In this issue

Clinical Image

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Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-85

Published On: June 16, 2019 | Pages: 085 - 085

Author(s): Giselher Schalow*

The girl looks at you in the hope that you will help to cure spinal cord injury (and other diseases) in children. The picture was taken from the fairy tale film “Till Eulenspiegel”. In the film she (Jule Hermann) is hoping that her father wants her. ...

Abstract View  Full Article View

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Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-84

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Author(s): Giselher Schalow*

Poster of the Author Schalow G (Number 38) at the international conference IPBIS2018 in Belfast 2018: Pediatric acquired brain injury repair. The poster is not especially good because of lack of money. But the repair progress of the nervous system in children can clearly be seen It is also shown that human anatomy and physiology is needed for repair. ...

Abstract View  Full Article View

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Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-83

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Author(s): Giselher Schalow*

The SCI patient Nefeli during exercising only with the legs while playing/working with the iPhone (A) or singing and moving (B). While playing a bit crazy during CDT (B) is beneficial for repair because it keeps the patient in a good mood
in spite of the SCI. Being addicted to the iPhone (A) is mostly not beneficial for repair. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-82

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Author(s): Giselher Schalow*

Nefeli is watching the coordinated moving of the fins of fishes. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-81

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Author(s): Giselher Schalow*

The spinal cord injury patient Nefeli during performing hula hoop and playing at the same time with the sister/Author with a balloon. B. Nefeli during hula hoop with two rings. C. With three rings, which was possible only for a few seconds. D,F,G. Nefeli during hula hoop and swinging additionally rings with the hands. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-80

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Author(s): Giselher Schalow*

Running to improve pelvis positioning in a patient with a SCI at the level of Th10/11. A. During walking on knees, the pelvis is too much backwards mainly because of spasticity. B-E. During running the patient is able to bring the pelvis forward, especially in E. F. After running 10 times the distance of 6m the patient was exhausted but happy. Note that the patient is ...
Improved running performance (A) of the SCI patient because of being able to flex and lift more the knees instead of swinging the leg outwards during walking (B) and running (C)....

Jumping on springboard of the 11-year-old SCI patient Nefeli after 2.5 years of CDT. Jumping in anti-phase (A-C), in rotation (D,E) and in abduction-adduction (F,G)....

Exercising on the special CDT device with coordinated support by the Author. The Author recognized with the left hand when Nefeli started to sweat in the leg first time after the SCI, which means that the sympathetic nervous system re-innervated the body below the injury level Th10. ...
The spinal cord injury patient Nefeli just after learning to ride a normal bicycle at an age of 12.5 years (A). She manages also to ride curves (slalom) (B). She still has problems to keep the feet on the pedals, but when she slips from pedals, she has no problems to keep the balance (C). Note that she has to concentrate very much to keep the feet on the pedals (A), s ...

Relearning to ride a bicycle (A-G) instead of riding wheel instruments in the lying position (H) of patients with spinal cord injury. In B the feet are fixed. In C Nefeli is demonstrating the improvement of trunk stability. In D through G the feet are not fixed. E. With support of the father, Nefeli can manage a bit to ride a normal bicycle. ...

Improvement of the low load coordination dynamics best values with therapy. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-75

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-74

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-73
Natural standing of the SCI patient at school following 12 months of therapy (A). After 18 months of CDT she stands straighter during working in the kitchen (B). The patient prefers to be bare foot (B) or to wear socks to have more input from the soles of the feet for better balance because of the damage of the fasciculus gracilis.

Improvement of the straightness of the trunk during hula hoop. The treatment time is 12 months in A, 18 in C and 22 months in D. The improvement of straightness may not be characteristic for the improvement of her scoliosis.

Improvement of longest hula hoop exercising times in dependence on therapy. Note that the individual times varied much.
The arching of the back is impaired in the patient Nefeli (A). In the four-year-old brother the arch of the back is physiologic (B). ...

Nefeli during dancing at school. Disappointing is that 16 of the 18 pupils had over-weight. ...

Foot arches during supported walking. Note the right foot has in the stance phase (A, arrow) no foot arch. ...

Practical judgment of extensor spasticity. When the Author holds the patient Nefeli (SCI Th10), one can judge her
extensor spasticity by the extension of her legs (A). Her present spasticity is medium strong. A physiologic leg position can be seen in B. The healthy seven-year-old sister has no spasticity and the legs are flexed. ...
Zones of Head and referred pain. ...
The 10-year-old SCI patient Nefeli during training with the hula hoop to improve trunk mobility/stability and balance. ... 

The patient with a SCI learned to lift the knees and strike the ground first with the heel to induce the stepping automatism for SCI repair. Note, the arch of the foot is preserved in the left foot but not in the right foot during the stance phase. With the lifting of the knees, Nefeli became able to activate the quadriceps much more; the regeneration of the spinal co ... 

Improvement of running and walking times when moving along a floor. The patient is using the arms also for keeping the balance. ...
Sclerotomes (B) and Dermatomes (A)....

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Coordination dynamics values over time of the SCI patient Nefeli. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-56

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Patient with SCI during exercising on the special CDT device different movement patterns to improve phase and frequency coordination of neuron firing. In A and B also trunk rotation is trained. When turning in the standing position (F), the performance of the right foot is pathologic (plantar flexed). ...
Two ways to get up from the floor after falling. In A through D mainly the arms are used for getting up and in E through H the legs. ...

Volitional dorsal flexion of the feet in a patient with 70% SCI. In ‘A’ plantar flexed and in ‘B’ dorsal flexed. To improve foot power, the hand grip is co-activated (clench her fists). ...

Automatic stepping in a newborn infant. A. The 5-day-old infant, Juliane, performing primary automatic stepping; slight backward posture. The heel of the right foot touched the ground first. B. Infant Juliane, 8-day-old, performing automatic stepping. ...
In spite of all the struggles the Author had with the patient Nefeli when pushing her to the limits of exercising, she wrote into the control book that she likes the Author. ...

Supported jumping in anti-phase of the 9.5-year-old Nefeli with SCI in comparison to other girls. Note, with the right small finger the therapist (Author) is trying to keep the right foot of Nefeli in a physiologic position. The progress in jumping is quantified by the increase of jumps per series. \( y = \text{age in years} \). ...

Free walking on treadmill in the forward and backward direction of a patient with a SCI. Note the pathologic inward rotation of the left knee and the not straight upper body because of the scoliosis. ...

Improvement of free walking on treadmill of the 10-year-old patient Nefeli with a SCI. At the beginning a walking speed of
2.5km/h was only possible, later on a speed of 4km/h became possible. The patient walked without shoes to have a better sensory input and in this way a higher stability, which was the limiting factor of continuous walking. ...
Severe scoliosis of the SCI patient Nefeli caused by the spinal cord injury and the cancer removal. With the removal of the neuroblastoma at least one intercostal was removed.

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A. Posterior funiculus, containing the posterior columns fasciculus gracilis (medial, afferent fibers from the leg) and fasciculus cuneatus (lateral, afferent fibers from the arm). Afferent fibers sub-serving different sensory modalities traverse the root entry zone and enter the posterior horn (B). The type of myelin changes from peripheral to central, and the myelin...

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Neuron operating as a coincidence or coordination detector. A. Afferent input is reaching rather uncoordinated the cell soma. Only sometimes an action potential is generated, because the threshold of action potential generation is mostly not achieved. B. The action potentials in fibers 1 through 4 are reaching time-coordinated the dendrites or the cell soma. The posts...
Up and down movements of the trunk to arch the patient's back and to activate neurogenesis at the SCI level Th10. The impaired arch is marked with SCI Th10.

Spinal cord cross section with indicated approximate injury (cross-hatched) and loss of interneuron (dotted area) of the patient Nefeli. Synapses of descending motor tracts onto anterior horn neurons are shown.

Primary motor areas (homunculus of the brain). Note that the toes are close to urinary bladder and rectum areas.
A-C. Volitional abduction and adduction of the toes becomes possible again in the SCI patient Nefeli. With the activation of the Mm. interrossei dorsales and plantares (C), the regeneration of the spinal cord has reached the S1 to S3 spinal cord segments. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-38

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Activation of the halluces longus muscle (C) when dorsal flexing the big toes separately (B). Spinal cord regeneration reached the L5 level. ...

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Segment-indicating muscles of the L4, L5, S1, S2/S3 and S4/S5 spinal cord segments for measuring the level of spinal cord regeneration. A. Relation between spinal cord and vertebra segments. B. The spinal cord segment L4 indicating muscle is for example the quadriceps. The extensor halluces longus is characteristic for the L5 segment. C. The plantar muscles of the foo ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-36

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MRI of the 10-year-old patient Nefeli with a spinal cord injury at the levels around Th10. Because of scoliosis, the spinal
cord is not fully in the plane. The injury of the spinal cord is mainly from the dorsal site. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-35

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Author(s): Giselher Schalow*

Salamander-crawling (C, D) in similarity salamander-walking (A, B) of the 10-year-old Nefeli with a spinal cord injury (Th10). In D the bending is disturbed because of the scoliosis and spasticity. ...

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-34

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Author(s): Giselher Schalow*

A, B. Possible rotational body movement of Tiktaalik, caused by alternately using one front limb for forward locomotion. C, D. This front limb movement is simulated by a patient with a spinal cord injury (Nefeli) by using alternately the right and left arm. Tiktaalik roseae is a lobe-finned fish from the late Devonian period, about 375 million years ago, having may be...
Ten-year-old patient with an incomplete spinal cord injury at the Th10 level during creeping. Note, because of the severe scoliosis, the creeping is not symmetrical. The rotation to the left is limited because of the scoliosis. C. Training of right-left symmetry via the corpus callosum (D) when exercising on the special CDT device with crossed arms.

The 5.5-year-old Nefeli after suffering an incomplete spinal cord injury Th10 by medical malpractice. B. Nefeli after eight months of conventional children rehabilitation in Switzerland (Affoltern). Sticks and orthosis were needed. C,D. Ten-year-old patient Nefeli after six months of coordination dynamics therapy. At school she can walk again and can write at the whit ...

Evolution of the attractor layout of bladder functioning induced by learning transfer from movements to bladder functions upon CDT. The region around each local minimum of the potential landscape acts like a well that weekly traps the system into a coordinated state. Black balls correspond to stable minima of the potential. With learning, the pattern 'spasticity of th ...
Direct comparison of secondary muscle spindle afferent activity and motoneuron activity between the brain-dead human HT6 with a synergy of the bladder (A) and the paraplegic 9 with a dyssynergia of the bladder (B). A. Simultaneous measurements of activities of secondary muscle spindle afferents (a), parasympathetic preganglionic motoneurons (b) and oscillatory firing ...

Comparison between changes in secondary muscle spindle afferent activity and detrusor pressure (measured before the surgery; for the implantation of a sacral anterior root stimulator). Paraplegic 9. A. Activity changes of the afferent fiber SP2(1) following bladder catheter pulling (Figure 37Ba). Approx. mean activity level is represented by a dashed line at 7.5 Il/s/...
Self-organization of premotor spinal *2-oscillator O1, which innervates the external urinary bladder sphincter (skeletal muscle). Brain-dead human HT6; recording from a dorsal S4 nerve root. A. Recordings from *2-motoneurons O1 and O2, firing in the oscillatory mode with impulse trains of 2 (upper recording) and 3 (lower recording) action potentials (APs). The duration ...

Location of receptors and muscles for the continence of the urinary bladder and the rectum, innervated by motoneurons the activities of which were recorded, in the brain-dead human HT6 (dS4 root), paraplegic 9 (vS4 root) and paraplegic 7 (nerve root S5). ...

Schematic diagram of the sympathetic and parasympathetic nervous system. Yellow = sympathetic, blue = parasympathetic. The recording from a sacral root shows single action potentials of preganglionic neurons (par) and a skin afferent fiber. ...
Clinical urinary bladder function test (Urodynamics). Improvement of the urinary bladder functions, quantified by urodynamics in a 30-year-old female patient. A. 3 months after the accident resulting paraplegia sub Th12 following spinal cord lesion. B. 12 months after the accident (lesion level lowered to sub L3). In A, the detrusor pressure (Pdet) is generated by the ...

Relation of coordination dynamics values to therapy duration for a load of 20N and for exercising in the forward (lines and dots) and backward directions (20Nb; dashed line and crosses) in a patient with a SCI sub C5/6 (Kadri). Note that with no therapy the coordination dynamics values got worse (increased) and upon therapy they improved again. Upon metal removal the ...

Comparison between the development of an infant and repair of a cervical spinal cord injury upon CDT. Left penal, positioning upon 0.5 years of therapy and right penal after 5 years of therapy. ...
Comparison between development and the repair of an almost complete cervical spinal cord injury upon one year (A,C,G) (therapy started at an age of 15.5 years) and 5 years of coordination dynamics therapy (B,E,H) (CDT started with 17 years). The MRI of the SCI of the patient of the left panel is shown in ‘I’ and those one of the right panel in ‘K’. Trunk rotation (A,B ...

Relation of coordination dynamics values to therapy length for increasing load between 20 and 150N. The loads for forward exercising (dots, 20N, 100N, 150N) are marked at the curves (20Nb = backward exercising (crosses) at 20N). Note that with no therapy the coordination dynamics values got worse and upon administering therapy again the values improved again even 2 ye ...

Improvement of times for running 60 and 400m (A,B) and increase of jumps with a skipping-rope per single session (C) in relation to on-going therapy sessions. Therapy period = second half of 2006 (Next PDF No 160). ...
The outcome of a SCI repair depends strongly on the severance of the injury. A-D. MRI's of approximately 99, 95 and 50% injury. C shows the 50% injury with titan fixation and B without. The severance of an injury can also be estimated with a fixation in place. G,H. In 50% injury, the patient can relearn walking, running and jumping. E,F. In 95% (and 99%) the patient c ...

A. Improvement of high-load coordination dynamics (CD) values in a patient with severe brain injury upon coordination dynamics therapy for several years. The high-load CD values were obtained by summing up the single CD values for forward and backward exercising, (high-load CD value) = 20N + 50N + 100N + 150N + 200N + 150N + 100N + 100N + 50N + 20N + 20N). ...
Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-17

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Author(s): Giselher Schalow*

Layout for measuring coordination dynamics (arrrhythmicity of exercising) between arm and leg movements, displayed on the laptop; for the intermediate coordination's between pace and trot gait, the fluctuation of the network states is larger.

The recording of sEMG activity (displayed on the oscilloscope) from the tibialis anterior and other muscles is also shown.

The i ...

Abstract View  Full Article View

Exclusive Image Gallery on Human Spinal Cord Regeneration-Clinical Image-16

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Author(s): Giselher Schalow*

The 11-year-old Nefeli with an incomplete spinal cord injury (SCI) during exercising coordinated arm, leg and trunk movements to improve the coordinated firing of neurons and sub-neural networks. This special CDT device for measuring and therapy (int.pat.) is produced by the firm: Giger Engineering, Martin Giger dipl.Ing.ETH/SIA, Herrenweg 1, 4500 Solothurn, Switzerland ...

Abstract View  Full Article View
The potential, $V()$, of the coordination dynamics for jumping on springboard (D, Nefeli) of a healthy (A) and injured CNS (B,C). The region around each local minimum acts like a well that weakly traps the system into a coordinated state. Behavioral changes are represented by the over-damped movement of a rolling ball in the potential “landscape”. High fluctuations (in ...}

Trot gate crawling of a cerebral palsy girl in interpersonal coordination with the therapist. The crawling performance of the therapist is not optimal. The right arm is leading with respect to the left knee. The crawling performance of the patient is also not optimal; the knees are too much apart. ...

Motor program bursts in patients who suffered a spinal cord injury, structured with clonus activation and rhythmic firing of FF-type motor units A. EMG recording of a clonus ($f = 5.3$Hz) in the right tibialis anterior muscle of a patient who suffered a complete spinal cord injury sub Th5/7; the patient was not exercising. B, C. Motor programs of a patient who suffered ...
Phase and frequency coordination between oscillatory firing motor units (FF-type) during the generation of a motor program during exercise on the special coordination dynamics therapy device at loads increasing from 100 to 200N. Oscillation periods ($T$) and oscillation frequencies ($f$ [Hz]) of oscillatory firing motor unit 1 are partly indicated. ‘A,B,D,E’ same recording ...

Correlation of muscle fiber types, motor nerve fiber types, and oscillatory firing spinal neuronal networks, based on histochemical, morphological and physiological properties. This figure provides a simplified correlation between muscle fiber, motoneuron and sacral oscillator types. No additional subtypes have been included. $=$ motoneuron, 1, 2 = dynamic and stati ...

Touch (and pain)-stimulated afferent activity. Touch and pain activity, stimulated by pin-prick (A) and touch (Ea) of S5 or Co dermatomes and recorded extracellularly from a dorsal coccygeal root (brain-dead human HT6). T1, T2, T3, T4, P = mark action potentials (APs) from single touch and pain fibers. Subscripts 1, 2, 3 mark single fibers. ...
Classification scheme for human peripheral nerve fibers. Conduction velocities (V) and nerve fiber diameters (Ø) of afferent and efferent nerve fiber groups in normal humans and in patients with a traumatic spinal cord lesion for 0.5 to 6 years. The splitting of the 1-motoneurons into the 3 subgroups, 11, 12, 13, has not yet been confirmed. This is the only existi...

Abstract View Full Article View

Development of a classification scheme for human peripheral nerve fibers. Conduction velocities (V) and nerve fiber diameters (Ø) of afferent and efferent nerve fiber groups in normal humans and in patients with a traumatic spinal cord injury for 0.5 to 6 years. ...

Abstract View Full Article View

Schematic splitting of the activity of several nerve fibres into simultaneous impulse patterns of single fibres by comparing waveforms, conduction velocities and reoccurring characteristic impulse patterns (rhythmic firing of sphincteric motoneurons). The different conduction times and waveforms were recognized on an expanded time scale. Stretch receptor and secondary ...

Abstract View Full Article View
Layout of the recording of single-nerve fiber action potentials to measure the self-organization of neuronal networks of the human CNS under physiologic and pathophysiologic conditions. By recording with two pairs of wire electrodes (B) from sacral nerve roots (cauda equina, C), containing between 200 and 500 myelinated nerve fibers, records were obtained in which sin ...
Human spinal cord with dorsal (A) and ventral side (B,C). Intumescentia cervicalis and lumbosacralis are visible. The caudal ventral roots are thinner than the dorsal roots. The passage of the artery spinalis magna (Artery of Adamkiewicz) and the anterior spinal artery are indicated. The C5 and Th10 roots and the intercostal nerve Th12 are indicated.

Dissection of the ...

Spinal cord (A) and dermatome segments (B-D). The segmental innervation of the skin in B is according to Hansen-Schliack and in C after Keegan and Garret. The overlap of dermatomes (D) is according to Foerster. Note the different location of the T1 dermatome in B and C. There is variation of the segmental skin innervation especially in the lower sacral range.

A. Spinal cord segments and their relation to the vertebral bodies. Note the Ascensus of the spinal cord, giving rise to the long cauda equina nerve roots. B. Approximate segmental innervation of the skin. C. Below the spinal cord injury level there is loss of sensitivity and loss of connectivity to muscle and other functions.