

Neuromuscular arthroosseous plasticity

Further development of traditional physiotherapy concepts **Renata Horst**

So-called traditional concepts are increasingly under pressure to underpin their methodological approaches with current scientific knowledge. An essential content of the N.A.P.[®] concept (Neuromuscular Arthroposis) is that the body function / structure is influenced by realistic activities, as motor learning takes place at the activity and participation level. Structural treatment is integrated into the (senso-) motor skills training - according to the motto: the (functional) activity determines the structure. The treatment principles underlying the methodological approach are based on modern

knowledge of biomechanics and neurophysiology. Case studies in orthopaedic / traumatological and neurological rehabilitation are explained below to illustrate some of the methods.

Plasticity means change, or "further development".

This article presents an integrative neuro-orthopaedic concept for the promotion of motor strategies in everyday life. The philosophy of the N.A.P.[®] concept is based on the idea that everyday activities determine body function / structure.

- Learning takes place through experience.
- Learning requires an action-oriented approach in order to develop solution strategies.

This means that structural treatment (joint mobilization, joint stabilization, muscle strengthening, muscle stretching) is not considered a "preparatory

The training is not carried out as a "training" for the functional activity, but is always practiced within a target motor task.

Introduction

In this concept, the therapist's hands are used as a specific tool to create the best possible bio-mechanical situation, which is coordinated by the neuro-muscular system under healthy conditions. This gives the brain an "idea" of the movement and helps it to plan it. Since joint positions and muscle activities are not

consciously perceived and



Fig. 1a_ Patient after TBI does not use her right hand when using her speech computer, although she is right-handed. She cannot open her right hand when prompted



Fig. 1b_ Before her accident, she enjoyed climbing. This situation is used in the hospital area and she opens her right hand automatically



Fig.2_Restricted inflection without supination

Although these movements are not consciously controlled, specific tactile information combined with voluntary action can help patients to experience their goal-oriented movements in a positive and, above all, pain-free way. The automatization of these positively experienced movements takes place through self-exercises that are based on the individual patient's needs. Ideally, the patient learns to perform their movements independently without outside help.

Promoting movement with traditional concepts

In many treatment concepts, stimuli are applied by the therapist to promote movement. The paradigm of the 1980s and early 1990s implied that passive mobilization of joint structures would lead to an improvement in functional activity. Structural approaches to prevent or treat movement restrictions are fundamental to many manual therapy concepts such as Maitland, McKenzie and Kaltenborn-Evjenth. Tests and treatment methods are mainly carried out passively. Facilitation

concepts (e.g. Bobath, PNF, Vojta) aim to promote neuromuscular coordination by means of stimuli, primarily tactile. Tactile input is used to initiate movement. The term "initiation" is often used in this context. As long as voluntary motor skills are not possible, these concepts offer opportunities to prevent contractures and muscle atrophy.

Promotion of individual movements

In the N.A.P.[®] concept, information is used to bring about central changes, which in turn lead to changes in the periphery. The patient is encouraged to focus his attention on the characteristics of the task itself and on environmental factors that are relevant to the moment. His search for suitable strategies is supported by the therapist, possibly also tactilely.

The basic method-defining hypothesis of this concept states that long-term changes >>>



Fig. 3_Low supination in sitting position, without stabilization of the elbow in flexion

The following illustration shows that improvements can be achieved when body structures are practiced during the execution or mental imagery of realistic activities (Fig. 1 a and b).

Principles, methods and objectives

The principles of the N.A.P.[®] method on which the concept is based are:

- Cognitive pain management
 - a) Habituation training
 - b) aerobic training
- Use of positive resources. Every structure is only as resilient as it is stressed
 - a) Structures are determined by functional activities.
 - b) Weak muscles are activated by summation stimuli.
 - c) Elasticity of stiff muscles is achieved through biomechanical adaptation processes.
- Specific application of the input systems
- Targeted design of the therapy situation
- Plasticity of the tissue structures

The corresponding treatment goals are derived from these treatment principles. Pain perception and

-Chronicity is avoided in the acute phase. Resources are promoted and coping strategies are trained to enable the patient to carry out everyday activities independently. Contractures and stiffness are avoided or eliminated by promoting elasticity. The cortical representation of weak body parts is promoted under correct biomechanical conditions and unnecessary coping strategies are prevented. The specific needs of the client in relevant everyday and professional situations are supported.



Fig. 4_Exercise: Mobilization of the elbow flexion

The treatment methods of the N.A.P.[®] concept contain the following features:

1. The patient is supported in organizing the action.
His attention is directed to the input systems required for the task at hand.
For patients with cognitive deficits

the therapist must try to con

texts in which actions can be accompanied. In situations in which the actual action cannot be carried out, the visualization of actions should be encouraged.

2. Action and treatment form a unit in that structures are specifically influenced during the execution of an arbitrary action.

The therapist's hands are used to create the biomechanical situation required for economic execution. They are only applied after it has been ensured that the target has been recognized and are used to stimulate mechanoreceptors.

3. Starting positions are chosen specifically.

Primarily, the starting positions are chosen that the patient needs in order to cope with everyday activities and participate in their individual socio-cultural life.

increase. Gravitational influences will



Fig. 5_Exercise: Supination while standing

depending on the type of muscle activation required or the structure to be influenced (contractile / non-contractile).

Case studies

Plexus palsy

Mr. A., 36 years old, suffers from plexus palsy of his right dominant arm after a serious traffic accident. Three months after

the accident, only an 80°

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Fig. 6_Occupation-specific exercise: Supination of the forearm with simultaneous stabilization of the elbow in flexion

flexion in supine position, but without any supination (Fig. 2). After a further five months, some supination in a sitting position is possible, but without being able to stabilize the elbow in flexion (Fig. 3).

The patient has recently set up as a dentist. The doctors and therapists treating him advise him to consider changing careers due to the severity of his injuries. But then the therapy begins to show success. Elbow flexion with supination is initially practiced in an activity similar to a pull-up.

practiced (Fig. 4). The therapist mobilizes the elbow flex by simultaneously sliding the olecranon distally. While standing, supination is improved by the patient grasping the bar and shifting their weight onto their affected leg. Meanwhile, the therapist pushes his distal radius dorsally (Fig. 5). When the patient performs his typical occupational movement after a total of nine months, he succeeds for the first time in supinating his forearm while simultaneously stabilizing his elbow in flexion (Fig. 6). In a further exercise, the therapist stabilizes his shoulder in AR while mobilizing his radius dorsally (Fig. 7).

Eleven months after his accident, he resumed his job and thirteen months later he was able to treat his patients full-time again.

Restriction of movement after plaster removal

A right-handed 16-year-old female patient, Ms. E. L., suddenly develops linear pain along her left little finger and the latera



Fig. 7_Occupation-specific exercise: stabilization of the shoulder in AR and mobilization of the radius dorsally

forearm during an internship at a hotel. Her doctor diagnoses tendinitis due to overuse and gives her a cast. After five days, she complains of unbearable pain. Her cast is removed and a bruise is discovered on her dorsal forearm. She cannot move her hand and fingers at all, although nerve conduction tests were normal. After two months, she is able to move her



Fig. 8a to 8c_a:Unnatural mass movement in the sense of "spastic dystonia", b_During real activities the patient shows natural hand and finger extension, c_Isolated finger movements are possible at the participation level

wrist and finger extensors. However, these movements were very abnormal, as she can only stretch her fingers all together and not in isolation, in the sense of spastic dystonia (Fig. 8a). On the same day, however, she bounces a volleyball and bounces a ball (Fig. 8b). These movements appear completely normal in the video documentation. Selective finger movements are also possible when playing the flute (Fig. 8c).

The mirror neuron system (see Glossary) offers a possible explanation for these different movement patterns. Without context, only the primary motor cortex is activated. In context, the premotor areas are also involved and provide the primary motor cortex with the information relevant to the task. This clinical observation confirms the hypothesis of the N.A.P.[®] concept. Movement is only learned in a meaningful context.

Results

Movement with context

It is crucial whether activities are practiced in therapy that are relevant to the patient. Exercises that are performed without context do not have the same

for the brain. Current knowledge supports the hypothesis of the N.A.P.[®] concept. Practicing realistic and meaningful activities leads to an increase in synaptic efficiency and a change in neuronal representation. This is the only way to achieve the necessary change in synaptic efficiency and neural representation (1, 2, 3).

Voluntary motor skills more than muscle contraction

Different neuron populations are activated when a movement is performed with or without context. Activation of the motor cortex without involvement of the premotor areas leads to a caricature of the movement (Fig. 8a to c). It is not actually body parts that are represented in the cortex, but rather these are represented in functional associations (4).

Plasticity


The basis of the treatment methodology is the idea of "plasticity". This can be understood as the ability to adapt to functional requirements. When tasks vary or environmental conditions differ, motor and sensory systems must also exhibit variability in synaptic connections. This variability in the organization of patterns is fundamental to learning (5). As a result, the brain learns behavioral patterns instead of movement patterns.

Summary

The results of the case studies described here are not only available to those who have been treated.

methods of the N .A.P.[®]-





ADDITIONAL SERVICE

Additional information on the topics of neuronal, muscular and arthro-osseous plasticity, postural control and reciprocal innervation, the development of protective mechanisms and hands-on and hands-off to promote motor control can be found on the Internet at:

www.physiotherapeuten.de/exclusiv/archiv/2009/pt05/_horst_xxxx

concept. Individual motivation probably plays the main role in the success of rehabilitation. To achieve this, the therapist must know the needs of his client and create appropriate contexts. Depending on the therapy environment, this may be more or less feasible. The primary goal of rehabilitation is to prepare the patient for their "normal" life and to promote their social interaction (6). This can be achieved through communication between the patient, therapists, support staff, attending physicians and - last but not least - with relatives, by developing joint treatment goals. The patient's potential can often be found at the participation level in particular.

Individual case studies illustrate the need for structural treatment within the activity itself and, above all, within interesting contexts. Current biomechanical and neurophysiological knowledge

These findings form the basis for working according to the N.A.P.[®] concept. "The practice of evidence-based medicine involves the integration of individual clinical expertise with the best possible external clinical evidence from systematic research" (7). Individual case studies are the beginning of future randomized controlled trials that can scientifically prove the effectiveness of the N.A.P.[®] concept.

FIGURES

All photos in this article by Renate Horst.



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LITERATURE

Bibliography under:

www.physiotherapeuten.de/exclusiv/archiv/2009/pt05_horst_literature.pdf



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