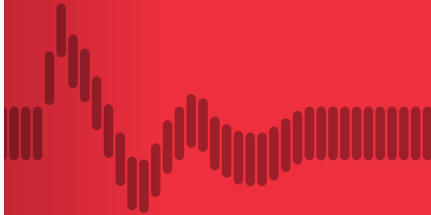


ESSENTIAL KNOWLEDGE

Series  
Volume 1



# Pseudarthrosis

Treatment with focused shock waves

Dr. med. Frank Bätje

LEVEL 10 

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# PSEUDARTHROSIS

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- / Classification of pseudarthrosis types
- / Treatment options for pseudarthrosis
- / Shock wave therapy of pseudarthrosis
- / Shock wave therapy: its mode of action
- / Shock wave therapy: indications and contraindications

## AETIOLOGY

Pseudarthrosis – from the ancient Greek words “pseudes” (false) and “arthros” (joint) – refers to the failure to heal of a broken bone or an osteotomy. A fracture, osteotomy or surgical stiffening of a joint is generally followed by osseous healing. The time it takes for stable bony fusion to occur depends on various factors:

- | Type of bone (long narrow bones, vertebral bodies, etc.);
- | Location of fracture (diaphyseal, metaphyseal, etc.);
- | Form of fracture (transverse fracture, spiral fracture, etc.);
- | Nature of traumatological care  
(internal fixation, external fixation, conservative, etc.).

If there is certainty that bony consolidation failed to occur, we speak of a pseudarthrosis (i.e. a nonunion).

Some forms of fracture are more typical than others and are therefore conducive to standardized osteosynthesis procedures. Rarer fracture types are subject to a wider range of treatment methods and are more likely to postoperatively develop into non- or malunions. The incidence of bone-healing problems or genuine pseudarthrosis differs considerably from bone to bone, even where conditions are comparable (primary specialist traumatological care, high medical standards, patients in averagely good health, etc.). For example, pseudarthrosis occurs more frequently after fractures of the medial third of the clavicle than at the lateral malleolus. Following arthrodesis it is more likely to develop at the upper than the lower ankle joint.

The guidelines of the German-speaking International Society for Extracorporeal Shock Wave Therapy (DIGEST) recommend that therapists choose the electrohydraulic and electromagnetic systems to treat bone-healing problems, as there is a good deal of evidence to support them.

*Based on the literature, treatment of pseudarthrosis with electromagnetic and electrohydraulic shock waves is recommended.*

#### Recommendation for treatment by DIGEST<sup>4</sup>

##### | Electrohydraulic

Single treatment, with second or third treatment possible after 3-6 months

Frequency:

1-4 Hz, 3,000 pulses on average, energy flux density (EFD):

0.3-0.4 mJ/mm<sup>2</sup>

##### | Electromagnetic

3-4 treatments at intervals of 4-7 days

Frequency:

1-4 Hz, 4,000 pulses, energy flux density (EFD):

0.4-0.7 mJ/mm<sup>2</sup> (long bones), 0.1 mJ/mm<sup>2</sup> (scaphoid bone)

##### | Piezoelectric

No relevant literature available

##### | Radial pressure wave therapy

No relevant literature available

#### FOCUSED SHOCK WAVES VS. RADIAL PRESSURE WAVES

Focused shock waves are (in physical terms) the genuine shock waves that converge into a focal zone in which energy of a preset flux density is released. Modern devices allow variable penetration depths making it possible, for example, to treat a deep femoral fracture just as individually as a superficially located olecranon fracture. The size of the focal zone (e.g. that of a bean or cigarette filter) varies between devices.



Fig. 14  
Focused handpiece

Since radial pressure waves are ballistically generated and hence divergent, they reach only relatively superficial locations. With regard to energy flux density, they are consistently low in energy and, as such, have not yet played any part in the treatment of bone-healing problems.



Fig. 15  
Radial handpiece

Fig. 39 (left)  
Marking indicating the  
thoracic application direction.  
Fig. 40 (right)  
Treatment of the clavicle from  
the ventrocaudal direction at  
30° tilt.

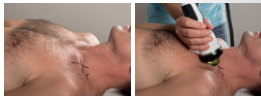


Fig. 41  
Measurement of oxygen  
saturation (pulsosymetry)  
during ongoing treatment.



#### FIFTH METATARSAL / JONES FRACTURE | Table 5

Energy mJ/mm <sup>2</sup>	0.35-0.45
Pulses	3,000 per application direction
Application directions	Dorsal/plantar
Number of sessions	2
Stand-off	II

A Jones fracture can be treated from both the dorsal and plantar direction in order to access the bone across its entire diameter. As the bone calibre is relatively low, equipment designed for use in practices is preferable to a large device.

#### Preparation and treatment



Fig. 42 (left)  
3,000 per application direction  
Fig. 43 (right)  
Treatment of the base of the fifth  
metatarsal from the dorsolateral  
direction, applying 3,000 pulses.

#### ARTHRODESIS OF THE METATARSOPHALANGEAL JOINTS, FIRST RAY | Table 6

Energy mJ/mm <sup>2</sup>	0.35-0.45
Pulses	3,000 per application direction
Application directions	Dorsal/plantar
Number of sessions	2
Stand-off	II



Fig. 44 (left)  
Marking indicating the dorsal  
application direction.  
Fig. 45 (right)  
Treatment of the first ray from  
the dorsal direction, applying  
3,000 pulses.