

Novel Technique for Fracture Non-Union in Children – A Case Report

Vikas Basa¹, Chirag Manwani¹

Learning Point of the Article:

Low-intensity Pulsed Ultrasound (LIPUS) offers a safe, non-invasive, and effective alternative for managing pediatric fracture non-union, potentially reducing the need for revision surgery.

Abstract

Introduction: Pediatric fracture non-union is more common than generally expected. The risk factors are similar to those in adults, and treatment remains equally challenging. Surgery is almost always necessary to restart the healing process. One of the conservative options now being used is low-intensity pulsed ultrasound (LIPUS). It has been applied both in fresh fractures to stimulate all stages of healing and in non-unions, working by promoting repair at the molecular level.

Case Report: We present a case of a distal one-third humeral shaft fracture in a child that developed atrophic non-union and was treated with LIPUS. Therapy was initiated, and sequential radiographs were evaluated for healing. Encouraging signs of union were seen at 3 months, with successful fracture union at 6 months.

Conclusion: This was the 1st time LIPUS was used in India for the management of pediatric fracture non-union. While several studies have demonstrated the use of LIPUS in adult non-unions, little literature exists regarding its use in children. Even though this is a single case report, we hope it will encourage further trials and research and help establish LIPUS as a novel technique for managing pediatric fracture non-union.

Keywords: Pediatric, fracture, non-union, humerus, low-intensity pulsed ultrasound.

Introduction

In clinical practice, humeral fractures are common in children. Most heal well due to the strong biological capacity for bone healing and remodeling in this age group. However, some progress to non-union despite appropriate treatment. Although non-union is often considered rare in children, it is more common than generally believed. Scaphoid (12%) and femoral neck fractures (5%) are at the highest risk, with humeral fractures (2%) not far behind [1].

Risk factors for pediatric non-union include the anatomical location of the fracture, the nature of injury (open or closed), soft

tissue loss, body mass index, smoking, and Vitamin D deficiency [1,2]. When non-union occurs, intervention is usually required – surgical or otherwise – to restart the healing process [3]. Revision surgery, with success rates ranging from 68% to 96% [3,4], is standard but carries risk. Therefore, more conservative options are being explored, particularly for cases with a high surgical risk.

One such method is low-intensity pulsed ultrasound (LIPUS), a form of ultrasound applied in both acute fractures and non-unions [5]. It promotes osteogenesis by inducing micromechanical stress, thereby stimulating healing at the

Author's Photo Gallery



Dr. Vikas Basa



Dr. Chirag Manwani

Access this article online

Website:
www.jocr.co.in

DOI:
<https://doi.org/10.13107/jocr.2026.v16.i04.7138>

¹Department of Orthopaedics, Centre for Bone and Joint, Kokilaben Dhirubhai Ambani Hospital and Research Medical Centre, Mumbai, Maharashtra, India.

Address of Correspondence:

Dr. Vikas Basa,
Department of Orthopaedics, Centre for Bone and Joint, Kokilaben Dhirubhai Ambani Hospital and Research Medical Centre, Mumbai, Maharashtra, India.
E-mail: basavikas@gmail.com

Submitted: 03/01/2026; Review: 06/02/2026; Accepted: March 2026; Published: April 2026

DOI: <https://doi.org/10.13107/jocr.2026.v16.i04.7138>

© The Author(s). 2026 Open Access. This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and non-commercial reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated.

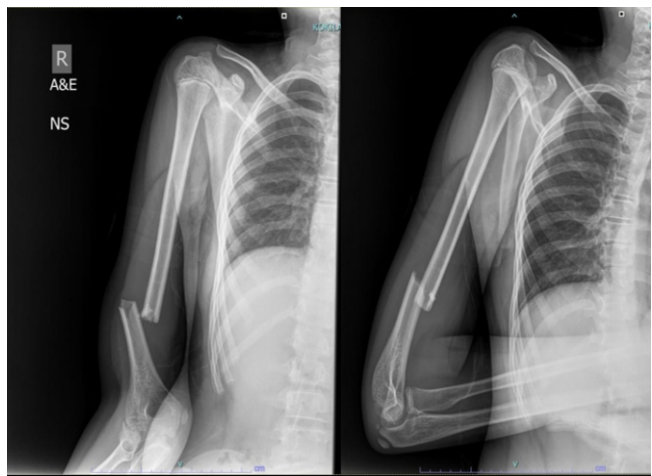


Figure 1: Initial presentation – distal humeral shaft fracture.

cellular level [6]. While LIPUS is commonly used in adults, there are only a few reports of its use in pediatric fractures.

We present a case of aseptic non-union of a distal humeral shaft fracture treated with LIPUS. Parents have provided informed consent for publication of this case.

Technique

The treatment of LIPUS was discussed with the parents in detail, and informed consent was obtained, as this would be the first reported case in India. Therapy was started in February 2020. The treatment area was marked on the skin, and LIPUS administered daily for 20 min. To monitor the progress and the fracture healing, monthly radiographs were obtained.

Case Report

A 13-year-old boy presented in May 2019 with a fracture of the distal third of the right humeral shaft after a fall (Fig. 1). The

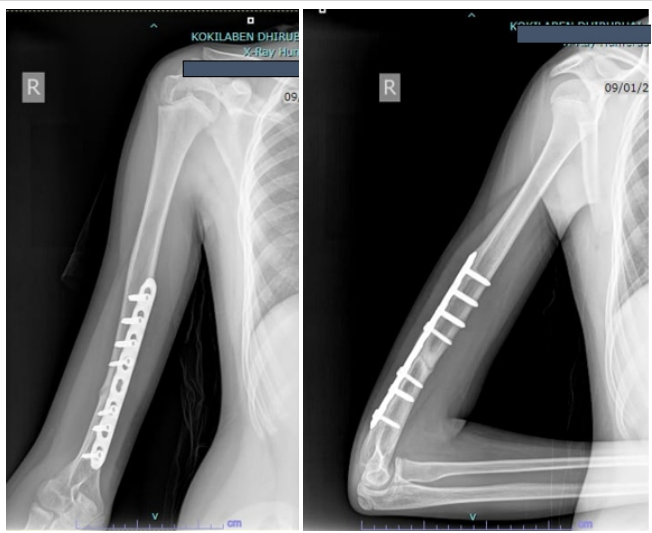


Figure 3: Radiograph at 7 months showing non-union.

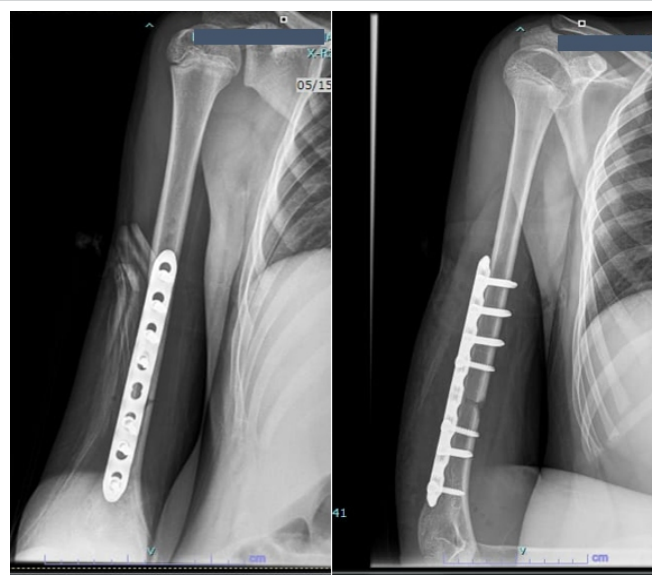


Figure 2: Post-operative radiograph after plating.

injury was closed, with no neurovascular deficit. After discussion with the family, he underwent open reduction and internal fixation with plating. The procedure was uneventful, and he was discharged a few days later with intact neurovascular status (Fig. 2).

His wounds healed well, and there were no complications during the initial post-operative period. However, even after 7–8 months, radiographs showed no signs of union (Fig. 3 and 4). Revision plating with bone grafting was initially considered, but after a multidisciplinary team consultation and with an orthopedic surgeon in Japan experienced in LIPUS, the decision was made to attempt LIPUS therapy.

The procedure was discussed in detail with the parents, as this would be the first reported case in India. After written consent

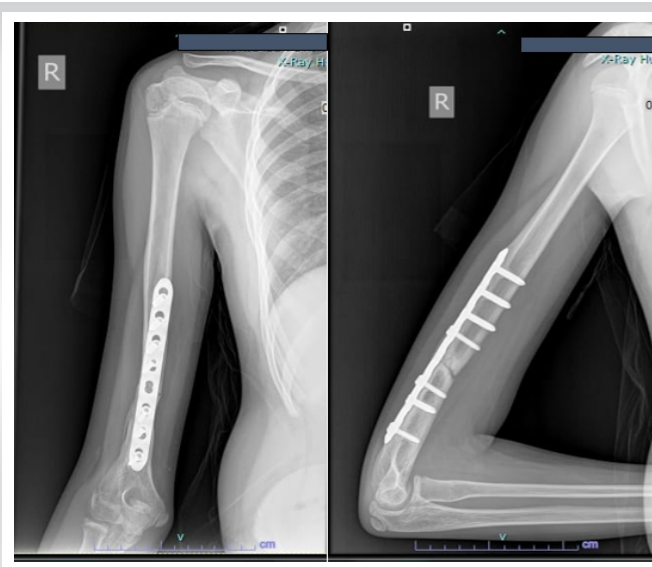


Figure 4: Radiograph at 8 months confirming non-union.





Figure 5: Radiograph at 3 months after starting low-intensity pulsed ultrasound showing early healing.

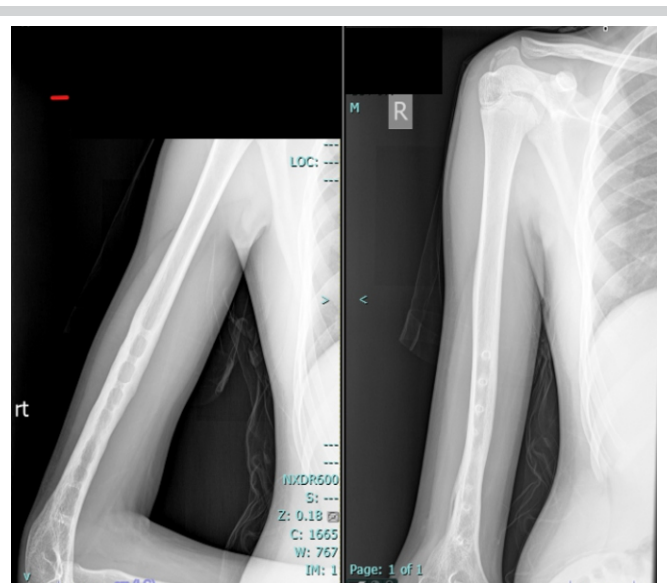


Figure 6: Radiograph at 6 months after low-intensity pulsed ultrasound showing complete union.

was obtained, therapy was started in February 2020. The treatment area was marked on the skin, and LIPUS was administered daily for 20 min. Monthly radiographs were taken to monitor progress.

By 3 months, early signs of healing were visible. Therapy was continued, and by 6 months the radiographs showed complete union (Fig. 5). The patient had regained a full range of motion at the elbow and shoulder. He subsequently underwent implant removal and returned to pain-free, unrestricted activities (Fig. 6).

Discussion

Fracture healing occurs in four phases: Inflammation, soft callus, hard callus, and remodeling. LIPUS has been shown to stimulate all of these phases [6]. Lou et al. [7] demonstrated that LIPUS reduces the time to union in fresh fractures without

affecting functional recovery. A systematic review and meta-analysis by Leighton et al. [3] provided significant evidence supporting its use in non-unions. Although hypertrophic non-unions are thought to respond more readily than atrophic non-unions due to higher biological activity, evidence is inconclusive. LIPUS generates micromotion at the fracture site, which is converted into biochemical signals. This activates cellular pathways involving integrins, focal adhesions, and prostaglandin E2, ultimately leading to increased COX-2 expression and stimulation of osteogenic genes [5]. Worldwide, LIPUS is increasingly used for both fresh fractures and non-unions [4,7-10]. Tsukada et al. [11] reported promising results in patients under 18 years with early spondylolysis, showing a faster return to sports (61 days with LIPUS vs. 167 days without). Other studies have demonstrated its usefulness in unstable forearm fractures, supracondylar humeral fractures, and scaphoid non-unions in children [5,12,13]. Concerns have been raised about heat generation and possible thermal necrosis. However, modern devices produce only 1/10th to 1/50th of the heat generated by conventional physiotherapy ultrasound machines. The therapy is considered safe, with the main adverse effect being skin irritation from the coupling gel [14]. Contraindications include local skin disease, pacemaker use, pregnancy, and malignancy. The average treatment duration is 3–6 months [11]. Since this was the first case of pediatric non-union treated with LIPUS in India, the device was provided free of cost by the manufacturer (Accellus, Nippon Sigmax Co Ltd, Japan) (Fig. 7). Nevertheless, cost remains an important consideration, particularly in developing countries.



Figure 7: Low-intensity pulsed ultrasound device (Accellus, Nippon Sigmax Co Ltd, Japan).

Conclusion

This case demonstrates a favorable outcome for a challenging condition – pediatric fracture non-union – using LIPUS therapy. Although a single case, it highlights the potential of this non-invasive modality and may encourage further studies to establish its role as a novel treatment option in pediatric fracture non-union.

Clinical Message

Pediatric fracture non-union, though uncommon, poses significant treatment challenges due to a lack of significant evidence and associated surgical risks. Low-intensity pulsed ultrasound offers a promising, non-invasive therapeutic alternative that stimulates bone healing at the molecular level. In this case, a successful union was achieved in an atrophic humeral non-union without the need for revision surgery. The therapy was well tolerated, safe, and effective, demonstrating its potential role in managing pediatric non-unions, especially when surgical intervention carries a higher risk or is not preferred.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

References

- Zura R, Kaste SC, Heffernan MJ, Accousti WK, Gargiulo D, Wang Z, et al. Risk factors for nonunion of bone fracture in pediatric patients: An inception cohort study of 237,033 fractures. *Medicine (Baltimore)* 2018;97:e11691.
- Arslan H, Subaşı M, Kesemenli C, Ersuz H. Occurrence and treatment of nonunion in long bone fractures in children. *Arch Orthop Trauma Surg* 2002;122:494-8.
- Leighton R, Watson JT, Giannoudis P, Papakostidis C, Harrison A, Steen RG. Healing of fracture nonunions treated with low-intensity pulsed ultrasound (LIPUS): A systematic review and meta-analysis. *Injury* 2017;48:1339-47.
- Gebauer D, Mayr E, Orthner E, Ryaby JP. Low-intensity pulsed ultrasound: Effects on nonunions. *Ultrasound Med Biol* 2005;31:1391-402.
- Elsebahy SY, Olama KA, Elsayed MM. Low-intensity pulsed ultrasound for healing supracondylar fracture. *Physiother Q* 2020;28:15-9.
- Mundi R, Petis S, Kaloty R, Shetty V, Bhandari M. Low-intensity pulsed ultrasound: Fracture healing. *Indian J Orthop* 2009;43:132-40.
- Lou S, Lv H, Li Z, Zhang L, Tang P. The effects of low-intensity pulsed ultrasound on fresh fracture: A meta-analysis. *Medicine (Baltimore)* 2017;96:e8181.
- Lou S, Lv H, Li Z, Tang P, Wang Y. Effect of low-intensity pulsed ultrasound on distraction osteogenesis: A systematic review and meta-analysis of randomized controlled trials. *J Orthop Surg Res* 2018;13:205.
- Padilla F, Puts R, Vico L, Raum K. Stimulation of bone repair with ultrasound: A review of the possible mechanic effects. *Ultrasonics* 2014;54:1125-45
- Nolte PA, Van Der Krans A, Patka P, Janssen IM, Ryaby JP, Albers GH. Low-intensity pulsed ultrasound in the treatment of nonunions. *J Trauma* 2001;51:693-702; discussion 702-3.
- Tsukada M, Takiuchi T, Watanabe K. Low-intensity pulsed ultrasound for early-stage lumbar spondylolysis in young athletes. *Clin J Sport Med* 2019;29:262-6.
- Ota T, Itoh S, Yamashita K. The efficacy and safety of combination therapy of low-intensity pulsed ultrasound stimulation in the treatment of unstable both radius and ulna fractures in children. *Biomed Mater Eng* 2017;28:545-53.
- Farkash U, Bain O, Gam A, Nyska M, Sagiv P. Low-intensity pulsed ultrasound for treating delayed union scaphoid fractures: Case series. *J Orthop Surg Res* 2015;10:72.
- Poolman RW, Agoritsas T, Siemieniuk RA, Harris IA, Schipper IB, Mollon B, et al. Low intensity pulsed ultrasound (LIPUS) for bone healing: A clinical practice guideline. *BMJ* 2017;356:j576.

Conflict of Interest: Nil
Source of Support: Nil

Consent: The authors confirm that informed consent was obtained from the patient for publication of this article

How to Cite this Article

Basa V, Manwani C. Novel Technique for Fracture Non-Union in Children – A Case Report. *Journal of Orthopaedic Case Reports* 2026 April;16(04): 329-332.

