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Leeches (Hirudinea): Historical Significance and Contemporary Therapeutic Applications in Medicine, Surgery, Dentistry, and Prosthodontics

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Abstract

The use of dental implants in the anterior region is a challenging endeavor. Placement of an implant in an ideal position is often not possible because of lack of sufficient bone. The restoration of the extracted anterior teeth and maintenance of the surrounding soft tissue by means of adequate surgical and prosthetic techniques are demanding for clinicians. In this case report, the Essix appliance was used as a provisional restoration post-implant placement, which was later utilized for the fabrication of an implant-supported FPD by incorporating its external form by lab scanning in order to obtain a better emergence profile and aesthetic results. The aim of this article is to report the laboratory and clinical steps involved in the restoration of anterior teeth with implant-supported FPD which was guided by an Essix appliance provided as a provisional prosthesis.

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Introduction

Leeches (phylum Annelida, class Hirudinea) are hematophagous annelids with a long history of therapeutic use across diverse cultures. Their medicinal relevance is rooted in their salivary secretions, which contain bioactive molecules capable of modulating coagulation, inflammation,

and tissue perfusion.¹ Historically, leech therapy was an integral component of traditional medicine systems, including Ayurveda, ancient Greek, and medieval European practices, primarily employed for bloodletting, detoxification, and the management of various systemic

disorders.²

In modern clinical practice, leech therapy has experienced a resurgence due to its efficacy in microsurgery, reconstructive procedures, and tissue transplantation.³ The anticoagulant and vasodilatory properties of leech saliva facilitate venous outflow, reduce hematoma formation, and enhance graft survival. Also, leeches have demonstrated potential in managing inflammatory conditions, vascular disorders, and musculoskeletal ailments.

In dentistry and prosthodontics, leech therapy remains underexplored, although preliminary evidence suggests benefits in improving post-surgical tissue healing, vascularization, and management of local hematomas. This review seeks to consolidate historical knowledge with contemporary evidence, examining the molecular mechanisms, clinical applications, and safety considerations associated with leech therapy. By highlighting both established and emerging therapeutic roles, this article underscores the continuing relevance of leeches in modern medicine and identifies potential avenues for integration into dental and prosthodontic practice.

Historical Perspectives

Leech therapy has a rich historical lineage, spanning several millennia and multiple civilizations. In Ayurveda, leeches (jalouka) were employed for bloodletting, detoxification,

and the management of systemic imbalances, often under the guidance of texts attributed to Lord Dhanvantari, the divine physician. Classical Ayurvedic literature describes leech therapy as beneficial in disorders of blood, skin, and circulation, emphasizing its role in restoring humoral balance and promoting healing.

In ancient Greek medicine, leeches were used for similar purposes, particularly for controlling blood volume and addressing conditions associated with “humoral excess.” The practice was later adopted in medieval Europe, where leeching became a standard therapeutic intervention for a range of illnesses, from fevers to inflammation, often guided by humoral theory. During the 18th and 19th centuries, leech therapy gained popularity in Europe, particularly in France for use in medicine and surgery.

The transition from ancient and medieval practices to modern medicine reflects a shift from empirical bloodletting to evidence-based applications, driven by an understanding of leech-derived bioactive compounds and their physiological effects. While historical use was largely systemic and generalized, contemporary therapy leverages specific molecular properties—such as anticoagulation, vasodilation, and tissue perfusion—to achieve targeted therapeutic outcomes. This historical evolution underscores both the enduring relevance of leeches in medicine and the necessity of integrating traditional knowledge with modern clinical evidence.

Bioactive components of leeches and their therapeutic properties:

S. No	Bioactive components	Therapeutic properties
1.	Hirudin	Thrombin inhibitor prevents blood coagulation, primary anticoagulant in microsurgery and flap survival. ⁴
2.	Calin	Inhibits platelet aggregation, enhances local perfusion in compromised tissues.
3.	Destabilase	Exhibits fibrinolytic activity, aiding in the breakdown of existing clots and maintaining vascular patency during tissue healing.
4.	Bdellins and Eglins	Protease inhibitors that provide anti-inflammatory and analgesic effects, reducing tissue edema and pain after surgical interventions. ⁶
5.	Hyaluronidase	Enhances tissue permeability, facilitating the diffusion of other bioactive components and improving local blood flow.
6.	Factor Xa Inhibitors	Contribute to anticoagulation, complementing the effects of hirudin and calin in preventing thrombosis.

Cotemporary Medical Applications

Leech therapy has experienced a resurgence in modern medicine due to its proven efficacy in microsurgery, reconstructive procedures, and tissue transplantation. The primary clinical applications are centered around the ability

of leech saliva to promote venous outflow and prevent hematoma formation by inhibiting platelet aggregation.

1. Microsurgery and Reconstructive Surgery: Leeches are frequently employed in the management of venous congestion following replantation of digits, ears, and

other small tissue flaps. By facilitating localized blood drainage and enhancing microvascular perfusion, leech therapy significantly improves the survival rate of transplanted tissues.⁵

2. Cardiovascular and Vascular Disorders: The anticoagulant and vasodilatory properties of leech saliva, particularly hirudin and calin, contribute to the management of thrombotic events and peripheral vascular insufficiency,
3. Orthopedic and Musculoskeletal Applications: Leech therapy has demonstrated benefits in reducing inflammation and pain in conditions such as osteoarthritis and chronic joint disorders, owing to the anti-inflammatory effects of bdellins, eglins, and protease inhibitors.
4. Pain Management and Anti-inflammatory Effects: Beyond musculoskeletal conditions, leech-derived compounds are explored for analgesic effects, providing a complementary modality in postoperative pain management and in patients with inflammatory disorders.

Surgical Application

Leech therapy has established a significant role in modern surgical practice, particularly in procedures requiring management of venous congestion and tissue perfusion.

1. Replantation and Reconstructive Surgery: Following digit, ear, or nose replantation, venous outflow can be compromised, leading to congestion and potential flap necrosis.⁷ Leeches facilitate controlled bloodletting, reduce venous pressure, and enhance tissue oxygenation thereby improving graft survival rates to a greater extent.
2. Management of Hematomas: Postoperative hematomas pose a risk to wound healing and graft integrity. Leech therapy provides a minimally invasive method to evacuate excess blood, reduce edema, and maintain local perfusion through platelet inhibition.⁸
3. Microsurgical Flap Salvage: In free and pedicled flaps, especially in reconstructive and plastic surgery, leeches are employed as adjunctive therapy to maintain venous circulation during the critical postoperative period⁹

4. Evidence from Case Reports and Studies: Numerous case reports and clinical studies document successful outcomes of leech therapy in complex surgical scenarios that includes

Sublingual and lingual hematomas: Several case reports describe the successful use of medicinal leeches to evacuate sublingual or lingual hematomas that developed after anterior mandibular surgery or traumatic injury. In situations where immediate surgical drainage is not feasible or when airway management is a concern, hirudotherapy has been used as a temporizing, non-operative measure to reduce venous pressure and allow gradual decompression.¹³

Implant-related intraoral hematoma: A reported case following implant placement in the anterior mandible describes the application of leeches to the tongue hematoma with subsequent reduction in swelling and uneventful healing.

Reconstructive oral surgery: Leeches have been used as an adjunct in free and pedicled flap venous congestion in the oral and maxillofacial region (e.g., a forearm free flap following hemiglossectomy) where re-anastomosis failed or was incomplete; leech application provided temporary venous outflow allowing flap survival.

These clinical anecdotes underscore the potential role of medicinal leeches as an adjunctive measure in specific, oral and maxillofacial situations. They also highlight the importance of careful patient selection, monitoring, and prophylactic antibiotics active against *Aeromonas* species when leeches are used.

Dental and Prosthodontic Applications

Although leech therapy is well-established in general and reconstructive surgery, its application in dentistry and prosthodontics remains relatively underexplored. Emerging evidence suggests potential benefits in post-surgical tissue management, vascular enhancement, and local healing, particularly in complex oral and maxillofacial procedures.

1. Post-Extraction and Surgical Hematoma Management: Leeches can be applied to control localized hematomas, reduce venous congestion, and facilitate efficient blood drainage, promoting and minimizing tissue necrosis.¹⁰
2. Maxillofacial Reconstruction: In procedures involving

tissue flaps or grafts for trauma or oncologic survival by improving microcirculation and oxygenation in compromised tissues.

3. **Prosthetic Implications:** Although direct evidence is limited, leech therapy’s role in improving local vascularity could be attributed to prosthetic interventions where surgical site healing, implant integration, or soft tissue adaptation is critical. Enhanced tissue perfusion and reduced edema may facilitate faster recovery and better prosthetic outcomes.
4. **Therapeutic Integration and Safety Considerations:** As with surgical applications, aseptic handling, prophylactic antibiotic administration, and careful patient selection are essential. Leeches may serve as an adjunct to conventional dental therapies, particularly in high-risk or complex cases requiring optimized tissue perfusion.

Current Challenges and safety

Despite the therapeutic potential of leeches, several challenges and safety considerations must be addressed to ensure effective and safe clinical application.

1. **Infection Risk:** Leeches harbor symbiotic bacteria, most notably *Aeromonas hydrophila*, which can cause localized or systemic infections. Prophylactic antibiotic coverage, typically with fluoroquinolones or third-generation cephalosporins, is recommended.
2. **Standardization of Treatment:** Variability in leech species, size, and number used, as well as application duration, complicates the establishment of standardized protocols. Controlled guidelines for dosage, timing, and site of application are essential for clinical safety.
3. **Ethical and Patient Acceptance Issues:** The use of live leeches can elicit psychological discomfort in some patients, so adequate patient counseling and informed consent are critical. .
4. **Hemorrhagic Complications:** While leech saliva contains anticoagulants beneficial for perfusion,

reconstruction, leech therapy may enhance flap prolonged bleeding at the application site can occur. Monitoring and timely intervention are necessary to prevent excessive blood loss, particularly in patients on anticoagulants.

5. **Regulatory Considerations:** Regulatory approval and classification of leeches as medical devices or therapeutic agents vary by region, affecting availability, clinical use, and research opportunities.

Future Perspectives

The evolving understanding of leech biology and the bioactive properties of their salivary secretions presents significant opportunities for expanding therapeutic applications.

1. **Bioengineered Leech-Derived Compounds:** Advances in molecular biology and biotechnology may enable the synthesis of hirudin analogs, protease inhibitors, and other leech-derived molecules. Such bioengineered compounds could provide the benefits of leech therapy without requiring live organisms, reducing infection risk and improving acceptability.
2. **Integration into Dental and Prosthetic Practice:** Systematic clinical trials are needed to establish standardized protocols for leech therapy in oral surgery and prosthetics.
3. **Personalized Therapeutic Approaches:** The potential for tailoring leech therapy based on individual patient’s vascular status, coagulation profile, and tissue healing requirements represents excellent treatment outcomes for each patient
4. **Research on Mechanisms and Safety:** Further studies on the molecular mechanisms of leech bioactive components, their pharmacokinetics, and long-term effects are needed.
5. **Multidisciplinary Collaboration:** Future research integrating surgeons, dentists, prosthodontists, pharmacologists, and bioengineers can facilitate innovative applications, optimize therapeutic efficacy while minimize risks.

Summary

Author	Clinical intervention and outcome
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Ali K Sig et al 2017	When a leech bites, hyaluronidase and collagenase allow access to the tissues and blood vessels; vasodilatation occurs by the action of histamine-like molecules; platelet functions, kinin activity, and the coagulation cascade are inhibited; and inflammatory reactions are suppressed. In addition, analgesic and antimicrobial effects are observed.
Bushra Husain et al 2024	Recent studies indicate that leech therapy can significantly alleviate pain and improve joint function in osteoarthritis patients, enhance blood circulation, and reduce inflammation. It is also beneficial for chronic pain conditions & wound healing, particularly after reconstructive surgery, as leeches enhance blood flow to compromised tissues, aiding recovery.
Kubranur Unal et al 2023	Because of the continuous bleeding caused by the anticoagulant substances in the leech saliva, the capillary network is relieved, and tissue congestion is greatly reduced. That also causes an increase in lymph flow, positive changes in local hemodynamics, ease of hemorrheology, an increase in oxygen supply, improvement of tissue metabolism, and elimination of tissue ischemia. Thus, the survival rate of the affected area is increased.
Swaia abdulla et al 2012	Leech therapy is most often used in the settings of localized venous congestion associated with flap reconstructions and surgical replantations. Hirudotherapy has also been used to treat soft tissue swelling and hematomas in trauma.
Kunal Jha et al 2015	Leech therapy can be safely and effectively used to evacuate blood and morbid humours from deeper tissues and in diseases like psoriasis, chronic ulcers and eczema. Leech therapy can produce better results as a mono or an adjunctive therapy in diseases like angina pectoris, coronary thrombosis, hypertension, atherosclerosis, varicose veins and in many surgical and traumatic conditions.
Syal Kumar et al 2012	The Indications for Leech Therapy include Benign tumors, Hemorrhoids. Abscesses and boils Skin disorders—such as dermatitis, psoriasis, vitiligo, alopecia, ulcers, Gout, Diseases of the throat Diseases of the eye and Cysts
A.M.Abdualkader et al 2013	Although, the benefits of leeching in dentistry have not been established yet, many reports mentioned leech application in dental abnormalities. Traumatic and postoperative macroglossia (tongue swelling) have been associated with life-threatening complications, especially, airways occlusion. The bloodletting by leeches was reported to be considerably successful in the management of severe postoperative macroglossia cases when the common treatment method was not satisfactory.
Sarvesh Kumar Singh et al 2020	MLT has beneficial effect as adjuvant therapy on inflammatory conditions like abscesses, hypersensitivity conditions, rheumatic disease (rheumatoid arthritis, fibromyalgia and myasthenia gravis), gout, arthritis, systemic lupus erythematosus, paronychia, tendinitis, tendovaginitis, sialadenitis and inflammatory diseases of internal organs.
Shabnam Farzali et al 2025	Both clinical studies and case reports confirm the effectiveness of medicinal leech therapy in relieving pain. Leech therapy has been recommended in patients with knee osteoarthritis because of the decrease in pain after HT and few side effects after the procedure. In this study, the 100% success of HT applied against joint pain due to osteoarthritis reveals that leech therapy can be an effective method in managing and reducing or eliminating pain.
Azad Hussain Lone et al 2011	Leech therapy can be used effectively for the management of various disorders specially skin and musculoskeletal disorders where western medical treatment is of less value.

Conclusion:

Leeches (Hirudinea) represent a unique intersection of traditional medicine and modern therapeutic innovation. Historically valued for bloodletting and systemic regulation, their resurgence in contemporary practice is driven by the discovery of bioactive compounds in leech saliva, including anticoagulants, anti-inflammatory agents, and vasodilators. Clinical applications span microsurgery, reconstructive

procedures, orthopedic conditions, and emerging roles in dentistry and prosthodontics.

While challenges such as infection risk, standardization, and patient acceptability remain, careful protocols and evidence-based approaches allow safe and effective use. The integration of leech therapy into modern practice exemplifies how ancient knowledge can be harmonized with contemporary practice as alternative medicine.

Future directions include bioengineering of leech-derived molecules, personalized therapeutic applications, and rigorous clinical studies in dental and prosthodontic contexts. By consolidating historical wisdom, molecular

understanding, and clinical innovation, leech therapy continues to hold promise as a versatile and valuable tool across multiple disciplines.

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