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Innovative and cost-effective hanger traction for proximal phalanx Fracture: A case report

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Abstract
This case report highlights the use of a novel, low-cost hanger traction method for the management of a proximal phalanx fracture in a financially constrained patient. The method, inspired by historical techniques from the Mother Journal (1939) by Allyn King Foster Jr., was adapted with modern materials to provide effective treatment in resource-limited settings. The results demonstrate that this approach is not only cost-effective but also customizable, making it a viable alternative to expensive surgical interventions for underserved populations.

Keywords: Innovative, cost-effective hanger traction, populations, proximal phalanx, case report

Introduction
Proximal phalanx fractures are among the most common injuries of the hand and, if not managed properly, can lead to functional impairment. The choice of treatment often depends on the severity of the fracture, patient circumstances, and available resources. While surgical options like internal fixation offer reliable results, they are financially prohibitive for many patients, especially in low-income settings.
Historical literature, such as Allyn King Foster Jr.'s 1939 article used as our Mother Journal describes early techniques for treating hand fractures using simple mechanical principles and accessible materials. Foster's approach, which utilized basic tools to achieve traction and alignment, was revolutionary for its time and remains relevant today. Building upon these principles, we present a modified hanger traction technique that addresses both affordability and accessibility.

Case Presentation
Patient Profile
- **Age/Gender:** 72-year-old male.
- **Presenting Complaint:** Inability to move the left 4th finger with persistent pain following a fall.
- **History:** The patient sustained a proximal phalanx fracture one week prior. Financial constraints precluded surgical intervention.
- **Examination Findings:** On examination, the patient exhibited swelling, tenderness, and deformity in the 4th finger of the left hand. Radiographic imaging confirmed a displaced proximal phalanx fracture (Figure 1).
- **Management Plan:** Given the patient's financial limitations, a non-surgical approach was planned using a customized hanger traction method.

Materials and Methods
1. Fabrication of the Hanger Traction Device
A standard metal hanger was reshaped into a Z configuration to serve as the frame. The design ensured adequate leverage and traction while being lightweight and easy to secure. (Figure 2 and Figure 3).

2. Traction Application
A base was created on the nail of the fractured finger using micropore tape and adhesive glue. The hook was secured to the nail using the prepared base.

A gamgee roll was used for padding, and a plaster cast was applied to immobilize the forearm, wrist, and fingers.
The free end of the hanger frame extended outward from the cast, allowing for the attachment of a rubber band loop to maintain controlled traction (Figure 5).

3. Follow-Up and Monitoring
Weekly clinical and radiographic assessments were performed. The fracture demonstrated proper alignment and healing without complications (Figure 4).

Discussion

Historical Context
The concept of simple, effective traction for hand fractures was first detailed by Allyn King Foster Jr. in the Mother Journal (August 1939). Foster described the use of rudimentary tools like metal wires and splints to create dynamic traction systems. His work underscored the importance of mechanical alignment in promoting fracture healing. This case revisits Foster's principles, adapting them with contemporary materials to address modern clinical needs.

Comparison with Existing Techniques
1. Fingernail traction with digital splints, Jehan, *et al.* (2012) [2]
A prospective study conducted on 43 cases explored the use of fingernail traction combined with digital splints for proximal phalangeal fractures. The method involved attaching traction to the fingernail with adhesive strips or hooks, paired with elastic bands for dynamic force application. Prefabricated splints were used to maintain proper alignment.
The main distinction between digital splints and our hanger traction system are evident in material accessibility, cost, and ease of implementation. Digital splints rely on specialized, prefabricated devices, which can limit their availability, especially in resource-limited settings. In contrast, our hanger traction system utilizes basic materials such as a reshaped metal hanger, micropore tape, and adhesive, making it a universally implementable solution. Regarding cost, digital splints and elastic bands add to the treatment expenses, whereas our approach is nearly cost-free, offering a practical solution for economically disadvantaged patients. Furthermore, the digital splint technique requires specialized training to fit the splints correctly, while our method is simple and intuitive, needing minimal instruction for healthcare workers to apply effectively.

2. Low-cost static external fixators, Tank, *et al.* (2018) [3]
Another approach involves using static external fixators constructed with prefabricated frames and percutaneous Kirschner wires (K-wires). This system offers rigid stabilization but necessitates surgical insertion of the wires, which requires sterile facilities and trained personnel.
The crucial contrast between dynamic traction and static external fixators are evident in terms of traction application, invasiveness, and cost. Static external fixators lack the ability to provide continuous traction, which can lead to joint stiffness and restricted mobility. In contrast, our method applies dynamic traction through rubber bands, ensuring continuous alignment and reducing the risk of immobility in proximal phalanx fractures. Additionally, while external fixators often involve minor surgical procedures for wire placement, our approach eliminates the need for surgery, offering a safer and fully non-invasive alternative. In terms of affordability, the external fixator system, despite being labeled as "low-cost," still incurs expenses for surgical equipment and prefabricated frames. Our method, however, minimizes these costs to nearly zero, making it an economically viable solution.

3. Open Reduction and Internal Fixation (ORIF)
The standard surgical approach for displaced proximal phalangeal fractures, ORIF, involves the use of mini-plates and screws to stabilize the bone fragments. While highly effective in terms of alignment and stability, ORIF is not without its drawbacks.
Primary variation between ORIF (Open Reduction and Internal Fixation) and our traction system lie in cost, invasiveness, and recovery. ORIF is a cost-prohibitive procedure that requires advanced surgical expertise, sterile facilities, and expensive implants, which limits its availability in underprivileged settings. In contrast, our approach is both accessible and economical, making it a viable option for a broader range of patients. Furthermore, ORIF is a highly invasive procedure, carrying risks such as infection, scarring, and soft tissue damage. Our traction system, being non-invasive, avoids these risks entirely. Additionally, post-operative care for ORIF often involves managing surgical wounds and undergoing prolonged rehabilitation, while our method minimizes tissue damage and promotes a faster recovery with fewer complications, making it a safer and more efficient alternative.

Key benefits of our method over existing techniques
The hanger traction system offers several significant advantages, making it an ideal solution for fracture treatment, especially in resource-limited settings. It is highly adaptable, allowing for easy customization to meet individual patient needs using commonly available materials like metal hangers, rubber bands, and adhesive. These materials are not only cost-effective but also easily sourced, even in rural or underfunded clinics, making the system highly accessible. Unlike commercial devices or surgical interventions, the materials used in the hanger traction system are affordable, costing only a fraction of those alternatives.
The system applies continuous traction through rubber bands, ensuring better fracture alignment compared to static methods. Additionally, its adjustable Z-shaped hanger accommodates variations in fracture anatomy and patient size, offering greater versatility. The lightweight design further enhances patient comfort by facilitating ease of movement and reducing discomfort during treatment. Another advantage is its simplicity; the technique requires minimal training, making it feasible for primary care physicians to implement in settings with limited resources. Overall, the hanger traction system combines affordability, accessibility, customizability, and ease of use, making it a practical and effective tool for treating fractures in various healthcare environments.

Clinical Implications
The prefabricated and surgical techniques described in existing studies, while effective, are less practical for economically disadvantaged populations. Our method fills

this gap by offering a cost-effective, non-invasive solution that does not compromise on treatment efficacy. Moreover, it bridges the divide between modern techniques and the constraints of real-world healthcare delivery, particularly in underserved regions.

By directly addressing the limitations of current methods, our approach provides an innovative and equitable alternative for managing proximal phalangeal fractures. Future comparative studies could further strengthen the case for widespread adoption of this technique.

Clinical Relevance

This case underscores the importance of revisiting historical methods like those documented in the. By integrating modern materials and techniques, these foundational principles can be adapted to address contemporary challenges in healthcare.

Conclusion

The hanger traction method provides an innovative, low-cost solution for the management of proximal and middle phalanx fractures in financially constrained patients. Inspired by historical literature and modified for modern use, this technique offers an accessible alternative to conventional surgical treatments. Its success in this case highlights its potential for broader application, particularly in resource-limited settings. Future studies should further evaluate its efficacy and scalability.

Images

Fig 1: Pre Procedure x-ray hand (AP/Lateral/Oblique View)

Fig 2: Plaster Applied

Fig 3: Traction Given

Fig 4: Post Procedure X-RAY Hand (AP/Lateral/Oblique View)

Fig 5: Allowing for the attachment of a rubber band loop to maintain controlled traction

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