially cartilaginous, it undergoes progressive ossification and eventually fuses with the sternal body at the xiphisternal junction, which typically converts from a symphysis to a synostosis during adulthood [1, 2]. It serves as an attachment site for the rectus abdominis and abdominal aponeuroses anteriorly and is intimately related posteriorly to the diaphragm, transversus thoracis, and pericardium. Considerable variation exists in its shape and orientation, with anterior (ventral) deviation representing a common anatomical variant [3, 4].

Symptomatic disease involving the xiphoid process is uncommon and most frequently manifests as xiphodynia, a syndrome first characterized by Lipkin et al. in 1955 as the “syndrome of the hypersensitive xiphoid” [5]. Patients typically present with localized xiphisternal pain that may radiate to the chest, back, throat, or epigastrium, often mimicking cardiac, pulmonary, or upper gastrointestinal pathology and resulting in delayed diagnosis [5–7].

Cutaneous manifestations of xiphoid disease are extraordinarily rare. To our knowledge, only a single previous report has described an ischemic xiphisternal ulcer caused by a protruding xiphoid process, which was successfully treated by xiphoidectomy [8]. We describe a more advanced and previously unreported manifestation in which progressive protrusion of the xiphoid process led to perforation of the overlying skin, with chronic ulceration, sinus tract formation, and secondary infection, in a bedbound patient with post-traumatic cervical myelopathy. We propose that, in this setting, the underlying mechanism is more appropriately viewed as a pressure-related injury occurring over an atypical bony prominence rather than as classical xiphodynia. In addition, we review the relevant anatomy, the spectrum of xiphoid disease, the pathophysiological basis of skin breakdown, and the role of surgical management. This report was prepared in accordance with the CARE guidelines [13].

## Case Presentation

### History

A 71-year-old man was admitted for evaluation of generalized weakness and functional decline. His medical history was notable for type 2 diabetes mellitus and hypertension. Approximately six months before presentation, he had sustained a fall resulting in cervical fracture(s) with spinal cord injury and paraparesis/paraplegia. He underwent cervical decompression surgery abroad and subsequently experienced partial neurological recovery. However, persistent post-traumatic cervical myelopathy with spastic weakness rendered him largely bedbound and dependent for activities of daily living. He was receiving physiotherapy together with baclofen and gabapentin for spasticity management.

During the admission, a chronic lesion over the lower anterior chest was noted. According to the patient and family, a longstanding prominence at the xiphisternal region had progressively enlarged over several months. The prominence subsequently eroded through the overlying skin, producing a chronically

discharging ulcer associated with intermittent local inflammation. Thoracic surgery consultation was requested because of the increasingly prominent xiphoid process and persistent ulceration.

## Physical Examination

The patient was alert and oriented. He appeared thin, with marked loss of subcutaneous tissue over the anterior chest wall. Neurological examination demonstrated spastic weakness with Medical Research Council grades of 3/5 in the upper limbs and 2/5 in the lower limbs.

Inspection of the lower sternum revealed a prominent anteriorly projecting hook-shaped xiphoid process producing a cone-shaped elevation of the overlying skin. At the apex of the prominence was an ulcerated lesion with an exophytic granulating base, a yellowish necrotic and crusted center, and a surrounding violaceous rim with peripheral erythema. A cutaneous opening communicating with an underlying sinus tract was present over the tip of the protruding xiphoid, findings consistent with chronic pressure-related skin breakdown with secondary infection (Figs. 1 and 2).

## Investigations

The frontal projection was unremarkable. The lateral projection demonstrated marked anterior angulation (hooking) of the xiphoid process with ventral protrusion beyond the expected anterior chest wall contour, and mild cortical irregularity was present at the distal tip (Figs. 3 and 4). Cross-sectional imaging was not obtained because operative intervention was considered indicated on clinical grounds.

Inflammatory markers were mildly elevated.

Magnetic resonance imaging of the cervical spine demonstrated a small non-enhancing intramedullary lesion at the C3–C4 level measuring approximately 3.5 mm, which was hypointense on T1-weighted images and hyperintense on T2-weighted images without cord expansion or compression, consistent with chronic post-traumatic myelopathic change.

The patient's hospitalization was additionally complicated by urinary tract infection due to *Pseudomonas aeruginosa* and *Escherichia coli* and by subsequent candiduria caused by *Candida tropicalis*. These infections were managed independently by the medical and urology teams and were considered unrelated to the xiphisternal lesion.

## Differential Diagnosis

The appearance of an ulcerated, exophytic midline lesion raised concern for several possibilities, including cutaneous squamous cell carcinoma, basal cell carcinoma, pyogenic granuloma, infected epidermoid cyst, cutaneous metastasis, and a chronic draining sinus arising from infection involving the protruding xiphoid process. Because clinical differentiation between chronic inflammatory lesions and

malignancy can be difficult, definitive diagnosis required histopathological examination of the excised specimen.

## Treatment

Under general anesthesia, the patient underwent xiphoidectomy with en-bloc excision of the ulcerated skin and surrounding soft tissue. Through a limited midline incision, the xiphoid process was exposed and carefully separated from the attachments of the rectus abdominis and diaphragm while protecting adjacent mediastinal structures, including the pericardium and diaphragm. The xiphoid was divided at the xiphisternal junction and removed together with the overlying ulcer and devitalized tissue. After thorough irrigation and hemostasis, the wound was closed in layers. No drain was used.

The specimen was submitted for microbiological and histopathological analysis. Intraoperative culture from the resected xiphoid specimen demonstrated heavy growth of extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli*. The isolate exhibited resistance to penicillins, cephalosporins, fluoroquinolones, and piperacillin–tazobactam but remained susceptible to carbapenems, aminoglycosides, tigecycline, and colistin. Culture-directed intravenous meropenem therapy was administered according to infectious diseases recommendations.

## Pathological Findings

Gross examination revealed a segment of bone measuring  $3.0 \times 2.5 \times 0.4$  cm with attached skin and soft tissue measuring  $2.0 \times 1.5 \times 1.0$  cm. The skin specimen contained an ulcerated opening measuring  $0.7 \times 0.5$  cm corresponding to the sinus tract.

Microscopic examination demonstrated extensive ulceration with inflamed granulation tissue and sinus tract formation. Reactive squamous epithelial hyperplasia consistent with pseudoepitheliomatous hyperplasia was present at the ulcer margins. The underlying xiphoid bone was histologically unremarkable, and no evidence of malignancy was identified.

The pathological findings indicated that the inflammatory process was predominantly confined to the skin and soft tissues. Although culture of the resected xiphoid specimen yielded ESBL-producing *E. coli*, no histological features of established osteomyelitis were present.

## Outcome and Follow-Up

The postoperative course was uneventful. The patient recovered satisfactorily and was discharged in stable condition after approximately 21 days of hospitalization. He continued rehabilitation and antispasticity therapy with planned neurological follow-up.

At 3 weeks of follow-up, the surgical wound had healed satisfactorily without evidence of recurrent ulceration, drainage, or local infection. No surgery-related complications were observed.

## Discussion

# Anatomy and Morphological Variation of the Xiphoid Process

The xiphoid process is the smallest and most anatomically variable component of the sternum. Its morphology exhibits considerable interindividual variation with respect to shape, length, degree of ossification, and sagittal orientation [1–4]. In a multidetector computed tomography study of 500 adults, Akin et al. demonstrated ventral deviation in 65.4% of cases, alignment with the sternal body in 33.2%, and dorsal deviation in only 0.6%, whereas a hook-shaped ventral curvature of the distal tip was identified in 2.2% of subjects [3]. Similarly, Xie et al. reported pointed (44.8%), oval (41.0%), and forked (14.2%) configurations and confirmed substantial variability in xiphoid orientation [4]. Other recognized variants include elongated, bifid, trifid, and foraminate processes [1, 2, 12] (Table 1).

Anterior prominence of the xiphoid process is a common finding, but protrusion pronounced enough to threaten the overlying skin is uncommon and likely lies at the extreme end of normal anatomical variation.

Table 1  
Reported morphology of the xiphoid process in large imaging/anatomical studies.

| Feature                              | Finding                                                                         | Source                                             |
|--------------------------------------|---------------------------------------------------------------------------------|----------------------------------------------------|
| Sagittal orientation (MDCT, n = 500) | Ventral deviation 65.4%; in-axis 33.2%; dorsal 0.6%; ventral hook-like tip 2.2% | Akin 2011 [3]                                      |
| Shape (cadaver + MDCT)               | Pointed 44.8%; oval 41.0%; forked 14.2%; ventral deviation ~ 23%                | Xie 2014 [4]                                       |
| Xiphisternal angle                   | Normal ~ 172 ± 14°; reduced (anterior) angle proposed in xiphodynia             | Maigne 2010 [6]                                    |
| Other variants                       | Bifid/trifid, foraminate, elongated, anteriorly deflected processes             | Mashriqi 2017 [1]; Eid 2018 [2]; Enomoto 2011 [12] |

## Xiphodynia and the Spectrum of Symptomatic Xiphoid Disease

Symptomatic xiphoid disease is uncommon and most frequently presents as xiphodynia, a syndrome originally described by Lipkin et al. in 1955 as the “syndrome of the hypersensitive xiphoid” [5]. Characteristic symptoms include localized tenderness and pain over the xiphisternal junction with radiation to the chest, epigastrium, back, throat, or shoulders, often mimicking cardiac, pulmonary, or upper gastrointestinal pathology and resulting in delayed diagnosis [5–7].

Mechanical trauma, occupational strain, obesity, weight loss, and abnormal anterior angulation of the xiphoid have all been proposed as contributing factors [6, 7, 11]. Maigne et al. suggested that a reduced xiphisternal angle may underlie symptomatic prominence [6]. Surgical series have reported a predominance among middle-aged men, although the condition remains rare and likely underrecognized [9, 10].

In contrast to classical xiphodynia, which is primarily a pain syndrome, the present case represents structural progression to cutaneous breakdown and infection.

## **From Prominence to Skin Perforation: Proposed Pathophysiology**

Cutaneous complications arising from a protruding xiphoid process are exceptionally uncommon. Kiriya et al. described what they considered the first reported xiphisternal ulcer caused by chronic pressure exerted by a protruding xiphoid process, leading to ischemic skin breakdown and exposure of the bone, which was successfully treated by xiphoidectomy [8].

Whereas the previously reported lesion consisted of ischemic ulceration with exposure of the xiphoid process, the present case appears to represent the most advanced manifestation of a symptomatic protruding xiphoid process reported to date, progressing beyond pressure-related ulceration to complete transcutaneous perforation with chronic sinus formation and secondary bacterial infection.

Several factors likely contributed to this progression. First, the anteriorly angulated xiphoid concentrated pressure over a very small surface area. Second, chronic recumbency and severe immobility related to post-traumatic cervical myelopathy resulted in prolonged and repetitive pressure over the prominence. Third, marked loss of subcutaneous tissue reduced the protective soft-tissue envelope normally separating bone from skin. Finally, diabetes mellitus likely impaired tissue perfusion, delayed wound healing, and increased susceptibility to infection.

Considered together, these factors suggest that the lesion is best regarded as a pressure-related ulcer developing over an atypical bony prominence. Although pressure injuries classically occur over the sacrum, greater trochanter, heels, and ischial tuberosities, the underlying mechanism appears analogous in the present case. To our knowledge, no previous report has described an exposed xiphoid process breaching the skin with sinus tract formation and secondary infection.

## **Histopathological and Microbiological Considerations**

An important feature of this case was the discordance between microbiological and histopathological findings. Intraoperative culture of the resected xiphoid specimen yielded ESBL-producing *Escherichia coli*, whereas histological examination demonstrated extensive ulceration, inflamed granulation tissue, sinus tract formation, and reactive squamous epithelial hyperplasia (pseudoepitheliomatous hyperplasia), with otherwise unremarkable underlying bone.

Pseudoepitheliomatous hyperplasia is a benign reactive epithelial proliferation that may closely mimic well-differentiated squamous cell carcinoma both clinically and histologically. Consequently, histopathological examination of chronic ulcerative lesions involving the xiphisternal region is mandatory to exclude malignancy.

The absence of histological evidence of osteomyelitis suggests that inflammation was predominantly confined to the ulcer bed and adjacent soft tissues, with reactive changes involving the exposed xiphoid surface rather than established medullary infection.

Isolation of ESBL-producing *Escherichia coli* is unusual in chest wall infections and may reflect colonization or unrecognized secondary infection by multidrug-resistant gram-negative organisms in a debilitated patient with multiple comorbidities.

## **Diagnostic Considerations**

Diagnosis is primarily clinical and is based on recognition of a protruding xiphoid underlying the lesion. Lateral radiography may demonstrate distal angulation, whereas CT better delineates morphology and adjacent structures and may assist operative planning. Differential diagnoses include cutaneous malignancy, pyogenic granuloma, infected epidermoid cyst, metastatic disease, and chronic inflammatory sinus formation. Histopathological examination remains essential for definitive diagnosis.

## **Surgical Management and Review of the Literature**

Conservative management of uncomplicated xiphodynia consists of reassurance, analgesics, non-steroidal anti-inflammatory drugs, and local anesthetic or corticosteroid injections [7]. In contrast, ulceration, skin perforation, or infection constitute indications for operative intervention.

Xiphoidectomy is a straightforward and safe procedure. Through a limited midline incision, the xiphoid process is mobilized from the rectus abdominis and diaphragmatic attachments with careful protection of the pericardium and diaphragm. Division at the xiphisternal junction followed by layered closure generally results in excellent outcomes [8–10] (Table 2).

Dorn et al. reported 11 patients undergoing xiphoidectomy for intractable xiphodynia and observed significant symptom improvement without postoperative complications [9]. Garssen et al. subsequently described 19 patients, reporting clinical improvement in 94% and complete symptom resolution in 63%, again without surgery-related complications [10]. Likewise, the ischemic xiphisternal ulcer reported by Kiriya et al. was successfully cured by xiphoidectomy [8]. In the present case, xiphoidectomy combined with excision of the ulcer and culture-directed antimicrobial therapy resulted in satisfactory clinical recovery, supporting surgical excision as definitive treatment when skin integrity has been lost. Because no preoperative CT was obtained, the precise three-dimensional morphology and degree of anterior angulation of the xiphoid process could not be quantified, representing a limitation of the present report.

Table 2  
Selected reports of surgical management of xiphoid disease.

| Study               | n  | Indication                                                                                                                                     | Outcome                                                                      |
|---------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Dorn 2018 [9]       | 11 | Intractable xiphodynia                                                                                                                         | Pain relief in 8/10 patients available for follow-up; no complications       |
| Garssen 2021 [10]   | 19 | Xiphodynia                                                                                                                                     | 94% improved, 63% pain-free; no complications                                |
| Kiriyama 2022 [8]   | 1  | Ischemic xiphisternal ulcer + exposed xiphoid                                                                                                  | Cured by xiphoidectomy (T-saw)                                               |
| <b>Present case</b> | 1  | Skin perforation by protruding xiphoid; chronic ulcer + sinus tract; ESBL <i>E. coli</i> infection; bedbound diabetic with cervical myelopathy | Xiphoidectomy + debridement + culture-directed carbapenem; discharged stable |

## Strengths

The principal strength of this report is the description of an apparently previously unreported manifestation of xiphoid disease characterized by perforation of the skin by the xiphoid tip, sinus tract formation, and secondary infection in the setting of chronic immobility and diabetes mellitus. Correlation of operative findings with microbiological and histopathological examination further strengthens the report.

## Limitations

Limitations include the inherent constraints of a single case, the absence of dedicated preoperative computed tomography, and limited follow-up. Additional reports will be required to determine the incidence, risk factors, and optimal management of this uncommon complication.

## Conclusion

Although anterior deviation of the xiphoid process represents a common anatomical variant, severe protrusion may rarely progress beyond pain and superficial ulceration to skin perforation with sinus tract formation and secondary infection. Chronic immobility, reduced soft-tissue padding, and diabetes mellitus appear to have contributed to pressure-related skin breakdown over an atypical bony prominence in the present case. Recognition of a protruding xiphoid process underlying a chronic xiphisternal ulcer is important because the lesion may mimic malignancy and can progress to skin perforation and secondary infection. Histopathological evaluation and culture are essential, and xiphoidectomy with excision of devitalized tissue appears to provide definitive treatment. Thoracic surgeons, plastic surgeons, wound-care specialists, and physicians caring for chronically immobilized patients should consider a protruding xiphoid process in the differential diagnosis of persistent midline xiphisternal ulceration. Early recognition and timely xiphoidectomy may prevent progression to skin perforation and secondary infection.

# Declarations

**Patient consent.** Written informed consent for publication of clinical details and images was obtained from the patient. A copy is available to the editor on request.

**Ethics.** Ethical approval was waived because this study describes a single-patient case report. Written informed consent for publication of clinical details and images was obtained from the patient.

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**Conflicts of interest.** The authors declare no conflicts of interest.

**Authors' contributions.** HAA performed the operation, participated in perioperative care, and drafted the manuscript. WJ assisted in surgery, contributed to perioperative care, and collected clinical data. NA contributed to manuscript drafting, pathology and microbiology interpretation, and preparation of the figures. All authors read and approved the final manuscript.

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## Figures



**Figure 1**

Frontal clinical photograph demonstrating marked anterior protrusion of the xiphoid process with transcutaneous penetration through the overlying skin, resulting in an ulcerated lesion with surrounding inflammatory change.



**Figure 2**

Lateral clinical photograph demonstrating the pronounced anterior hook-like deformity of the xiphoid process producing a conical elevation of the anterior chest wall. The ulcerated tip corresponds to the point of maximal xiphoid prominence.



**Figure 3**

Lateral chest radiograph demonstrating marked anterior angulation of the distal xiphoid process with protrusion beyond the expected contour of the anterior chest wall.

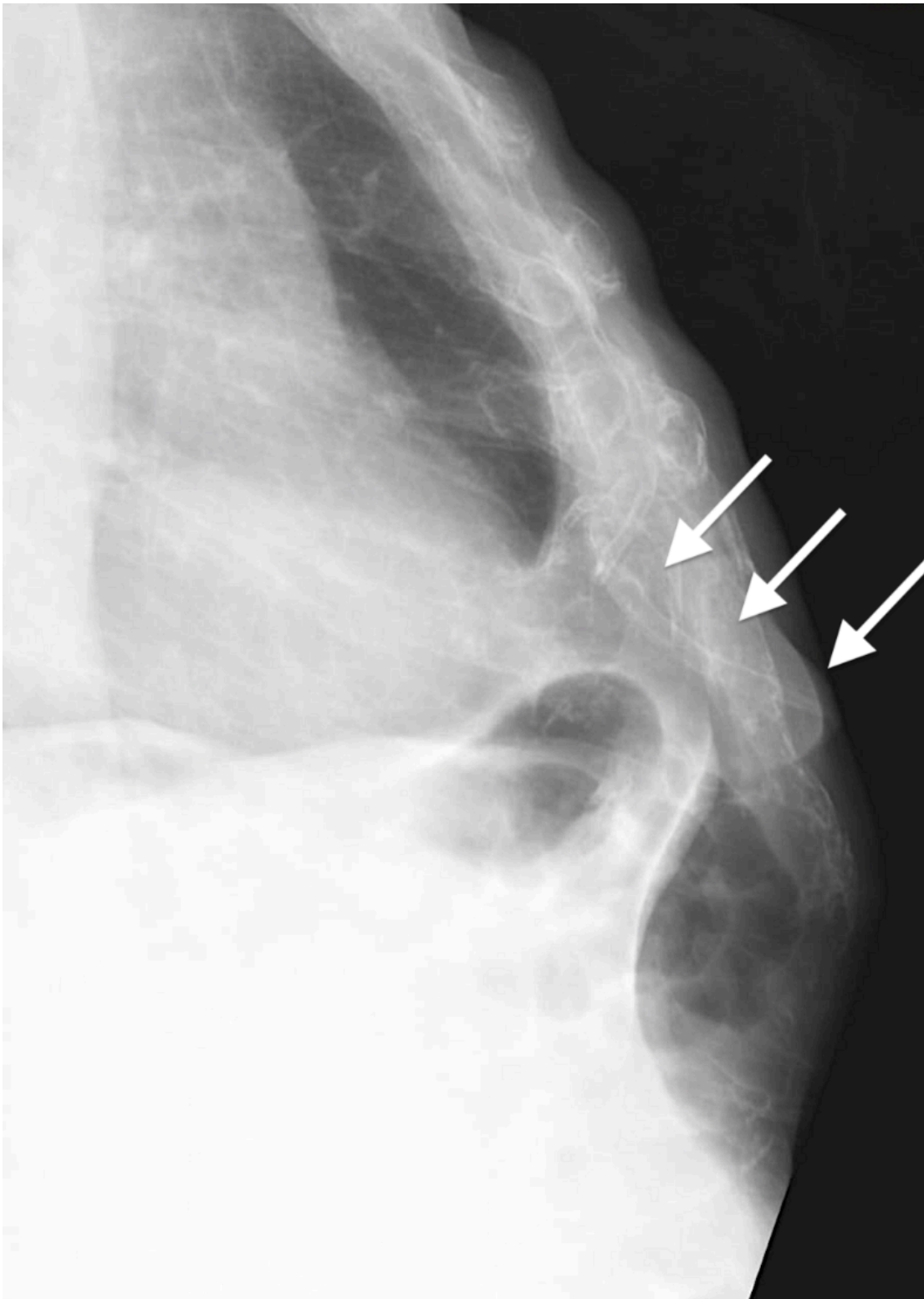


**Figure 4**

Annotated lateral chest radiograph. Arrows identify the markedly anteriorly angulated xiphoid process corresponding to the site of skin penetration and ulcer formation.