

## Rehabilitation in Water and the Handicapped Patient's Mouth.

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In a recent editorial on sports for the paediatric age group W.B. Strong (17) cites a handicapped athlete on what you can learn in sports:

"Discipline... how to make most of your time...flexibility.." and he continues summing up "the essence of sports - to have fun, to learn one's abilities and to learn how to take appropriate but safe risks. Sports should prepare a youngster for the game of life, which after all, should be an enjoyable journey."

I am sure that all who know the Halliwick method as it has been created and developed by J. McMillan ("Mac" for his friends) over the years will agree that this citation although aimed at the able bodied is applicable to the handicapped and to their able bodied "helpers" and "instructors" as well. Especially the notions of "game" and "joy" fit well to Mac's habilitation and rehabilitation concept in water.

With respect to cerebral palsy, the condition from which the majority of our patients suffers, it is appropriate to point to 'flexibility' and "learning one's abilities" (by pushing one's limitations) and "to have fun".

The clinical pictures of practically all handicaps are characterized by too few performance variations of postures and movements. It is this restriction of functional choices which constitutes the main reason for individual clinical pictures. In so called "cerebral palsy" as well as in other central movement disorders these restrictions usually are not a direct consequence of an altered quality of central nervous system functions. Not are such restrictions the consequence of structural (e.g. skeletal) changes in many other cases. A mixture of several factors amongst which the psycho-social ones are not the least important in restricting the performance level. This can be seen even in sound and valid persons. We all are well aware that at least the majority of us having to act under different sorts of stress usually will fall back to a poorer functional level and rarely perform in an optimal manner.

Stress in its different forms does not only seduce a person to perform on a lower functional level but also to reduce the degrees of functional freedom for an intended movement (10). Motor behaviour thus becomes a predictable stereo-type. Which in itself is considered as a major expression of pathology. Although the 'patterns' used by a handicapped person do belong to the repertoire also found in the non-handicapped population the exclusive use of too few of them has ill functional - and ultimately structural - consequences. That is why in a higher sense the use of such a restricted set of per se 'normal' postural and movement patterns has been termed 'pathological'. The level at which negative and positive stress such as joy, excitement or 'overwhelming good will' starts to reduce variational freedom is an important determinant of the degree of handicap in a given person.

To raise this critical threshold of stress that triggers deterioration, to break up these functional restrictions in fact is the primary target of all forms of physical treatments. Particularly of Bobath's neurodevelopmental therapy as well as its different aspects of 'handling' (3). Therapeutic sports such as riding on horseback and especially McMillan's Halliwick approach to therapeutic swimming have offered exceptionally fertile counteractions to the ever-threatening tendency of restriction.

This also holds true for the "borderlands" of sensori-motor pathology, aggravated by mental, emotional and behavioral problems, such as 'pseudospasticity' (Haberfellner, in preparation).

Halliwick is not intended to teach swimming exclusively, as Mac is used to state. It is intended to break up restrictions and to give more freedom to a population that is on the easy but dangerous way of avoiding 'unnecessary' risks and hardships. The psycho-social constellation of both the patient and his helper/instructor simultaneously being in the pool and having to adapt to the conditions in water offers unique possibilities. They are further augmented by the Halliwick-specific features that can downgrade negative stress of insecurity of fear: e.g. the 1:1 ratio of handicapped and 'helpers', the special games, and the use of songs which are providing the supporting time-frame of rhythm and above all the emotional splint of commonly expressed feelings of mutual respect, trust and joy. Lewin has defined swimming as "breathing in water" (11). The interrelations between respiration, muscular tone, posture, movement and one's feelings are common knowledge and need no further delineation. To sing together in water is a royal short-cut towards the normalization of these factors which are so badly out of balance during every day life in far too many of our patients. Singing, or humming when used optimally, is started by an attempt to tune into the patient's peculiar type of breathing. This powerful communicative tool can give the patient trust and confidence and provide an emotional anchor. A skilled instructor will change this individual pace in due time to bring it closer to the pace of the group in water.

The 'vicious cycle' of continuous restriction is broken up and by and by replaced by elements of a 'beneficious cycle' paralleling the patient's start to enjoy that taste of being accepted into this cordial community in water, and gain of emotional stability. Enhanced effectiveness with respect to postural and movement control reinforces this tendency. On top of all these positive circumstances we have to mention that the phenomenon of 'transfer' into every day life does exist. Although even temporary experiences of this sort - during 15-30 minutes - of immersion in water - would justify all our efforts.

Actual work in water as elsewhere usually meets with many difficulties which impede our attempts to enhance the patient's abilities as quickly as we want to. Fifteen year's work with special emphasis on impaired face-, mouth- and throat-functions have taught us some insight into the reasons of the "stubborn clinging" to some 'inertia patterns' - as Mac

has happily dubbed the individually modified tonic patterns displayed by so many patients. We learned some of the reasons why many good-willing people unadvertedly feel offended of 'emotionally left alone' by the specific behaviour of handicapped people, and why some potential and actual helpers feel so uneasy that they have troubles to share their time with patients suffering e.g. from certain cerebral movement disorders.

In short: There is a hierarchy of human interests. First of all comes the need to feel secure. That is, whenever the patient gains the impression that vital functions, his very survival are on stake, he turns to a stabilizing, securing manoeuvre - one of these few restricting 'patterns' usually of mixed but mostly extensor type - at least with respect to the neck (see below). And he will stick to it as long as he feels insecure. Next on the hierarchy scale comes the human interest in communication. Note that vital interests always will precede communicative wishes while these precede locomotive ones which in turn are given way by the desire to change one's surroundings directly by 'manipulation'.

An untrained person may need time to realize that painfully experienced 'obvious offenses' against established but narrowly framed communicative rules (as they are set by a sound community) are caused by the patient's handicap. These rules exist only in the unconscious part of our mind. Nevertheless they are very potent.

Non-verbal expressions such as postures, gestures, facial movements, vocal utterances and their refinements by articulation and prosody all are influenced directly and indirectly by the sensorimotor control of one very delicate area, the neck region.

Inappropriate hyper- or hypomobility of this region with visible consequences in practically all parts of the body are found in many muscular, spinal, or cerebral movement disorders as soon as the patient faces a potential vital threat - such as finding himself in water.

Let's have a look on how specifically dysfunctions of this region can prolongue the time needed for 'mental adjustment' to the being in water: Head and trunk are linked dynamically by the mobile structures of the neck. By adapting the position of the head in space and relatively to shoulder girdle and trunk these neck-structures provide the basis for passive communication: i.e. vision, hearing, smelling, as well as active communication: posture and expressive movements of the body, the limbs and especially the face and - not least - of vocal utterances.

On the other hand the neck contains the vitally critical crossing of respiratory and digestive tract. The postural protection of this area, the portal area of J.F. Bosma (2), is given permanent preference. Indeed as long as the individual is breathing, by day and by night the width of this area has to be guarded, and collapse as well as undue widening and distortion of it's mobile walls have to be prevented. In fact the single parts of this area, especially the tongue and it's neighbouring structures are kept at an individual distance from each other. This fact provides a sense of security and

remains unchanged throughout lifetime within very narrow limits.

Eruption of teeth as well as loss of teeth thus leads to a change of facial resting expression and facial dynamics. - More seriously for the handicapped's sensory-motor function of his tongue is this influence of positional change on transport of saliva, of food and speech articulation. That is why we try to protect every single tooth by proper dental hygiene and fluoride prophylaxis - especially in the group of severely handicapped patients. Positional adaptations in most cases mean forward displacement of the tongue, part of an 'extensor stereotype' (see below).

It's worth to remember that physical and emotional stress makes all human beings prone to exaggeration of certain functional traits by turning their casual use into stereotyped use - at the expense of a whole range of other possibilities. One of the most frequently encountered and most impressive postural stereotypes is the pattern of neck extension. It's sudden onset especially in patients with athetosis or an additional athetotic component to another movement disorder usually does not only offend communicative rules but actually terrify the lesser experienced helper/instructor. Referring to the hierarchy of domains we are to conclude that this pattern is caused by the patient's impression of inadequate vital security.

But then - marked and usually asymmetric neck extension will cause asymmetric extension in other parts of the body too (4,10,12,13,16): In water it first causes the patient to change his position. If he was, let's say in an aided upright position, patient and helper will have troubles to keep it. They rather tend to turn asymmetrically into the horizontal plane.

There will also be changes in the facio-oral region. By mechanical and reflexive mechanisms of 'tonic' character the facial expression will be one of a terrorized person: Widely opened eyes and mouth, further accentuated by retracted lips and protruded tongue. At first glance this is not a very good adaptation to the submersion under water that is likely to follow. Still the unexperienced helper's instinctive reaction, namely to lift the patient so "that the water does not go into his widely opened mouth" is a step into the wrong direction. Constant mouth closure in and under water is not practised by able bodied persons either. Expiration, sealing of the airway by velo-pharyngeal contact and opposition of the back of the tongue to the soft palate as well as closure of the glottis are very effective means of airway protection mastered also by the most severely handicapped persons.

So, what causes a frightened patient as well as a sound athlete who approaches the point of exhaustion or the people who are about to raise their voice to relatively extend their neck? First of all the structural peculiarities of the neck regions which effectively widen and stabilize the pharyngeal 'cross-road-area'.

J.F. Bosma has shown that the neck lordosis provides as much wider sagittal diameter of this pharyngeal part (2). Forward movement of the tongue which constitutes it's mobile anterior

wall is the single most effective factor. The Y-shaped suspension system of the hyoid bone which in turn provides support for the base of the tongue causes by purely mechanical reasons a forward movement of the tongue by virtue of an extended/lordotic posture of the neck. There are additional reflex mechanisms such as the tonic genioglossus reflex (Sauerland and Mitchell) but also volition - all acting in the same sense.

Before considering other factors that favour neck extension and its described effects on mouth and throat let's pause for a moment and face a structural and finally facial-communicative consequence of the described motor complex: The position of front teeth is secured by the balance between tongue and lips in their respective resting positions, with swallowing etc. Frequent retraction of lips and forward - thrusting of the tongue alters front teeth position so that lip closure may become very difficult. Or also the facial expression accompanying lip closure may distort the communicative situation in such a way that the patient prefers to have his mouth permanently open. Constant irritation of lymphoid tissues will aggravate the problem of mouth closure further. Drooling of saliva is but one of the consequences of the vicious circle referred to here. If we want to help the patient with this problem using the possibilities that are offered in water we must first reduce the patient's stress by the specific Halliwick techniques partly already alluded to and second help him with indirect stabilization of the neck area. The Halliwick-specific way of helping the patient into the pool stabilizing his arms and shoulder girdle and hence his neck is aptly illustrating this point.

Help with postural control of the neck by influence on the posture of arm and shoulder girdle is a widely and spontaneously used technique. Witness the sleeping infants with 'floppy' muscular tone in the supine position (especially those suffering from muscular or spinal diseases) or the neck-stabilizing armposition of the infant or young child who starts to walk, or the beautiful but - with respect to the face - uncommented illustration in N.R. Finney's book (3). It demonstrates the well-known fact of mutual intensification of outward rotation and abduction of the shoulder and neck extension, and on the other hand, of shoulder pronation and inward rotation and neck flexion. Please note that 'flexion' and 'extension' are relative and show great inter-individual variations.

Such mutual interactions lead to larger 'functional blocks'. Bernstein (1) explains that motor control becomes much easier for the central nervous system if large parts of the body are kept rigidly instead of being loosely moveable at the joints. This is one of the primary functions of 'patterns'. Time, space, and knowledge does not allow us to analyse other commonly observed patterns too - that is why we here in an exemplary manner only shall continue to consider neck extension and its causes as this pattern is by far the most common one if we consider all forms of handicap and all age groups. Blockage of nasal airways will change neck posture towards extension though sometimes in a very subtle way. This be-

haviour may partly have its roots in the early weeks of extrauterine life when blocked nasal airways are in fact a dangerous situation for the majority of infants. From the reflexes which are to protect and to clear the vitally important pharyngeal area only is facilitated by relative neck flexion (note that this is a flexion with a "long" neck): Swallowing. The other three are favoured by relative neck extension: Sneezing, coughing and gagging/vomiting. On considering the complex task of protecting the permanently endangered cross-road of the pharyngeal airway, it becomes clear why the needs of this area dominate posture, and why one has to respect it if one is to change a person's habitual postures and movements, and finally why illustrations of somatotopic representations at all levels of the central nervous system give a disproportionately large share to the facial-oral-and pharyngeal region.

Now, this was only the situation on land. There are additional factors in water: Mac taught us theoretically and practically about the big changes that man experiences if being upright in the water while the waterline reaches higher than Th 11.

I will not repeat here all the details of postural and movement change brought about by the interactions of water with its specific qualities and the human body. Only some main consequences: Control of position of legs and feet becomes difficult and the general human tendency towards vertical posture is replaced by a horizontal one. The sensory organs providing references for position in space thus work under different conditions.

Especially the telereceptors (eyes, ears) but also vestibular organs and -obviously tactile and temperature receptors of the body surface. Partial weight-loss and different (rotatory) movement patterns change proprioceptive afferences. Although reduction of postural muscle tone clinically becomes impressive 10-15 minutes after immersion, to hold on for 3-5 hours after leaving the pool the change of afferences is an immediate one.

Insecurity by alteration of sensori-motor and other competencies force the patients to look for compensation. Proprioception close to the spinal column, especially of neck, mouth and throat still offers (relatively) unaltered afferences. Small wonder that postures activating these structures are preferred and often in an extreme way.

Before going on the other aspects of oral and neck interrelations let us state again that neck extension is a relatively safe but functionally very restrictive posture. Especially with respect to muscular interplay as necessary for adequate communication by facial expression, speech articulation, swallowing of saliva and intake of food for instance. Still most of us have witnessed patients in water who profitted from Halliwick with respect to facial and oral control by reduction of drooling and amelioration of speech. The main reason is that all mentioned factor have different consequences indifferent patients (even in one individuum at different developmental stages). The posture(s) as facilitated in water seem(s) to be optimal with respect to these func-

tions.

By a series of lucky circumstances we can offer modified orthodontic devices (ISMAR= Innsbruck-sensory-motor-activator and regulator) to our orally handicapped patients. They consist mainly of elements of Andresen-Häuple monobloc activators and Fränkel's function regulators which have been widely used by orthodontists since decades. Such ISMAR's (6,7,8,9,14) are used by the patient's at home during periods of little or no communicative urge, - even during sleep just as classical orthodontic devices are. They are produced and consecutively adapted by orthodontists and their respective teams to the individual needs of our patients according to their progress. Basically they consist of two lateral 'shelves', allowing the patient to stabilize their jaws by biting at them. This will provide stabilization for the hyoid bone complex and hence for the critical pharyngeal area. The frontal and medial connecting part of the shelves called 'tongue shield' brings the tongue into a better starting position for swallowing. This intra-oral part is connected by wires to - usually four - vestibular pads in the vestibular area, that is between teeth and lips. Many modifications of these pads and their connections to the lingual (retrodental) parts allow for very selective and successful training to counteract deficits of the mobility of lips, cheeks, tongue, velum and soft palate. But above all they allow training of co-ordinated movements of these parts as needed of intake of food or speech for instance. (For details and illustrations please see ref. 6-9, 14). These ISMARs have furthered our understanding of functional interrelations which are not visible readily. Improvements of mobility and coordination of oral structures, especially the tongue also act on the neck (e.g. via the sternocleido mastoid muscles) and thence on the body as a whole as we could demonstrate even in healthy volunteers (5). We were hinted to this phenomenon by spontaneous tongue movements of handicapped patients accompanying their attempts to rotate their trunks (but did not appreciate it then) as well as by amelioration of gait and automatic reactions of the trunk in ISMAR-treated patients who achieved better lateral tongue mobility. Either by marks on the 'tongue shield' provoking 'Weiffenbach's curiosity-reflex of the tongue' (18) or, to the same end by use of small resin pearls mobilily attached to the 'tongue-shield' of their ISMAR. Nature is economic. Such bidirectional mechanisms seem necessary. If active or passive changes of head position in relation to the trunk position are able to change size and shape of the vitally important pharyngeal airway crossing, there must be a local 'first line' defense system. And this consists of voluntarily moving or tonically posturing one's tongue. We always would remember that our work on trunk - and limb-symmetry never will be without impact on the functions of face -, mouth and throat. But if we respect the prerequisites of the oral and pharyngeal region (e.g. need for feeling secure; 'stabilization' of hyoid bone complex, etc.) we can assist our therapeutic efforts with respect to body and limbs also from the 'oral corner' in a very potent way. It always pays off to respect the linkage of patterns such as:

Extension of body and neck - protrusion of tongue - inspiration, flexion of body and neck - broad and spoon-shaped tongue - expiration and also of lateral movements of the tongue intro- and/or extraorally to assist rotation of the trunk if the patient's oral region is relatively lesser handicapped. It is worth while at least to respect oro-pharyngeal difficulties, especially during infections of the upper airways habilitating or rehabilitating a patient - be it in water or elsewhere.

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