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# *Proteus mirabilis* Ischial Osteomyelitis with Sinus Tract Treated by Live Leech Therapy: A Case Report and Literature Review

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## Abstract

**Background:** Chronic ischial osteomyelitis, particularly when complicated by sinus tract formation, presents a significant therapeutic challenge. While systemic antibiotic therapy remains a cornerstone of treatment, its efficacy is often limited in resolving established sinus tracts. This case report explores the therapeutic potential of living leech therapy in this challenging clinical scenario, providing a detailed account of its application and reviewing the supporting evidence from the literature. Reporting this case may provide clinicians with new ideas for the treatment of chronic ischial osteomyelitis. **Case Presentation:** A 41-year-old unemployed Chinese male was admitted to the hospital due to recurrent perianal exudation for 3 years and a diagnosis of ischial osteomyelitis for 1 year. The patient had a past history of "paraplegia" and no drug allergies. Laboratory examinations showed that the patient's erythrocyte sedimentation rate and C-reactive protein were significantly increased, and CT and magnetic resonance imaging showed the presence of buttock sinus tract, and histopathology showed tissue necrosis in the lesion of buttock sinus tract. After anti-infection, surgical debridement, and living leech therapy, the buttock sinus tract of the patient was basically healed. Follow-up demonstrated the buttock sinus tract of the patient was completely healed without fluid exudation. **Conclusion:** This case highlights the potential of Live Leech Therapy combined with antibacterial agents for treating chronic ischial osteomyelitis with refractory sinus tracts, demonstrating satisfactory therapeutic outcomes. While Live Leech Therapy is characterized by its ease of use, low cost, and encouraging initial efficacy,

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and possesses promising biochemical effects, the underlying mechanisms require further elucidation and potential risks such as infection or allergy must be carefully considered. Further research is warranted to explore the role of Live Leech Therapy in managing refractory osteomyelitis and other complex wound conditions.

## Keywords

Hirudo Medicinalis, *Proteus mirabilis*, Osteomyelitis, Wound Healing

## 1. Introduction

Osteomyelitis is a common and severe orthopedic complication, characterized by inflammation within the bone and/or bone marrow, and encompasses both chronic and acute forms. It is straightforward to diagnose but complex to treat, remaining one of the challenges in orthopedic management [1]. Osteomyelitis can be further classified into hematogenous, traumatic, and diabetic foot osteomyelitis based on different etiological factors [2]. While the pathogenesis of osteomyelitis theoretically includes both infectious and non-infectious factors, most cases are caused by bacterial infections, with non-bacterial osteomyelitis predominantly seen in children and adolescents [3]. Clinically, approximately 10% to 30% of patients with acute osteomyelitis progress to chronic osteomyelitis [4]. This progression is often due to bacteria forming a biofilm at the infection site, which antibiotics cannot completely eradicate, leading to recurrent episodes and ultimately chronic osteomyelitis [5]. Traditional treatment methods for osteomyelitis include thorough debridement, anti-infective treatment, and bone cement filling [1] [6] [7]. However, in special cases, such as patients with refractory wounds or sinus tracts, these traditional treatments may not yield satisfactory outcomes. Live Leech Therapy (LLT), supported by emerging scientific evidence for its anti-inflammatory, anticoagulant, and vasodilatory properties mediated by bioactive salivary components (e.g., hirudin, hyaluronidase, bdellins, eglin) [8], has shown promise in promoting wound healing and microcirculation in conditions like venous congestion and selected inflammatory/infectious conditions. However, its application in chronic osteomyelitis remains understudied. Here, we present a rare case of chronic ischial osteomyelitis with a persistent unhealed sinus tract that was successfully treated using LLT in combination with antimicrobial drug treatment.

## 2. Case Presentation

### 2.1. Chief Complaints

A 41-year-old unemployed Chinese male, with a height of 150 cm and a weight of 55 kg, was admitted to the hospital due to recurrent perianal exudation for 3 years and a diagnosis of ischial osteomyelitis for 1 year.

### 2.2. History of Present Illness

At admission, a large amount of yellow purulent secretion was observed exuding from the ulcer surface of the right buttock, without associated pain, fever, or chills.

### 2.3. History of Past Illness

The patient underwent corrective surgery for "severe scoliosis" during adolescence and became paraplegic in the lower extremities post-operation. He had a history of anal fistula and had undergone multiple excision surgeries without healing. In 2023, the patient was diagnosed with sinus tract in the right buttock accompanied by the formation of ischial osteomyelitis. He had been managing long-term home wound dressing changes and oral antibiotic treatment.

### 2.4. Personal and Family History

No significant personal history, and no familial genetic diseases were reported.

### 2.5. Physical Examination

There was a right convex deformity of the thoracic spine. Longitudinal old surgical scars, approximately 15 cm and 12 cm in length, were visible on the posterior midline and lateral aspects of the back, respectively. The mobility of the thoracic and lumbar spine was significantly limited. The skin sensation below the umbilical level was absent. The muscles of both lower extremities were significantly atrophied, with a muscle strength of grade 0. An irregular ulcer wound, approximately 2 cm in diameter, was present on the body surface of the right ischioanal fossa, extending to the ischial surface. Yellow purulent secretion was exuding from the external opening of the sinus tract, which was slightly turbid and had an acidic odor. The patient had no control over urination and defecation.

### 2.6. Laboratory Examinations

Upon admission, white blood cells and neutrophils were within normal limits. The erythrocyte sedimentation rate (ESR) was 36 mm/h, and the C-reactive protein (CRP) was 74 mg/L. On the second day of admission, *Proteus mirabilis* was cultured from the secretion, and the drug sensitivity test indicated sensitivity to cephalosporin antibiotics.

### 2.7. Imaging Examinations

Post-admission pelvic computed tomography (CT) revealed the presence of sequestra in the inferior pubic ramus and ischial tuberosity. Pelvic magnetic resonance imaging demonstrated bone marrow edema of the right ischium and sinus tract formation in the right buttock, findings suggestive of chronic osteomyelitis (**Figure 1**).

## 3. Final Diagnosis

Based on the patient's clinical manifestations, physical signs, imaging examina-

tions, comprehensive laboratory microbial culture, and postoperative bone tissue pathological examination (Figure 2), the final diagnosis was chronic ischial osteomyelitis with a sinus tract.

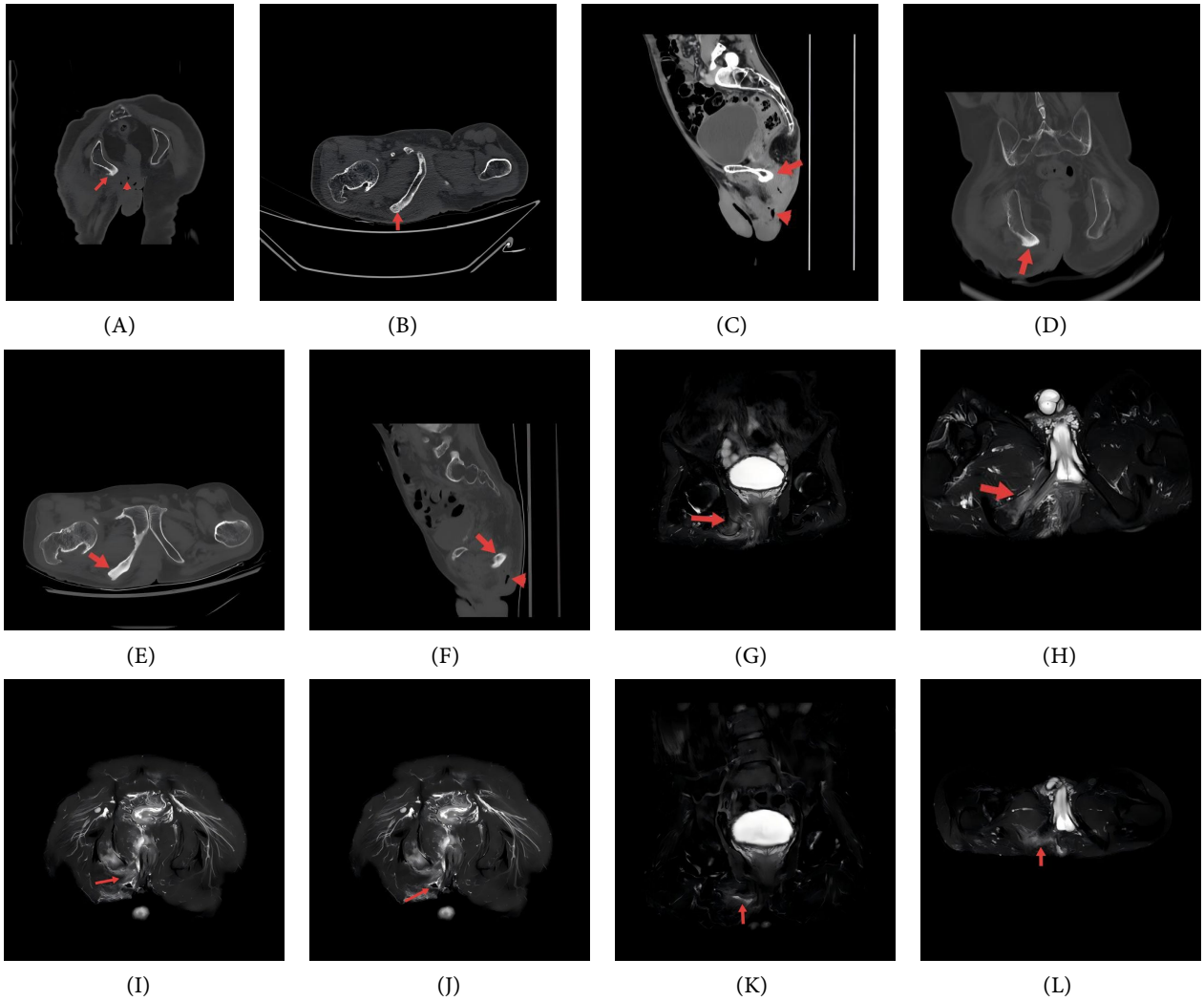
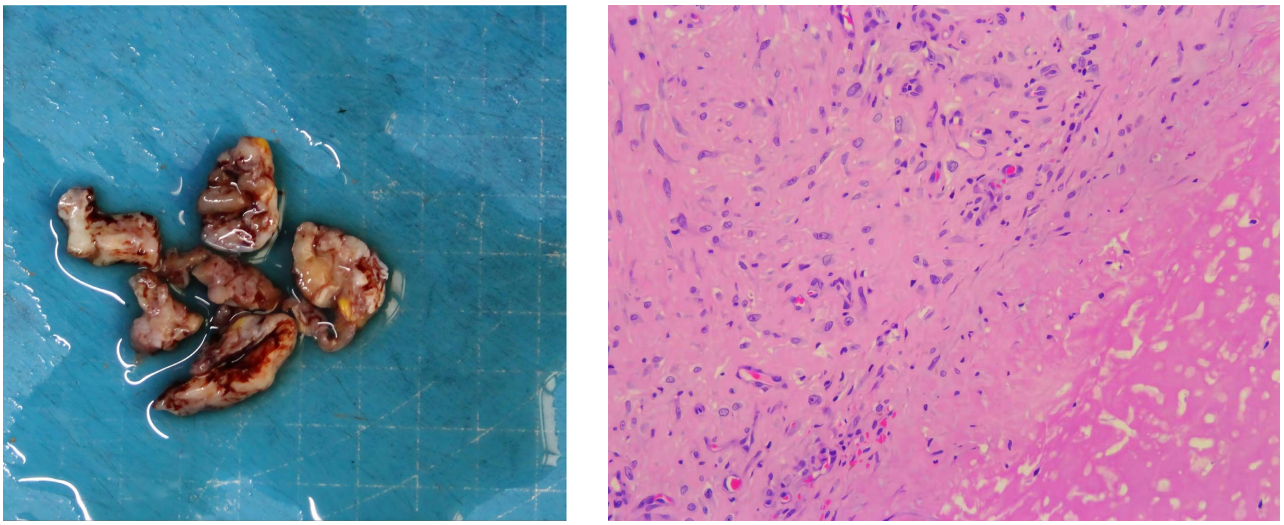



**Figure 1.** (A)-(C): Coronal, axial, and sagittal views (in this order) of pelvic CT in 2023. (D)-(F): Coronal, axial, and sagittal views (in this order) of the admission pelvic CT scan, compared to the 2023 CT. The arrow indicates nodular and patchy densities in the ischial tuberosity and inferior pubic ramus, with surrounding soft tissue swelling and gas, suggesting possible sinus tract formation (▲). (G)-(H): Coronal and axial views (in this order) of pelvic T2-weighted MRI in 2023. (I)-(J): The admission pelvic T2-weighted MRI. (K)-(L): Coronal and axial views (in this order) of the 2-month post-discharge pelvic MRI. Arrow shows ischial tuberosity edema and extensive perianal soft tissue edema. Right ischial tuberosity bone marrow edema was substantially mitigated, and soft tissue swelling significantly alleviated (▲).

## 4. Treatment

On the fifth day of admission, the patient underwent excisional debridement of the ischial ulcer wound, vacuum sealing drainage (VSD) with negative pressure suction, and pathological biopsy, and was administered ceftazidime (2 g intravenously every 12 hours) for anti-infective treatment. On the eighth day postoperation, the VSD drainage tube was removed, and daily cleaning and dressing

changes were initiated. Two weeks post-operation, the surgical incision and the ischial sinus tract opening of the patient remained open, with light yellow purulent secretion still exuding.



(A) (B)

**Figure 2.** (A): Right buttock sinus tract and peripheral scar tissue during the operation. (B): Histological examination (hematoxylin and eosin staining, 100 × under microscope) reveals granulation tissue from the right buttock sinus tract lesion, with myxoid change and fibrinoid surface necrosis.

Given the patient's long-term medical history, along with the presence of persistent wound exudate two weeks after surgery and scant granulation tissue within the sinus tract considering the refractory nature of chronic osteomyelitis wounds, we assessed the wound condition, past medical history (particularly allergy history), and the patient's tolerance, and subsequently attempted LLT for treatment. Artificially cultivated medical leeches (*Hirudo nipponica* Whitman) sourced from Guangxi Kekang Technology Group Co., Ltd. were used. These leeches were bred in strict accordance with relevant requirements, underwent a series of purification processes, and were certified free of pathogenic bacteria by a qualified third-party testing institution. Following the operational specifications of Zhuang medicine leech therapy [9], the specific procedure was as follows: Based on the condition of the patient's wound, five leeches were applied via their oral suckers to two wound sites on the patient's right buttock (the sinus tract opening and the anal fistula site), the leeches adhered only to the surface of the sinus tract opening and did not penetrate into the tract lumen. The leeches were allowed to feed until natural detachment occurred (typically around 0.5 hours). If leeches failed to detach within one hour, a cotton swab moistened with 75% ethanol was gently applied to the leeches' mouthparts from a distance of 0.5 cm to encourage detachment. After leech detachment, the next step was to irrigate the treatment area with normal saline three times and then disinfected with iodophor. Once hemostasis at the suction site was confirmed, the area was covered with sterile gauze and dressed. Post-treatment, leeches were counted,

euthanized by submersion in 75% ethanol, and disposed of as medical waste. Leech therapy was administered twice weekly, in conjunction with ongoing anti-infective management (ceftazidime, 2g intravenously every 12 hours). The patient continued oral cefixime tablets (0.1g, twice a day) for one-week post-discharge.

## 5. Outcome and Follow-Up

The exudate from the sinus tract was significantly reduced on the day of leech treatment. The patient experienced no discomfort during or after the treatment. As treatment progressed, the exudate from the sinus tract opening gradually disappeared, new granulation tissue formed, and the wound healed. On the 14th day post-treatment, the sinus tract opening and surgical wound of the patient were essentially healed, with no exudate. The CRP and ESR level returned to normal before discharge. At the two-month and six- month post-discharge follow-up, the perianal sinus tract opening was completely closed, with no bleeding or exudation from the wound (**Figure 3**), the follow-up pelvic MRI two months after discharge indicated that the bone marrow edema in the right ischial tuberosity was substantially mitigated and the soft tissue swelling was significantly alleviated; anal crypt depression also significantly improved on anoscopy compared to 2023, indicating remission of the anal fistula (**Figure 4**).

## 6. Discussion

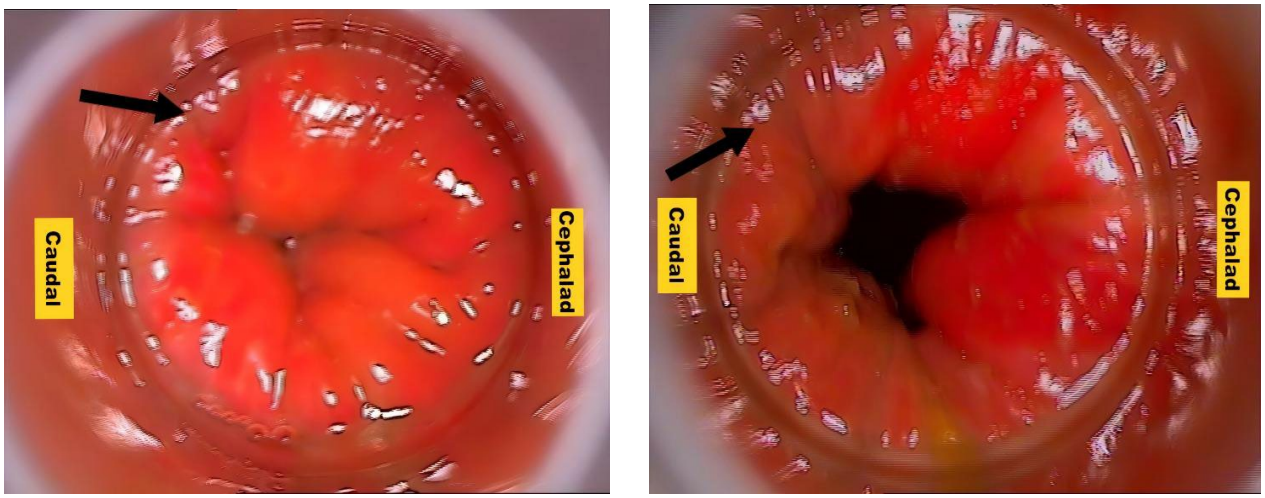
In this study, we report a rare case of chronic ischial osteomyelitis successfully treated with Live Leech Therapy, a novel, yet underutilized, therapeutic modality.

(A) (B) (C)

(D) (E) (F)

(G)

**Figure 3.** (A): Buttock appearance at admission. (B): Buttock appearance 2 weeks post-debridement. (C): Leech therapy process. (D): Buttock appearance one week after leech therapy. (E): Buttock appearance at discharge 2 weeks after leech therapy. (F): Buttock appearance 2 months post-discharge. (G): Buttock appearance 6 months post-discharge.




(A) (B)

**Figure 4.** (A): Arrow indicates prominent crypt depression at 7 o'clock, suggestive of sinus tract formation (in 2023). (B): Reduced crypt depression, 2 months post-discharge.

After unsuccessful attempts with radical debridement and antibiotic therapy, we utilized Live Leech Therapy to eliminate infected soft tissue, stimulate granulation tissue formation, and ultimately achieve closure of the patient's sinus tract. Osteomyelitis is classified based on duration as acute or chronic osteomyelitis, further subdivided into chronic primary and chronic secondary osteomyelitis [10]. However, the clinical significance of this classification is debatable, as the time-based definitions of acute and chronic osteomyelitis lack strict and precise criteria. Chronic osteomyelitis is generally defined as persistent infection lasting several months to years. However, treatment strategies do not demonstrably differ based on duration. Thus, the presence of dead bone, rather than the length of the disease process, is more critical in determining treatment plans [11]. Chronic osteomyelitis is more commonly observed in the metaphyses of long bones, but less so in the pelvis. In pediatric patients, the infection often originates in the superior ace-

tabular region, due to the rich blood supply, then gradually spreads to the iliac, pubic, and ischial bones. In adults, however, osseous maturation of the acetabulum leads to more frequent involvement of the iliac crest, pubic, and ischial bones [12]. The diagnosis of chronic osteomyelitis typically relies on a combination of clinical, laboratory, and imaging findings. These may include elevated white blood cell counts, ESR, CRP levels, and positive bacterial cultures, as well as CT and MRI. A prior surgical history also contributes to the diagnosis. Common clinical manifestations include localized pain, erythema, and sinus tract formation, while fever is relatively uncommon [13]. Although laboratory tests, such as elevated ESR and CRP, can aid in the diagnosis, their limited specificity, coupled with non-specific early clinical and imaging features, often leads to delayed or missed diagnoses [14]. Treatment strategies for chronic osteomyelitis, regardless of the affected bone, are generally consistent. Systemic antibiotic therapy is the primary approach. If dead bone is present, surgical debridement is necessary.

Chronic osteomyelitis is characterized by a complex and variable spectrum of pathogens, often exhibiting mixed, polymicrobial, and cross-infections, which are identifiable through laboratory testing and pathological biopsies. While traditionally, Gram-positive bacteria (e.g., Staphylococcus aureus, Enterococcus spp.) were considered predominant [5] [15], recent years have seen a significant rise in Gram-negative bacteria (GNB), especially in developing countries. In Middle East conflict-related osteomyelitis, GNB detection even surpasses Gram-positive bacteria, despite the latter often causing more severe infections [16]. Notably, GNB detection can reach 51.5% in some parts of Egypt [17], and studies in China show GNB as the sole causative microorganism in infectious bone diseases more often than Gram-positive bacteria [18]. Commonly implicated GNB in osteomyelitis include Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Acinetobacter baumannii, and Enterobacter spp. [19] [20]. Though *Proteus mirabilis* osteomyelitis is rare, most cases link to enterogenous urinary tract infections [21], though retrograde dissemination via pelvic veins or paravertebral nerve plexuses is also possible [22]. In this case, the patient's MRI revealed that the anal fistula tract communicated with the sinus tract. The patient exhibited no urinary symptoms, and laboratory urinalysis results were normal. Based on these findings, we speculate that the onset of osteomyelitis in this patient may be associated with an exogenous *Proteus mirabilis* infection, which could be related to the anal fistula, prolonged bed rest due to paralysis, and poor perineal hygiene.

Chronic osteomyelitis is characterized by repeated infections, long treatment cycles, and high recurrence rates. It incurs high treatment costs, and the wound surface after debridement surgery is difficult to heal, which poses a great challenge to orthopedic surgeons and also brings psychological burdens to patients. There are numerous factors contributing to the recurrence of infections, among which the refractory sinus tract is one of the main factors in this case. Generally speaking, the sinus tract is a drainage channel extending from the infectious focus inside the bone marrow to the surface of the skin and is a high-risk factor for recurrent infections [23]-[25]. In orthopedic diseases, the presence of a sinus tract may reflect

the degree of infection and local inflammatory response in bones and joints. However, the mechanism by which the sinus tract causes recurrent infections remains unclear. Some scholars believe that it may be related to the relatively poor condition of the soft tissues around the sinus tract. For example, the probability of the sinus tract occurring in the hip joint is relatively higher [26]. Moreover, in chronic osteomyelitis, the sinus tract is also a high-risk factor for the occurrence of malignant tumors, especially squamous cell carcinoma [27]. Therefore, special attention should be paid to patients with chronic osteomyelitis accompanied by sinus tracts in clinical practice. Although thorough debridement surgery can effectively remove the sinus tracts and necrotic tissues, due to the fact that chronic osteomyelitis reduces the local microcirculation and self-repair ability, for larger lesions, the effect of debridement surgery is unstable, the surgical wound recovers slowly, and the condition may even be aggravated. Hence, exploring methods to quickly promote the closure of sinus tracts has become one of the focuses in the treatment of chronic osteomyelitis.

Live Leech Therapy (LLT), a historical alternative therapy, involves the application of live leeches to a patient's wound to treat diseases through their blood-sucking action [28]. In regions including China, India, Japan, and Central Asia, this therapy has been applied in modern medicine for inflammatory, metabolic, and cardiovascular diseases, as well as to promote wound healing, with reported effectiveness [29]. Its proposed mechanisms in wound healing, including its potential role in infected contexts, involve: 1) Decongestion: Removal of congested, potentially hypoxic blood and inflammatory exudate. 2) Pharmacological Action: Delivery of bioactive molecules with anti-inflammatory, anticoagulant, antiplatelet, vasodilatory, and potential bacteriostatic/bactericidal effects. 3) Mechanical Stimulation: Induced bleeding may stimulate localized angiogenesis and granulation tissue formation. While the evidence base specifically for LLT in osteomyelitis is limited primarily to case reports (like this one), the established biological effects provide a plausible rationale for its adjunctive use in refractory cases involving impaired microcirculation and persistent exudate, as seen in our patient [8] [30] [31]. Recent studies have demonstrated the effectiveness of LLT in various surgical applications. Nair *et al*. found that LLT significantly reduces pain in patients with infected wounds and promotes wound healing [32]. Cohn *et al*. applied LLT to patients with complex facial lacerations, achieving significant efficacy with no sequelae [33]. Some scholars propose that LLT may promote vasodilation, increase blood flow, and reduce inflammation and bacterial load by means of histamine in the leech saliva, thereby promoting wound healing. Gerivani *et al*'s study further confirmed the efficacy of LLT in chronic osteomyelitis, especially when used in combination with antibiotics, demonstrating significant reductions in bacterial colony counts, pathological assessments of bacterial-infected bone tissue, and serum levels of tumor necrosis factor-$\alpha$ (TNF-$\alpha$) in rats with induced osteomyelitis [34]. Despite some studies noting potential complications of LT such as worsening infections, allergic reactions, and prolonged bleeding—with worsened infection

being among the most commonly reported complications—no studies with sufficient sample sizes have confirmed a direct link between LLT and nosocomial infections [35] [36]. Most reports indicate that improper procedures (such as a lack of strict aseptic techniques, reusing the same leeches, and failing to closely monitor patients during treatment) are the main causes of these complications. A large-scale clinical study indicates that properly performed LLT does not increase the incidence of nosocomial infections [37]. In the present case, all leeches used were strictly farmed medical-grade live leeches. During LLT, ceftazidime was continued for anti-infective coverage, which is effective against common pathogens associated with leech therapy, such as *Aeromonas hydrophila*. Throughout the treatment period, the patient's infection markers were closely monitored, and no new infection was observed afterward. Thus, we contend that strict adherence to proper procedures can effectively avoid these complications. When performing LLT, strict aseptic principles should be followed, such as wearing gloves, using sterile toothed forceps for leech handling, and conducting timely follow-up checks on patients' infection markers post-treatment to ensure the absence of recurrent infections. Furthermore, some critiques of LLT focus on psychological factors such as patient informed consent and compliance [38]. Patients may fear treatment involving blood-sucking parasites, resulting in lack of cooperation, treatment failure, or the emergence of complications. This underscores the need to fully explain the treatment procedure, precautions, and potential complications to patients and their families before applying LLT, and obtain their written consent. During treatment, close monitoring of the patient's reactions and psychological support should be provided to alleviate any tension or fear. Properly performed Live Leech Therapy is an effective therapeutic approach, but its implementation requires strict adherence to aseptic principles and careful attention to the patient's psychological responses to ensure its safety and efficacy. Additionally, although no recurrence was observed in this case at the two-month and six-month follow-ups, the relatively short follow-up period of only half year remains a limitation given the high recurrence rate of chronic osteomyelitis. Therefore, the long-term efficacy of leech therapy requires further validation.

## 7. Conclusion

We present a unique case of treating chronic ischial osteomyelitis with refractory sinus tracts through the combination of Live Leech Therapy (LLT) and antibacterial agents. Follow-up after discharge indicated satisfactory therapeutic outcomes, suggesting that LLT represents a potentially novel option for patients with chronic non-healing sinus tracts. This therapy is characterized by its ease of administration, low cost, significant efficacy, and high safety profile. As a traditional alternative medicine, LLT possesses potent biochemical effects. Although the treatment mechanisms remain incompletely elucidated and potential complications (e.g., infection, allergy) exist, these risks can be effectively mitigated through standardized protocols that include utilizing medicinal leeches certified as pathogen-free from

regulated suppliers, ensuring strict adherence to aseptic techniques during application and wound management, conducting comprehensive pre-treatment screening for bleeding diatheses and allergic predispositions, and implementing close post-treatment clinical monitoring for adverse events. In this case, the rigorous implementation of these measures not only ensured a robust safety profile but also corroborated the observed therapeutic efficacy, demonstrating the feasibility of integrating systematic risk mitigation strategies into clinical practice. This approach offers new insights and directions for clinical treatment, warranting further research and exploration.

## Author Contributions

Yang-Fei Wei contributed to conceptualization, data analysis,, performed the literature search, and writing of the original draft paper, and reviewed the paper; Dan Zhang contributed to conceptualization, data collection, performed the literature search, patient care, and reviewed the paper; Ming Shi contributed to conceptualization, performed the literature search, and data collection; Jun-Jun Cao contributed to data collection; Song Li contributed to data analysis.

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## Declarations of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data Availability

The data sets generated and analyzed during the current study are not publicly available due to our research center policy, but are available from the corresponding author on reasonable request.

## Ethical Approval

No approval was required. All authors complied with the ethics and policy of the journal.

## 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-in-Chief of this journal.

## Conflicts of Interest

The authors declare no competing interests.

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