

# Risks

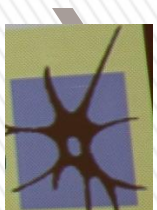
**High-energy ESW** can **destroy** non myelinated nerves but afterwards there is an even **faster regeneration**

(Lee 2007, Hausdorf 1 2008, Wu 2008, Ohtori 2013)

**Low energy ESW** do not damage motoric or somatosensible nerves. (Manganonotti 2012) They have **no influence** on the nociceptive system. (Haake 2002).

**Avoid Pain!** Move the therapy source constantly!  
**Stimulation: Yes! Irritation: No!**

ESW on painful or sensitive structures are painful  
Too many ESW on one spot cause pain.



**I'm throwing you a ball.  
Please, Play with it.**

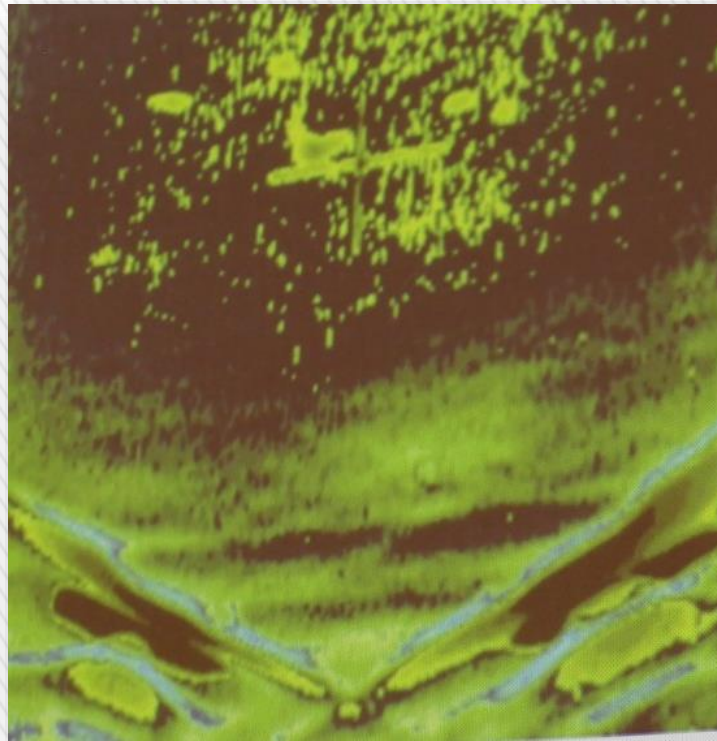
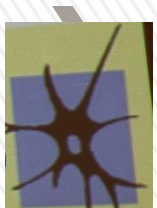


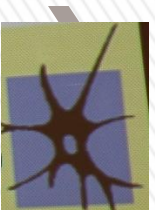
Photo of a shock wave by O. Wess Storz Medical



**Focused extracorporeal shock waves  
Improve pareses  
in 8 cases of spinal cord injury  
and 3 cases of myelomeningocele.**

H. Lohse-Busch, U. Reime, R. Failand  
Rheintalklinik  
D-79189 Bad Krozingen

The first author received research grant f  
From Storz Medical AG Tagerwilen



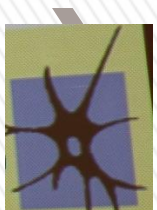
# Methods

Longitudinal observation case study, anecdotal

8 adults, 43 years old and posttraumatic paraparesis

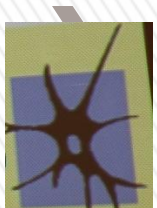
3 children from 9-12 years old with myelomeningocele

**well known patients** 2-4 daily physicomedical complex therapy  
Series over 3 weeks with ESWT (“Duolith”, Storz Medical) on  
peripheral muscles alleviated only the cloni.



# Methods

- **Then complex therapy and additionally ESWT to the region of the Spinal cord lesion, 2000 shots 0.15 mj/mm<sup>2</sup> foot soles 2000 shots, 0.12 mj/mm<sup>2</sup> 3 times a week.**
- Documentation with surface EMG, manual muscle test (MMT) And functional reach test.
- Permission of the ethical committee of the University Hospitals Freiburg.



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## Grade of strength, manual muscle test (MMT)

0	flaccid paralysis
1	visible/palpabel activity
2	active movement without gravity
3	active movement against gravity
4	active movement against resistance
5	normal

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## Classification of paraplegia (American Spine Injury Association)

ASIA A	complete and sensible paralusis (S4/S5)
ASIA B	sensibility below injury maintained („incomplete“)
ASIA C	strength < 3 MMT below injury although paralysis S4/S5
ASIA D	strength > 3 MMT at least 3 segments below injury
ASIA E	normal innervation

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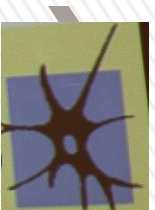


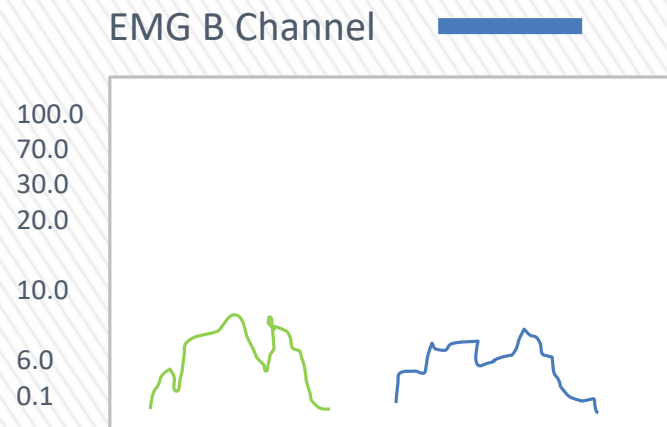
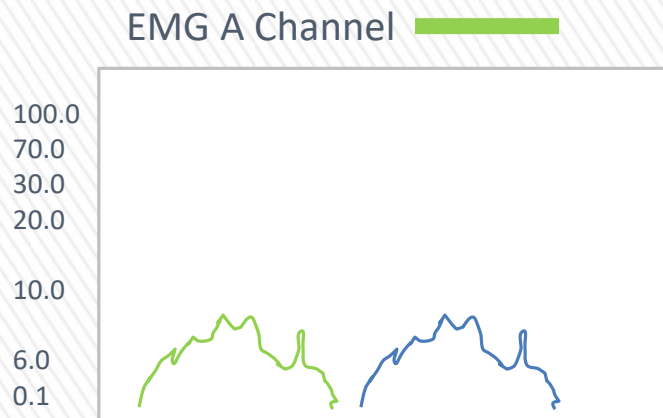
## Results

**Previously non-innervated muscles  
Showed increasing EMG activity  
and an average improvement in  
strength of about 2.5 points in the MMT.**

**The functional reach tests  
Improved with seated patients  
Of about 8.5 cm on average.**

**Deep and superficial sensibility was better.**

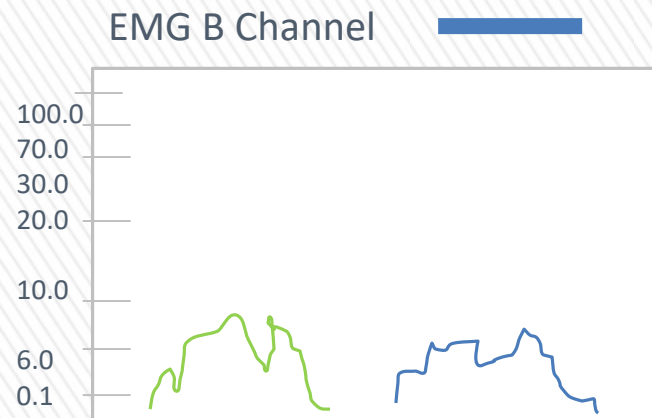
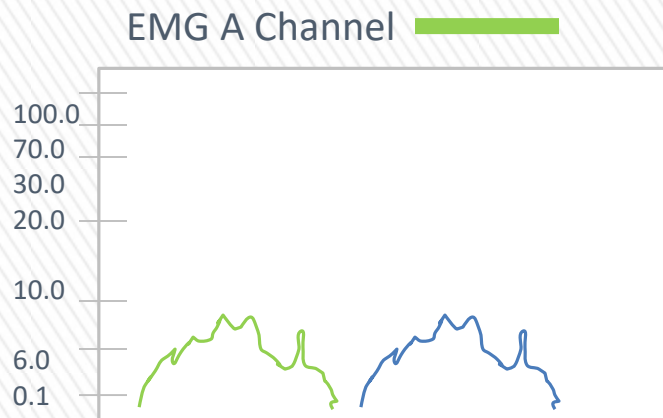




**Activity of the m. erector spinae L4/L5 during the unsuccessful Attempt to straighten the trunk before application of ESWT to the spinal cord lesion and after **three -3 weeks courses** of complex therapy with 27 ESWT. **Sitting at a table with free hands!****

	Before	After 31 Months
<b>A R, 38 years old, fracture of Th 5</b>		
<b>28 months before treatment.</b>	0-1	4
<b>MMT lumbal m. erect spinae</b>	0	3
<b>MMT m. rectus femoris, left</b>	0	1
<b>MMT m. rectus femoris, right</b>	0	12
<b>Functional Reach in cm, sitting</b>	A	C
<b>ASIA classification</b>		

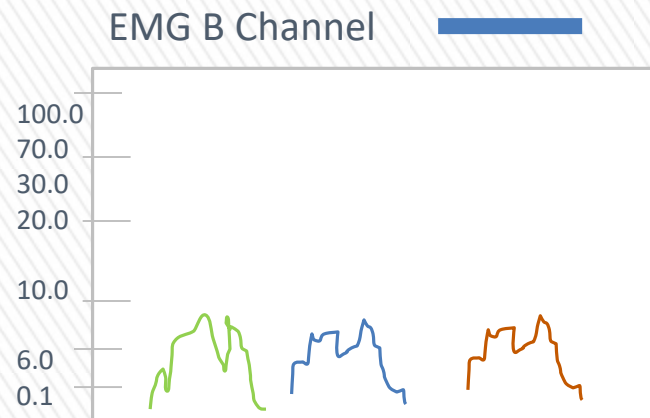
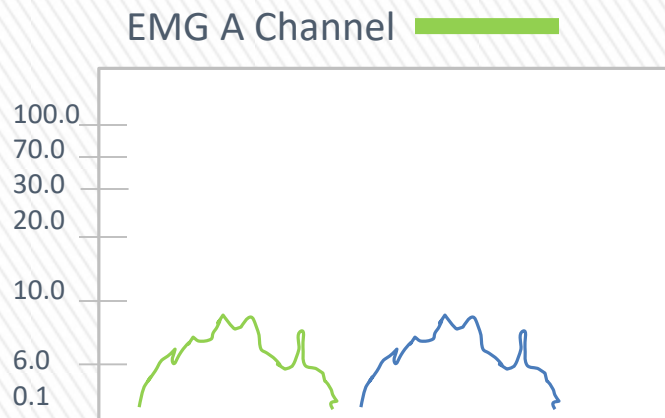




**Activity of the m. erector spinae L4/L5 during the unsuccessful Attempt to straighten the trunk before application of ESWT to the spinal cord lesion and after **three -3 weeks courses** of complex therapy with 27 ESWT. **Sitting at a table with free hands!****

GG, 39 years old, fracture Th6, Th7 + craniocerebral injury 9 years before ESWT on spinal cord	Before	After 13 months
MMT limber m. erector spinae	3	4
Functional Reach in cm, sitting	6	14
ASIA classification	D	D



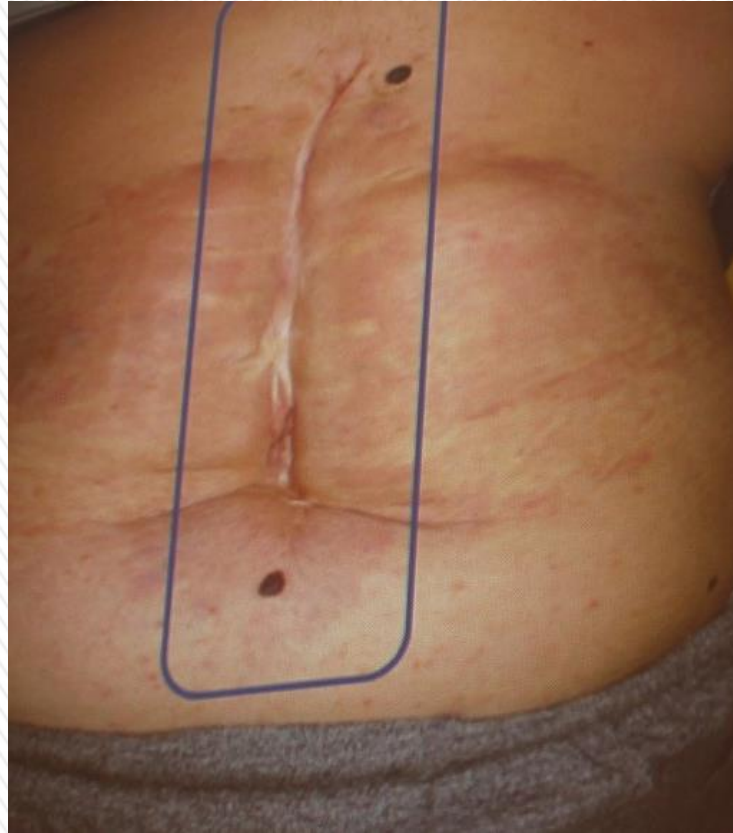


Activity of m. rectus femoris attempting the extension of the knees before application of ESWT to the spinal cord and **after three 3-weeks** complex therapies and 36 ESWT. Then successful straightening of the knees. Feels menstruation pain and somehow her anus.

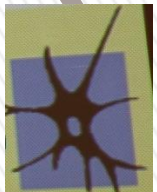
MT, 13 years old <b>myelomeningocele L2</b> flaccid paraplegia	Before	After 22 Weeks
MMT knee extensors	0	3
Lumbal m. erector spinae	0	3
Functional Reach in cm, sitting	0	5
ASIA classification	A	C



# ESWT on the lower limb **and** the spine

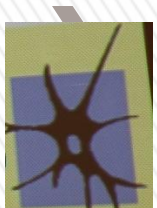


**Thank you for your attention!**



# Methods

- Longitudinal observation case study, pilot study
- 5 patients, 8 to 18 years after the brain lesion, unresponsive Wakefulness syndrome of different severity, 4 PEG feeding tubes. 3 had stabilized epilepsy. All patients had palliative surgical Interventions on muscles.
- 2-5 previous physicomedical complex therapy regimes over 3 Weeks each with ESWT on peripheral muscles improved the cloni but not the vigilance.



# Methods

- Then the patients received **3 sessions weekly with transcranial extracorporeal shock waves (TESWT)**, device Duolith, Storz Medical) during 4-week physicomedical complex therapies **moving the therapy source** 5,000 ESW with 0.15 – 0.2 mj/mm<sup>2</sup>.
- Documentation with the German Coma Remission Scale (KRS) and the Glasgow Coma Scale.

**Permission of the ethical committee of the University Hospitals Freiburg**



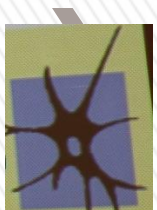
# Results

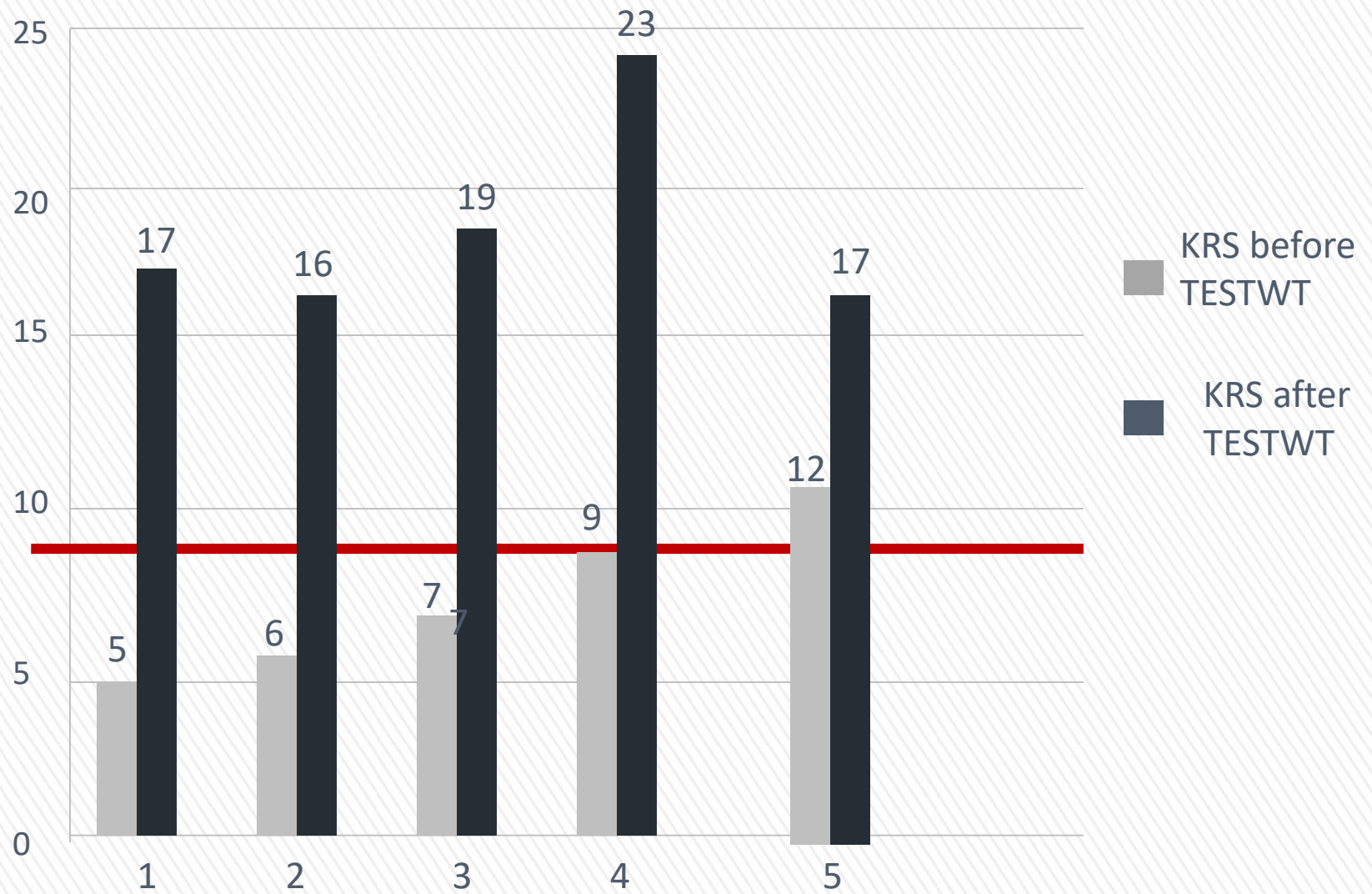
After 2-4 years  
and an average of 5.2 treatment series  
(27 TESTWT sessions on average)

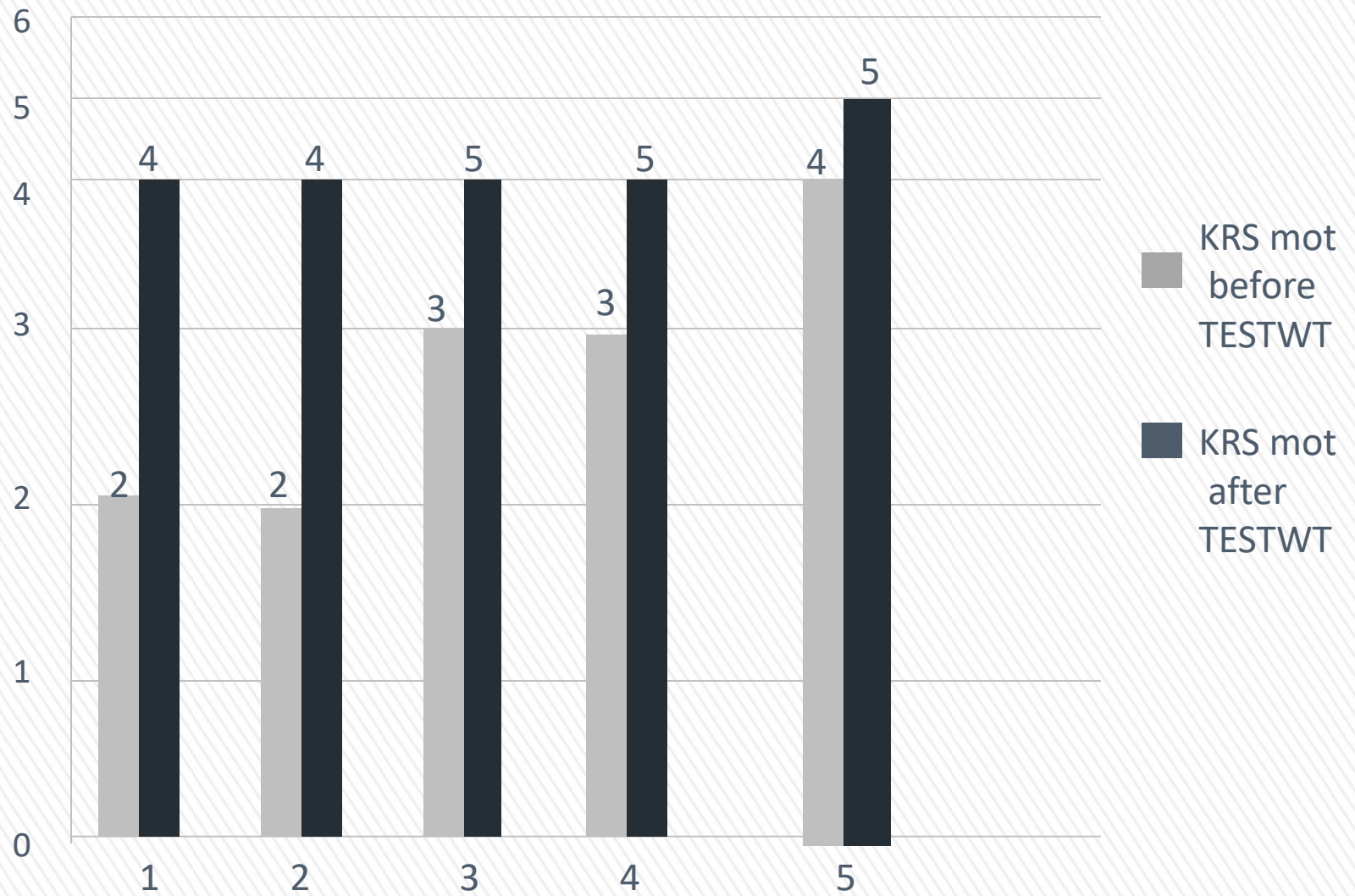
the total improvement on the Coma remission Scale  
for the 5 patients is 135.9% (motor area 64.3%)/  
43.6% improvement on the Glasgow Coma Scale.

Three PEG feeding tubes could be removed

A nonverbal communication initiated 4 times.





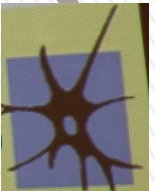




**It looks like this:**



**Thank you very much for your attention!**

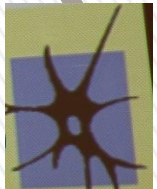


**Focused low-energy  
Extracorporeal shock waves  
With distally  
Symmetric polyneuropathy (DSPNP)  
A pilot study.**

Lohse

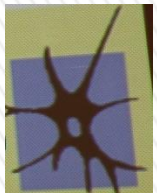
-Busch, H (1); Marlinghaus, E. (2); Reime, U. (1) Mowis, U. (1)  
(1) Rheintalklinik, D-79189 Bad Krozingen, Germany.  
(2) Storz Medical AG, CH-8274 Tagerwilen, Switzerland.

**The first author received a research grant  
From Storz Medical AG Tagerwilen  
The second author is an employee of Storz Medical**



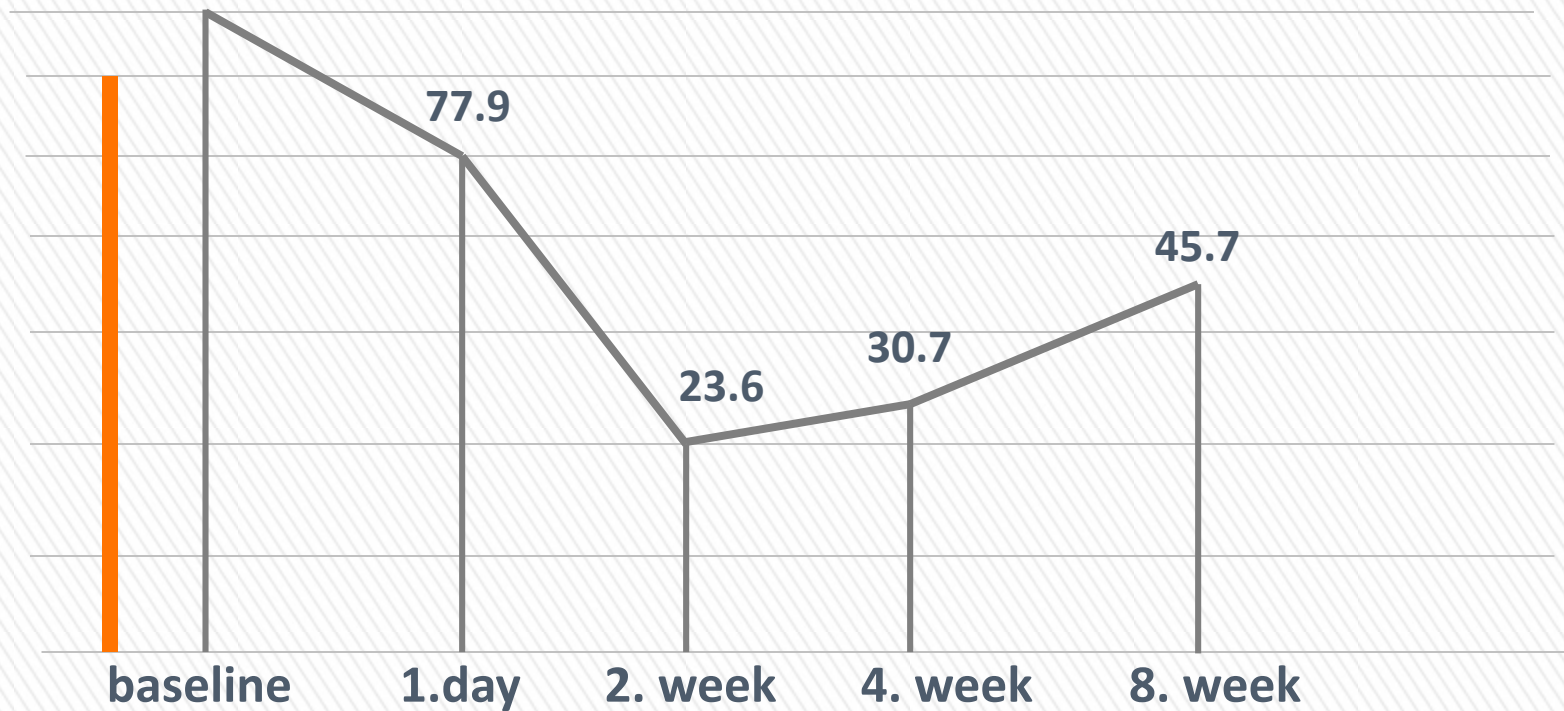
# Methods

- **Pilot study with 24 patients with DSPNP**
- **10 patients with diabetes mellitus excluded because of Inhomogeneous performances**
- **14 remaining patients**
- **6 received one sham treatment at the beginning**
- **All 14 patients were then treated with ESWT to the soles of the feet using the Duolith shock wave generator (Storz Medical) 3 times weekly for 2 weeks.**
- **Documentation with the GaitRite mat measuring kinematics before and after the sham treatment, the first ESWT and after 2, 4 and weeks.**

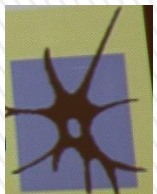


# Reduction of paresthesia and pain

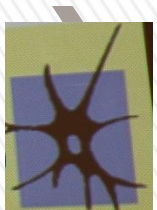
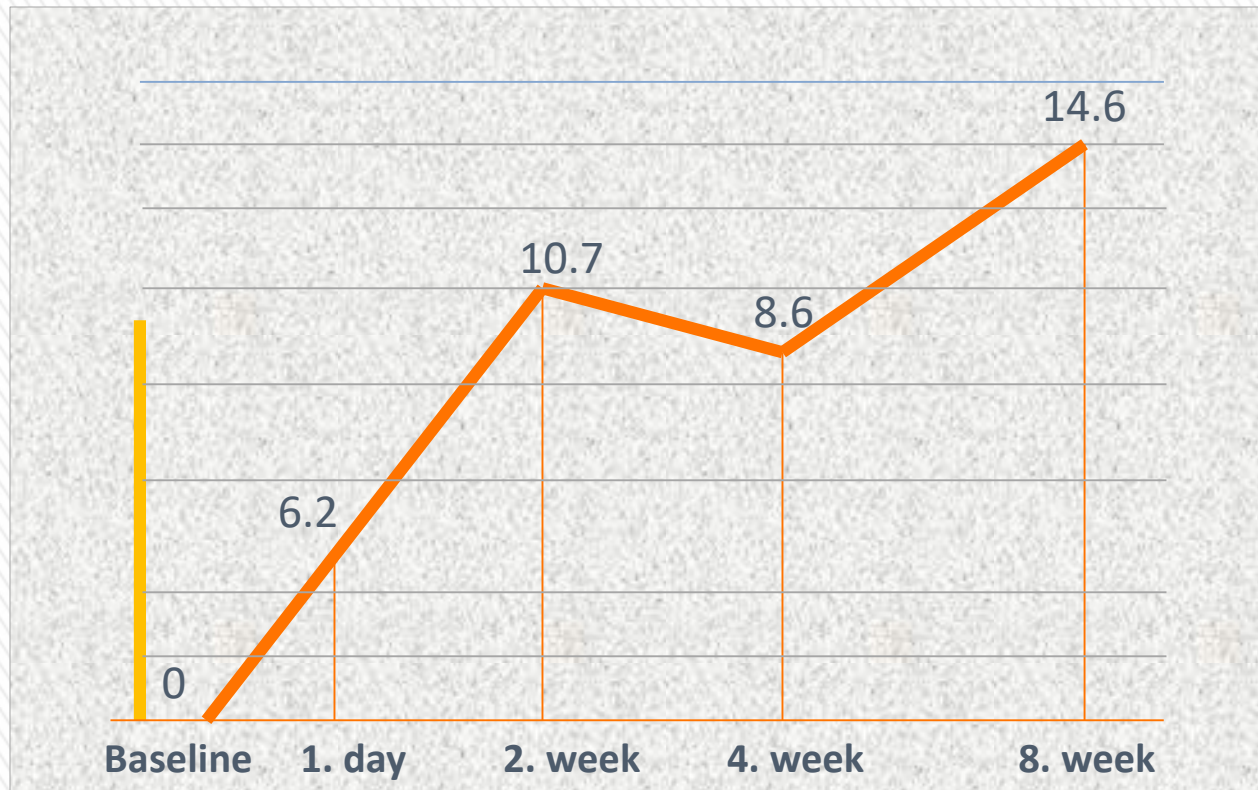
placebo -5% 100



P < 0.001 for all values



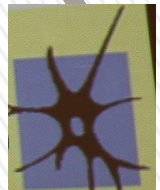
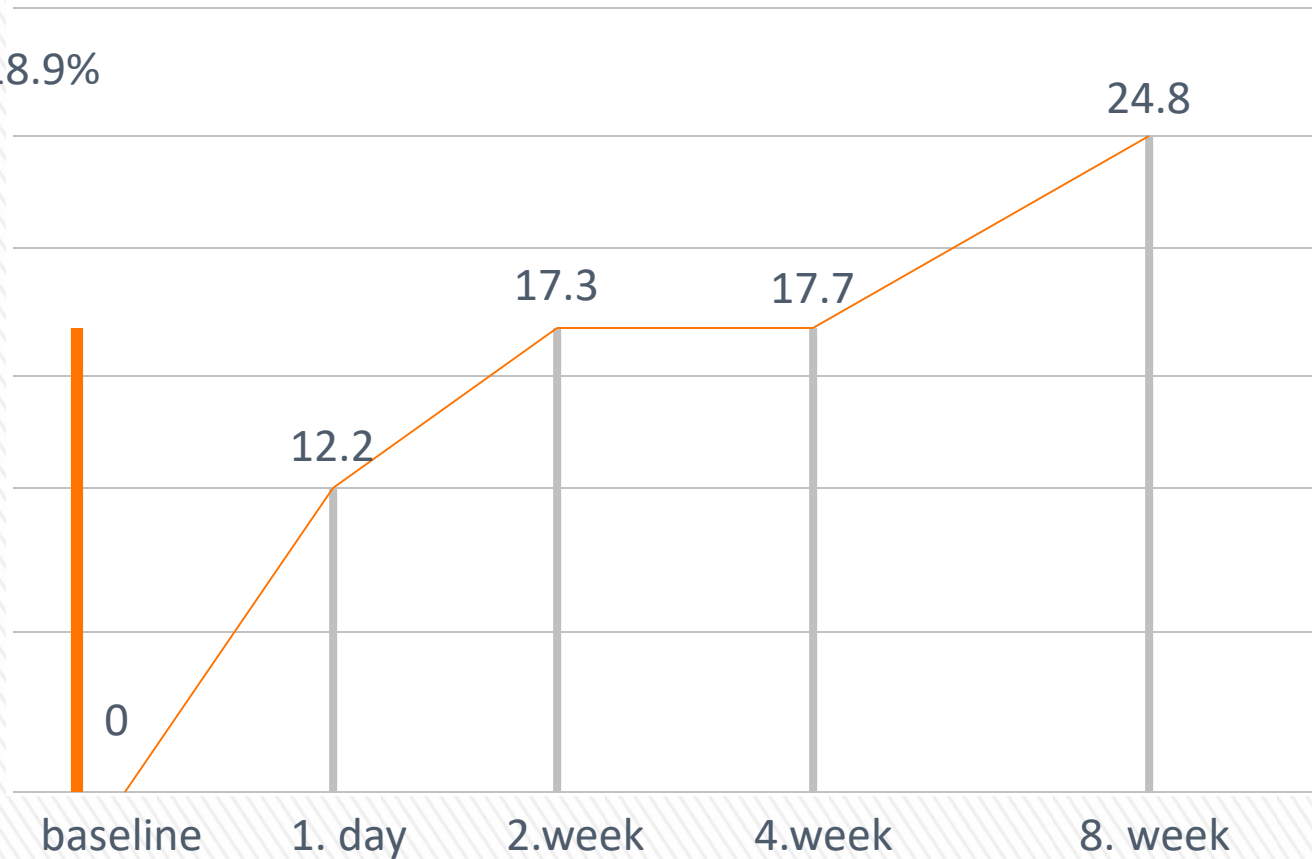
# Increase in step length in %



# Increase in walking speed in %

Placebo 18.9%  
P= 0.041

p < 0,001





**The ugly face of the diabetic polyneuropathy:  
partial amputation of 1. and 2. toe 4 years ago.  
Weekly 1 ESWT for 7 weeks**



# Multimodal complex therapy?

German health insurance guideline ICD “OPS 8977” for the Orthopaedic and neuro-orthoepaedic treatment of the movement system:

## The doctor's work

- manual medicine (myofaszial release techniques, manipulations)
- Reflex therapy, (physical methods, ESWT not funded)
- Interventional pain management (therapeutical local anesthesia etc.)
- Psychotherpie
- Minimum 3 of these “therapeutical windows” are necessary funding

## The paramedicals

- Physiotherapy, occupational therapy, massage
- Medico-mechanical training (treadmill, vibration etc.)
- Physical medicine (hydrotherapy, peloids, etc.)
- Relaxing techniques

**Minimum 3 of these are the basis for funding**





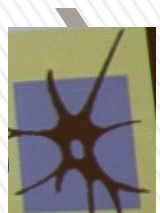
# ESWT in the neurological rehabilitation

35 children severe spastic disorders. Rct. Biomechanical  
Results after 2 weeks of complex therapy with 4 ESWT sessions on  
Foot soles and plantar flexors. Results observed 3 months.

Lohse-Busch 1997	<b>hips</b>	<b>knees</b>	<b>upper ankle joint</b>
<b>extension+</b>	<b>19.1<sub>o</sub></b>	<b>11.9<sub>o</sub></b>	<b>9.1<sub>o</sub></b>

63 children with severe spastic disorders. Rct. Biomechanical  
results after 2 weeks of complex therapy **with 4 ESWT sessions on  
Interossei & lumbricales + arm flexors**. Results observed 2 months.

Lohse-Busch 1997	<b>extension (elbow)</b>	<b>supination (hand)</b>
<b>ROM+</b>	<b>21.4<sub>o</sub></b>	<b>40.5<sub>o</sub></b>



# ESWT in the neurological rehabilitation

Long-term effect of shock wave therapy as Monotherapy on upper limb hypertonia in patients **affected by stroke**. Mananotti (2005)

<b>N20</b>	<b>Baseline</b>	<b>After ESWT</b>	<b>After 4 weeks</b>	<b>After 12 weeks</b>
Ashworth wrist flexors	3.4	2.0	2.3	3
Ashworth finger flexors	3.2	0.8	1.3	1.8
Passive ROM wrist	20 degrees	50 degrees	40 degrees	30 degrees

# ESWT in the neurological rehabilitation

28 children with CP, Kinematics after 6 ESWT on gastrocnemius and foot soles + complex therapy.  
Open cohort study.

Lohse-Busch 2010

N=28 children left side “declared” most affected	in %
left upper ankle joint wing phase plantar flexion	-35.0
Right pelvis angle stance phase	-15.0

## Radial Shock waves

15 patients with spastic cerebral palsy,

Aged 19-46 years, rct

Ashworth points -1,

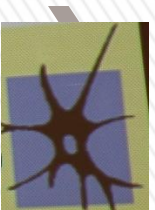
ROM of lower limb joints (???) improved by about 10 (no exact numbers given) Vidal 2011



**The newest one:**

**15 children with CP. Kinematics after 15 ESWT  
on spastic muscles of the lower limb. Gait analysis. Rct.**

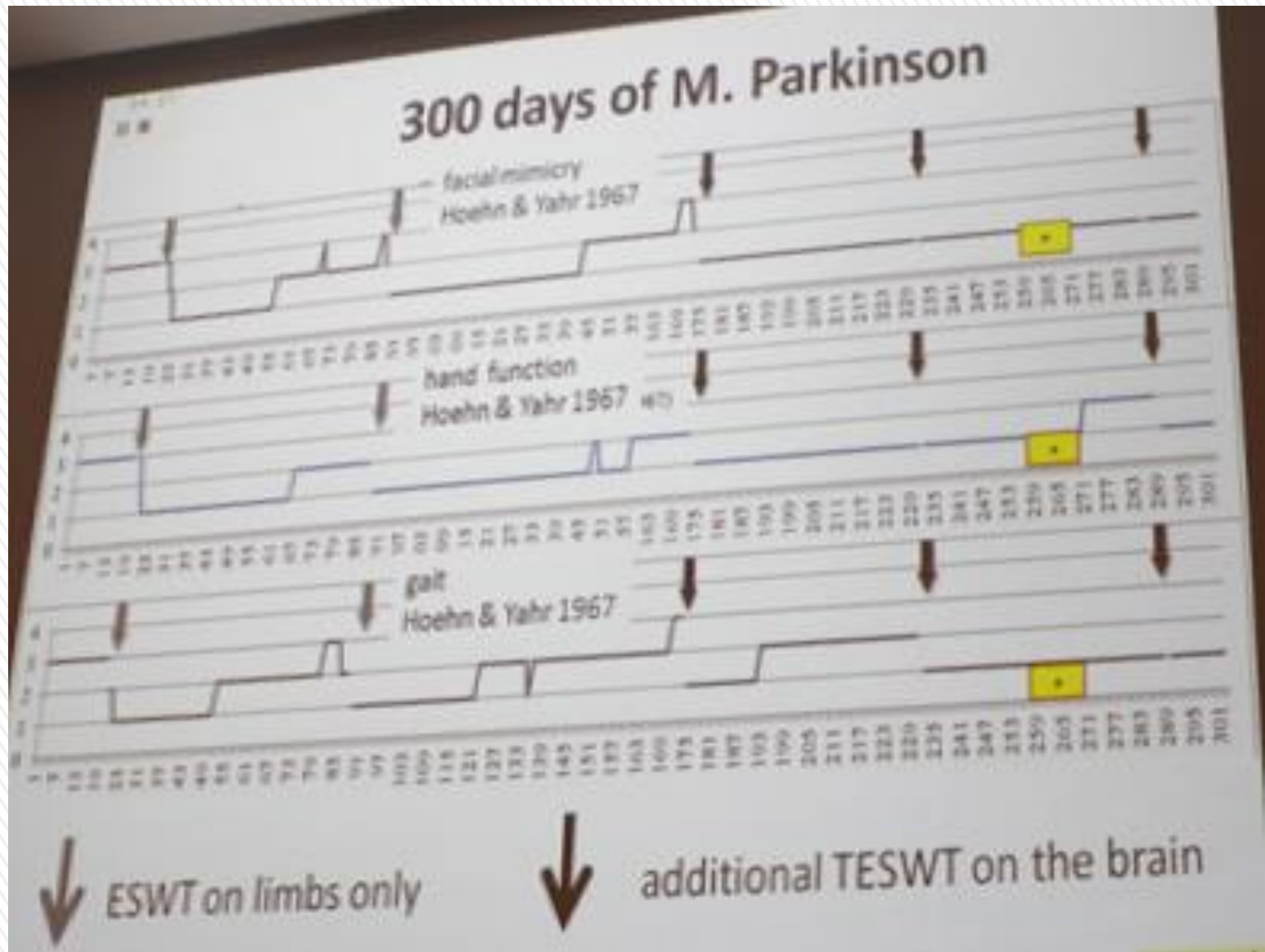
**The stride length, cadence, speed, cycle time,  
and stance phase improved by about 25%.**





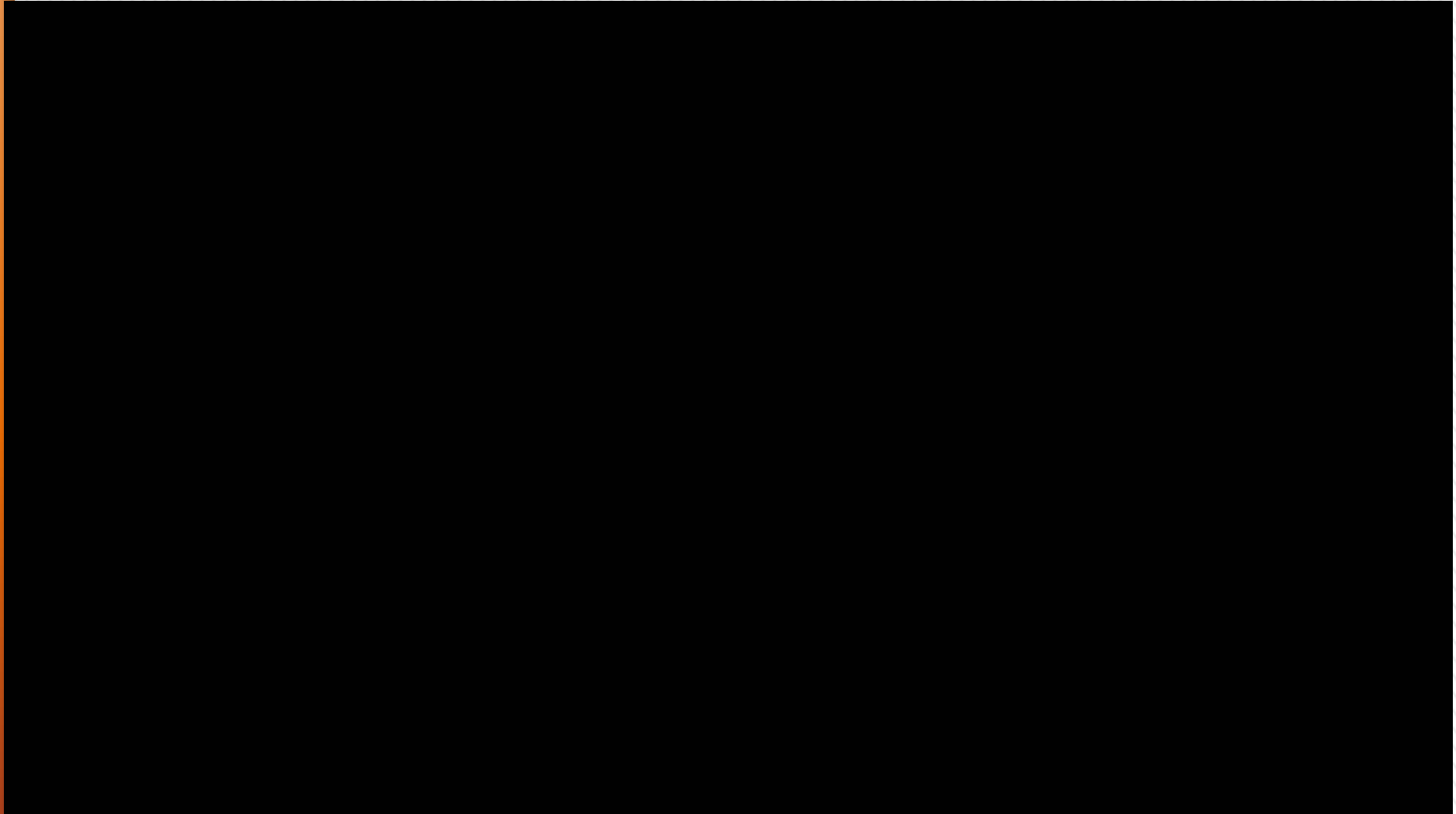
**38 years old, incomplete paraparesis 1998 C&/Th1 ASIA D  
walks with crutches, maintained sensibility.  
Sympathetic algodystrophy 2005.  
Before and after 9 ESWT during 3 weeks 2011.  
X-ray control after 6 weeks.**

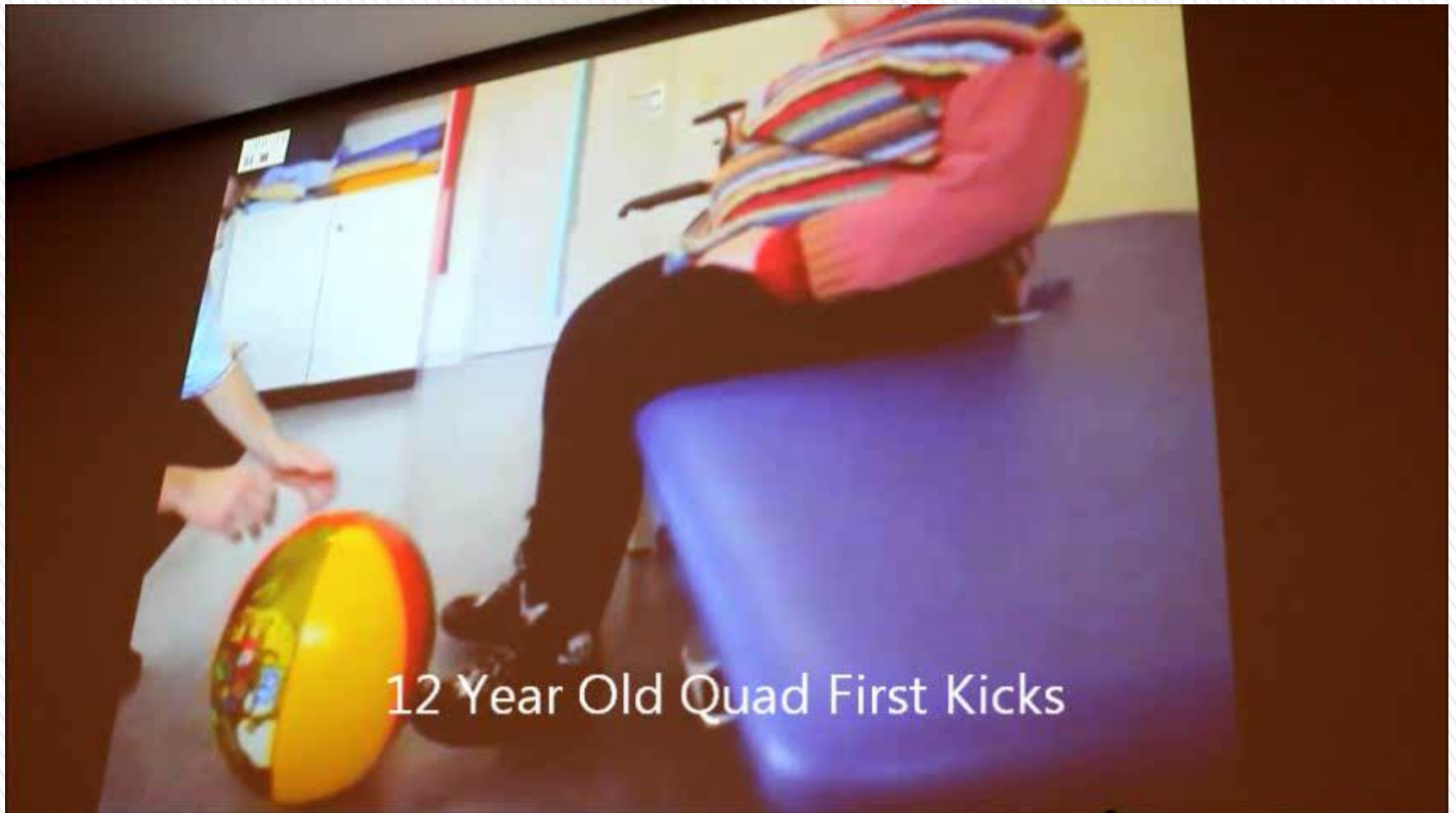




Reduction of Levodopa/Carbidopa/Entacapon from 375mg to 200mg. Piribed from 150mg to 100mg successively during 3 weeks

## Parkinsons Patient Video I





12 Year Old Quad First Kicks

Quad Kicking Ball

