Orthopedic Research and Reviews

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CASE REPORT

O-Arm CT–Guided Intercostal Nerve Radiofrequency Ablation for Refractory Tietze's Syndrome: A Case Report

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Background: Tietze's syndrome is a rare inflammatory condition of the anterior chest wall that may cause chronic localized pain resistant to conservative treatment. Surgical cartilage resection often provides only temporary relief, and recurrence of pain presents a significant therapeutic challenge.

Case Presentation: We report the case of a 49-year-old female with recurrent anterior chest wall pain due to refractory Tietze's syndrome following two costal cartilage resections. Despite corticosteroid injections and physiotherapy, pain persisted with a VAS score of 7–8/10. Considering multiple treatment failures, O-arm CT-guided radiofrequency ablation (RFA) of the intercostal nerves at the 2nd–3rd ribs was performed. The procedure allowed precise cannula placement under 3D visualization and correction of intrathoracic misplacement detected on intraoperative O-arm CT (not evident on conventional fluoroscopy). After final lesioning at 80 °C for 90s, the patient experienced complete pain relief (VAS 0–1/10), restored respiratory comfort, and full functional recovery without complications.

Conclusion: O-arm CT guidance enables accurate targeting and improved safety during intercostal nerve RFA in anatomically complex anterior chest wall regions. This technique represents a promising minimally invasive option for refractory Tietze's syndrome when surgery and conservative therapy fail.

Keywords: Tietze's syndrome, radiofrequency ablation, intercostal nerves, O-arm CT, chest wall pain

Introduction

Tietze's syndrome is an inflammatory disorder of the anterior chest wall characterized by pain and localized swelling at the costosternal junctions, most commonly involving the II–III–IV–V ribs.[1,2] Despite its benign nature, Tietze's syndrome can cause significant pain and a marked reduction in patients' quality of life.[3]

According to various reports, up to 50% of all chest pain presentations are of musculoskeletal origin, and in 80% of cases the cause is non–life-threatening.[1,4] However, due to nonspecific symptoms and the absence of pathognomonic signs on laboratory or radiological investigations. Tietze's syndrome is often underdiagnosed or diagnosed by exclusion.[5] Importantly, the condition is most frequently observed in individuals of working age, typically under 40, and may be associated with chest wall microtrauma, repetitive strain, or occupational factors, as recent clinical observations have demonstrated.[6,7] The post-traumatic variant of Tietze's syndrome, as described in several publications, can be recognized as an occupational disease requiring a multidisciplinary approach.[7] Although the syndrome is generally benign, delayed or inappropriate treatment may result in chronicity. Several sources emphasize the importance of early diagnosis and the establishment of a clear treatment algorithm.[3,8]

Conservative management of Tietze's syndrome typically includes nonsteroidal anti-inflammatory drugs, activity modification, and physiotherapy, which are effective in most patients but may fail in chronic or recurrent cases.[3] Local anesthetic and corticosteroid injections at the costosternal junction are commonly used for both diagnostic and

https://doi.org/10.2147/ORR.S574131
Received: 22 October 2025
Accepted: 10 February 2026
Published: 24 February 2026

therapeutic purposes; however, their analgesic effect is often temporary.[3,8] In patients with persistent or refractory symptoms, surgical resection of the affected costal cartilage has been described, although recurrence of pain after surgery has been reported.[5,7] In this context, interventional pain management techniques such as radiofrequency ablation (RFA) of the intercostal nerves may represent a minimally invasive alternative for selected patients with treatment-resistant Tietze's syndrome.

Thus, Tietze's syndrome remains a clinically relevant issue, both in terms of differential diagnosis of chest pain and in the development of effective treatment strategies for patients with thoracalgia.

Case Presentation

We observed a 49-year-old female patient. She had a hypersthenic body type with grade II obesity (by WHO classification); height – 165 cm, weight – 100 kg, BMI – 36.7. According to the patient, since 2015 (at age 39), she began experiencing discomfort in the left side of the chest, which she did not associate with any specific cause and did not seek treatment. Since 2018, she reported episodic pain in the left 3rd–4th rib region, aggravated by deep inspiration. The patient was referred to a clinical research center for evaluation. Based on her account and medical records, following clinical and diagnostic procedures, she was diagnosed with Tietze's syndrome and underwent surgical intervention:

In August 2022: Resection of the costal cartilage of the left 2nd–3rd ribs. The postoperative course was uneventful.

In February 2023 (6 months post-op): Due to recurrence of pain, she received conservative treatment (NSAIDs and physiotherapy) without sustained benefit.

In September 2023 (13 months post-op): Owing to the recurrence of symptoms, a repeat surgical intervention was performed – additional resection of the costal cartilages at the same level.

In November 2023 (2 months after second surgery): She again reported recurrent pain and underwent further conservative treatment (NSAIDs and physiotherapy).

In October 2024: In view of recurrent localized pain at the costal cartilage of the 2nd–3rd ribs, the patient underwent CT examination (Figure 1) and received local corticosteroid injection, which resulted in positive clinical response, allowing for discharge in satisfactory condition.

Nine months later (15 July 2025), following a repeat corticosteroid injection, the patient presented with complaints of severe localized pain in the anterior chest wall, exacerbated by deep inspiration, coughing, and palpation. The pain was unilateral, predominantly localized to the region of the left 2nd–3rd–4th costosternal junctions, without radiation. On physical examination, there was marked tenderness on palpation of the corresponding costal cartilages, without signs of erythema or swelling. The patient described the pain as sharp and stabbing, interfering with normal breathing and sleep. According to the VAS (Visual Analogue Scale), pain intensity was rated at 7–8/10. The clinical presentation was consistent with classic Tietze's syndrome — an inflammatory pain syndrome involving the costal cartilages of the anterior chest wall, specifically the 2nd–5th ribs at the sternocostal junctions.

In view of the new recurrence of pain localized to the anterior portions of the left 2nd–3rd ribs, a chest CT examination was performed, followed by radiofrequency ablation (RFA) of the intercostal nerves (Figure 2).

Interventional Technique

The procedure was performed with the patient in the supine position under local anesthesia. After sterile preparation and preoperative marking of the area of maximal tenderness, soft tissue infiltration was carried out using 0.5% novocaine. Initial cannula placement was performed under conventional fluoroscopic guidance with the C-arm in the anteroposterior projection at the level of the left 2nd–3rd ribs.

To improve procedural accuracy and safety, intraoperative O-arm CT imaging with three-dimensional reconstruction was used to assess the spatial relationship between the cannula, rib, and adjacent thoracic structures. Sensory and motor stimulation tests were conducted to confirm proximity to the intercostal nerve. After detection of intrathoracic cannula misplacement on O-arm CT imaging, the cannula trajectory was immediately corrected under CT guidance. Final cannula positioning was confirmed using repeated O-arm CT acquisition. Thermal radiofrequency lesioning was then performed at 80 °C for 90 seconds. No intraoperative or early postoperative complications were observed.

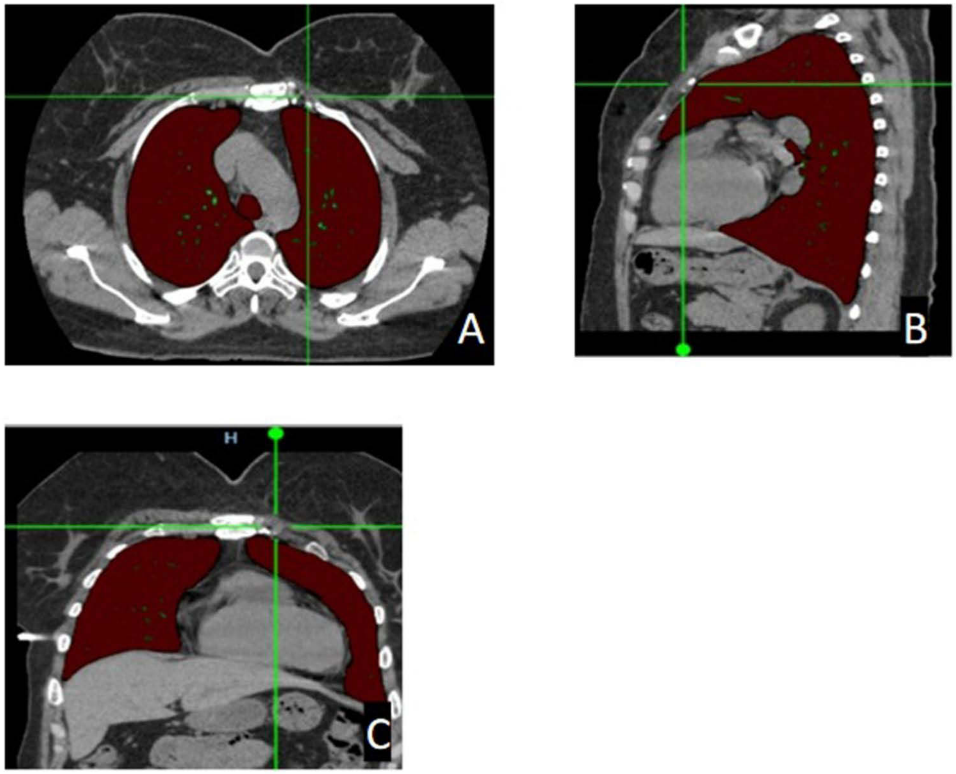

Figure 1 Chest Computed Tomography (16 October 2024) revealed: "In bone window settings, bony outgrowths were identified in the projection of the cartilaginous portions of the left 2nd and 3rd ribs". (**A**) Axial slice. (**B**) Sagittal slice. (**C**) Coronal slice.

After preoperative marking of the surgical field and identification of areas of maximal tenderness on palpation, the breast was secured using adhesive tape, which provided optimal visualization of the pain trigger points and access to the 2nd–3rd costosternal junctions during radiofrequency ablation (RFA) of the intercostal nerve (Figure 3).

The anterior chest wall contains a substantial amount of soft tissue structures, including subcutaneous fat, female breast tissue, pectoral muscles, fascial layers, and neurovascular bundles. This large volume of soft tissue creates a pronounced projection "mask", which complicates visualization of the underlying osseocartilaginous structures. Conventional radiography often fails to adequately visualize the bone and cartilage at the level of the 2nd–5th ribs due to this soft tissue overlay.

The patient was positioned supine, and the C-arm fluoroscopy system was set in the anteroposterior projection to visualize the 2nd–5th ribs.

Following triple antiseptic preparation of the surgical field with povidone-iodine, the soft tissues were infiltrated with 0.5% novocaine (10.0 mL) at the level of the left 2nd–3rd ribs (Figure 4).

Considering the anatomical characteristics of the neurovascular bundle, and to improve procedural efficacy, it was decided to perform the radiofrequency ablation (RFA) at the inferior margin of the costal cartilage of the rib.

The radiographic image demonstrates the initial positioning of the cannula (Figure 5A), and the 3D CT reconstruction shows the cannula placement (Figure 5B).

The cannula with the electrode was positioned prior to RFA after correction of cannula placement: the cannula was advanced beneath the rib (Figure 6A), with confirmation via 3D CT imaging (Figure 6B). The stylet was removed, and a CSK-TC10 electrode was inserted into the cannula and connected to the generator. The impedance measured 150 Ω. Sensory stimulation was performed with gradually increasing power up to 0.5 W. The patient reported a sensation of pressure, stretching, and tightness in the targeted area without radiation along the nerve. Motor stimulation was then conducted, gradually increasing the voltage to 1.2 W, resulting in mild local muscle contractions. C-arm fluoroscopy

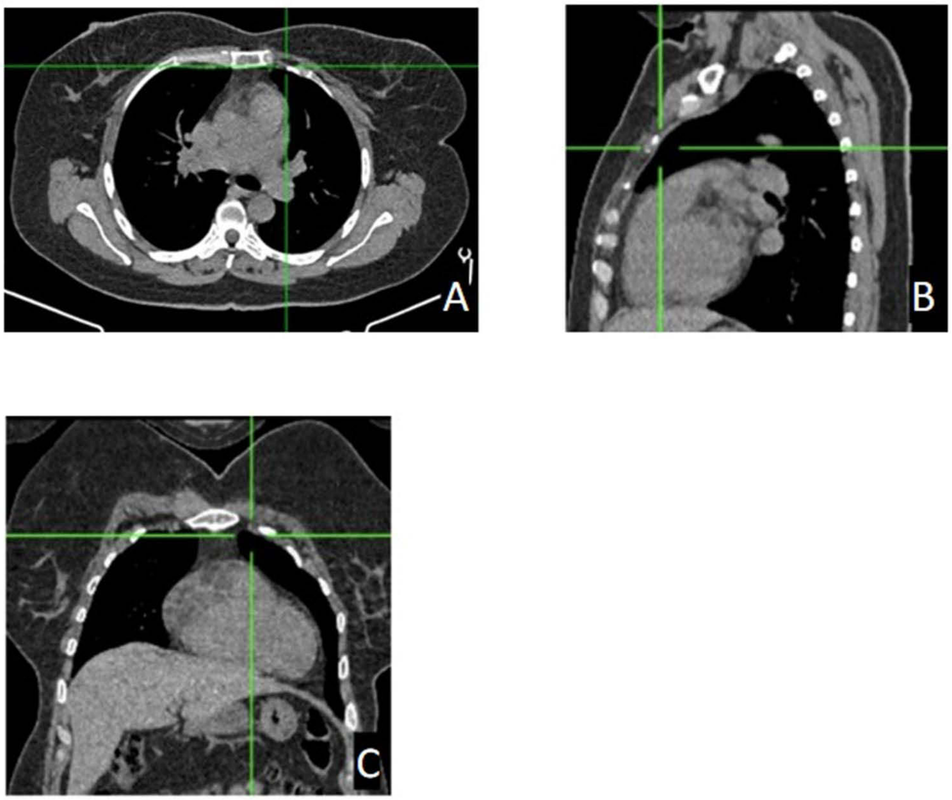

Figure 2 Chest Computed Tomography. At the time of admission, a chest CT scan performed on 12 May 2025 demonstrated: CT findings were consistent with bilateral bronchitis, linear pneumofibrosis, and bronchopulmonary lymph node adenopathy. However, no calcifications were noted in the parasternal region at the sites of previously resected osteophytes and costal cartilages. (**A**) Axial slice. (**B**) Sagittal slice. (**C**) Coronal slice.

Figure 3 Preoperative marking.

confirmed satisfactory positioning. Thermal lesioning was subsequently performed at a temperature of 80°C for 90 seconds.

Considering the lack of significant pain reduction and a weakly positive sensory stimulation test—with no radiation along the intercostal nerve—it was decided to advance the tip of the cannula deeper, closer to the intercostal nerve, to improve efficacy.

After advancing the cannula to the intercostal nerve, positioning was verified using the O-arm fluoroscopy system. The cannula placement after adjustment was assessed via chest radiography, CT, and 3D CT using the O-arm.

Figure 4 Infiltration with 0.5% novocaine.

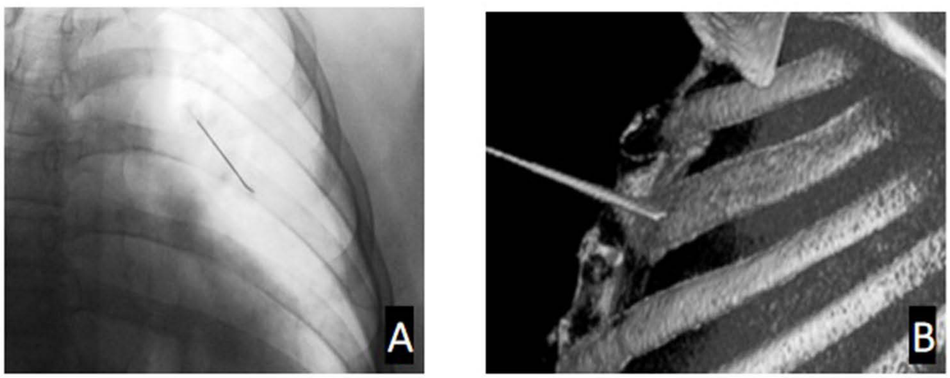

Figure 5 Initial cannula positioning during intercostal nerve radiofrequency ablation. (**A**) X-ray of the cannula position. (**B**) 3D CT of the cannula position.

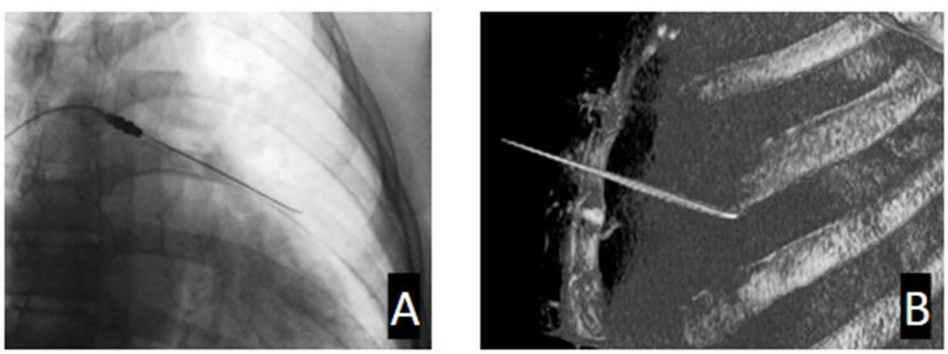

Figure 6 Cannula advancement beneath the rib prior to detection of intrathoracic misplacement. (**A**) X-ray of the cannula position. (**B**) 3D CT of the cannula position.

On the radiograph (Figure 7A), the position of the cannula tip appeared unremarkable. However, CT imaging confirmed intrathoracic placement of the cannula, with a portion extending into the lung parenchyma (Figure 7B).

3D imaging using the O-arm system confirmed that the electrode was positioned within the lung parenchyma (Figure 8).

The images obtained with intraoperative O-arm CT clearly demonstrate the cannula passing beneath the rib arch and penetrating directly into the pulmonary parenchyma. This needle trajectory was barely detectable on conventional fluoroscopy (Figure 6A).

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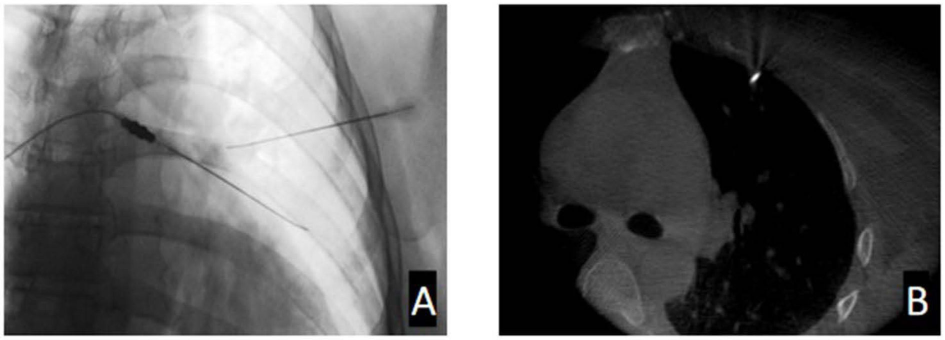

Figure 7 Incorrect intrathoracic cannula placement detected by O-arm CT. (**A**) X-ray of the cannula position. (**B**) 3D CT of the cannula position.

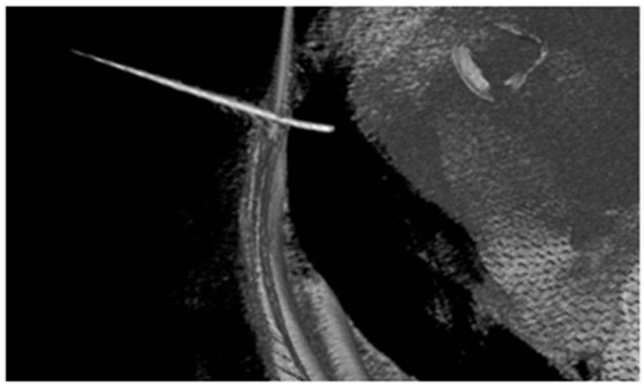

Figure 8 3D CT of the cannula position.

Cannula position was subsequently corrected taking into account the CT control and 3D O-arm visualization findings.

After cannula repositioning, CT imaging confirmed optimal placement: the cannula tip was located outside the pleural cavity (Figure 9A), and 3D CT reconstructions demonstrated the cannula positioned beneath the rib (Figure 9B and C).

Following O-arm CT–guided adjustment, the cannula was accurately aligned along the anticipated course of the intercostal nerve, without protrusion beyond the rib or entry into the pleural space. The standard radiofrequency ablation (RFA) procedure was then performed: Sensory stimulation was conducted with gradually increasing power up to 0.5 W. The patient reported pressure, stretching, tightness, and pain radiating along the intercostal nerve and at the costosternal junction. Motor stimulation was performed with gradual increase of voltage to 1.2 W, eliciting pronounced local muscle contractions. C-arm fluoroscopy confirmed satisfactory cannula tip positioning. Thermal lesioning was applied at 80°C for 90 seconds. The puncture site was dressed with an alcohol-based aseptic dressing.

The use of O-arm CT significantly improved navigation accuracy and procedural safety by providing real-time three-dimensional visualization of anatomical structures, making it preferable to conventional fluoroscopic control.

Thus, during RFA of intercostal nerves at the 2nd–5th ribs, where ribs are covered by a thick layer of soft tissue that can obscure osseocartilaginous structures on radiographs:

- O-arm CT provides 3D monitoring of cannula position at all procedural stages;
- Minimizes the risk of vascular and pulmonary injury;
- Ensures precise cannula placement within the target zone—the intercostal nerves.

This makes O-arm CT an objectively safer and more accurate navigation method compared with conventional fluoroscopy, particularly in anatomically complex areas of the anterior chest wall covered by thick soft tissue.

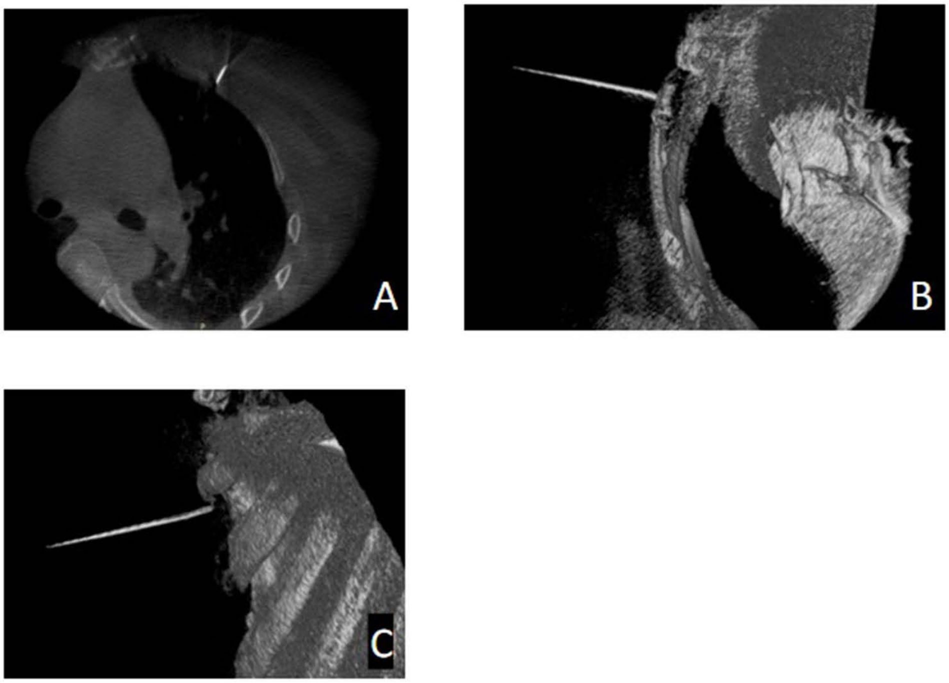

Figure 9 Corrected cannula position after O-arm CT–guided adjustment. (**A**) CT of the cannula position. (**B**) 3D CT of the cannula position. (**C**) 3D CT of the cannula position.

Prior to the procedure, the patient experienced severe anterior chest wall pain, localized to the cartilaginous portions of the 2nd–4th ribs, exacerbated by inspiration and palpation. The pain was consistent with Tietze's syndrome, with a VAS score of 7–8/10. After RFA under O-arm CT guidance, the patient reported a significant reduction in pain: in the early postoperative period, the VAS score decreased to 0–1/10. The patient noted restored full respiratory function, the ability to sleep on the affected side, and no requirement for analgesics. The patient's condition after RFA is presented in Figure 10.

Figure 10 Patient's condition after RFA.

Discussion

Tietze's syndrome remains a rare but clinically significant condition, manifesting as localized thoracic pain and swelling at the costosternal junctions. Despite its benign nature, the course of the disease can be prolonged and resistant to conservative therapy, as demonstrated in the presented case.

Initial surgical intervention, in the form of resection of the affected cartilage, may lead to temporary symptom relief; however, some patients, including the present case, experience recurrence of pain. Repeat surgical procedures increase the invasiveness of treatment, elevate the risk of complications, and do not always provide sustained analgesic effect.

In this context, minimally invasive methods, such as radiofrequency ablation (RFA) of the intercostal nerves, represent a promising alternative. In the presented case, after ineffective repeated cartilage resection and only short-term benefit from corticosteroid injections, RFA was performed, resulting in a significant and durable analgesic effect.

A distinctive feature of RFA is its targeted impact on pain transmission with minimal trauma to surrounding tissues, short recovery time, and the possibility of repeating the procedure if necessary. However, performing intercostal nerve RFA in the anterior chest wall at the level of the 2nd–5th ribs is technically demanding and requires reliable imaging guidance. Conventional fluoroscopy may be insufficient in this region due to the complex anatomy and thick soft tissue layers, increasing the risk of cannula misplacement and pleural or pulmonary injury.

The principal importance of the present case lies not only in the clinical effectiveness of RFA, but in the clear demonstration of a potential procedural hazard that was not detectable using conventional fluoroscopy alone. In this case, intrathoracic cannula misplacement was not evident on standard C-arm imaging and was identified only after intraoperative O-arm CT acquisition. Without three-dimensional imaging, such needle positioning could have resulted in pulmonary injury or pneumothorax. The use of O-arm CT enabled immediate recognition and correction of the cannula trajectory before thermal lesioning, thereby preventing a potentially serious complication. This step-by-step visual documentation highlights the critical role of three-dimensional imaging in improving procedural safety during intercostal nerve interventions in anatomically complex regions of the anterior chest wall.

Thus, intercostal nerve RFA can be considered an effective treatment option for refractory Tietze's syndrome, particularly in patients with recurrent pain after surgical intervention. Further follow-up and studies involving larger patient cohorts are required to evaluate the long-term efficacy and safety of this technique.

Limitations

This report describes a single clinical case; therefore, the findings cannot be generalized to all patients with Tietze's syndrome. The absence of a control group and the lack of direct comparison with other interventional or surgical treatment modalities limit the ability to draw conclusions regarding relative efficacy. In addition, although the clinical outcome was favorable, longer follow-up and larger patient cohorts are required to evaluate the durability of analgesic effect and procedural safety. Nevertheless, the value of this case lies in the detailed intraoperative imaging demonstrating how O-arm CT guidance can prevent potentially serious complications during intercostal nerve radiofrequency ablation.

Conclusion

The present case demonstrates that O-arm CT guidance overcomes the limitations of conventional fluoroscopy during intercostal nerve radiofrequency ablation in anatomically complex regions of the anterior chest wall. Three-dimensional imaging allows accurate cannula positioning and facilitates early detection and correction of potentially hazardous needle misplacement, thereby enhancing procedural safety.

In a patient with refractory Tietze's syndrome and recurrent pain after multiple surgical interventions, O-arm CT–guided intercostal nerve RFA resulted in marked and sustained pain relief. This minimally invasive approach may represent a valuable treatment option for selected patients with chronic anterior chest wall pain when conservative therapy and surgical management have failed.

Ethics Approval

Institutional approval was not required for publication of this single anonymized case report in accordance with local institutional policies. All procedures were performed as part of routine clinical care.

Consent for Publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor of this journal.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosure

The authors declare no conflicts of interest.

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