Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/jcot

Case Report

Natural tibialization of fibula in non-union tibia: Two cases

Vinay Prabhat^{a,*}, Gauresh S. Vargaonkar^a, Sunil R. Mallojwar^a,
Ramesh Kumar^b

^a Senior Resident, Central Institute of Orthopaedics, Vardhaman Mahavir Medical College and Safdarjung Hospital, New Delhi, India

^b Director Professor, Central Institute of Orthopaedics, Vardhaman Mahavir Medical College and Safdarjung Hospital, New Delhi, India

ARTICLE INFO

Article history:

Received 23 July 2015

Accepted 5 March 2016

Available online 22 March 2016

Keywords:

Tibia

Fibula

Bone remodeling

Hypertrophy

Ununited fracture

ABSTRACT

Background: Non-union of tibia is known to be a common complication after fracture both bones of leg treated conservatively. During the course of natural healing, fibula usually unites early as it had more soft tissue attachment and vascular supply. Due to early union of fibula and absence of axial force across the tibia, it undergoes non-union.

Case characteristics: Two cases, a 32-year-old male and 65-year-old female treated conservatively for fracture both bones of leg long years back, presented to us with mild calf pain on and off. On radiological examination, there was non-union of tibia along with compensatory fibular hypertrophy to the extent that fibula became main weight bearing bone.

Outcome: In both the cases, we observed gross fibular hypertrophy in presence of non-union of tibia.

Conclusion: In conservatively treated cases of fracture, both bones of leg, non-union of tibia may coexist with compensatory hypertrophy of fibula to the extent that, it becomes main weight bearing bone of the leg.

We are presenting here two cases of natural tibialization of fibula along with nonunion tibia. Our article supports the theory of Wolff's law.

© 2016 Delhi Orthopedic Association. All rights reserved.

1. Introduction

As an orthopedic surgeon we frequently deal with fracture of tibia and fibula. Fractures of tibia are the most common long bone fracture and occur at a frequency of about 26 fractures per 100,000 population per year.^{1–3} They are approximately three times more frequent in males than in females. Among both bones of leg, tibia is a major weight bearing bone as it

transfers weight of upper skeleton to the foot. The fellow bone mainly plays a role in syndesmosis at proximal and distal ends of tibia. It is fracture tibia that is the major concern for all surgeons. Nonunion of tibia is common because of its subcutaneous anatomic location, less soft tissue coverage, frequent open fracture, precarious blood supply mainly in lower third of tibia. There are various methods mentioned in literature for the treatment of non-union tibia.^{4–7}

* Corresponding author. Tel.: +91 8130547173.

E-mail address: vinay.prabhat@rediffmail.com (V. Prabhat).

<http://dx.doi.org/10.1016/j.jcot.2016.03.001>

0976-5662/© 2016 Delhi Orthopedic Association. All rights reserved.

We are presenting here two cases of natural tibialization of fibula along with non-union tibia. Our cases satisfy the law stated by German anatomist Julius Wolff, who said "bone in a healthy person or animal will adapt to the loads under which it is placed. If loading on a particular bone increases, the bone will remodel itself over time to become stronger to resist that sort of loading."⁸⁻¹⁴

2. Case report

2.1. Case 1

A 32-year-old male patient came to our outpatient department with chief complaint of vague pain in right calf on and off for past 2 months. There was no other significant complaint. On physical examination, there was no swelling, local rise in temperature or any tenderness in calf. Range of motion of knee and ankle was full and painless. Bony irregularity was noted in the mid part of leg on medial aspect which was non-tender on palpation. On further detailed history, patient mentioned about trauma to same leg 7 years back. It led to fracture of both bones of leg, for which patient had taken treatment in the form of long leg cast for 2 months and followed by patellar tendon bearing cast for a month. Patient had no complaints since then. Patient has been walking without aid for past 7 years. We advised radiograph of right leg with ankle and knee antero-posterior and lateral view. On radiological evaluation of X-ray, there was thin radiolucent oblique line at the level of fracture site with hypertrophic and sclerosed fracture end (Fig. 1).

Fig. 1 – Antero-posterior and lateral views of both bones of leg showing non-union tibia with widened and dense fibula.

Fig. 2 – Clinical photograph of patient showing deformed post-poliotic limb.

Fracture of fibula was united and appeared to be dense and widened along its whole length. This was an incidental finding of remodeled and hypertrophic fibula in non-union tibia. Patient was asymptomatic for past 7 years and had no functional limitations as well as bearing full weight on leg. So no active intervention was done. Further radiological assessment could not be done as patient lost to follow-up.

2.2. Case 2

A 65-year female patient with post-polio residual paralysis in right leg came to our outpatient department with non-healing ulcer in the same foot. On physical examination, the leg appeared to be thinned and deformed as compared to the opposite limb (Fig. 2). There was varus deformity at the ankle joint. Patient had developed pressure sore in the right deformed foot measuring 4 cm × 3 cm. Patient was subjected to X-ray of right foot and leg. On radiological examination of radiograph, tarsal bones of foot appear to be deformed and smaller in size with equino-varus deformation at ankle and sub-talar joint. No osteomyelitic changes were seen in foot. There was thin radiolucent line at the mid-part of tibia showing nonunion. Fibula was hypertrophied, widened and

Fig. 3 – Antero posterior and lateral views of both bones of leg showing non-union tibia with widened and dense fibula.

dense along its whole length (Fig. 3). Patient has been bearing weight on same leg for past 10 years. The pressure sore of foot was treated with regular antiseptic dressing, antibiotics, along with strict non-weight bearing. Patient was planned for corrective osteotomy of the foot, but patient was reluctant to undergo surgery. She was treated further with regular physiotherapy and foot-bracing as had post-polio residual deformity. No active intervention was done for nonunion of tibia. Further radiological assessment could not be done as patient lost to follow-up.

3. Discussion

Nonunion tibia is a challenging concern for all orthopedic surgeons. In our cases, tibia had undergone non-union mainly because of early union of fellow bone and premature weight bearing by the patient. Other factors of nonunion added to this problem. The fibula is surrounded by muscles all around and has abundant blood supply from the nutrient branch of peroneal artery and circular anastomosis of musculo-periosteal vessels, which supports early union of fibula.¹⁵ This is also a basis behind Huntington procedure in which medialization of ipsilateral fibula is done for gap non-union.¹⁵

In both of our cases, patient started early weight bearing, which added to the problem as weight bearing stress was subjected over fibula rather than tibia. This led to non-union of

tibia and simultaneously caused hypertrophy and widening of ipsilateral fibula. This supports the theory of Wolff's law.¹¹⁻¹³ On persistent loading of bone, trabecular pattern undergoes adaptive changes, along with subsequent thickening in cortex of the bone. The inverse is true as well: if the loading on a bone decreases, the bone will become weaker as there is no stimulus for continued remodeling that is required to maintain bone mass, which is seen in tibia in our cases. Tibia is more osteopenic and less dense as compared to fibula.

4. Conclusion

Bone has immense potential to undergo remodeling, when subjected to continuous mechanical load. In rare cases as we reported here, when tibia fails to unite fibula undergoes compensatory hypertrophy to the extent, where it acts as the major weight bearing bone of the leg.

Conflicts of interest

The authors have none to declare.

REFERENCES

1. Court-Brown CM. Fractures of the tibia and fibula. In: Bucholz R, Heckman J, Court-Brown C, eds. et al. In: *Rockwood and Green's Fractures in Adults* 6th ed. Philadelphia, PA: Lippincott Williams and Wilkins; 2005:2079-2146.
2. Court-Brown CM, McBirnie J. The epidemiology of tibial fractures. *J Bone Jt Surg Br.* 1995;77(3):417-421.
3. Bucholz RW, Court-Brown CM, Heckman JD, et al. *Rockwood and Green's Fractures in Adults*. 7th ed. 2009;1867.
4. Gupta SP, Garg G. The Huntington procedure: still a reasonable procedure for large tibial defects in paediatric patients. *J Child Orthop.* 2014;8(October (5)):413-421. <http://dx.doi.org/10.1007/s11832-014-0618-8>.
5. Hertel R, Pisan M, Jakob RP. Use of the ipsilateral vascularised fibula for tibial reconstruction. *J Bone Jt Surg Br.* 1995;77:914-919.
6. Tuli SM. Tibialization of the fibula: a viable option to salvage limbs with extensive scarring and gap nonunions of the tibia. *Clin Orthop Relat Res.* 2005;431:80-84.
7. Yusof NM, Khalid KA, Zulkifly AH, et al. Factors associated with the outcome of open tibial fractures. *Malays J Med Sci.* 2013;20(October (5)):47-53.
8. Kohlprath R, Assal M. Open fractures of the tibia in the adult: surgical treatment and complications. *Rev Med Suisse.* 2011;7(December (322)). 2482, 2484-2488.
9. Shahid M, Hussain A, Bridgeman P, Bose D. Clinical outcomes of the Ilizarov method after an infected tibial non union. *Arch Trauma Res.* 2013;2(August (2)):71-75. <http://dx.doi.org/10.5812/atr.11300>.
10. Frost HM. A 2003 update of bone physiology and Wolff's Law for clinicians. *Angle Orthod.* 2004;74(February (1)):3-15.
11. Burr DB, Martin RB. Mechanisms of bone adaptations in the mechanical environment. *Triangle (Sandoz).* 1992;31:59-76.
12. Frost HM. Structural adaptation to mechanical usage (SATMU). 1. Redefining Wolff's law: the bone modeling problem. *Anat Rec.* 1990;226:403-413.
13. Frost HM. Wolff's law and bone's structural adaptations to mechanical usage: an overview for clinicians. *Angle Orthod.*

- 1994;64(3):175–188. [http://dx.doi.org/10.1043/0003-3219\(1994\)064<0175:WLABSA>2.0.CO;2](http://dx.doi.org/10.1043/0003-3219(1994)064<0175:WLABSA>2.0.CO;2). PMID 8060014.
14. Ruff C, Holt B, Trinkaus E. Who's afraid of big bad Wolff? "Wolff's law" and bone functional adaptation. *Am J Phys Arthropol.* 2006;129(April (4)):484–498.
15. Date AS, Solanki SB, Badhe NP, Sonsale PD, Pandit HG. Management of gap non-union of tibia by tibialisation of ipsilateral vascular fibula. *J Postgrad Med.* 1996;42(October–December (4)):109–111.