

Tibial delayed bone healing in a pediatric patient treatment with focused shock wave therapy

Martín Turco¹, Fernando Dobkin¹, Purrello Silvia²

Abstract

Surgery for leg fractures in children and adolescents can have complications such as delayed healing and non-unions. When this complication occurs in many cases, it is necessary to remove the previously placed implant, generate a new active focus (bone curettage), and place a new implant, with or without the addition of bone graft. In cases where the fracture site is stable, focused shock waves can play a therapeutic role with a low complication rate. We present the long-term results in a case of tibial shaft fracture with delayed healing treated with shock waves in an 11-year-old patient.

Keywords: Tibial delayed healing, Non-union; Leg fracture; Shock Waves, Pediatric Fracture

Introduction

Fractures of the leg in children and teenagers are not very common. When they occur, most are successfully treated with noninvasive, closed methods, such as cast immobilization [1]. In some cases where reduction cannot be maintained with these methods, surgical treatment is performed, usually with elastic intramedullary nailing. Although this is a safe and effective method, it is not without complications, including delayed healing and non-union [2]. In many cases, it is necessary to remove the previously placed implant, generate a new active focus (bone curettage), and place a new implant, with or without the addition of bone graft [3].

These procedures significantly increase the patient's risk of morbidity and mortality, prolong hospital stays, and increase healthcare costs.

Extracorporeal focused shock wave therapy has emerged as a reliable noninvasive option for the treatment of delayed unions and/or non-unions [4-10]. There is good evidence in the scientific literature in cases of adult patients, but it is not as common in the pediatric population [11-13].

The aim of this communication is to present the outcome of a case of tibial fracture with a delayed bone union in a pediatric patient treated with focused shock waves, suffering a delayed healing after surgical intervention with an elastic nail.

Case Report

We present a case report of an 11-year-old female pediatric patient with no significant medical history. She suffered a closed, distal third-

diaphyseal, spiral-shaped, simple fracture of the left tibia, a distal tibial epiphysiolysis, and a fracture of the distal shaft of the fibula as a result of a car accident. The fracture was classified as distal tibia and fibula, AO 42-D/5.1, with epiphyseal involvement, Salter Harris type II.

The initial treatment was the implant of a titanium elastic nail technique. Epiphysiolysis fixation was performed with a cannulated screw.

The internal fixation was accompanied by a long cast boot for 6 weeks, weight-bearing with crutches for 6 weeks, and partial weight-bearing for another 6 weeks. Full weight-bearing without crutches began in the third post-operative month.

The post-operative period was satisfactory. No local or general complications were observed.

Radiographic follow-up was performed.

Healing was observed in the distal tibial epiphysis and distal fibula, with a persistent fracture line visible in the metaphyseal tibia and diaphyseal region in serial radiographic follow-ups at 16 weeks (Fig. 1).

For this reason, the decision was made to administer extracorporeal focused shock waves.

A piezoelectric focused device was used. Three weekly sessions of focused shock waves were applied, with 3,000 pulses per session at an intensity of 0.35 m/Joules.

These sessions were well tolerated; there was no need for anesthesia, and no adverse effects were observed during the application. Follow-up radiographs were taken at 4, 8, and 12 weeks.

¹Department of Orthopaedic Surgery, Sanatorio Parque Rosario, Rosario, Argentina,

²Department of Orthopaedic Surgery, Sanatorio de Niños Rosario, Rosario, Argentina.

Address of Correspondence

Dr. Martín Turco,
Sanatorio Parque Rosario, Rosario, Argentina.
E-mail: martinturco@live.com.ar



Dr. Martín Turco



Dr. Fernando Dobkin



Dr. Purrello Silvia

Submitted Date: 10 Feb 2025, Review Date: 12 Mar 2025, Accepted Date: May 2025 & Published: 30 Jun 2025

Journal of Regenerative Science | Available on www.jrsonweb.com | DOI:10.13107/jrs.2025.v05.i01.157

© The Author(s). 2025 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: Radiographic signs of delayed healing of the distal third tibial shaft fracture at 16 weeks of follow-up.



Figure 2: Radiographic confirmed healing at 2 months follow-up.



Figure 3: Control X-ray at 2 years follow-up.

Healing was evident on follow-up x-rays at 8 weeks. (Fig. 2). Two years later, the patient has no limb length discrepancy, is leading a normal life, including sports, and is asymptomatic. (Fig. 3).

Discussion

Fixation of pediatric tibial shaft fractures with elastic titanium nails is effective but has a substantial rate of delayed healing, particularly in pediatric patients [14-17].

Focused shock wave therapy is a useful method for treating delayed healing and non-union. Among its benefits are that it is a safe, non-invasive, well-tolerated method with good results [4-13].

There is extensive literature in adult patients supporting its use for the treatment of non-union, but there is not enough documented literature to support its routine use in children. Despite controversial data in the literature [18], the presence of an open physis in the area of application is considered a contraindication to the use of high-energy focused waves. In our case, the diaphyseal location made the application safe. The 2-year follow-up did not reveal any changes in

limb length compared to the opposite side.

We share a successful case of a tibial delayed bone healing. The patient achieved healing after three applications of focused shock waves after no changes for 4 months after surgery.

The presentation of more cases resolved with this therapy will hopefully support its routine use in this difficult-to-treat condition.

Conclusion

This result suggests that the use of focused waves in patients under 18 years of age with delayed bone healing. Extracorporeal shock wave treatment is a useful and safe alternative in specific cases. Caution should be exercised avoiding application to the area of the open physis.

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

1. Wang Y, Doyle M, Smit K, Varshney T, Carsen S. The toddler's fracture. *Pediatr Emerg Care* 2022;38:36-9.
2. Rockwood CA, Wilkins KE, Beaty JH, Kasser JR. *Rockwood and Wilkins' Fractures in Children*. Philadelphia, PA: Lippincott Williams and Wilkins; 2001.
3. Gordon JE, Gregush RV, Schoenecker PL, Dobbs MB, Luhmann SJ. Complications after titanium elastic nailing of pediatric tibial fractures. *J Pediatr Orthop* 2007;27:442-6.
4. Valchanou VD, Michailov P. High energy shock waves in the treatment of delayed and nonunion of fractures. *Int Orthop* 1991;15:181-4.
5. Moya D, Ramón S, Schaden W, Wang CJ, Guiloff L, Cheng JH. The role of extracorporeal shockwave treatment in musculoskeletal disorders. *J Bone Joint Surg Am*

2018;100:251-63.

6. Haupt G. Use of extracorporeal shock waves in the treatment of pseudarthrosis, tendinopathy and other orthopedic diseases. *J Urol* 1997;158:4-11.

7. Rompe JD, Rosendahl T, Schöllner C, Theis C. High-energy extracorporeal shock wave treatment of nonunions. *Clin Orthop Relat Res* 2001;387:102-11.

8. Wang CJ, Chen HS, Chen CE, Yang KD. Treatment of nonunions of long bone fractures with shock waves. *Clin Orthop Relat Res* 2001;387:95-101.

9. Schaden W, Fischer A, Sailler A. Extracorporeal shock wave therapy of nonunion or delayed osseous union. *Clin Orthop Relat Res* 2001;387:90-4.

10. Elster EA, Stojadinovic A, Forsberg J, Shawen S, Andersen RC, Schaden W. Extracorporeal shock wave therapy for nonunion of the tibia. *J Orthop Trauma* 2010;24:133-41.

11. Schaden W, Mittermayr R, Haffner N, Smolen D, Gerdesmeyer L, Wang CJ. Extracorporeal shockwave therapy (ESWT)--First choice treatment of fracture non-unions? *Int J Surg* 2015;24:179-83.

12. Moya D, Brañes M, Guilloff L, Ramón S, Olivieri H. Use of Focused Shockwaves Under 18 Years Old: Is it Justified to Cross the Limit? 22nd ISMST Congress, Beijing, China, 2019.

13. Senes S, Staudacher G, Iglesias S, Moya D, Goyeneche R.

Treatment of a femoral shaft non-union in a pediatric patient with focused shockwaves. Regen Sci 2022;2:36-8.

14. Ruíz-Mejía O, Pimentel-Rangel J, Escudero-Rivera D, Valle-de Lascrain G, Oribio-Gallegos JA. Manejo de las fracturas diafisarias en pacientes pediátricos con clavos elásticos de titanio [Management of shaft fractures with elastic titanium nails in pediatric patients]. *Acta Ortop Mex* 2012;26:162-9.

15. Mendoza-Balta RJ, Bello-González A, Rosas-Cadena JL. Tratamiento de fracturas diafisarias en niños con clavos elásticos de titanio [Treatment of shaft fractures in children with elastic titanium nails]. *Acta Ortop Mex* 2009;23:286-91.

16. Yao LF, Chen Q, Zhong ZP, Xu RM, Wang HR, Peng LR, et al. [Analysis on complications of elastic nail treating children's long bone fractures]. *Zhongguo Gu Shang* 2009;22:98-100.

17. Lascombes P, Haumont T, Journeau P. Use and abuse of flexible intramedullary nailing in children and adolescents. *J Pediatr Orthop* 2006;26:827-34.

19. Jhan SW, Wu KT, Chou WY, Chen JW, Siu KK, Huang WC, Wang CJ, Cheng JH. Does extracorporeal shockwave therapy treat leg length discrepancy? an experimental animal study. *Arthritis Res Ther.* 2025 Mar 4;27(1):47. doi: 10.1186/s13075-025-03519-6. PMID: 40038756; PMCID: PMC11877862.

Conflict of Interest: NIL

Source of Support: NIL

How to Cite this Article

Turco M, Dobkin F, Silvia P | Tibial delayed bone healing in a pediatric patient treatment with focused shock wave therapy. | *Journal of Regenerative Science* | Jan-Jun 2025; 5(1): 05-07.