Clinical Results of Extracorporeal Shockwave Therapy for Medial Malleolar Stress fracture in Elite Athletes

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COI disclosure
Author: Nobuhiko Sumiyoshi

I have no financial conflict to disclose
Background

• Medial malleolar stress fracture is rare
• It accounts for only 2.5%～4.2% of whole stress fracture of the lower extremities
• It is often difficult to treat by usual conservative treatment

Indication of Extracorporeal Shock Wave Therapy (ESWT)
～Bone pathologies～
• Delayed bone healing
• Bone Non-Union
• Stress fracture
• Avascular bone necrosis without articular derangement
• OCD without articular derangement

To date, no case series of ESWT for medial malleolar stress fracture
Purpose
To report clinical results of ESWT for medial malleolar stress fracture in Athletes

Patients

Subjects: 10 athletes treated with ESWT for medial malleolar stress fracture
Sex: 7 men, 3 women
Age: 15.9 (12-20)
Follow up period: 12 months (12-36)
Athletes with open physis: 4

ESWT application:
- ESWT as part of conservative Tx (5)
- post-ORIF ESWT for enhancement of bone healing (3)
- previous ORIF in other Hp, referred for ESWT as Tx for delayed union (2)

Sports: Basketball (3), Figure skating (2), Gymnastics (2), Track & Field (2), Trampoline (1)
ESWT Application

<Setting>

• Measure the distance from medial malleolar to fracture line by CT scan
• Apply Shockwave from anterior to posterior direction using ultrasound for the precise targeting

<Application>

• 3000 shocks/session
• Energy Flux Density (EFD): 0.07～0.25mJ/mm²
• Total EFD: Mean 516mJ/mm²
※ Shock intensity adjusted to the maximum that patients can tolerate without anesthesia

Number of sessions: 6.3 times (4-10)
Frequency: At biweekly intervals
(Continued until bone union)

<Rehabilitation>

• Allowed unlimited weight bearing without immobilization
• Started jogging once resolution of tenderness or radiographic bone union

Methods

➢ Retrospectively studied clinical outcome and bone union
Results (n=10)

- All cases returned to play eventually
- Bone healing: All cases
- Duration until bone healing: Mean 16.2 weeks (4-32)
- Resolution of tenderness: Mean 4.6 weeks (2-12)
- Start of running: Mean 5.5 weeks (2-12)
- Return to play: Mean 15.8 weeks (4-36)
- Recurrence: None
Case #1  13 y/o female, trampoline: Conservative Tx

Initial Xp

Initial CT

Resolution of tenderness
Start of running

Bone union
Returns to play
Selected for national member

8 weeks Xp

8 weeks CT

weeks 0  2  4  6  8

ESWT
Case#2 14 y/o female, gymnastics: post ORIF ESWT

Initial Xp

Initial CT

Post-op Xp

ESWT

ORIF

Resolution of tenderness
Start running

weeks 0 2 4 6 8 12 24

Starts practice

Returns to play

Bone union
Wins international competition

24 weeks Xp

24 weeks CT
Discussion
ESWT for recalcitrant stress fractures

**Conservative Tx**

- Tibial stress fx • 5th metatarsal stress fx, n=10 feet: low EFD ESWT, 3~4 sessions
  - All achieved bony union at 2 months (100%) and returned to play at their previous level
    (Moretti B. Ultrasound Med Biol. 2009)

- 5th metatarsal base stress fx, 34 feet: 0.22-0.51 mJ/mm², 1 session
  - Rate of bone union: 3M 71%, 6M 89%, 12M 90%
    (Alvarez AL. FAI 2011)

- Rabbits, acute fracture model: ESWT group showed significantly higher BMD, bone formation, and bone strength than control group (4000 shots/0.47mJ/mm²)
  (Wang CJ. Bone 2004)

**Post-op use of ESWT**

- ESWT soon after ORIF for 5th metatarsal base stress fx
  - ESWT groups showed significantly earlier bone union and return to play than non-ESWT groups

<table>
<thead>
<tr>
<th>Post-op (weeks)</th>
<th>ESWT</th>
<th>Non-ESWT</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone union</td>
<td>7.8</td>
<td>10.4</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Return to play</td>
<td>8.0</td>
<td>11.7</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

(Takahashi T. Japan foot and ankle assoc. conference, 2016)
Medial malleolar stress fracture
- ESWT as conservative treatment

✓ Usual conservative treatment: NWB for 6-8 weeks with casting
  (Robertson, World J Orthop. 2017)

✓ Systematic review: (Conservative treatment)
  Start of running: Mean 7.6 weeks
  Bone union: Mean 14.3 weeks
  (Irion V, Sports Health. 2014)

<In the present study n=5 feet: ESWT, FWB without immobilization>

resolution of tenderness Mean 4 weeks (2-8)
Start of running Mean 5 weeks (4-8)
Bone union Mean 16 weeks (8-32)
Return to play Mean 18 weeks (8-36)
Medial malleolar stress fracture
- ESWT with ORIF

✓ Usual post-op rehab after ORIF: NWB for 1-3 weeks with casting
  (Robertson, World J Orthop. 2017)

✓ ORIF (post-op rehab: NWB for 4 weeks, casting for 2 weeks)

  ➡ Bone union: Mean 40 weeks (20-84)
  (Nishii, J. Japan foot and ankle assoc. 2016)

< In the present study n=3 feet: ORIF + ESWT (FWB as tolerated, no immobilization) >

<table>
<thead>
<tr>
<th>Event</th>
<th>Mean Duration (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution of tenderness</td>
<td>Mean 6 weeks (2-12)</td>
</tr>
<tr>
<td>Start of running</td>
<td>Mean 5 weeks (3-8)</td>
</tr>
<tr>
<td>Bone union</td>
<td>Mean 14 weeks (6-12)</td>
</tr>
<tr>
<td>Return to play</td>
<td>Mean 9 weeks (4-16)</td>
</tr>
</tbody>
</table>

◆ In both, as conservative and post-op use, ESWT facilitated early start of running which lead to earlier return to play
Conclusion

• ESWT is a safe and viable option for treating medial malleolar stress fracture in athletes, even in the adolescent with open physis

• Although all patients engaged in intensive sports, all of them achieved successful return to play without recurrence
References


