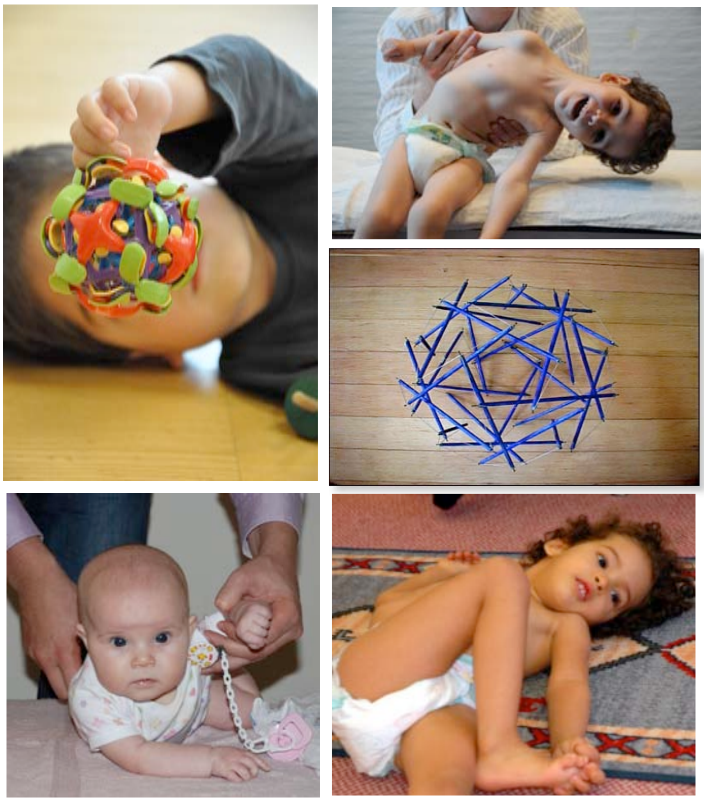
Advanced Biomechanical Rehabilitation

A considerable beneficial treatment method for children with Cerebral Palsy?

and

Deep tissue manipulative bodywork in comparison to classic rehabilitation in Cerebral Palsy



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Chapter 1 INTRODUCTION

1.1 Motivation for thesis

"The soul of man with all the streams of pure living water seems to dwell in the fascia of his body. When you deal with the fascia, you deal and do business with the branch offices of the brain. That is as under the general corporation law, the same as working with the brain itself, so why not treat it with the same degree of respect?" (Andrew Taylor Still, Founder of Osteopathy, 1899)

The more medicine and other applicable methods of the ill body and mind treatment is available, the more man must decide himself what kind of application he trust and believes most in: the classic, mostly artificial and time-preserving method of pharmaceutical and machine supplied methods, or the traditional believe in proper musculoskeletal correction of the body and tissue itself. (Juhan, Deane (1987); Kamenetz, H.L. (1980))

All around us medicine and rehabilitation methods try to improve individual's life's that has been destined and impacted by varies forms of neurological incidents. All these methods are obviously gathering and contributing towards the same intention: to improve the individuals affected quality of life.

But while medicine develops and grows in terms of possibilities, pharmaceutical means and machines, one important question tends to become more and more forgotten about: How about the individuals own body perception? How about his own individual *feeling* and *sensation* about his own body, about the processing of external and internal information, that everybody of us hast started to learn and develop from?

It was sensation that made us primarily able to participate and as ell that made us become the individual we are: *Tactile stimulation seems to be a fundamentally necessary experience for the healthy behavioral development of individuals.* (Montagu, A. (1971))
But how is an individual able to develop proper in relying on his senses and integrate all external and internal feelings, if he is missing the core and basics for receipting all these senses? Our body is a unit, which we find our own minds covered and well cushioned in. It is a unit of connected tissue. This tissue is more than underlining or covering layers of cells (Schleip, R. (2003)). Connective tissue or fascia, as it is called, is our organ of form, the tissue that connects and surrounds every muscle and every single organ of our body. It forms a true continuity (Varela & Frank (1987), Garfin et al. 1981). A brain injury child, that obviously has not had the chance to fully develop as other children, is missing an essential component of this fascia: its strength and volume. We must wonder how medicine or any other classic intervention in treating cerebral palsy, substantiate their reasoning of injecting Botox, applying splints or last but not least make surgery, if these children are obviously lacking one and the same, essential component: proper tissue development.
Apparently classic methods are still very much widespread, used and believed in, reasonable

due to many factors: fast, cost efficient and most of the time with the desirable outcome. But as far as I was able to follow and observe certain procedures and interventions in brain-injured individuals, all these interventions are of short term. All of these procedures are used to fight against one and the same enemy: a strong component within the imbalance of a CP child's body. But there is more than this strong component: every imbalance has two parties, two oppositional, two excessive, two hyper-elements. In Cerebral palsy, it is not different: opposed to the strong element man kind fights, there is weakness, in fact deep and profound tissue weakness. This weakness could be the key to the child's desperate need for help. It *feels* its weakness. (Blyum, L (2009))

For many hundred years, bodyworks are treatment methods that successfully base their principles on healthy body feelings and perceptions. (Juhan, D. (1987)) I had the chance to get to know one kind of bodywork, that uses methods and principles based on these senses and feelings we all started with: An advanced method of manipulative bodywork therapy. Preciously, it contents physiologically musculoskeletal correction used to treat cerebral palsy children. It is called Advanced BioMechanical Rehabilitation (ABR). Within my internship with ABR, I was introduced to philosophy, principles and main objectives of ABR, their working techniques and teaching method.

Many factors contributed to the decision that made me want to document ABR in my final bachelor thesis. Most essentially: It was imbalance that I was most aware of before I even started learning from ABR, but it was the weakness I was least aware of. I want to make sure that this in my eyes unique and very special treatment method for CP children does get more attention. Most logically it addresses the child at its weakest point: Its fascia.

1.2 Thesis question

Within the following chapter it is my intention to document ABR methods and treatment, and analyze whether Advanced Biomechanical rehabilitation, as compared to classic rehabilitation, improves general physical condition and active daily functioning of CP children, with specific emphasis on weight bearing components and trunk control.

1.3 Main aims and objectives

It is my aim to present working method and strategy of ABR, based on their philosophy, principles and main objectives regarding Cerebral Palsy Children. In order to understand the approach of ABR, one needs to understand the basics and main differences in a CP child development in comparison to a normal child development, outlined in Chapter II. To give deeper meaning and understanding to all this, I will give definition, measuring functions, underlining conditions and syndromes in Cerebral palsy. To outpoint and focus on the main differences in approach and methods ABR substitutes, I will give in chapter III an overview of classic rehabilitation, whereas the main concepts of ABR are covered in Chapter IV. To show practical evidence, I will draw the line with presenting a cerebral palsy child's case and history that has and still does approach ABR.

1.4. Limitations and borders of thesis

Even though ABR and its institution exists now for more than 10 years, there is little research and evidence published yet, that verifies numbers and rates that state the success of ABR in numbers. For the theoretical part, covering Chapter I-VI, I was able to use evidence and methodological researches on the general application of deep tissue manipulative therapies, and referred these to the main principles of ABR.

As my time is limited and all children I will observe, assess and treat, might only see once, I have chosen one specific individual, to analyze its history of complaints, the application of ABR procedure and the outcomes with the use of data reported by parents and ABR professional over the years. In that manner I am able to expose the outcome and effect ABR has on that specific child. For this practical and underlining last chapter, I will use these outcomes, and additionally comments from various parents all over the world (approaching ABR) as support and as substantial matter of facts, and will rely on these outcomes to consider the approach, ABR substitutes, as beneficial and considerable.

Chapter 2 HUMAN DEVELOPMENT OF ESSENTIAL STRUCTURES

2.1 Introduction

Since ABR has a very advanced, in some opinions strange and odd approach in treating brain injured children, I want to clarify what seems to be obvious forgotten in years of developed treatment options: we all started from one and the same point when developing.

The reasons for our forgetfulness are entwined in the development of modern philosophy, science and technology. It is not that we have forgotten, to listen and trust what we feel, but rather that we have adopted whole new way of looking at facts. (Juhan, D. (1987), p.1)

But what we have forgot is following: When a thing does not work, shouldn't we find out how it is supposed to work properly? Human bodies are objects, and there is every reason to suspect that the processes of matter within us are no different than natural processes anywhere. So no piece of laboratory equipment could ever put me closer to a form and its process of formation than can my direct perception of my own body. (*Juhan,* D. (1987) p.9 ff)

Simply spoken: we should under no circumstances ignore or degrade what our bodies are telling us, because they are giving us every moment a wealth of information about forms and formation within this body. "*Whether is a question of someone's else body or my own body, I have no other mean of knowing the human body except that of living its life, that is so to say of accepting involvement in the action which passes trough it and minglinin with it. Thus I am my body, at least to the extent to which I have acquired one and conversely my body is, as it were, a natural subject, a provisional sketch for my whole being […] (*Merleau-Ponty, M. (1945)). Hence, the reversible forgetfulness we are finding ourselves at this modern stage of treatment options covered in well explored and advanced medical possibilities should make one not forget one very important aspect: Those things which we perceive as being the givens in any situation will be the limits within which we understand our problems, conceptualize our choices, and search for solutions. (Juhan, D. (1987) pp. 1-4)

In fact, the more we focus on those certain givens, the less we are aware of what broad perspective we could actually work and react in. Human beings tend to act within their given limits. But that does not necessarily mean that one has to limit himself in the options and capacities he can fulfill his work? To verify this I make use of the Heisenberg uncertainty relation: In quantum physics, the Heisenberg *uncertainty principle* states that certain pairs of physical properties, like position and momentum, cannot both be known to arbitrary precision. That is, the more precisely one property is known, the less precisely the other can be known. It is impossible to measure simultaneously both position and velocity of a microscopic particle with any degree of accuracy or certainty. This is not only a statement about the limitations of a researcher's ability to measure particular quantities of a system; following the tenets of logical positivism- it is a statement about the nature of the system itself. *"The more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa."* (Heisenberg, uncertainty paper, 1927)

2.2 Human development- a life-long active process

“While unconscious creation- animals, plants, crystals-functions satisfactorily as far as we know, things are constantly going worn with man.“ (C.C. Jung, An Answer To Job)

So let’s start with reality: reality is, that our physical forms will develop into what our chromosomes dictate; no more, no less. But is that reality? The experiments of Gregor Mendel in the nineteenth century developed an old observation of a discovered form of genetic principle into something much more like a scientific theory. Mendel opened the door and a century later genetic research was crowned by the discovery of the DNA double helix by James Watson and Francis Crick in 1953.

Biological science typically strives to identify all of the characteristics of an organism with its genetic code, and all deviations from normal structure and function come to be regarded as errors in the arrangement of these coded molecular chains, which make up the chromosomes. And further, every sort of malady or deformation, that in not attributable to a particular germ or trauma comes to be labeled as a “congenital” condition. So in that manner, we are creating a bin in that we throw all anomalies, while additionally giving environmental circumstances recognition. But generally we see the gene as the “thing” having all the power in his hands to decide between anomaly and the normal, “usual” way of creating a new life.
These genetic principles have become so generally applied in order to account for almost all the internal conditions and behavior patterns of organisms that their power to eventually explain all biological developments has in turn become on of our unshakable articles of modern faith. Frankly speaking: labeling some condition as congenital, as we do so often, we basically mean that we don’t really know the cause of this condition yet.

Applying this form of perception to rigid, forming in our perception the only light in which we view extremely complicated elements involved in human development and human dysfunction, this can exert a very pernicious effect upon the sense of our own perception. It has huge impact upon our entire relationship to the world around us. It basically puts the only important formative elements of my development permanently beyond our personal control. This in turn makes us passive, helpless and unable to confront us with our won body. It makes our cells and our organs and systems integer in a fixed equation, rather than grammatical elements in an unfinished sentence. (Juhan, D. (1987), pp.11-14)

In modern theorizing, individual development is assigned a central place in evolution. The reversal of the relationship between ontogeny and phylogeny as initially stated by Garstang (1922), is only now becoming more generally accepted in developmental biology and psychology. Oyama (1985, 1989), for instance states that nature is constructed instead of being transmitted by some entity. The characteristics that define an organism at a given time, its nature, do not stem from a pre-existing plan or program, and thus are not genotypic but phenotypic. Nature is not static but transient. Nature and nurture are not alternative sources of form and causal power but nature is the temporary outcome of the process of nurture (developmental interactions at many conceivable levels). Nature depends just as deeply and profoundly on the genome as on developmental context at any other level. According to Gottlieb (1991, 1992) changes in the genome are not even a necessary precondition for evolution to occur; evolution can occur without changes in the genes because there remains so much untapped potential in the existing developmental system (nurture, which includes the genes). Such an evolution may finally lead to changes in the genetic constitution but evolution takes off at the phenotypical level. In this view evolution is the derivational history of developmental systems.

Science has a long tradition of belief in causation by design, which is reflected in biology and psychology in the prevalence of reductionistic and mechanistic approaches. While being heavily inspired by evolutionary biology, many developmental psychologists still cling to an entity perspective, starting off with the assumption that entities which emerged accidentally during evolution can be used to explain mental structures that appear during ontogeny (nativism). Nativism leads to a static science, which has nothing to say about mechanisms of change. Nativistic developmental psychology is simply not about development. […] It is biology itself that has inspired developmental psychology to adopt nativism. Developmental biology brought forward a brilliant process theory in which the focus of inquiry was on species, on populations and their histories, instead of on the organism and its structure. In elaborating on the theory of evolution, biology has put forward theories to provide the organism with the entities necessary to account for evolution. These theories are, as we have seen, typical entity theories.

Only in the last two decades has the organism occasionally been conceived of as a whole in relation to evolution. That is, only recently have theorists begun to aim at relating evolution to the *process* of ontogeny. Although nativism represents an inappropriate position from which to study development itself, it has, as we have seen, been extremely fruitful in biology. Indeed, it may be a good strategy to adopt an entity perspective on credit, to develop a better theory of process. For instance, it is a good thing that the probability of a certain disorder can sometimes be estimated on the basis of population genetics.
However, correlations are static entities that reveal nothing about the dynamics or process of (patho-) genesis. *From a developmental perspective, one must keep on looking for factors that co-regulate the morphological process under consideration. All variables that may possibly co-control the outcome in the developmental system as a whole must be scrutinized* (De Graaf, J. W. (2000)). Lets look at the perception of our genetic programming: Even nowadays we usually still assume that the genetic program can be legitimately regarded as an aspect of the DNA. Deoxyribonucleic acid, the sequence of genetic coding that crated life. But what does it actually do? DNA provides a sequence of chemical letters of the genetic code, which spells out the sequence of amino acids in proteins. Some of the DNA is involved in the control of proteins; some are directly coding the protein itself. DNA, by providing the

code for the sequence of amino acids, enables the cell to make particular proteins. And that is all DNA can do. It enables the cell to make particular proteins. So basically, DNA helps us to understand how we get the bricks and mortar with which the organism is built, but is does not explain how these bricks and mortar assemble into particular patterns or shapes. The modern idea, of DNA shaping the organism or programming its behavior is a very illegitimate extrapolation from anything we know about what DNA does. (Sheldrake, R. and Weber, R.V.(1982)) So DNA does not have unexplained power. The genetic code is only the point of departure for every human being's life that is *a life-long and continually active process.* (Juhan, D. (1987), p.16). It is this active process we as physiotherapist are interested in, given the power and knowledge we have to help disabled individuals.

2.3 Individuality formed by life

All the elements we see in each and every individual - height, weight, profile skin texture, amount of fat, amount of muscle, tone, strength, facial expression, neural responsiveness, range of motion, function ability of internal organs, degree of coordination, self-awareness- all of them can fluctuate widely from individual, regardless of similar genetic background. But not only that: they also can fluctuate widely within the same person at different times.

These elements are not secondary or "accidental"- in modern words "congenital". No, they are the results of the total formative process of living, and play as a significant role in the shape and quality of life as do any potentials coiled in the genes. (Juhan, D. (1987), p.16)

To substantiate this fact lets have a look at the dynamic system theory: This theory has emerged in the movement sciences as a viable framework for modeling athletic performance. From a dynamical systems perspective, the human movement system is a highly intricate network of co-dependent sub-systems (e.g. respiratory, circulatory, nervous, skeletomuscular, perceptual) that are composed of a large number of interacting components (e.g. blood cells, oxygen molecules, muscle tissue, metabolic enzymes, connective tissue and bone). In dynamical systems theory, movement patterns emerge through generic processes of self-organization found in physical and biological systems (Williams et al., 1999, Chapter 7). *Dynamical systems theorists claim that the number of biomechanical degrees of freedom of the motor system is dramatically reduced through the development of coordinative structures or temporary assemblages of muscle complexes* (Turvey, 1990). The reduced dimensionality/complexity of the motor system encourages the development of functionally preferred coordination or "attractor" states to support goal-directed actions. Within each attractor region (the "neighborhood" of an attractor) system dynamics are highly ordered and stable, leading to consistent movement patterns for specific tasks. Variation between multiple attractor regions, however, permits flexible and adaptive motor system behavior, encouraging free exploration of performance contexts by each individual .(Glazier, P.S. Davids,K. Bartlett''

R.M. (2003)). Putting it in simple words: throughout life human bodies move and function in constant conditioning regarding to their environment.

2.4 Force must be met by force

Our bodies are not simple. They are nor reducible to simple principles, though exceedingly complex and chimerical, and maybe it is because of that, that they have to teach us so much about reality. As we have the opportunity, to actively learn and percept throughout our entire life, with the simple use of conscious exercise of our own perception, we create a connection and feel the laws of nature. It is categorically impossible to passively receive an adequate sense of reality. Any conception that is not constantly rediscovered or reconfirmed by the efforts of our own participation and scrutiny cannot to be actively true for us. This passiveness is itself the seed of our destruction. *Strength and health cannot be pumped into any organism that clings to its own passivity*. (Juhan, D. (1987), p.17)

2.5 Development of essential structures

“ When we command movement of an arm or a leg we establish all the conditions to effect the movement of several long levers in organized action. The wisdom lies not in mans “command”, but in the various systems cooperating with (and within) the neuromuscular mechanisms to establish right conditions.” (Mabel Ellsworth Todd, the thinking body)

Our body is a unit, a unit formed and mastered by certain sub functions and divisions that in the end all work together. Without these systems and their proper quality, physical and functional activity of the body cannot be exerted in a proper and healthy manner.

These systems are all kind of tissues that build and make up our body. They give our body stability and mean of function and life. Within the following pages I will give present some of these tissues, as being elementary and essential for each and every living individual that is to survive and owns a health physical body. The following pages include substantial declaration and analysis of essential structures as they should be approached and remembered in a healthy individual, and therefore enable us to translate and transform it onto the imaginary sick body. Knowing these essentials is crucial for us to understand how various systems work together and create a proper, well-designed and organized system of functioning of the human body in daily life. Only if one understands our body and its components, the situation of brain-injured individuals we focus on might enlighten and form a proper and useful image that we can approach and should work on.

2.5.1 The Skin

"Not only our geometry and our physics, but our whole conception of what exists outside us, is based upon the sense of touch. " (Russell, B.)

The skin is the largest, the most varied and the most constantly active source of sensations in the body. Besides the impressive array of other physiological functions, the skin enables sensation and therefore contributes more information than any other sensory source to our successful assessment of and appropriate response to our surroundings. Sensation helps to determine the overall physical and mental health of the organism in powerful ways. Considering the five special senses of sight, smell, hearing, taste and touch, that Aristoteles first enumerated, it is only touch that involves the entire body, as the others are localized in their respective organs. Touch is the chronological and psychological mother of the senses. In the evolution of sensations, it was undoubtly the first to come into being. It is for instance, rather well developed in the ancient sell amoeba. All the other special senses are actually exquisite sensitizations of particular neural cells to particular kinds of touch: compression of air upon the ear drum, chemicals on the nasal membrane and taste buds, photons on the retina. (Juhan, D. (1987), pp.21-24)

2.5.1.1 Sensing ourselves

Touch defines ourselves: Every time we touch an object, we are as aware of the part of us that is touching as we are of the things we touched. *Tactile experience tells us as much about ourselves as it tells us about anything that we contact.* Having said that, we come to following conclusion: Our tactile surface is not just the interface between our body and the world, it is the interface between our thought processes and our physical existence as well. *In contact with the world, we define us.* It s therefore only logical conclusion, that the sensory activities of the skin is a major element in the development of disposition and behavior, an element with enough sophistication and plasticity to account for a wide divergences of experience and observation**.**

Sometimes the skin is considered as, second to the brain itself, especially when talking about our "feelings" about something: we tend to say, "I feel good", or "I don't feel comfortable in my skin". Indeed, the association between skin and the brain are extremely intimate: All tissues and organs from the body develop from three primitive layers of cells that make up the early embryo: the endoderm produces the internal organs, the mesoderm produces the connective tissue, the bones, and the skeletal muscles, while the ectoderm produces *both, the skin and the nervous system. Skin and brain develop from the same primitive cells. Depending on how one might look at it, the skin is the outer surface of the brain, or the brain is the deepest layer of the Skin.* Skin and brain function as a unit, and throughout life, and despite of increasing distance that separates them, properties of the skin continue to play a material role in the development and organization of the central nervous system. (Juhan, D. (1987), pp.34-35)

In order to accurately locate any stimulus on the body's surface, the brain relies upon as precise spatial arrangement of its circuits, such that specific adjacent nerve endings on the skin transmit their signals through parallel neurons, which terminate in specific adjacent cell bodies in the sensory cortex. The spatial relationships of the various parts of the periphery are then, protected by their parallel nerve fibers and mapped onto corresponding areas of the cortex, where they are arranged as the familiar sensory homunculus. It is in this way, that the brain separates functions and pinpoints locations throughput the body. The same principle of parallel fiber arrangements and projection produces a similar homunculus upon the motor cortex, and another upon the cortex of the cerebellum. Each map, sensory, motor cortex and cerebellar, corresponds point for point to each other and all are linked together by parallel circuits (Juhan, D. (1987), pp.37-39). Once it was suggested, that such parallel pathway developed in the embryo before being assigned to any specific functions, and their particular channels were later created by habitual usage. Later, it was postulated, that these parallel circuits were established genetically in the developing brain and spinal cord, which then reached out form the central core with axons and nerve ends to contact the periphery. But it was never clear how the nerve ends knew exactly where to go. More recently, it seems that neither of these earlier views may be the case. It now appears, that the organization of this parallel circuitry is actually *initiated at the periphery.* Local qualities in the skin, the joints and the deep tissues "tag" the nerve ends which contact them with subtle chemical messages, and these chemical "tags" direct axons growing inward toward the appropriate connections in the spinal cord and brain. This process is highly specific, and it is *the periphery, which helps to organize the connections in the central nervous system, not an organized central nervous system that reaches out to innervate the periphery.*

This view suggests that it is peripheral conditions, which organize the actual development of neural circuits and guide the process of mapping is of central importance to bodywork. It suggests that the *use of touch and sensation* to modify our experience of peripheral conditions *exerts an active influence upon the organization of reflexes and body image deep within the central nervous system.* (Sperry, R.W. 1959)

2.5.1.2 Touch as food and maturation

So apparently the skin offers and excellent means of influencing internal processes. Its sensory pathways unite the surface and the interior of the organism, and its surface does not shield any more than expose. Additionally, that internal state of mind and that of physical health directly affect the skin. We know for many years, that transitory moods creates paling, flushing, goose flesh, cold shivers and sweating, that chronic anxiety and exhaustion darken the area under the eyes, that healthy circulation makes the surface pink and warm, that faulty diet can make too dry or too oily skin, and acute emotional distress can erupt in a plethora of rashes, bumps, pimples and boils. But how about the other way around: Can conditions and sensations on the skin really have equally potent effects on our organs, our circulation, our moods and our personalities? In the year 1915, certain different medical institutions reported, that in spite of adequate physical care, 90-99% of infant orphans transmitted for medical care died within a year of admission. Such statistics for abandoned infants were in fact almost universal in the nineteenth and early twentieth centuries.

Whenever a child is abandoned from touch, its retards and dramatically rebuilds: Whether it is the children being separated form the mother for medical treatments in hospital becoming quickly after admission depressed, listless and apathic, or whether it is the child that could not be fed by the mother due an incomplete esophagus development- both types of cases and deprivation of touch improved immediately in terms of healthy physical development as soon as physical contact and care was applied to the child (Gardner, L.I. (1972)).

We can therefore state: it is adequate tactile stimulation –whatever its source- that is necessary for healthy physical development, and neither some mysterious bonding with the mother per se, nor unique characteristics inherited from her. Tactile stimulation, physical contact with the environment, appears to be a food that is as vital for the development of a healthy physical development as is any protein. (Juhan, D. (1987), pp. 43-47)

2.5.1.3 Conclusion: Sensing ourselves though the world

Summarizing what was said within this chapter emphasizes what seems to be the most important, but unfortunately a forgotten aspect in modern treatment modalities:

For an individual, that is obviously being deprived and “physically retarded”, it seems inappropriate trying to make it “feel” better, without approaching his senses, but using passive and external forces to align and reduce the obvious negative strong components. We should not forget about what the child obviously needs most: A proper, basic sensational nutrition provided by skin and underlining tissues, and within these some well functioning receptors enabling the child to feel. The imbalance in these weak children should be addressed at its core: the tissues and cells that so many of us think as being passive and secondary to what we need for function. This image will be disproved and negated as being an obviously wrong and unfortunate myth being spread widely.

Within the next chapter, it will become more clear, how much we rely on skin and its underlying tissues- in fact not just tissue, but more a all covering, substantial connecting organ: in fact connective tissue.

2.5.2 Connective tissue

Human beings are in fact, mostly water:*" Human beings are container invented by water so that it can walk around." (*Deane Juhan, Job`s body*)*

Because of being terrestrial organisms we may live on solid ground and breathe air, but as a collection of individual cells we still live within the same liquid medium from which we first emerged- from the sea water. As organic compounds, nucleic acids, and finally amino acids - the primary proteins of living cells- were dissolved, these complex compounds and their interactions to be sustained the development of a membrane was needed so that the form of what we call "life" was not scattered by every passing current or eddy. As soon as aggregates of these became larger and larger and as individual cells within the growing aggregate began to differentiate and establish, more specialized function and relationships with neighboring cells (merging basically into primary organisms), some kind of "meta-membrane" became equally necessary in order to glue the whole mass together. Since every organ and system in the body supports in some way the containment, the renewal, and the circulation of this internal sea, the packaging of those elements started to be done by various sorts of connective tissue.

Connective tissue that is basically made up of the protein collagen is derived from the mesenchyme- a subdivision of the primitive mesoderm layer of embryonic cells. That same germinal layer subsequently produces tendon, ligament, cartilage, bone, marrow, muscle, blood, lymph, blood and lymph vessels, and the surface linings of the body cavities he joint capsules, the kidneys, ureters, gonads, genital ducts, and the adrenal cortex.

There is no tissue that is ubiquitous as connective tissue, and as it migrates and develops in various locations, its connective qualities cannot be overstated. It binds specific cells into systems, binds together other specific tissue into their organs shapes and supplies them with vessels and ducts, ties these organs together, and suspends them in their proper relationships in the body cavities, forms the walls of the blood and lymph vessels, surrounds these vessels, and anchors them into place among the muscles, bones, and organs. It anchors nerves in the same fashion. It ties, wraps, cements, laces and envelopes. Every part of us is in its embrace. In short: connective tissue constitutes the immediate environment of very cell in the body, wrapping and uniting all structures with its moist, fibrous, cohering sheets and strands. Because of its complexity and continuity, it can well be regarded as one of the largest and most extensive organs in our body. Ubiquitous in its network connective tissue would preserve our physical forms in detail, if everything else would be removed. (Gross, J.(1961) and Synder, G.E. (1987),p.66)

2.5.2.1 The main ingredients

Connective tissue, although present throughout the body, takes on many different shapes and properties, and has local qualities that differ widely from place to place. All the present forms of connective tissue are in a vary active state of flux in the growing individual, with hardenings and dissolvings continually producing changes in shapes, size and consistencies of all the structural members which it composes. This process slows down after we reach full growth, but it continues uninterrupted throughout adult life. This remarkable plasticity and versatility are possible due the complex tissue being made up of a number of fluid, cellular, fibrous, and crystalline constituents which can alter radically their relative concentrations at different times and in different places to produce very different kind of building material. (Juhan, D. (1987), p.63)

A transparent fluid ground substance is found to one degree or another in all other of the body's connective tissues, and it may be thought as the basis for the production of all their other forms. This viscous liquid surrounds all the cells in the body and is a part of the internal ocean, and is the liquid medium through which all the other intercellular fluids (containing mostly plasma, nutrients and hormones) exchanges takes place.
It does not come from other tissues, but is produced by cells, which are the earliest specialized cells to emerge from the embryonic mesoderm, the fibroblasts. This fluid ground substance, that – again- varies in make-up of the basic fluids from location- is the immediate environment of every cell in the body, and they undoubtedly have a wide range of effects upon every cellular membrane which they contact. Disruptions, such as malnutrition, trauma, fatigue, stress and the build-up of foreign particles and toxins, strike at the very basic of healthy metabolic activity, as the ground substance as such is considered as both facilitators and as barriers between blood and the cellular surfaces, chemical filters that regulate many interactions. *A healthy ground substance works constantly to help maintain a supportive chemical and physical equilibrium between all body's tissues.* (Synder, G.E. (1969), p.70)

The most abundant constituents of this intercellular support system are the white fibers of collagen. These fibers are the chief fibrous content of skin, ligament, tendon, cartilage, bone, vessels, and all organs, and *their though strands give to these tissues their shape, their tensile strength, their resiliency, and their structural integrity.*
These fibers are not living tissue, but are made up of protein chains that are produced by the same living cells that exude the fluid ground substance, the fibroblasts. As mentioned already before, collagen and its ground builder, develop first in the mesenchyme, from which they are dispatched throughout the growing organism. When they settle in a particular area, they begin manufacturing and secreting collagen chains, which then respond to local chemical properties and stresses in the area to form an appropriate kind of fibers and arrangements- sacs around the muscles, ligaments across the joints, the walls of blood vessels, the cornea of the eye, and so on.

Of all the cells in the body *these fibroblasts are the only ones which retain throughout our lives the unique property of being able to migrate to any point in the body, adjust their internal chemistry in response to local conditions, and begin manufacturing specific forms of structural tissue that are appropriate to that area.* (Synder, G.E. (1969), p.67 and Ross,R. (1967)).

As mentioned, the ground substance can vary considerably from a water sol-state to a viscous gel-state. Taken as a whole, then the connective tissue in its various forms can be regarded as a fluid crystal, a largely non-living material that can be adjusted over a wide range from sol to gel- watery, gelatinous, dense, and elastic, or hard as stone.

Organ shapes are outlined by genetic codes and then continually modified by the specific stresses and strains experienced by the developing organism. Flaccidity, flexibility and rigidity emerge as the conditions of life demand. This activity should continue, albeit at a slower rate, throughout the adult life. The fact, that life demands especially during first years of development, modify organ shapes regarding the stress component they need to sustain, is especially important to keep in mind when later on ABR principles and basic treatment ideas are explained and documented.

2.5.2.2 Tixotrophy and bodywork

Connective tissue shares with many other gels phenomena called thixotropy: it becomes more fluid when it is stirred up, and more solid when it sits without being disturbed. In the human body, the heat energy and movement required for a solvent states of connective tissue can provided by rapid and efficient metabolism, by physical work, aerobic exercise and the like. With disuse and inactivity, the connective tissue becomes little older, less energized and the thixotropic reaction makes them gel more, become sluggish, lose their full, juicy quality and their ability to soften, stretch and flex. (1,p.63ff) (Little, K.E. (1969))

Since we are talking about individuals being affected within their capacity of movement and activity level, we should keep those facts in mind when lateron considering treatment possibilities. This thixotrophic effect provides one of the cornerstones for effective bodywork. Since connective tissue is largely non-living, it is the mechanical motion and friction caused by muscular activity, which provided much of the energy, and warmth that maintains its fluid qualities. When a part of the body loses degree of movement and vitality through trauma, disuse or disease, it will automatically not as inviting, maybe not even possible, to move this part of the body with the vigor it requires to keep the connective tissue warm, moist and resilient. At this point, manipulation of the tissues by skilled hand can provide a pleasant and extremely effective means of introducing freer movement and higher levels of energy into connective framework. The hands of the therapist can literally supply the mechanical activity, which a sluggish limb fails to produce, raising the metabolic rate and restoring some of the fluidity of its connective tissues.

The mechanism behind is well known: By means of pressure, the friction they generate, the temperature and therefore the energy level of the tissues has merely been raised slightly. This added energy in turn promotes a more fluid ground substance which is more sol and ductile, and in which nutrients and cellular waste can conduct their exchanges more efficiently. In addition to mechanical stimulation of pressure, a powerful thermodynamic effect can be produced upon the bioenergetics field of the patient by the stronger and healthier heat transferred by the therapist's penetrating touch. Thus with regard to its effect upon the connective tissues, bodywork accomplishes its end in an utterly different fashion than do the additive and subtractive means of pharmaceuticals and surgery. Skillful manipulation simply raises the energy levels and creates a greater degree of sol (fluidity) in organic systems that are already there, but are behaving sluggishly. (Taylor, R.B. and Little , K.E. (1969)).

Bodywork has great impact on the typical collagen bundles, that form connective tissues: As these bundles have the tendency to glue together as soon as they are not being actively demanded by physical activity, they tend to from adhesions which impair their ability to glide freely over another. Because the bonded tissues themselves limit the very activities, which would help to restore their flexibility, it is usually very difficult for the individual to work his or her work out of such a degenerated situation. In these manipulations of connective tissue can be of invaluable assistance on helping to restore some energy and some resilience to an area, so that more normal feel and function can begin to foster more normal activity.
(Doty, P. (1957), Verzar, F. (1963) and Erlingheuser, R.F. (1959))

2.5.2.3 Connective tissue as resort

Since the ground substance makes up a large part of the intercellular fluids, it is as well the site of a large number of metabolic exchanges as nutrients cross from capillaries to cells and wastes cross back. Its temperature, its relative states of sol or gel, its specific chemical variations, the presence of foreign particles and toxins, and its mechanical activity all have a direct bearing upon the efficiency of these exchanges. In turn of course, all ground substances affecting the quality of the ground substance condition it to a great degree, for better or worse.
Additionally, many compartments of the fascia throughout the body are of great assistance in the prevention of spreading of infections, diseases and tumors. Each separate compartment tends to contain the destructive agent, and prevent its spilling into adjacent compartments, and partly by specific chemical barriers in the fluid ground substance. And again of course every weakness in fibers or disturbances of the protective chemicals in the ground substance contributes directly to the spread of infections an diseases from compartment to compartment. Thus the chemistry of connective tissue itself – above and beyond whatever antibodies or white blood cells may be swimming around in its ground substance- is an important part of the body's immune system. (Juhan, Deane (1987),pp.83-4)

2.5.2.4 Tensegrity

The connective tissue framework provides a kind of tensional force that is crucial to the upright structure of the skeleton. We are not made up of stacks of building block resting securely upon one another, but rather of poles and guy wires, whose stability relies not upon flat-stacked surfaces but upon proper angle of the poles and balanced tensions on the wires.

This so called “tensegrity” is a term used for a construction, that, as weight bears down, the solid beams tend to spread; this they are prevented by doing form doing by the tension of the wires and it is the tensional force, not the compressional strength of the beams, which keeps the structure rigid. But one should realize, that it is the strength of the connecting cables, not the strength of the beams, upon which superior function of the tensegrity unit principally relies. (Juhan, D (1987), pp. 82-3) The tensegrity concept was discovered first by the artist Kenneth Snelson, and popularized by Buckminster Fully. (Myers, T. (1997-2000)). The principle of “tensegrity” describes precisely the relationship between the connective tissues, the muscles, and the skeleton. There is not a single horizontal surface anywhere in the skeleton that provides a stable base for anything to be stacked upon it. Like the beams in a simple tensegrity structure, our bones act more as spacers than as compressional members. More weight is actually borne by the connective system of cables than by the bony beams. The support system of the spine, and indeed the remainder of the body as well, is a function of continuous tension, discontinuous compression, so that the skeleton, rather than being a frame of support to which the muscles and ligaments and tendons attach, has to be considered as compression components suspended within a continuous tension network.

“*Since the spine is a mechanical structure, investigators have used mechanical models to attempt to study spinal kinematics and kinetics. Until now, all models, mathematical or actual, have been based on the axial-loaded compression support system. The problem of such a construct is that they are unidirectional, so that, like a ‘stack of blocks,’ or the Great Pyramid, they would be pulled apart by the very forces that were conscripted to hold them together if tilted out of plumb. The mechanical laws of leverage that operate in the compressional system would create forces that far outstrip any strength of biologic materials. We could not use such as system to walk on our two legs, crawl on all fours, walk on our hands or stand on our head with the addition of tensional forces to hold us together.Such as system is only as strong as its weakest link. [Levin]*

When applied to the human body, (the tensegrity) model is characterized by a continuous tensional network (tendons), connected by a discontinuous set of compressive elements (struts, i.e. bones), forming a stable yet dynamic system that interacts efficiently and resiliently with the forces acting upon it. [Oschman] The structural system of continuous tension, discontinuous compression, hereafter referred to as tensegrity, and described by Buckminster Fuller, can be used as a model to understand the physiological support systems of the body. (Levin, S.M. (1982)) Of course, maladjustments, weakness and imbalance in the length and tension of the cables rob the structure of much of its stability.

2.5.2.5 Hydrostatic pressure

Since we started this chapter with human beings being mostly water, lets continue with that statement and relate it back to what we consider as the hydrostatic model: A water balloon is a special type of tensegrity structure, with the surrounding skin as the tension member. We can imagine each and every single cell in our body as water balloon, staked upon each other to from a hydrostatic, “tensegritic” model.

Lets analyze that more preciously: In addition to supporting individual cells, tissues and other organs, the connective organ serves as an over-all structural purpose as well – it is woven together with the bones to create the movable frame, which supports our posture and from which everything else is suspended. As we normally think of ligaments surrounding and lacing a joint, and tendons that tie muscle to the bones, as being the chief support that connective tissue offers the skeleton, we should enlighten the situation as it is for real clearly: Not only joint capsules and tendons, but literally all of the connective tissues-together with the fluids they contain- aid the weight bearing capabilities of the skeleton. To understand this mechanism, view the body as water filled balloon: If the surface and interior of this balloon were perfectly uniform, it would rest on the ground in the shape of a slightly flattened sphere. However, if we circle this sphere with cords and tighten them up, the sphere is transformed into a cylinder, and can be made to stand erect. The more of these cords we add, the thinner and taller at the same time we can make the balloon- all without adding a single rigid member to the interior. In that manner, we actually created hydrostatic pressure, the same kind of pressure we find in al our cells of the body. At this point, our cylinder does not really need a internal skeleton in order to remain upright; in fact, as skeleton could be suspended inside the cylinder from the top, without its toes touching the bottom, supported solely by the tension of the pressurized walls of the balloon. This of course is exactly the same what various shape-giving cords and bands of connective tissue do to our own bags filled with liquid, trussing them up into cylindrical shapes and squeezing them tightly enough to give them rigidity. When all the bands and cords are properly adjusted, and the hydrostatic pressure is strong and balanced, this tensional force alone does the work to keep us up erect. It is the network of connective tissue-the pressurized water bags and the tension cables- and not the bones, that bears most of the structural responsibility for stable, upright posture and graceful carriage. (Robbie, D.L. (1977))

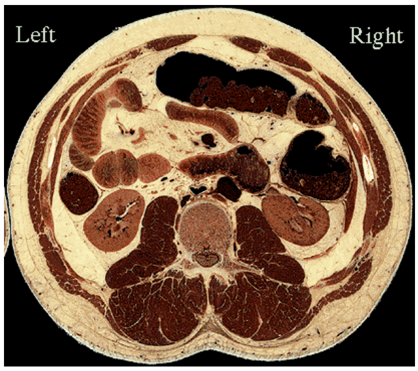
2.5.2.6 Fascia

Fascia, also known as dense irregular connective tissue, truly a fascinating tissue: as stated it surrounds and connects every muscles, even the tiniest myofibril, and every single organ of the body. It forms a true continuity troughout our whole body and is often referred to as our organ of form (Varela & Frenk 1987, Garfin et al. 1981)

In order to understand the role of fascia within our complex body structure, I will use the extract of one of the popular myofascial series by Mr. Gil Hedley and his serial the Somanautics. He makes the different type of the dissections with the idea of preserving the integrity of the consecutive layers and the outcomes are visible on following pictures:

On top– surprisingly- the entire rib cage could be actually taken away without any interference with the underlying myofascial complex. Controversy, the lower picture shows that there is a solid integrity of the underlying volumes, which is being maintained there.

In the equation of the trunk composition, enabling every (healthy) individual to rely on in case of weight bearing, trunk control, and so many others, one must wonder which ones of these two is the more important component: The tiny ribcage on the left picture or the significant consolidated hydraulic mass that we see from within and found on the right picture.



Remember when I was talking about connective tissue as "*because of its complexity and continuity, it can well be regarded as one of the largest and most extensive organs in our body. As this connective tissue wraps virtually every other tissue formation in our bodies, the network of empty connective tissue would preserve our physical forms in detail, if everything else would be removed.* " That is the direct link to understand how strong and essential this network is for real.

Supportive, lets look at the cross section of the human body at thoracic level supports the just explained importance aspect: The cross section shows that total volume of the skeletal participation might be about 15% to 20% of the total volume of the cross section. The natural questions to ask would then be "what about the remaining 70% of the volume? Are the remaining 70% just covering and additional weight causing structures? The answer might be self-explanatory for what ABR is aiming for. Without the support of this entire volume of internal myofascia, everything would fall apart.

Having the classic model of bones and muscles in mind, muscles pulling the bones over the pivots and bones being the strongest component we have, forming a strong and powerful casing of the ribcage, this model does not seem to be very ideological. But reflecting back on what one could observe himself in the unprepared, not manipulated thorax of a human body, and the above presented cross section, the old model of bones and muscles seems to be inappropriate. But still: within the last twenty years of medical research and treatment, the role of fascia has always been included in the classic anatomical approach declaring the fascia *passive role and wrapping status* of all these fascia layers, which are sublevels of the connective tissue. The particular emphasis of fascia was its active metabolic role of the internal organs, but without any specific regard to their biomechanical role. In the last past 10 years, especially the last 5 years, the acceptance and the proliferation of the myofascial paradigm has been growing and creating a baseline ABR focuses on: the viscoelastic mechanical properties fascia has and is able to adapt to (Blyum, L. (2009)).

Since fascia consists of elastin and collagen giving it owns specific viscoelastic mechanical properties, being therefore imulti-dimensional, anisotropic, and able to adapt to mechanical properties (contains smooth muscles) both instantaneously and permanently, fascia can be considered as being able to remodel according to demands imposed by surrounding environment (Schleip, R. (2003))

Fascia is usually considered to be a passive force transmitter in musculoskeletal dynamics. Nevertheless the literature mentions indications for an active contractility of fascia due to the presence of contractile intrafascial cells. (Yahia et al (1993); and Staubesand et al.(1996)). Schleip, Lehmann-Horn and Klingler concluded in their study of 2006, that fascia is a contractile organ, due to the presence of myofibroblasts, expressing on one hand the ability of chronic contractures including tissue remodeling, on the other is able to contract in a smooth muscle-like manner and can thereby influence musculoskeletal biomechanics. (Schleip, Lehmann-Horn and Klingler (2006)) These facts proclaim capacities and abilities of fascia that cannot be hidden behind terms such as “passive” and “wrapping”, but much more “active” and “supporting”.

2.5.2.7 Conclusion: Connective tissue as powerful organ providing function

The entire connective tissue system is large enough, complex enough, sophisticated enough in its varsities of forms, and important enough to our survival to be regarded as one of the vital organs of the body. It is connective tissue that glues cells into discrete colonies, defines shapes, forms them into functional units and suspends them together into the correct relationships within the organism. The contractive power of muscle is *absolutely useless without this extremely complicated system of sheets, pulleys, hinges and cables, which transfers muscular efforts to the levers of the skeleton.* Besides transferring contractile movements to the appropriate points on the skeleton, these same cables and sheet of connective tissue provide the tensional elements, which support the bony spacers to form rigid, weight-bearing tensegrity structures of the body. (Juhan,D. (1987) ,pp.86-7)

Despite the fast gaining popularity of the myofascial concept, it is still an extended and only partial included model in understanding of the classic model of bones and muscles. It's not an addition or an alternative to the classic model. It's an integrative concept, which absorbs all the good things that exist in the classic model and add new terrain incognitos which are yet to be explored.

Leonid Blyum, the inventor and creator of ABR, went to the cerebral palsy conference in April 2009 in Sydney, Australia. Later on he reported, *"out of 200 speakers promoting multiple poison injections and surgeries, not a single time the word "myofascia" was mentioned."* The myofascial approach gained big attention in the superficial level within the specific domain of dealing with back pain and neck pain, but is obviously under-employed and an still untapped potential that could be of such a big use to focus on and work with.

2.5.3 The Bones

“Bones are not building blocks, they are complicated and dynamic sets of levers and spacers.” (Juhan, D. (1987), p.107)

Due to their mineral hardness, bones are not often considered as subjects for most kinds of bodywork. There is not after all, much there to soften, or lengthen, or relax, nor even many sensory possibilities. Most “bone” therapies deal primarily with seating the bones together properly at their joints.

But in fact -as with all our other softer tissues- the inherited features of the skeleton become subject to the same array of addition as all the other tissues mentioned before: It is true that the rate of growth and the final size and shape of every bone is genetically coded to a very high degree of specificity but once we leave the womb, tactile stimulation, diet, exercise, trauma, the relative strength and balance of various muscles sets, postural habits, proper use or abuse, or *disuse*, and all kinds of psychological factors enter into the conditions under which the bones are formed throughout infancy, youth and adulthood. These things are knit in our bony frames as a surely as genetic code. (Juhan, D. (1987), pp.91-93)

Connective tissue is the mother of bone – its precursor as a structural material and literally the womb in which it is formed. Remember: One of the distinctive things about the different combinations of collagen and ground substance is their changeable sol/gel properties, which are responsible for connective tissue’s wide varieties of fluidity and solidity as liquid crystal.

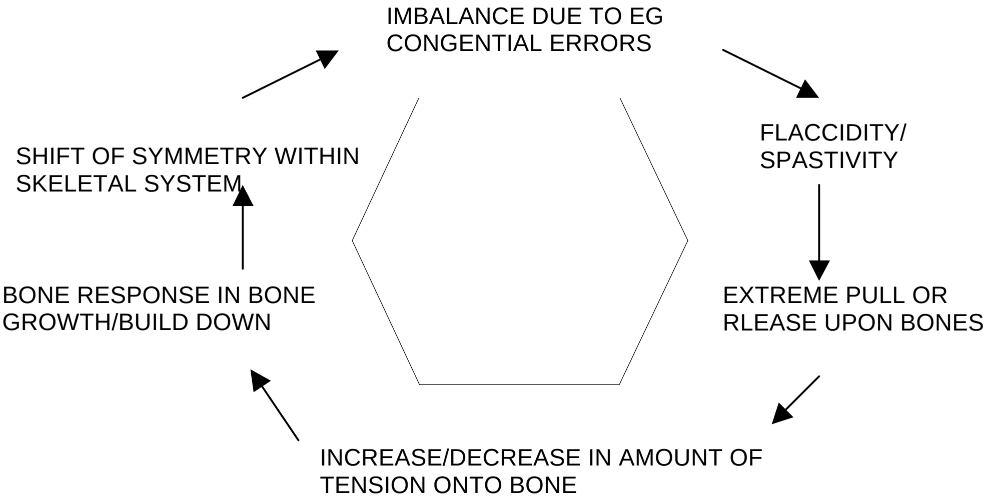
Bone is the most gelled from of this continuum: The connective tissue matrix forms specific pockets, or molds; these mold are then packed with crystallized mineral-principally calcium and phosphorus, but including vital traces of magnesium, sodium, carbonate, citrate and fluoride. *Thus bone is born, the hardest form of connective tissue.* The dried sedimentary deposit of a skeleton comprised only seventy-five per cent of a living bone; the remaining twenty-five per cent consists of connective tissue-collagen fibrils and their ground substance, whereas of these twenty-five per cent, about ninety-seven per cent is made up by collagen fibrils. (Romanes, G.J. (1972); Lockhart,R.D., Hamilton,G.F. and Fyfe,F.W., (1969) p.12; and *Vander, A.J., Sherman,J.H. and Luciano, D.S. (1970), p.217)*

2.5.3.1 Bone Plasticity

The plasticity of seemingly fixed bones is dramatically illustrated by the ways in which mechanical stresses alter them over time. Postural habits not only rearrange the relationships of the bones to another, but also can alter the overall shapes and articulations of individual bones themselves. The loads placed upon a bone will directly transfer into its adaptation to this certain kind of stresses and loads in order to be increase its load ability.

Asymmetrical loads and unconscious abuse distorts the internal symmetry of our frame. A bone that seldom or never receives any stress will atrophy just like and unused muscle. Clearly the absence of stress is no healthier than is too much stress. *Disuse harbors as many evil as does abuse. Neither utmost endurance nor utter passivity is the condition, which best serves, our health: health is always as dynamic balance between the two.*

Most of the time it is the weight of our won bodies, our relative postural balance and the tone of our muscle that create the loads and stresses placed upon our skeleton: Flaccid muscles result in weakly supported growth, maintenance and repair. Flaccid muscles result in weakly supported joints. Muscles sustaining a large amount of tension place constant strain upon bones and their joints, just as surely does a heavy weight (Guyton, A.C (1981) and Romanes, G.J. (1972). In case of asymmetrical loads due to flaccidity or spasticity, the bones respond paradox:



2.5.3.2 Conclusion- Bones and the body

The extensive fascia network and the bones provide the frame and the rigging for the support of the body and its parts. These two structural elements are woven into a single unit and its parts, parts being as a unit connected by periosteum, ligaments, joint capsules, tendons, and muscle sacs. Together they compose a complex and flexible tensegrity structure, made up of connective cables and bony spacers.

It is crucial to our understanding of stability which this unit affords to realize that our skeleton do not support our posture in the same way that flat block stacked on top of each other support a building. There are no flat surfaces or securely sacked members anywhere in our frames. Bones are not building blocks; they are complicated and dynamic sets of levers and spacers though which the entire musculature can act in order to constantly counterbalance the forces of gravity and of contraction, producing a stable erect posture and freedom of motion.

In the skeleton itself is nothing inherently that would make us stable and upright. The rigidity we basically need to survive is created by the working concert of connective tissue and muscles that are attached and surrounding our bones.

Additionally, the bones are the major storehouse of the body's supplies of calcium and phosphorus, tow elements whose proper level in the blood, in the muscles and in the nerves in absolutely crucial to the chemistry of those tissues. Phosphorus is continually necessary for the renewal of our supplies of ATP, adenosine triphosphate, a gasoline, which powers almost all of our metabolic functions.

The correct level of calcium in the blood is likewise a prerequisite for healthy cell function, particularly, in the muscle and nerves: A low calcium concentration increases the excitability of muscle and nerve and muscle membrane, creating muscle spasms. These spasms may become widespread and severe enough to be fatal if calcium levels are sufficiently low. Conversely, too high a concentration of calcium depresses neuromuscular activity, casing flaccidity and even heart failure. Thus the skeleton provides more than one kind of support and stability: It has a highly functional and chemical relationship with the body's connective tissues as we have already seen. Relating that back to what we saw in the scheme before, the imbalance in stress applied on a bone will create bone growth at that place, and therefore increase its level of calcium. As a result we might see and increased inhibition of neuromuscular function, resulting in flaccidity. This flaccidity as such can cause furthermore imbalance, creating a vicious circle itself. (Vander, A.J., Sherman,J.H. and Luciano, D.S. (1970) pp.346-7) By working at reducing imbalanced tensions, we not only create local muscular tone changes by an adjusted sensor-motor input, but additionally also general muscle tone and therefore enhances general movement capacity due to changes in calcium concentration.

The role of bodywork is not to eliminate stress or to increase its input, but rather to educate the individual to recognize the right kinds of and the right amounts. Just with the productive rivalry and counterbalance of osteoblasts and osteoclasts, that build up and break down the bone tissue, it is the intelligence between our many opposing tendencies that will reward us with natural forms of beauty and strength.

2.5.4 The muscle

"For every thought supported by feeling, there is a muscle change. Primary muscle patterns being the biological heritage of man, man`s whole body records his emotional thinking." (Mabel Ellsworth Todd, The Thinking Body)

Muscle comprises the large majority of everything that is beneath the skin, and it is the localized discomforts and limitations that we normally associate with it, which makes persons, yearn for the soothing manipulations of the bodyworker.
Its unique ability to contract and lengthen is responsible for almost all of the movements of the body, although those activities consume the vast majority of all the food and oxygen that we take in. Our muscle apparatus is by far the largest and most metabolically active organ of the body- and therefore the most expensive one. Musculature as the primary organ of the body, the most dominant tissue of animal life. (Little, K. (1969), p.676)
Taken together, the skin, the connective tissues, and the muscles offer the skilled manipulator a wide and a direct path into individual's psychological and physical responses to the world. (Juhan, D. (1987), pp.109-10)

2.5.4.1 The dynamic structural tissue

According to the information given before, one would think connective tissue and bones are the major elements of structure in the body, and one would think as the muscles being primarily adding motion to this structure. But even bones and ligaments give our bodily network only a certain rigidity necessary for erect posture. And even though it is true that if all other bodily substances were emptied out of collagen matrix is would remain as a complete and detailed mold of the body and all its parts, this matrix- and even the rigid skeleton within it- has no power to maintain the shape of the erect human being which once filled it. It is *primarily muscle that gives substance, shape, and stability to the body*. Connective tissue and bone do not provide a solid framework from which muscle and organs are suspended, like the girders and beams of conventional architecture. Rather, the muscles actively *utilize* the cables and levers provided by the sheets of fascia, the ligaments, the tendons, and the bones in order to suspend the limbs and organs in an erect and weight-bearing form.

Muscles supply the crucial tension in our tensegrity structure. The skeleton is held by the musculature, and not vice versa. It is the combination of sufficient tone, and appropriate reflex responsiveness in our muscles that creates the blend of rigidity and mobility in our framework that is necessary for normal posture, gesture and locomotion. It is the improvements of *all wrong balanced tensions and releases in our body*, that bodywork has some of its most significant opportunities in, in order to restore posture function, vitality and normal activity to the individual. (Lockhart, Hamilton and Fyfe (1969), p.21; Dr.Milton Trager (1955))

2.5.4.2 Functional unity

There is mental convenience nowadays that simplifies enormous complexities within the musculature as such, in regarding each of the connective tissue compartments as an individual muscle with individual function. That might be true anatomically, but not functionally. This perception is danger of obscuring for us the real intricacies of the interplay of muscular tension and release throughout the entire system. There is *no single muscle* that controls one single motion; muscles may have anatomic individuality, but they do not have functional individuality. Lets use an example to clarify things: If we pull on any part of woven fabric, we create a pull over the entire warp and woof; a pull on one side of a tent affects the tension fabric clear across the roof and around all the sides. We will almost never find a single discrete muscle that is tense, rather we will find areas of tension, or body-wide patterns of tensions, whose boundaries do not necessarily follow the anatomical divisions of muscle compartment. And we will never release a single muscle, bit rather we will increase a range of motion that involves several, or many, separate compartments.

This aspect brings us closer to the complexity and truth of muscular activity, that effects our entire body in a fascial network, that needs to be conceptualized as a functional unit, having not such thing as being independent or creating single motion. (Little, K.E. (1969)) This is especially of importance for us when we talk lateron about muscles being individually stretched.

2.5.4.3 Tension and release

Muscle tissue displays the same crystal quality as all the other connective tissues in our body: Muscle tissue evolved out of connective tissue and it accomplished its variations in softness and hardness in ways that are reminiscent of its precursor. In both, collagen and muscles, it is the varying degrees of loose association of collagen strands or myofibrils, and the chemical bonding of long, thin molecules, which give us the varying qualities of sol and gel. The major difference is that connective tissue adjusts to its degree of sol and gel over long period of time: Its processes of hardening and softening, shortening and lengthening are relatively slow and conservative. Muscle tissue on the other hand, has developed the ability to shift sol/gel states almost instantaneously to conform to the needs of the movements. *The activities of maturing connective tissue unfold our structure as a species man, whereas the activities of maturing muscles unfold the innumerable momentary structures that the individual superimposes upon his species-sitting man, standing man, walking man, dancing man, slumped man, erect man. Muscle is connective tissue that had learned how to quickly lengthen and contract.* (Juhan, D (1987), pp.115-6)

These last aspects are of extreme importance: having said, that connective tissue unfolds our structures as such, whereas activities unfold the innumerable momentary structures that we superimpose within our activities, wouldn't it then make sense to approach-in case of underdevelopment and disease- the structures that are supposed to unfold and enlighten our structures as such, whereas implementing focus on muscles obviously seems to be an advanced state afterwards, in order to enable man to develop activity as such? Lets keep this question in mind while we continue momentarily with the muscles as structure.

2.5.4.4 The Fenn effect

In order to remain healthy and responsive, muscles must stay active, otherwise they will atrophy, loose their number of contractile fibrils until too weakened to be of much use. The more a muscle is used, the more important is a reliable delivery of oxygen and glucose via the circulatory system. This rule for energy consumption is called the Fenn effect: " The amount of oxygen and other nutrients consumed by the muscle increases greatly when the muscle performs work rather than simply contracting without work." This effect has extreme consequences for a muscle that is generally under sustained tension: Such a muscle is working, exerting a pull against a fixed resistance. And this very resistance is usually another muscle that is working in a static position. This muscle being under sustained working effort, is in much higher nutritive need than at rest and at neutral length. At the same time, the sustained contraction reduces circulation in the area by squeezing the small arteries and capillaries which service the working cells with glucose and oxygen.

This is the first step in a circle that can become very vicious indeed: the more work, the more need; the more tension, the less fuel delivery; the less delivery, the more difficult the work; the more difficult the work, and so on- until tissue exhaustion, with discomforts, limitations and toxic side effects takes over in that area. When a muscle shortens and lengthens during muscle work, it actually actively assists its own circulation by pumping fluids though the capillaries and the intercellular spaces. But within contraction for an extended period, the pump becomes a squeeze, and fluid delivery decreases. Judicious exercise assists both oxygen intake and circulation. Chronic tension, on the other hand, is worse than merely wasted effort; it initiates a vicious circle which plunges that area into deeper and deeper metabolic debts, draining energy from other parts of the body, producing ischemia, toxic wasted, creating discomfort and eventual disuse. (Guyton, A.C.(1981); Lockhart, Hamilton and Fyfe (1969), p.152)

2.5.4.5 Tonal habbits

We are born with an initial level of overall tone, keeping our bodies from collapsing ; *as we grow, this tone level must gradual increase to compensate for the greater pulls from heavier and longer limbs*. Every human being, as it matures and develops its own ways of doing things, its habitual repetitions begin to build up a new sort of "norm", a more highly individualized "neutral", which overlaps the primary levels. Thus the musculature establishes new tone settings, new shapes and tensions, which eventually becomes the individual postures, as minutely unique to each and everybody of us as are our fingerprints. Each stage of motor development sets overall tone and the idiosyncrasies which condition the next one, and we continually carry it all forward with us, becoming what we have created stage by stage. (Juhan,D (1987), pp.140-2)

But of course all that also happens, even though an individual was born weaker or not fully developed in the womb. The individual still keeps on growing, setting huge demands on the muscles it selves that constantly try to adapt to new postural demands and settings. There is one problem though: Muscles cannot work properly- without working super expensive and on high effort what they are not made for (remember they *utilize* the cables and levers provided by the sheets of fascia in order to suspend the limbs and organs in an erect and weight-bearing form) when they are missing the levers provided by sheets of fascia and the therefore hydrostatic system. That is creating a vicious circle itself: The more demand is put on muscles to compensate for underdeveloped structures, the more these muscles need to work, which in turn needs more fuel delivery; sustained contraction of the muscles reduces circulation in the area, oxygen delivery reduces in turn, making the muscle work more difficult; the more difficult the work, the more oxygen is needed, and we are back in a vicious circle the individual does not know any way out as constantly using its muscles in a very expensive fashion with renounce of any extra free activity such as playing and moving voluntarily.

2.5.4.6 Conclusion- “optimal” tone and posture

Muscles are only able to create motion when they can rely upon the supporting and hydrostatic system underlying their duties to utilize this system for movement and action.

When we just reflect that muscle holding chronic pattern of tension is working just as hard, and requires just as much metabolic support as does muscle that is exercising actively and getting actual work done, it becomes clear why muscular tension plays such a large role in our physical and mental health. (Juhan, D. (1987),pp.133-4) “Even small increases in muscle tone significantly increase metabolic rate, and severe exercise may raise heat production fifteen-fold. “ (Vander, Sherman, and Luciano (1970), pp.412-13)

The goal of bodywork should not be to impose universalized standards of posture and movement upon an individual but rather to help the individual to cultivate the mental awareness and the physical flexibility to continually adapt to the changing of the movement. Therefore it utilizes individual’s mobility, but does not correct. To find out the best of motion is the individual’s duty, its own responsibility to find his perception and feel of movement. (Juhan, D. (1987), pp.136, 142)

2.5.5 The nerve

"In its simplest form, the nervous system is merely a mechanism which a muscular movement can be initiated by some change in the peripheral sensation, say, an object touching the skin." (Lockhart, Hamilton and Fyfe (1969), p.269) Just as the skeletal and muscular system, the nervous system is surrounded, organized and supported by an elastic framework of connective tissue. The so-called glial cells, the cells that form and maintain this frame are specialized connective tissue cells in the nervous system. They account for a considerable part of the bulk of nervous tissue, making up the though, elastic netting which cradles and anchors the delicate neurons. The glial cells support every fiber, collect these fibers into bundles, and separate these bundles form the surrounding tissue and fluids. It is them that give the nerve fibers the tensile strength and elasticity to stretch where stretching is needed, and it is them that fix the nerve bundles securely to other structures where stability is needed. (Juhan,D. (1987),pp.145-7)

2.5.5.1 Peripheral and central

Due to two topographical major divisions medicine is using- central and peripheral system creates a perception of two systems being kept apart from each other and only being seen as a unit due to a action-perception-reaction mode of peripheral input causing central perception and reaction. Ultimately this leads us to an understanding of "mind" versus "body" and into fiercely argumentative theories about where the line between these two is. In those argumentation and definitions, we loose and divert ones attention away from irreducible facts such as: There is no tissue that is "body", and no response that is not "mind".

These limitations of our words become the limitations of our understanding and we proceed to mutilate our concepts in the name of logical convenience. "The basics of the nervous system must never be forgotten." There is no local activity in the network of our neural impulses that does not affect or is not affected by the entirely of the activities of the organism. It all creates a fundamental unit of function! It is essential to keep following aspect in mind: *Muscular activity is largely a response to the specific qualities of sensory input: As the quality of input changes, so does motor behaviour!* Hence bodywork can have semi-direct influence on muscular activity while approaching the sensory system. It is especially the afferent fibers, the inflowing pathways of the nervous system that constitute to the principles of bodywork: It is the somatic senses that are being picked up by the afferent fibers, that wide array of sensations referring to collectively as the "touch", that inform us of our internal state of affairs and our relationship to the outside of the world. It is by their means that the surface contact and pressure enter into deeper strata of the mind, where genetic potential and sensory experiences are fused into behaviour and character. (Juhan, D. (1987), pp.147-159)

2.5.5.2 Conclusion- an internuncial net

In bodywork, it is often problematical aberration of motor responses we want to change, but sensory affects are our only means of doing so! Until the body feels something different, it cannot act differently. The patterns of a tightened muscle pattern have been established over a lifetime by exactly the same kind of forces that we can have an influence on with, only now influenced to reverse the contraction of aggressive or defensive reflexes. *Muscular condition can change only when feeling states change.*

We must immediately forget about the tendency to think about afferent and efferent being opposed. The flow of information, which we are describing, is not really back and forth, it is circular, simultaneous, mutually integrated on every level. Sensation evokes movement; movement produces new sensations, thee sensations evoke and modify further movements, and so on. Sensory and motor activities are everywhere and at all times interpenetrating one another to create the homogeneity of conscious experience.

The failure to sufficiently appreciate this unity of seeming opposites leads us into separating absolutely afferent from efferent, sensation from behavior, and attitude from activity.
This in turn leads us into forgetting how powerfully touch and sensation continually alters internal conditions. It is only by influencing the flow of impulses through this so called internuncial net that we can have any effect upon tone, habit and behaviour. One of the readiest means- rather than just temporally interrupting- the conditions within the net is the introduction of more and more positive sensory experience, development of new habits, new conditions, new patterns of neural flow. (Juhan, D. (1987), p.160-3)

Chapter 3 UNDERSTANDING CEREBRAL PALSY

*" Cerebral palsy is one of the three most common life long developmental disabilities, the other being autism and mental retardation causing hardship to affected individuals and their families." (*Sankar, C., Mundukur, N.(2005))

This quiet striking, honest spoken statement tells already a lot about the life and challenges a individual affected by cerebral palsy has to life with a lifelong. When studying the literature, it becomes obvious that even though cerebral palsy is a condition that has variable causes and underlying pathological mechanisms, its affected population share one common feature they all seek for: achievements in quality of life and independence in daily life, that has been impacted by severe, irreversible neurological damage. (Graham, H. Kerr; Selber.P (2003))

3.1 Numbers and facts

The prevalence of CP depends on the age of the child at the moment diagnose is made. Especially in children with CP without a burdened medical previous history there often is a delay in making the diagnosis. But lets be aware of some facts and numbers:

There are more boys born with Cerebral Palsy than girls (for every 100 girls there are 135 boys). About 1/2 of children with CP are born prematurely. More than 1/2 of children with CP have bilateral spastic paraparesis (leg weakness). About 1/3 of children with CP have hemiplegia (one side of the body paralyzed, as typically seen in adult stroke).
Stroke in a baby or child less than the age of 3 results in CP. 1 in 9 people with CP have features of Autism.1 in 4 people with CP have epileptic seizures. 6 out of 10 people with CP have normal or superior intelligence. 1 in 11 children with CP are legally blind. About 3 of 10 children with CP have severe learning disabilities.1 in 50 children with CP are deaf. 1 in 20 children with CP have tremor and ataxia. 1 in 3 children with CP cannot walk. 1 in 4 children with CP cannot feed or dress themselves.

The incidence and prevalence of Cerebral Palsy is rising world wide, there are new treatments that must be tested to improve function and decrease the disability caused by CP. These include medications, regenerative techniques, physical and cognitive therapies, robotics, functional neuromuscular stimulation, bio-feedback and more. (Sweeney JK, Heriza CB, Markowitz R (1994))

3.2 Cerebral palsies- a definition as such

Cerebral palsy (CP) is the most common cause of physical disability affecting children, with an incidence of 2.0 to 2.5 per 1000 live births in developed countries. The prevalence of CP in the developed countries tends to be in similar range. (Rosen et al (1992), Okan et al (1995), Radzan et al (1994) and Liu et al (1999). Cerebral, referring to the brain as such (latin cerebrum “brain”) and palsy being a abbreviation for paralysis. This very vage term as such leaves a lot of freedom to interpret. The disorders covered by the term CP are heterogenous, both in clinical symptoms and in lesions causing these symptoms. Many attempts have been made thought the years to define CP. The most recent consensus definition states that CP is “*an umbrella term covering a group of non-progressive, but often changing motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development.”* (Mutch et al.,1992). This definition addresses primarily the motor symptoms, whereas other aspects of common comorbidity that significantly influences the children day-to-day performance omitted. (Carlberg, E.B. et al (2005)) Therefore, in 2005, a committee of the American academy for cerebral palsy an developmental medicine (AACPDM), led by Peter Rosenbaum, defined CP as “*a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behaviour, and /or by a seizure disorder.”* Additionally, they emphasized that motor dysfunctions resulting from progressive brain disorder or neurological disabilities that does not affect movement and postures cannot be considered as CP (Rosenbaum et al., 2006). This definition has been widely accepted among health professionals all over the world and provides a good basis for future research and clinical work. (Bialik,G.M. et al (2009))

CP as the collection of clinical syndromes, has been especially drawn special focus on two factors: First, CP is the result of a lesion in the immature brain, which is non-progressive; it is a static encephalopathy. It is clearly important to differentiate CP from progressive neurological conditions form the standpoint both- taxonomy and clinical management. Secondly, CP results in a disorder of posture and movement, which is permanent, but not unchanging. Since in most of the affected children it results in progressive musculoskeletal pathology, it would be appropriate to mention that as a third point. Defining that cerebral palsy is static, clearly does not include the fact it still results in changes being secondary to the primary lesion in the brain. The newborn child with CP usually has no deformities or musculoskeletal abnormalities at birth. Scoliosis, dislocation of the hip and fixed contractures develop during the rapid growth of childhood. Since CP describes a large group of children with motor impairment from many causes and expressed as a wide variety of clinical syndromes the preferred term should actually be “cerebral palsies”. (Graham, H. Kerr; Selber.P (2003))

3.3 Associated deficits, speech and language disorders

Associated deficits are present in large majority (75% of cases). Mental retardation (MR) as such is common in up to 60% of the cases. In a study of Singhi *et al* in India, they report MR in 72.5% of affected children. Children with spastic quadriplegia have greater degree of cognitive impairment than children with spastic hemiplegia. Visual impairments and disorders of ocular motility are common (28%) in children with CP. There is an increased presence of strabismus, amblyopia, nystagmus, optic atrophy, and refractive errors. Children whose CP is due to periventricular leukomalacia are also more likely to have visual perceptual problems. Hearing impairment occurs in approximately 12% of children with CP. This occurs more commonly if the etiology of CP is related to very low birth weight, kernicterus, neonatal meningitis, or severe hypoxic- ischemic insults.

Epilepsy is common in children with CP. And 35% to 62% of children develop epilepsy. Children with spastic quadriplegia (50% to 94%) or hemiplegia (30%) have a higher incidence of epilepsy than patients with diplegia or ataxic CP (16 to 27%). In an Indian study, it was found that 35% had epilepsy. 66% of children with spastic hemiplegia, 43% of spastic quadriplegia and 16% of children with spastic diplegia had seizures as an associated feature. (Shingi PD, Jagirdar S, Malhi P. (2003))

Speech is affected in CP due to bilateral corticobulbar and oromotor dysfunctions. Both receptive and expressive language deficits are common and go hand-in-hand with mental retardation. Articulation disorders and impaired speech are present in 38% children with CP.
Oromotor problems with feeding difficulties, swallowing dysfunction and drooling are also present. (Reily,S., Skuse,D. Poblete, X. (1996)) This can result in nutritional problems affecting physical growth. (Srivastava, Laisram and Srivastava (1992); Ojturk, Akkus, Malas , and Kisioglu (2002)) Behavioral problems are also well documented. Abnormalities of proprioception and tactile sensations are common in children with CP. Psychiatric disorders such as anxiety, depression, conduct disorders and hyperkinesis and inattention were seen in 61% of 6%- 10 year-old-children with hemiplegic CP. The associated deficits may be more disastrous for the CP child than the motor problem.

3.4 Classification of CP

Most known classifications are based on anatomic or topographic considerations, and on movement abnormality. Rosenbaum et al., proposed a classification based on several components at the international working group in 2005, including motor abnormalities, accompanying impairments, anatomical and neuro-imaging findings, and cause and timing of the disorder. Since neuro-imaging findings and cause and timing seem at this moment not to be very reliable in terms of classifying CP children, I will not explain these further.
Motor abnormalities are assessed based on the following: First of all *nature and typology* of the motor disorder such as spasticity, dyskinesia, and ataxia. Spasticity, the most common type of motor dysfunction, refers to a velocity-dependent increase in the muscle tone (resistance to stretch), Spasticity is usually associated with involvement of pyramidal tracts, the basal ganglia, or reticular formation, with upper motor neuron signs. Dyskinesia, an extra

pyramidal involvement, may be either dystonic, which includes hypertonia and reduced activity, or associated with choreoathetosis which includes irregular spasmodic, involuntary movements of the limbs or facial muscles. Ataxia refers to loss of orderly muscular coordination, usually caused by a cerebellar deficit.

Secondarily, the *functional motor abilities are considered.* This aspect of CP should be assessed using objective functional scales, and includes the extremities and oromotor function. The most commonly used system is the one developed by Palisano et al., the Gross Motor Function Classification System (GMFCS), based on disability and functional limitation. Many clinicians use this system adjacent to the above-mentioned classification. The GMFCS define five levels of function for four age groups, before 2 years, 2-4 years, 4-6 years, 6-12 years, with recent addition of 12-18 years. There is a strong correlation between this classification and the World Health Organization International Classification of Impairments, Disabilities and Handicaps, and is also easy to use. Another less known classification is the Bimanual Fine Motor Function Classification for the upper extremity in CP. This classification corresponds to the GMFCS. It includes five levels, where in level 1 both hands function with no limitation in fine motor skills, and in level 5, both hands have only ability to hold or worse. In the levels between these two, the hands have varying degrees of limitation in fine motor skills. Accompanying impairments include the presence of epilepsy, and decreased IQ, hearing, and vision.

The anatomic and topographic distribution of CP is based on the involvement of limbs, trunk, and oropharynx. Commonly used terms are quadriplegia, diplegia, and hemiplegia. There is a substantial overlap of the affected areas: in most studies, diplegia is the commonest form (30-40%), hemiplegiae is 20-30%, and quadriplegia accounting for 10%.

Quadriplegic CP

This is the most severe form involving all four limbs, and the trunk upper limbs are more severely involved than the lower limbs, associated with acute hypoxic intrapartum asphyxia. However, this is not the only cause of spastic quadriplegia.5 Neuroimaging reveals extensive cystic degeneration of the brain – polycystic encephalomalacia and polyporencephalon MRI and a variety of developmental abnormalities such as polymicrogyria and schizencephaly. Voluntary movements are few; vasomotor changes of the extremities are common. Most children have psuedobulbar signs with difficulties in swallowing and recurrent aspiration of food material. Half the patients have optic atrophy and seizures. Intellectual impairment is severe in all cases.

Hemiplegic CP

Spastic hemiparesis is a unilateral paresis with upper limbs more severely affected than the lower limbs. It is seen in 56% of term infants and 17% of preterm infants. Pathogenesis is multifactorial. Voluntary movements are impaired with hand functions being most affected. Pincer grasp of the thumb, extension of the wrist and supination of the forearm are affected. In the lower limb, dorsiflexion and aversion of the foot are most impaired. There is increased flexor tone with hemiparetic posture, flexion at elbow and wrist, knees and equines position of the foot. Palmer grasp may persist for many years. Sensory abnormalities in the affected limbs are common. Sterognosis impaired most frequently. 2 point discrimination and position sense is also defective. Seizures occur in more than 50%. Visual field defects, homonymous hemianopia, cranial nerve abnormalities most commonly facial nerve palsies are seen.

Diplegic CP

Spastic diplegia is associated with prematurity and low birth weight. Nearly all preterm infants with spastic diplegia exhibit cystic periventricular leukomalacia on neuroimaging. Periventricular leukomalacia (PVL) is the most common ischemic brain injury in premature infants. The ischemia occurs in the border zone at the end of arterial vascular distributions. The ischemia of PVL occurs in the white matter adjacent to the lateral ventricles. The diagnostic hallmarks of PVL are periventricular echo densities or cysts detected by cranial ultrasonography. Diagnosing PVL is important because a significant percentage of surviving premature infants with PVL develop cerebral palsy, intellectual impairment, or visual disturbances due to site of injury affecting the descending corticospinal tracts and visual radiations. Premature infants have impaired cerebrovascular auto regulation and are susceptible to intracranial hemorrhage (ICH) as well as PVL. Many premature infants have both PVL and ICH detected on ultrasonography. Maternal chorioamnionitis or vasculitis, with the production of cytokines, leading to inflammatory damage to the periventricular area in the developing brain is another factor in the pathophysiology of PVL. An estimated 60% 100% of patients with cystic periventricular leukomalacia go on to develop CP. (Wu and Colford (2000); (Menkes and Sarnat (2000)) In this condition, lower limbs are more severely affected then the upper limbs. Mild cases may present with toe walking due to impaired dorsiflexion of the feet with increased tone of the ankles. In severe cases, there is flexion of the hips, knees and to a lesser extent elbows. When the child is held vertically, rigidity of lower limbs is most evident and adductor spasm of the lower extremities causes scissoring of the legs. Seizures are common, most probably because of the focal brain lesion. Sensory abnormalities on the involved side are common. Fixation difficulties, nystagmus, strabismus, and blindness have been associated with PVL.

CP is as well classified based on the type of neuromuscular deficit into spastic, dyskinetic (inclusive of choreo-athetoid and dystonic), ataxic, hypotonic and mixed. Spastic CP is the commonest and accounts for 70%-75% of all cases, dyskinetic – 10% to 15% and ataxic is less than 5% of cases. Spastic types exhibit pyramidal involvement with upper motor neuron signs, weakness, hypertonia, hyperreflexia, clonus and positive Babinski.

Dyskinesia is characterized by extra pyramidal involvement in which rigidity, chorea, choreoathetosis, athetoid and dystonic movements are seen. This type of CP is also associated with birth asphyxia.(MacLennan,A (1999)) The severity of dystonic postures may vary with body position, emotional state and sleep. Clonus and Babinski are absent, but primitive reflexes are more prominent and persist for a longer time. These movement patterns are eliminated in sleep, with a decrease in tone of the affected limbs. There are also abnormalities of posture control and coordination. Those children who are hypotonic to start with may develop into this type by 1 to 3 yrs of age. In majority of this group, there is no cognitive impairment. Dysarthria, oromotor problems with drooling and swallowing difficulties are seen. 30% of children with CP have a mixed pattern of involvement. While contractures are common in spastic group, they are uncommon in the extra pyramidal group.

Hypotonic CP is characterized by generalized muscular hypotonia that persists beyond 2 to 3 yrs of age that does not result from a primary disorder of muscle or peripheral nerve. The deep tendon reflexes are normal or hyperactive, and the electrical reactions of muscle and nerve are normal. More than half the children develop frank cerebellar deficits with incoordination, ataxia and impaired rapid succession movements. (Menkes and Sarnat (2000).

3.5 Etiology

Most patients with CP have no known cause for the disorder, but multiple risk factors can be found. However, in over 30% of the patients, no risk factor could be identified. The injury of the developing brain can be prenatal, perinatal and postnatal. A history of prenatal cause is found in 75% to 80% of the patients. Only 10% to 15% are associated with hypoxia or birth trauma. Sixty percent of the children affected by CP are born at full term, and thus, prematurity is not the only cause for CP; nevertheless, low birth weight (less than 1500 g) and prematurity are well-known risk factors for CP. Other prenatal risk factors include infection and maternal drug or alcohol abuse, maternal epilepsy, mental retardation, hyperthyroidism, severe toxemia, and third trimester bleeding. Chorioamnionitis was found to be a risk factor for CP, in as many as 28% of premature infants. Cystic peri-ventricular leukomalacia, a congenital brain malformation, may play a causative role. Perinatal risk factors include multiple pregnancies, with significant-increased risk for CP. Twin pregnancies result in a child with CP about 12 times more than a single pregnancy, probably related to a low birth rate. Brain haemorrhage during delivery, other types of birth trauma, vaginal bleeding on admission, placental complications, hypoxia, and anoxia were all associated with increased rate of CP. Postnatal causes include head trauma, meningitis, encephalitis, and brain infarcts. Genetic causes that are known to be a risk factor for CP involve a gene on chromosome 19. ((Bialik,G.M., Givon,U. (2009))

3.6 Measuring function and natural history

Similar to other conditions, the most important priority in the first decade of Cerberal palsy childhood is function*, in the* second appearance and in third and the subsequent decades it is the avoidance of pain. Most functional gains are made within the first decade.

Gross motor function in cerebral palsies is related to degree of involvement, which in turn is manifestation of site and severity of the cerebral lesion. All children with spastic hemiplegia walk independently; most of those with spastic diplegia will walk but many require assistive devices. Those with spastic quadriplegia rarely have functional walking.

Motor function can be reliably measured using the cross motor function measure (GMFM) and classified using the gross motor functional classification scale (GMFCS). In fact, recently Rosenbaum et. al. described motor development in the cerebral palsies as a series of curves of motor development.

GMFCS is a recently developed system that has been found to be a reliable and valid system that classifies children with cerebral palsy by their age-specific gross motor activity. The GMFCS describes the functional characteristics in five levels, from I to V, level I being the mildest in the following age groups: up to 2 yrs, 2 – 4 yrs, 4 – 6 years and between 6 to 12 years. For each level, separate descriptions are provided. Children in level III usually require orthoses and assisting mobility devices, while children in level II do not require assisting mobility devices after age 4. Children in level III sit independently, have independent floor mobility, and walk with assisting mobility devices. In level IV, affected children function in supported sitting but independent mobility is very limited. Children in level V lack independence even in basic antigravity postural control and need power mobility. (Palisano RJ, Rosenbaum PL, Walter S et al. (1997))

These measurements aid our understanding of gross motor development in children with cerebral palsy of all degrees if severity. They are an excellent guide to prognosis and have significant implications in the understanding of the potential and limitations of management strategies. (Graham, H. Kerr; Selber**.**P (2003))

3.7 Early diagnose

Cerebral palsy is a clinical diagnosis made by an awareness of risk factors, regular developmental screening of all high risk babies and neurological examination. As in all medical conditions, a systematic approach focusing on maternal, obstetric and perinatal histories, review of developmental milestones, and a thorough neurological examination and observation of the child in various positions such as supine, prone, sitting, standing, walking and running is mandatory.(Sanger, et al (2003))

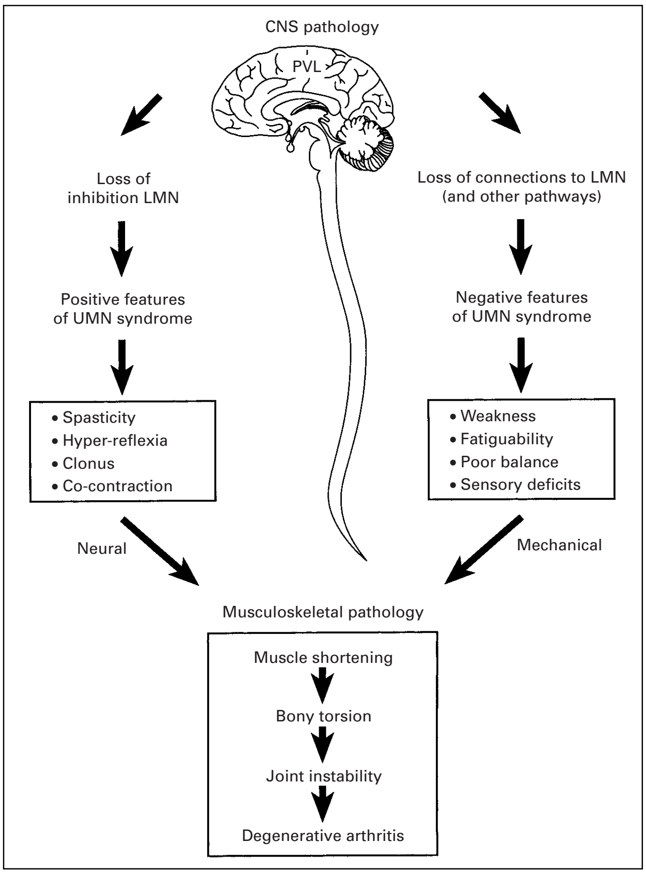
It is not possible to diagnose CP in infants less than 6 months except in very severe cases. The patterns of various forms of CP emerge gradually with the earliest clues being a delay in developmental milestones and abnormal muscle tone. In CP, the history is nonprogressive. Milestones once acquired do not show regression in CP. Tone may be hypertonic or hypotonia. Many of the early hypotonia change to spasticity or dystonia by 2 – 3 yrs of age. Early signs include presence of hand preference in the first year, prominent fisting, abnormalities of tone–either spasticity or hypotonia of various distribution, persistence of abnormal neonatal reflexes, delay in the emergence of protective and postural reflexes, asymmetrical movements like asymmetrical crawl and hyperreflexia. Primitive reflexes should gradually extinguish by 6 months of age. Among the most clinically useful primitive reflexes are Moro, Tonic labyrinthine and Asymmetric Tonic Neck Reflex (ATNR). In many cases a diagnosis of CP may not be possible till 12 months. Repeated examinations and observation over a period of time may be required in mild cases before a firm diagnosis can be made. (Ellison et al. (1985))

3.8 The upper motor neuron syndrome

Cerebral palsy is the most common cause of the upper motor neurone syndrome (UMN) in childhood which is characterized by positive features such as spasticity, hyper-reflexia and co-contraction, and negative features such as weakness, loss of selective motor control, sensory deficits and poor balance.

The key feature of the musculoskeletal pathology is a failure of longitudinal growth of skeletal muscle. The conditions for normal muscle growth are regular stretching of relaxed muscle under condition of physiological loading. In children with cerebral palsy, the skeletal muscle does not relax during activity because of spasticity. Additional these children have greatly reduced levels of activity because of weakness and poor balance. But it is much more complex than just development of contractures: Torsion of long bones, joint instability and premature degenerative changes in weight-bearing joints are common and debilitating as well and young adults with CP commonly experience pain from early degenerative joint disease. (Graham, H. Kerr; Selber**.**P (2003)) Even though the pathology of the central nervous system in cerebral palsy is defined as a static encephalopathy, one might understand that it cannot be considered as static since it produces secondary changes within the entire development and growth of the affected child. (Mac Keith et al (1958) and Rang et al. (1986))

The scheme on the right emphasizes the entire picture a CP child is challenged with, from the very beginning in the brain until the musculoskeletal changes in the very periphery that can be divided into positive and negative features.



Given the infinite variability of the location and severity of the lesions the clinical syndromes are in turn extremely variable. In motor terms, cerebral palsy results in an upper motor neurone lesion which in this diagram is considered to have a series of positive and negative features that interact to produce the familiar musculoskeletal pathology.

Positive features, such as spasticity, hyper-reflexia, clonus and co-contraction have historically been always more in focus of clinicians, whereas negative features have been relatively ignored. Negative features, that include weakness, fatiguability, poor balance and sensory deficits, are logically though included and closely related to the condition covered by positive features: If one thinks about the shoulder girdle as being profound weak within its capsule, the humerus is logically consequently not being very well stabilized within the GH joint. The muscles attached onto the humerus though still constantly pull onto the bone, enhanced due to possible enhanced stretch reflexes and shortening within their sarcomers. Concentrating in this situation on the obviously strong and hyper-element, the muscles, might be of short-term effect, but since the stretch reflex is generated by neurological tissues will re-appear and re-shorten the tissues. Strengthening of the weak component though, the shoulder joint itself, results in re-routing and organizing the entire tone around the joint and within its attached muscle, therefore resulting in considerable long-term solutions, especially when secondary the strong component automatically is addressed.

It is probable that the optimum management of children with cerebral palsy will require integrated management of both the positive features and the negative features. Within the next chapter we will discuss possible and most common classically used treatment approaches.

Chapter 4 CEREBRAL PALSY IN CLASSIC REHABILITATION

Because children with CP have multiple symptoms for which no curative treatment exists, their families seek therapies from many sources. Some look for cures, while other seek therapies that will improve the way their child functions or feels.

Any therapy, whether complementary or allopathic should be evaluated in terms of its effects on targeted body functions and structures, activities and participation (World health organization WHO). (Graham, H. Kerr; Selber.P (2003))

4.1 Classic management approach in CP: primary aim spasticity

The primary classic aim in CP children is to prevent the development of fixed contractures caused by spasticity. Regarding research and medical statements, the management of spasticity has increasingly become sophisticated and effective in the recent years. Treatment can be classified as temporary or permanent and as focal or generalized.

Given the following summary of common methods treating spasticity as their main target, one might become a better understanding and insight into differences and form of application, as well as their long and short-term benefits. (Graham, H. Kerr; Selber**.**P **(**2003)

Name	Method of application	Target management	Benefits	Side effects and complications
BTX-A or Phenol	Intramascular injection	Dynamic equinus (Toe-walking) Adductor spasticity Hamstring spasticity	Only Temporary/focal	
Baclofen	Oral			Poor solubility Target tissue reached in very low concentration
Baclofen	Intrathecal baclofen pump (ITB) Agent administered directly into subarachnoid space	Severe spastic quadriplegia with whole body involvement (specially hereditary spastic paraparesis)	Consistent reduction in muscle tone improved general comfort and ease of care	Expensive High incidence of complications Risk of rapidly progressive scoliosis
Selective Dorsal Rhizotomy (SDR)	En-bloc laminoplasty L1-S1 (section of 20-40% dorsal rootles)	Replacement of laminae/preservation of joints reduces risk of subsequent spinal deformity)	Immediate and marked reduction in spasticity Improvement in ROM of hip,knee/ankle Improvement dynamic gait functions (walking speed, stride length) Reduction in dynamic equinus	Reduction of tone accompanied by weakness of lower limbs Intensive physiotherpay is then required No effect on selective motor control, weakness, poor balance or fiexed deformities Risk of incresaed deformtities/ subluxations post-SDR

4.1.1 Orthopedic surgery

Most children who have management of their spasticity by BTX-A, ITB and SDR will still require orthopedic surgery for the correction of fixed deformities. (Rang et al. (1986); Miller et al (1995); Pirpiris et al. (2001); Boyd et al (1997) and Gormly et al.) At birth, no difference exists between the hips of children with spastic cerebral palsy and the hips of other children. The typical pathologic deformities of the hips in children with spastic cerebral palsy develops as the child gets older.

This statement gains in importance and meaning supported by evidence that the optimum management of spasticity will delay the onset of such problems and, in doing so, postpone the need for orthopedic surgery. (Boyd R, et al (1997); Cosgrove AP, et al. (1994); Graham et al (2000), Corry, et al (1998). This in turn means that the child, who has access to good management of spasticity, is expressing less prevalent contractures as well as less severity in case of present deformities. But still, bony torsional deformities and pes valgus remain common. (Boyd et al (1997) and Greene (1991))

Orthopedic surgery has a major role in the management of children with spastic cerebral palsy by correction of fixed deformity, which in certain circumstances may improve function and quality of life.(Rang et al (1986), Miller et al (1995) and Boyd et al (1997).

Since in the second decade of CP child's life, appearance and integration are of central importance to the child with physical disabilities, surgery to correct deformity will improve appearance and preserve function. However, evidence for the efficacy of most orthopedic operations is lacking. Krebs et al (2007) concluded in their research that the independence of the patients, based on the modified Barthel index, did not change significantly after surgery. Most improvements in quality of life were observed in those patients who had pain in the hip before the operation as a result of reduction of pain and improved mobility of the hip. (Krebs et al (2007)).

4.1.2 Stretching

Additionaly, and sometimes accompanied to the use of intramscular injections, stretching has been ever since a very wide spread treatment approach. It has been used for many decades now. Many practicioners proclaim the benefits and effecs of stretching as a possible and advaisable treatment approach for CP children, especially to fight spasticity. But in fact, the benefits of stretching are still far from being evidential proven as being beneficial for the treatment of CP children. In a study of Pin, Dyke and Chan in 2006, the authors reviewed seven studies that have evaluated passive stretching with the intention to evaluate the effectiveness of passive stretching in children with spastic cerebral palsy (CP). Concluding, there was limited evidence that manual stretching can increase range of motion, reduce spasticity and improve walking efficiency in children with CP. (Pin T, Dyke P, Chan M.

(2006)) Additionally, Schleip (2003) mentions that passive stretching does not stimulate the golgi tendon organs, the responsible organ for lowering the firing rate of the alpha motor neurons on spinal cord level and therefore soften and elongate muscle fibers. Such stimulation happens only when the muscle fibers are actively contracting. The reason for that lies in the arrangement of the golgi tendon receptors. They are arranged in series with the muscle fibers. When the muscle with its related myofascia is passively elongated, a resulting elastic elongation of the muscle fibers will swallow most of the stretch. (Ledermann 1997)

Additionally, following aspect might allow a different perspective of how to approach spasticity in CP: Although neurological aspects have been the blamed to be the primary reason cauing the spastic muscle to tighten up, there seems to be in fact a much more local and cellular reason: Booth et al (2001) investigated muscle biopsies of CP children to examine the role of muscle connective tissue in reducing the mobility of spastic CP children. Their conclusion was striking: An evidential accumulation of collagen I fibers in spastic muscles fibers suggested that the amount of total collagen in spastic muscle correlates with the severity of the children's disorder. The distribution of this increases collagen is consistent with it playing a role in increased muscle stiffness and in the role of formation of contractures. This research suggests that at cellular and biochemical level a spastic muscle can be very much influenced by local changes simply caused by tissue accumulation, instead of primarily regulated by neurological factors. That in turn can be used for local treatment possibilities enhancing and stimulating tissue qualities locally. (Booth et al (2001, 1988) and Wright et al 1990)

Concluding, one might say that there is no proven benefit of passive stretching for CP children, neither on physiological level nor on functional activity level. Contrary these facts, stretching consists being a world wide exepted method of treating spasticity.

4.2. Managing weakness in the cerebral palsies

As clearly stated before, clinicians have, until now, traditionally focused more on the "positive features" commonly observed in CP. Of course it is possible to treat spasticity, but it is the negative features that determine the locomotor prognosis. Spasticity is only one component of the upper motor neurone syndrome, as we have seen in the scheme drawn in the previous chapter. Spasticity seems not to be the important one in determining prognosis. Weakness and loss of selective motor control are more important than spasticity and are more difficult to manage.

Weakness and loss of selective motor control determine when or if a child will walk. Deficits in balance will dictate dependence on a walking aid. (Graham, H. Kerr; Selber.P (2003)) Brunner and Romkes (2006) concluded in their study that, conversely to the common suggestion of abnormal muscle activity in patients with CP during gait, commonly taken as of spastic origin, can be explained with muscle weakness. Since weakness is a well-recognized problem in patients with CP, they hence suggest that the primary problem for gait disorders in CP is weakness instead of spasticity.

In comparison to the management of spasticity and the correction of fixed deformities, the management of weakness has been neglected until relatively recently. The traditional views were that muscle strengthening in children with cerebral palsy was neither possible nor desirable because it might increase spasticity. But recent research has shown that muscle strength can be reliably measures in children with CP and that those who participate in strengthening programs demonstrate increases in muscle power and improvements in function. (Wiley and Damiano (1998); Damiano and Abel (1998) ;and Dodd, Taylor and Damiano (2002))

The management of spasticity in the cerebral palsies requires a multidisciplinary approach which should have representation from developmental paediatrics, neurology, physiotherapy, occupational therapy, neurosurgery and orthopaedic surgery.

4.3 Weakness as key factor- Research and facts developed by ABR

Let's take a closer look at this weakness in CP children and therefore take some examples:
During all the years, ABR has analyzed and evaluated CP children all over the world, trying to find out what is what all these children have in common. No matter if Asian, Caucasian or Black individuals- they all had one essential component in common, the component that states ABR as *the central concept itself*: Compressional weakness of the abdomen.

Having mentioned before that fascia is able to actively contract, as well as not to forget that- as seen in the cross section – the abdominal volume makes up to 70% of the total volume observed on the cross section at the thoracic level. The myofascia has big responsibility to ensure the internal abdominal volume that is necessary for any kind of postural control. (Schleip et al (2005/2006)) Unfortunately those current studies of Schleip and colleagues associate this active fascial contractility so far mostly onto increased or decreased myofscial stiffness (such as low back pain, tension headache, spinal instability, or fibromyalgia), and only have started to offer new insight for treatment directed on fascia itself.

Having those aspects re-freshed in mind, lets have a closed look at the following pictures that have been taken from ABR sessions for official demonstration purposes:

A 5-year-old Caucasian boy

And a 3-year-old Asian girl.

A 8-year-old Caucasian boy

And a 12-year old Caucasian girl

You can see the same compressional weakness, presented by a collapse of the thorax and a total collapse of abdominal volume. You might have realized already, that the collapsed abdomen is independently of age present among these individuals.

Additionally, it is important to remember that all these individuals have had years and years of rehabilitation effort on a very intensive scale. In order to understand and highlight the important presence within different age ranges, one should consider the following pictures and especially recognize the age of these children.

This is a 12-year-old.

This is a 3-year-old

A 10-year-old.

A 2-year-old.

This essential property of that collapse of the trunk is present consistently over and over again. For the reasoning of the conclusive statement ABR wants to highlight on, one should be aware of that again: all these children had years of intensive physical therapy under various type of applications and under various healthcare systems in different countries. All these individuals are coming from the civilized world where the best up to date services are being available for them. Conversely to the fact that all these individuals are able to approach all various types of applications, one can unfortunately easily observe the same visible feature they remain to have -nevertheless their interventions they underwent before: a gallery of children with those collapses of the trunk.

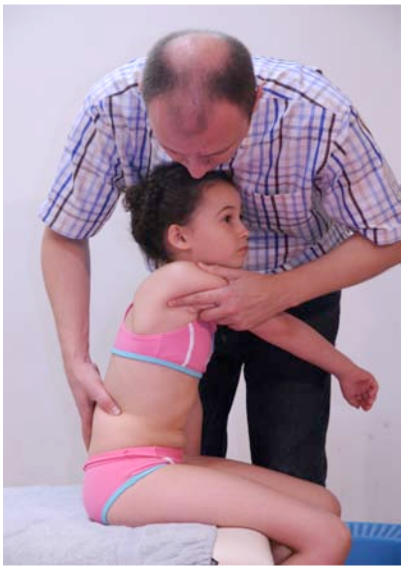
Since on of the world wide accepted evaluation measurement is the GMFCS level, (see chapter III) lets translate the analyzed aspects in to this tool set:
All of these children are classified as quadriplegic cerebral palsy and GMFCS levels IV and V. We observe the same set of challenges regardless of the age, race and gender, all manifest weakness of compressional core and the collapse of the trunk under their weight. One can therefore easily conclude that *compressional weakness is a universal factor that impedes the*

development of the child with cerebral palsy.

In order to be able to properly understand what ABR wants to highlight, it might be useful to take a look at following pictures of a healthy child.

This is a picture of effectively a premature newborn.


Reasonable one typically would consider the premature newborn as even weaker than a full term baby, but in fact it is apparently very obvious, this that is clearly a incompressible *trunk*. Even if the entire weight is shifted onto his anterior chest wall (second picture), one can see that he remains unhappy but the incompressible properties of the trunk remain.




The difference between the 2 girls, a 9 year old girl on the left and the 12 year old girl on the right, is striking and underlines what we could observe on the last couple of pictures. When we see these collapse of the upper body, the first natural idea would be to follow the classic line of thinking and argue that it is neurologically caused spasticity and is due to shortness of the intercostals muscles which are just pulling these ribs together. But on the other hand, there is another possible explanation, that is based on the extended myofascial understanding of the human body – the fascia I was talking about before and reasoning as an not deniable essential component in the biomechanics of the human being. Considering the body as the tensegrity structure, we should connect what we see in those pictures with what has been stated earlier:

The picture shows the conflict of ribs and pelvis due to an abnormal collapse into the abdominal cavity. Knowing now, that exactly this abdominal cavity is for a major percentage made up of fascial components, and that as well, this fascial component is able to actively contract, includes the fascia in the biomechanical concept of tensegrity.

Since the pathological features of CP not just include the extremely strong component, but in contrast as well the extreme weak component, it makes sense to see the effect that extremely strong components create on a very weak base, such as it is the case of the weakened fascial component of the abdominal cave: as there is a general weakness, of course not just the muscle are for one very strong or very weak, but as well the fascial that is, as mentioned before, surrounding and covering all the functional units in our body. If the entire underlying system of fascia is weakened and underdeveloped, it is a natural result that the system of sheets, pulleys, hinges and cables that were used to explain tensegrity, are out of control.

Having said that, one might wonder, if it is the underlying weakness of active contractile elements that are not able to stabilize the body in its tensegritic model, or whether it is the change of proportion within cables (muscle) or pulleys (bones) that in turn disturb the entire symbiotic of give and pull. As it is with the question whether egg or chicken was first, one should definitely keep in mind that it is not necessarily the strong component, but very well a general weak component that causes this visible struggle the girl and all the other children show when attending general weight bearing functions.

Despite the fast gaining popularity of the myofascial concept, it is still an extended and only partial included model in understanding of the classic model of bones and muscles.
It's not an addition or an alternative to the classic model. It's an integrative concept, which absorbs all the good things which exist in the classic model and add new terrain incognitos which are yet to be explored. Leonid Blyum, the inventor and creator of ABR, went to the cerebral palsy conference in April 2009 in Sydney, Australia. Later on he reported, *"out of 200 speakers promoting multiple poison injections and surgeries, not a single time the word "myofascia" was mentioned."* The myofascial approach gained big attention in the superficial level within the specific domain of dealing with back pain and neck pain, but is obviously under-employed and an still untapped potential that could be of such a big use to focus on and work with.

4.4. The inflated ball theory

In order to understand what is happening within the weakness of CP children, I will use the image of a balloon with a cloth layer around to protect the ball from being pinched. The balloon itself shall represent the volume and layers of tissue of the human body, whereas the layer of cloth represents the outermost layer: the skin. When pulling this outer layer – the skin- it is hardly removable from the underlying balloon that it covers.

As we know now having read Chapter III, CP children suffer instantly when they are born form a weakness being especially visible within a collapsed thorax. This weakness is internal as the internal fascia of CP children is weakened. If the internal side is weakened, the bones as being the stabilizer of the entire body structure itself, has no ability to create this stability because it misses is internal volume to contact to and build up the core. Relating this back the balloon, imagine the ball to loss air from the inside: it shrinks, constantly loosing its volume and loosing its contact to the outer cloth layer. If the skin has no contact to its core, no attachment whatsoever, it tends to slide superficial on the underlying tissues- it has no volume to rely and attach to. Additionally the inner tissue layers of the balloon loose volume and tensile strength as well: As the balloon shrinks, the muscle layer being attached to the bones to create as proper leaver system, loose their capacity because insertion and origin of the muscle move closer together, and therefore loosing their capability to create maximum contraction force.

The result is drastic: due to the loss of contractibility, the muscle shortens or tends to tighten up- most probably resulting in spastic muscle tissue. Either way, this muscle has no proper muscle function whatsoever! It is not able to generate any force that will help to child to move himself around in daily life.
Additionally, the hydrostatic tensegritic model I was mentioning before is instable and not functioning properly anymore: With the bones being its beams, being a dynamic set of leavers and spacers though which the entire musculature can act in order to constantly counterbalance the forces of gravity and of contraction, usually the system can be kept erected and stable. But due to abdominal and internal loss of volume and the therefore resulting shrinking of the attached tissues and structures, the dynamic set of bones is out of balance, being pulled from shortened muscular tissue and not equally balanced and loaded anymore.

Having this theory in the back of the mind, lets now switch to the most common feature that we see in almost all our CP children: compressional weakness in the thorax.
As we all know, the intercostals line the spaces in between our ribs and have three distinct functions: secondary and supplementary inspiration muscles, ensuring thorax stability as well as proper upright posture. If we reflect these muscle groups back on the inflated ball theory, we might now better understand what has happened in a CP child presenting this specific collapsed rib cage: Due to the loss of proper abdominal volume usually generated by healthy and strong fascial layers within the entire rib cage space, the ribs simply collapse. As a result, the intercostals muscle fibers, whose origin and insertion attachments at the ribs apparently have come closer together, will shorten and increase the impact on the overlapping of ribs onto the pelvic crest even more- a common feature observed in the CP kids before.

Additionally and worsening the situation, the drop of the tone of the abdominal cavity itself results in rotation of the pelvis, that causes the iliac bones starting to fold inwards. This in turn results an inwards rotation of the legs and therefore a very poor hip insertion into the pelvis, easily resulting in hip subluxation, as we know now (chapt. III) one of the major issues in CP children when they grow.

4.5 Classic management VS ABR- Fighting spasticity VS Managing weakness

Current CP rehabilitation constantly has one big fight with the wrongs in a CP child’s body. It’s either done with the poison injections, or the nerve blocks. It could be the muscle cuts, or the bone transitions. All of them are aggressive and they're all basically having one simple idea in mind, how to fight with excessively strong, or the uncontrollable muscular balance. In the classic intervention, spasticity is treated by the use of stretching, splinting or the injection of Botox to elongate and relax the muscle, in other words: One was fighting the excessively strong component. Whatever there possibly was, to change something in the extreme shortened and contracted limb position of the CP child, was done - with the use of force. On the other hand, ABR has a completely different perspective since it focuses on strengthening the weak. Not to fight, not to battle, not to try to fuse the child into cast or any other external “formative” device, but effectively to bring about the strengthening.

ABR considers the smooth muscles to be the primary victims of a brain injury. As their tone drops following a brain injury, the secondary victims are the structure of the musculo-skeletal system, which in turn collapses - changing the normal alignment of muscles and bones and shifting the distances between points of muscular attachments. Such shift of attachments in turn causes the skeletal muscles imbalance: i.e. spasticity and contractures. Finally, such muscular imbalance makes normal movements impossible. The resulting pathological diagnosis is cerebral palsy, as a disorder of posture and muscle control. Unfortunately, in traditional medicinal practice the internal organs are looked upon only from the viewpoint of chemical metabolism, while, on the other hand, the biomechanical approach does not normally focus on anything other than the classical skeleton comprised of «muscles and bones».

Even though namely referring to rehabilitation, ABR itself is not a pure rehabilitation method as such, it might be more or less considered as bodywork. Lets take a closer look at bodywork within the following chapter.

Chapter 5 THE PHILOSPHY OF ABR AND BODYWORK

5.1 The history of Bodywork

"Our tendency to live in the world of reality leads us to neglect what is going on in the field of sensations. " (Paul Schilder, The Image and appearance of the Human body)

Since bodywork, the so called method of all kind of variable manipulative hands-on therapies, has prodigiously increased in number of techniques and practitioners in the twentieth century, this might been reasoned on the fact of our growing possibilities of getting to know our body on the micro-level: machines, equipments and research created amazing possibility to have an "insight" into our body. The more we got to know about our body and its mechanism, the more we discover newer and more effective ways in which human hands can used to influence physiology. (Juhan, D. (1987) pp. xix-x)

In earlier days, skillful touch was considered as significant therapeutic value in all kinds of diseases regarding body as well as mind affected conditions. As earliest actual documentation of bodywork go back to 2000 B.C, it `s meaning and value is far from being new. Throughout the history of the progress and the development of their art, bodyworkers have established to provide relief for conditions as varied as too loose or too tight muscles, constipation, high blood pressure, broken boned or sprained ligaments that are healing, depression, anxiety, asthma, muscle strain or fatigue, sluggish lymph flow, poor venous return, epilepsy, manipulation of the fetus in the womb, headaches, to list but a few of the conditions that have been specifically referred to- whereas this list continues to grow as scientific understanding grows. But in spite of these facts, the use of bodywork as a legitimate therapy has in recent times diminished more or less (…) (Juhan, D. (1987),p xxi)

*It is definitely not the doubt in the efficiency of bodywork, but more or less the development of the pharmaceutical industry: The greater variety of machines together with new inventions (diathermy, microwaves, ultrasound, etc.) have supplanted older means of physical therapy including massage. A third, and in my opinion factor an underestimated one in its influence, is dehumanization in the relations between the patients and those who treated them. Physicians do not take the effort to learn-hence to teach- the time consuming art of manual treatment. Yet, possibly as a reaction to mechanization, there seems a tendency toward closer contact between those who seek for help and those that provide help. In other words: bodywork might not be history yet, but it might point to a swing of the pendulum in the reverse direction, towards the essence of physical contact. (*Kamenetz, H.L. (1980))

5.2 The essential benefit and use of bodywork in CP children

The one quality that is outstanding and present in all our organs and tissues, almost no matter in what shape we find them, is their great plasticity. Flesh is a highly malleable things, constantly shifting its depository layers between the demands of the internal and the external environments. Reducing biological events to fixed forms of chemical reactions and then extracting the subjective, responsive elements so that we can examine those events objectively has nothing whatever to do with comprehending the intelligence, the complexity and the plasticity of life forms. But as well, we must not forget, that this marvelous ductility does not in itself constitute the cure for any condition. Left to its own organic devices, our flesh will react like a silly putty: Without the exertion of sensibility and will, it will respond to local forces, bad as well as good. (Todd, M.E. (1979,p.24))

5.3 ABR as bodywork

ABR, that means Advanced BioMechanical Rehabilitation. In it`s technique it is unique, a biomechanically based rehabilitation approach for children and young adults with brain injury that brings predictable recovery of musculoskeletal structure and motor functions. The word *"advanced"* is self-proclaimed and is under the assumption that it is innovative and brings some extras to the classic model. "*Biomechanical*" highlights the fact that ABR focuses on biomechanical aspects as opposed to the neurological, biochemical, genetics, and psychological considerations. And *"rehabilitation"*- the primary goal of ABR is the practical outcome rather than just fiddling with certain structural biomechanical aspects and models.

As bodywork in general, ABR is as well a method of structural correction of musculoskeletal deformities. It is a hands-on method performed by the CP children parents who learn the ABR technique and receive individual prescription of applications from the ABR professional staff.

This biomechanical reconstruction of the musculoskeletal system follows the path of normal motor development - starting from the neck and trunk and later descending to the periphery (arms and legs). ABR self states, that it is more than just a new rehabilitation method: it is a comprehensive philosophy of the child's recovery. The cornerstones of the ABR philosophy are fundamental biomechanical principles of the human body's growth and development. Respectively ABR takes bio-electrical and bio-chemical factors into account only through their biomechanical manifestations. These biomechanical approaches allow ABR to have exact guidance for every single movement, so *every single* ABR application to a child's body is precisely calculated and adjusted for each individual patient. (Blyum, L. (2009))

ABR uses no pharmaceuticals, no electrical instruments and no surgeries - it is a hands-on method of manual applications to the child's body, based purely on biomechanical principles.

5.4 The effect of Bodywork

As there is a constant debate about what bodywork accomplishes, all physicians, practitioners presenting themselves as the ones using bodywork, rely on following points:

One is that most of the body's processes rely upon the appropriate movements of fluids through our system, and that bodywork can be an effective means of promoting these circulations. Because as all our tissue in our body rely on nutrients, oxygen, hormones, antibodies and other immunizers, and of course water, these must be delivered to every single cell continually if it is to survive and respond the way it should. There is no tissue in the body that cannot be weakened and ultimately destroyed by chronic interruption of these various circulations.

Another argument, and this one is especially important to understand ABR`s main principle, is the efficacy of bodywork on the connective tissue and our musculature. It is those tissues that hold us within mechanisms of tensegrity and hydrostatic pressure together, but as well those that often becomes stiffened or shortened or thickened, distorting our posture and limiting our movements. Additionally the integral system of skin, connective tissue, and muscles being vital organs with multiple functions that profoundly affect each other and all the other organs of the body creates a condition within every part of us is continually undergoing dynamic changes from liquid sol states to solid gel states and back again as we grow, move, learn, and age, and no single part ever changes its state without sending interconnectedness that goes far beyond the mechanical relationships between fluids, tubes, levers, cables and springs. If we can genuinely affect on level of this interaction, then through it we can reach many levels. The more sophisticated our sense of these interpenetrations are, the more varied and precise the manipulative facilitations used in bodywork can be. (Juhan,D. (1987) p.xxii-v) *"With equal justification, we can see it as an energy phenomena: application of pressure (energy) through muscular expansions and contractions fosters these transfers. To get more economical flow, we must start at the macro levels of muscular and fascial systems in order to influence the micro levels of cellular metabolism." (*Rolf, Ida P. (1977), p.180)

Gelhorn (1967), Eble (1960) and Schleip (1993) conclude in their studies, that deep manual pressure- specifically when applied slow or steady- stimulates interstitial and Ruffini mechanoreceptors, which results n an increase of vagal activity which then changes not only local fluid dynamics and tissue metabolism, but also results in global muscle relaxation, as well as a more peaceful mind and less emotional arousal.

Additionally, Schleip (2003) suggests that fascia and the autonomic nervous system appear to be intimately connected. A change in attitude in myofascial practitioners from a mechanical perspective toward an inclusion of the self regulatory dynamics of the nervous system is suggested. (Schleip, R. (2003))

5.5 ABR as Engram

An engram is the cortex`s means of learning new skills and behavioral patterns, and of imposing them upon the primitive levels of our motor organization. Our minds and thoughts exist in our skin, joints, and muscles just as surely as they do in our craniums. A.C. Guyton states, that experiments with monkeys, whose small portions of motor cortex that control the muscles normally used for the skilled activity, have been removed did not prevent the monkey from performing activity. Instead he automatically used other muscles in the place of the paralyzed ones. When they instead, destroyed cell bodies in the sensory cortex, which correspond to the area of muscle, skin, and joints that were involved in performance of the original skill, the monkey lost all ability to repeat the skill. The conclusion Gyuton proclaims is that the entire motor side of our nervous system appears to have little to do with the organization of the acquired motor behavior and the perpetuation of learned skills. *It is not the motor cortex itself that controls the pattern of activity to be accomplished. Instead, the pattern is located in the sensory part of the brain, and the motor system merely "follows" the pattern*. (Guyton, A.C. (1981)) If one studies a typical muscle nerve (e.g. tibial nerve), it consists of almost three times more sensory fibers than motor fibers. This points to a fascinating principle that sensory refinement seem to be much more important than the motor organization. (Schleip (2003)) This is precisely the point where bodywork is able to exert its most dramatic, most beneficial effects: Bodywork means essentially a carefully controlled tactile environment which the client is unable to effectively build up for himself, give his present habits or injuries, and is therefore unable to incorporate I to his feelings states and his behavior, unable to perform controlled motor behavior. This engramatic quality of bodywork is what the manner of working is ultimately so much more important than are particular procedures or techniques, more important than merely pushing tissues and structures back into the "right" place, a right place that does honestly spoken not exist. Even though structural changes are to be expected within bodywork, the crux and real matters of this therapy are not material, but have to do with the sensory evocation of "*feelings states".* Far more important than the local effects of a loosened muscle in the general feeling within the client that his comfort and his competences are not at the mercy of blind neuromuscular reflexes, but enjoyable sensations within controlled feelings that his mental state in turn responds powerfully to. This experience can constitute a break in a vicious circle of discomfort, withdrawal, and subsequent disability that may have been perpetuated for years. To experience pleasant peripheral sensations changing inner feelings, this inner feelings changing habitual attitudes, and those changing attitudes changing the tone and functionability of the muscles, which in turn produce more pleasant sensations. This is the reverse rotation of the vicious circle, *a new organizing engram at work*. The physical body and the activities of the mind are restored to one another through the interface of touch. Each finds in the other the very element without which it languishes and suffers in isolation. (Juhan,D. (1987),pp.275-6)

5.6 ABR`s philosophy

So far everyone believes that a CP child has poor functions because his/her brain is too damaged to be able to control normal movements. Respectively CP children are considered incurable because the brain damage is irreversible. ABR has a different philosophy: *“We believe that even the badly injured brain has enough electrical plasticity to allow control of normal motor functions, however, for this plasticity to become activated, a child's musculoskeletal structure has to be improved to a sufficient level - to the so-called plasticity threshold. Existing treatment methods fail to achieve recovery of motor functions. This failure is then blamed on the brain damage.”*

ABR shows evidence that irreversibility of initial structural brain damage does not make motor function recovery intrinsically hopeless. The brain damage is not a critical obstacle for successful biomechanical reconstruction, as long as the musculoskeletal system is addressed in an effective biomechanical manner. *There is no critical need to «repair» the brain before initiating the restoration of the biomechanical system. We believe that the answer lies differently. Existing treatment methods fail, not because of insufficient «reserves» of the damaged brain, but because they fail to provide sufficient structural improvements to the musculoskeletal system. As a result, the injured brain has "too little of a good musculoskeletal structure to work with" and cannot utilize its remaining plasticity (reserves) for control of motor functions.”*

ABR focuses on the restoration of motor functions in a spontaneous way through the rebuilding of the musculoskeletal structure and the restoration of bio-electrical signals flowing between the muscles and the brain. This kind of advanced rehabilitation provides a planned progress of the musculoskeletal structure and function through predictable stages. Results are predicted in numbers of hours of exercises done and changes in the alignment, mobility, size, tone and strength of the child's body – specifically in the chest, abdomen and the pelvis.

ABR is the only approach that does not focus on "managing" the child's limitations. Its aim is "reversing" poor mechanical integration in order to permit spontaneous development of movement. While it is commonly believed that a brain injured person needs specific training of his/her motor function - trying to make "better use" of a structurally deficient musculoskeletal system - ABR shows that true biomechanical structural improvement of the musculoskeletal system automatically converts into motor function progress, eliminating any need of specific training to perform motor tasks. Motor function develops as a "spontaneous" result of structural normalization. So to say, ABR grasps the problem right at its base, instead of trying to ease the outcome.

ABR considers that the information necessary for biomechanical rehabilitation is "written" on the musculoskeletal system directly, and therefore the instrumental methods of diagnostics (MRI, X-rays, EEG, EMG etc.) are only of supplementary value compared with the physical assessment. ABR does not support using splints or any “deformation-correcting” device, since their approach is no forceful intervention, no harm to the anyhow already weakened CP body, but adding and giving him what he needs in a peaceful way. All deformities visible in CP children are of course a normal, unusual and not as they are supposed to be, but these deformities will not improve with simply applying a splint. The essential component lies deeper, and therefore any “external” intervention to align and trying to push the limb in a “correct” and normal manner will in fact create even more stress on the specific joint. The more stress structures experience, the more they will contract, shorten etc. ABR does not want to force changes, but work properly for a beneficial and long-term improvement, that does not harm and stress the individual. (Blyum, L. (2009))

ABR emphasizes all over again, that restoration of the mechanical structure of the musculoskeletal system must come first and is the primary goal. How does one expect the brain to improve within functional training or repetitive movement strategies, if the underlying and all defining sub lying structures- muscles, bones, tendons, etc.- are not developed and function properly? When the musculoskeletal structure is profoundly distorted, any training is narrowed down to quite a limited scope: *"Trying to put poor structure to some better functional use. Without normalization of the musculoskeletal structure, any functional progress of a brain-injured person would always remain significantly limited and largely unpredictable.”*

ABR states, that mechanical transformation of the musculoskeletal elements (muscles, joints, etc.) automatically changes the parameters of their electrical charge. This respectively, changes the electrical activity of these elements (for instance, the skeletal muscles) and then translates into a transformation of the ascending signals sent to the brain, which in turn creates an adequate base for forthcoming descending signals to the muscles.

ABR states that even an injured brain still has enough reserves to rearrange its electrical connections in order to integrate biomechanical structural improvements of the musculoskeletal system, provided that the structural improvements are significant enough. This so-called neuroplasticity enables the brain to reroute and sprout in its electrical pathways. Having restored musculoskeletal structures, following results might be seen: First of all a full range of movements (i.e. the head being able to move unrestrictedly in all directions), second a proper alignment (i.e. legs in respect to the pelvis; arms in respect to the shoulders, etc.) and third a muscular mechanical response (proper muscular balance). These components will allow the child improved function and enhanced quality of life. In turn, the *“quality of mechanical performance”* requires *“bio-mechanical capacity”* of the musculoskeletal system, which implies: a proper volume, tone and strength of the skeletal muscles, a proper volume, mobility and alignment of the joint, an equilibrium of strength and length between reciprocal muscular groups (ex: biceps, triceps), an adequate proportions between size and strength of centre (head, neck, trunk) and periphery (arms and legs) and last but not least a cascade of muscular interactions (from centre to periphery).

5.7 ABR concepts

ABR emphasizes 3 essential concepts in describing the functional role of smooth muscles or internal myofascia with respect to the body's biomechanical structure. Those concepts are reasoned on following aspects.

5.7.1 The active breathing strengthening in healthy children

In the beginning, ABR focused primarily on the modeling of the naturally occurring mode of strengthening of internal respiratory muscles. This strengthening usually happens during the child’s first year of life: In the first months of life, prior to the unfolding of the gross-motor development, the child lies primarily on his/her back or stomach - essentially unable to use the arms and legs. At the same time the infant possesses specific bodily proportions: a large trunk and short limbs, and a specific bodily structure: a soft, pliable skeleton, with a great percentage of cartilage which has not yet undergone the hardening process or full ossification. Due to these specific proportions, almost the entire bodily weight of an infant is supported by the rib cage alone (without the help of the arms).

In other words: this skeleton itself is *not yet* the primary stabilizer and bearer of the child’s own body weight. On the other hand, because of the softness of the skeleton, a significant portion of this required body weight support is provided directly by the internal muscles of the respiratory system, utilizing their intrinsic sustaining tension in order to maintain the shape of the body. This therefore created substantial underlying tensional force that is basically kept up by *active breathing*, is the main source of the strengthening and the effective growth of the respiratory muscles - with a much greater efficiency than later in life.

There are several reasons why this underlying tensional force is that substantial: First of all, in the early child years there is by far greater involvement of the deep smooth respiratory muscles in the breathing excursions than later in life when the primary role belongs to the superficial intercostals muscles and the diaphragm. Secondly, because the respiratory muscles then have to work with maximum effort during inhalation in order to expand the chest against this tension and against the body weight. Thirdly, the deep, smooth, respiratory muscles have to work «full time», including during the exhalation phase, controlling the chest deflation in the so-called eccentric mode. Later in life the exhalation happens as a relatively passive deflation. As the child matures, the skeleton - in this case the rib cage - hardens and then the body weight is therefore constantly more and more passively absorbed by the emerging tensile strength or hardness of the ribs themselves. As a result, little to no extra effort is necessary from the side of the smooth respiratory muscles, and therefore the opportunity for their «supercharged» strengthening and growth disappears. It is at that stage when the child is able to begin learning to use and control the arms and legs. But before that, it must have trained and exercised his respiratory muscles as efficient and much as possible-because without that, it wont be able to focus on “additionals” such as using arms and legs.

In the first 3-4 months a child executes this breathing against its own weight 24 hours / 7 days a week, but even later - for the next 3-4 months - the infant further spends a good 18-20 hours a day lying down, continually building the respiratory system and the strength of the trunk, that then becomes the «nucleus» of the body's biomechanical structure - its' strongest core. *“Only when this core has formed properly, the control of the arms and legs becomes possible, and, in addition, we see that a tremendous acceleration in the acquirement of mobility and motor skills occurs from the age of 7-8 months and onwards.*
*Even a rough calculation shows us that the healthy child spends 4-5 thousand hours developing the internal structures (smooth muscles in particular) before gaining strength and stability enough to control the arms and legs.” (*Leonid Blyum)

5.7.2 Paradoxical breathing and weakness in CP

A brain-injured infant is deprived of this natural advantage. The respiratory muscles are sufficiently weaker than those of a healthy child's and lack sufficient strength to overcome the body's weight in breathing. As a result, the only option left for the CP child is excessive use of the diaphragm, which provides the suction necessary for drawing air into the lungs by bulging downwards into the abdominal cavity and spreading the lower ribs sideways. This is a so-called «paradoxical» type of breathing, which affects all CP children.

Additionally, for breathing to work well, the two diaphragms – the respiratory diaphragm and the pelvic floor- must face each other functionally: If the pelvis is too anteriorly tipped or the rib cage too posteriorly, this reciprocity between the two diaphragm is lost, and breathing becomes shallow and labored. This pattern is usually characterized by a very short, lower back, but a very long line of sternum to pelvis. (Myers, T. (1997-2000), p.60) As a result the CP child fails to achieve the formation of the strong biomechanical «core» or «nucleus» of the smooth muscles of the thoracic and abdominal cavities, which the healthy child develops via respiration over the first months of life. Without this «core», a CP child is then unable to meet the challenges presented by the growth of the arms and legs, which get proportionally larger and heavier later in life. As the result the imbalance between the weak trunk and enlarging limbs becomes more and more pronounced as a CP child gets older, eventually leading to a complete distortion of the muscular-skeletal system, resulting in spasticity, rigidity, contractures, etc. This situation increases dramatically as the child gets older. Unfortunately, this window of opportunity for spontaneous development of proper strength and growth of the smooth muscles of the respiratory system is very narrow - and as the CP child gets older it closes completely. The challenge that led to the development of the ABR technique was the re-creation of a similar effect of smooth muscle strengthening which is otherwise naturally present in the healthy child - regardless of the age of or severity of the child's condition.

5.7.3 Three essential concepts of the smooth muscles

Based on those essential components within the pathological course of a CP child, ABR uses three concepts that help understand how methods and techniques on CP children are substantiated.

5.7.3.1 *The hydraulic (or hydraulic/pneumatic skeleton)*

This concept highlights the structural roll of the smooth muscles - in comparison to the classical definition of the «hard», bony skeleton as being that which carries the sole responsibility for the body's structure. Smooth muscles and other structures of internal myofascia are the membranes that maintain the shape of the body, with an effect similar to the whitish-colored membranes within a grapefruit. These tissues envelope and en-sheaths the major bodily cavities (cranial, thoracic, abdominal etc.), enwrap each of the bodies' individual organs (lungs, liver, stomach etc.) and sustain the smallest compartments within each of the bodies system. It is the hydraulic quality of the smooth muscles that administers inner strength and form. The term 'hydraulic skeleton' is used most frequently by ABR for convenience. A normal "hydraulic skeleton" provides normal alignment of the bony skeleton and normality of skeletal muscles - allowing normal motor function. An abnormal, weakened "hydraulic skeleton" results in the collapse of the musculoskeletal system and impossibility of motor function.

5.7.3.2 The visceral skeleton (visceral core)

This skeleton is the name used for the observation and discovery that the structures comprising the hydraulic skeleton serve as the body's core and define the mechanical foundation of the internal organs for the body's structure.

5.7.3.3 Hydraulic pneumatic capacity

This term characterizes the "strength" and volume of the hydraulic/ pneumatic skeleton and the quality of «hydraulic support» that it gives to the musculoskeletal system and it summarizes several main characteristics: First of all, it is responsible for the level of pressure necessary for the development of sufficient internal volumes. Additionally this capacity produces the size of internal volumes and last but not least it represents the level of strength of the myofascial membranes that is necessary to achieve the normal internal pressure/volume ratio. This is in turn is required to sustain the challenges of gravity and of the external atmospheric pressure. Within these principles, the objective of ABR is to restore proper tone to the smooth muscles/internal myofascia, which in a cascade effect restores proportions and alignment of the skeleton. During this process, the muscle tone is normalized and arms and legs develop increasing muscle mass, normal range of mobility, and finally: sufficient strength. All other approaches address the skeletal muscles directly. Nevertheless, such a direct approach proves to give limited results. ABR sees the direct approaches as the ones addressing the "tip of the iceberg". The underwater part is the smooth muscles. (1)

5.7.4 Addressing the smooth muscles

Since the entire complex of internal myofascia (mucosa, smooth muscles, serosa etc. and their sublevels) are directly related to the quality of the general metabolism and being responsible for the general health of the child, ABR considers those smooth muscles as the "primary victims" of the brain injury. Additionally, superficial structures of a "classically" defined musculoskeletal system (muscles, ligaments, bones etc.) must be taken into account, as ABR states that this "hydraulic skeleton" defines the proportions and the alignment of the bony skeleton and the quality of the skeletal muscles.

ABR recognizes the importance of the strength of this lining made of smooth muscles (internal myofascia) for the proper development of a human body and, particularly of the musculoskeletal system, which is supported by this internal "hydraulic skeleton". This is why ABR proposes a unique technique to administer kinetic input directly to smooth muscles. Strengthening of the smooth muscles induces gradual growth of internal pneumatic capacity, which in a cascade effect restores: First of all, volume, shape and strength of the neck and trunk are formed, creating a stable and proper alignment of the child’s body. This alignment itself will already improve functioning and control of head and trunk within daily life tasks. Secondary, and that is a very important point a view: normal alignment of the joints of the limbs that itself in turn will eliminate spasticity and contractures. “Muscles supply the crucial tension in our tensegrity structure. The skeleton is held by the musculature, and not vice versa.” (Chapter II, Muscles). Imagining these muscles being tightened and stressed due to constant compensation of a disused or misused part of the CP child’s body, this will in stabilize the tensegrity of the internals structure of the body, itself causing even further on contraction of the muscles. The same of course counts for the circulation of constantly contracting muscles: Muscle surrounding nerves, we observed that circulation and metabolism of both the nerve and the muscle will constantly be diminished and chronically can result in scaring and loss of functional nerve and muscle tissue (Chapter II). In restoring normal and healthy fascial connective tissue, muscles and nerves will gain normal and physiological correct volume and strength of weakened skeletal muscles to encounter such imbalances such as spasticity. Normal alignment of the shoulder girdle and arms as well as pelvis and legs - allowing normal "insertion" of arms and legs will enable proper positioning and weight bearing processes possible. If the child is able to control his weigh bearing, it will constantly be able to use his limbs for skills that he can concentrate on while relying on his trunk control and balance. This itself, makes proper movements possible. Moreover, restoration of muscular skeletal structure re-establishes normal metabolism (flow of blood and oxygen supply) of 'defective', atrophied muscles and, in addition, normal electrical ascending activity to the brain, opening wide the "back door" to function. (1)

In the obvious lost balance of forces and a shift towards excessive strength and weakness within the CP child's body, ABR addresses contrary to almost all other classic rehabilitation methods *the excessive weak component, meaning strengthening that component in order to create a proper baseline for functional activity.* Within the proper fascial underlying component and the therefore proper baseline for the muscles to attach and function in, they create a secondary re-organizing of the tightened structures themselves. This mechanism is substantiated on the fact that fascial plasticity and deep tissue manipulation effects stimulation of mechanoreceptors and therefore the autonomic nervous system resulting in local tone changes: Fascia is densely innervated by mechanoreceptors which are responsive to myofascial manipulation. They are intimately connected with the central nervous system and specially with the autonomic nervous system.

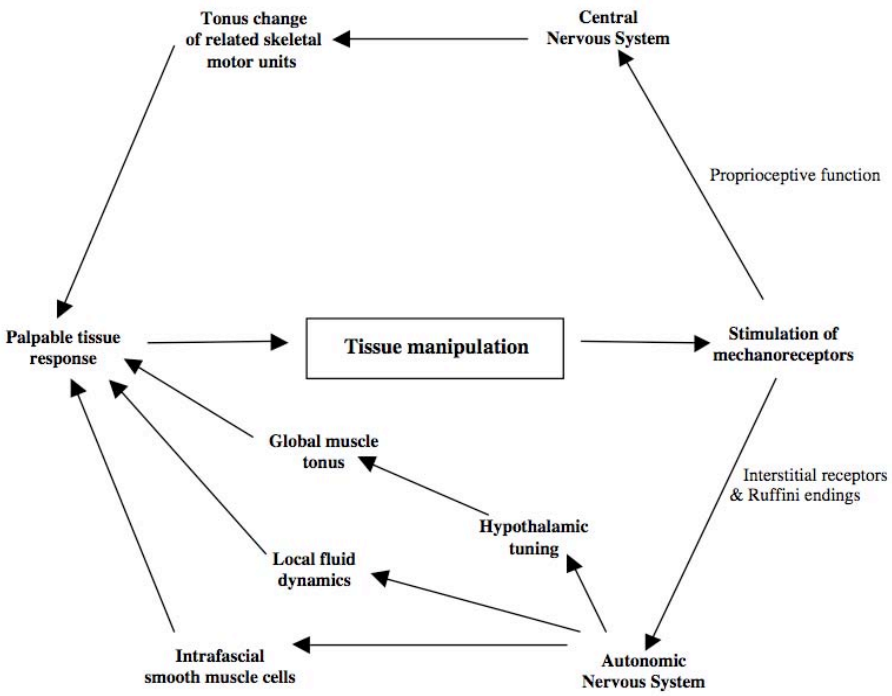


Fig. Flow chart of neural dynamics and tissue responses (7)

The practitioners manipulation stimulates intrafascial mechanoreceptors, which are then processed by the central nervous system and the autonomic nervous system. The response of the central nervous system changes the tonus of some related striated muscle fibers. The autonomic nervous system response included an altered global muscle tonus due to hypothalamic tuning, a change of vasodilatation and tissue viscosity, and a lowered tonus of intrafascial smooth muscle cells. (Cottingham, (1985), Gelhorn (1967), Mitchell &Schmidt (1977)), Staubesand and al.(1997), and Yahia (1993))

All these responses have the same effect on the palpatable sensation of the manipulator, but for ABR especially the component of a change in global muscle tonus in the specific region of interest. These changes might comfort the doubts of parents and classic rehabilitation practitioners, that usually think the opposite way: lets not strengthen what anyhow already seems to be so strong. ABR reasons its methods on the opposite way, creating a feedback loop and indirect stimulus on the excessively strong component.

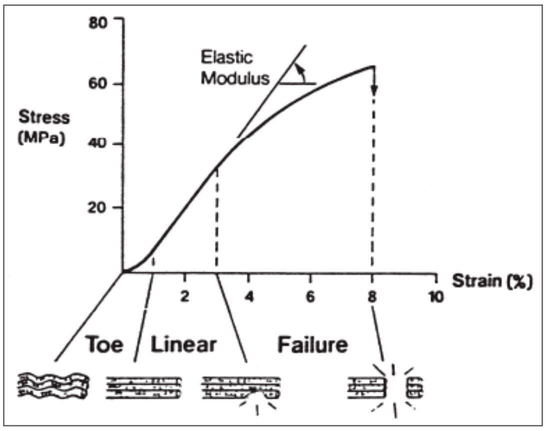
Therefore one can say that the ABR technique achieves the release of muscular tensions, shortness and spasticity with unparalleled efficiency, which far exceeds, and is incomparable to the effect reached by stretching. However, it would be completely incorrect to say that the ABR technique «aims» at the release of these superficial muscles. Internal strengthening is the only direct aim of ABR, but the release of the skeletal muscles is a «happy coincidence» or «fundamental biological law» (whichever name one prefers). Another simple explanation of this happy coincidence is the imagination of the inflated and collapsed ball I was mentioning before: The from-the-inside-out cascade effect rules the performance of the skeletal muscles. When internal myofascial structures weaken, the superficial muscles (dozens and dozens of them) automatically shrink and/or collapse. If, on the other hand, internal structures get stronger, the superficial muscles automatically release, elongate and increase in volume.

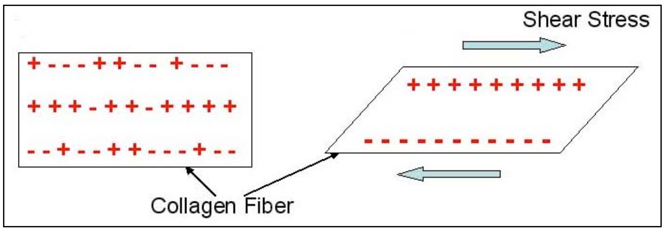
6.1 Strengthening of fascia

Strengthening the fascia is still not yet a very wide spread theme, and therefore it is difficult to find sufficient literature about it. The following module was used in Threlkeld,J. *"The effect on manual therapy on connective tissue",* 1992 and developed by Nordin M and Frankel VH.

Myofascial release can be explained due the zone of micro trauma or micro failure, which is the single local deformation that has the range of 3 to 8%. That is where the curve starts to branch off into a straight line and a curve. The elastic zone falls within the 1 to 3% strain zone and therefore nothing is happening. ABR is interested in is the range between 1 to 2% strains. As for ABR internal strengthening, it is explained by the repeated deformation happened at the range of 1 to 2%, where slow and permanent adaptation of the tissue takes place, resulting in permanent remodeling without harming health of membrane. This is reflected in the graph by the narrow zone between 1 to 2%. And that is where we want to work to deliver the mechanical stimulus inside but not to get lost outside (Fig Butler et al. (1978) in Threlkeld 1992) (Schleip, R. (2003)).

Evidentially both methods provide remodeling but the repetitive one is safer. Furthermore, Schleip presented a study that showed that producing enough stress to induce trauma in connective tissue (first method mentioned) would not be likely to be possible via manual therapy, thus providing additional support to the feasibility and appeal of method 2.





Additionally, we can make use of the so-called piezoelectric phenomenon in order to explain how mechanical energy is turned into electrical energy that stimulates remodeling. As we know now, fascia is primarily made up of collagen proteins. Collagen has dipole (+ive and –ive ends). Any deformation of tissue causes alterations in the electrical potential throughout, whereas this deformation itself creates a measurable electrical field. This field stimulates fibroblast activity to produce new collagen deposits.

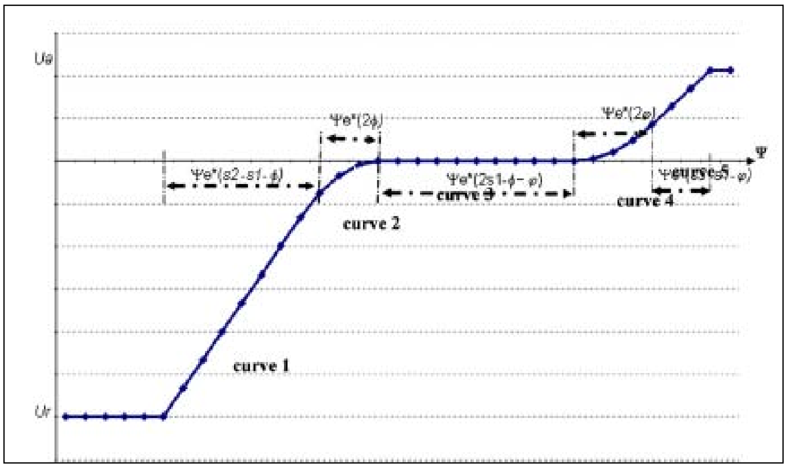
The mechanical absorption, i.e. the response of fascia as the active tissue to the mechanical input that we observe in ABR is what it is called a *Piezoelectric effect.* Prior to the mechanical input, the fascia has disorganized dipole structure. The impact causes deformation of the tissue, which in turn creates imaginable electrical field and that field stimulates the fibroblast activity. The fibroblast activity would then start laying new fiber according to new direction. This is how fascia is being strengthened.

All these entire process goes under the title of the mechano-transduction, which is today being studied at different levels. The following page will deepen this subject a little bit further, in order to make on understand of local mechanical transduction that take place on cellular level. Experimental difficulties complicate the method of cellular force application and magnitude required to stimulate a response. Further, the manner in which forces and stress is distributed within the cell is complex thus complicating the understanding of local mechanical response. Nevertheless, there are several theories available that attempt to describe the force transduction pathways in which a chemical reaction is stimulated:

1. Mechanosensitive ion channels have been identified as possible molecular transducers
2. Enhanced membrane diffusion also identified as intercellular signals often originate from membrane bound proteins
3. Cellular force may cause microtubule rupture which may initiate a biochemical reaction
4. Intracellular proteins expose protein-binding sites in reaction to induced forces (conformational change)
2. Forces lead to changes in transcription through stimulation of nuclear envelope

Although all these theories help supporting the theory of mechanotransduction into cells, its limitation is indicated by the use of cell-isolated procedures that clearly differs from regular response and altered by growth factors (in-vitro cell life maintenance).

And again when we return to the idea of the fascia and remodeling, there is a well-known thing called *Wolfs Law*. It rephrase the simple idea that anything within the human body that works in response to the environmental demand would develop while those that do not have any environmental demands get resorbed and wiped out. Since fascia is a physiological tissue within the body, it will respect Wolf's Law as well. This process is governed by the tissue mechanotransduction that is governed by stress (force) input.



Curve 1: resorption
Curve 3: equilibrium or lazy zone
Curve 5: apposition
Curve 2 & 4: transition zones

6.2 Essentials of ABR technique

6.2.1 The child as passive recipient of hands on application

Compared to other rehabilitation programs such as Bobath and Voijta, ABR doe instantly not make the child work and exercise, but implies the treatment on the passive child. The reason for that is quiet simple: Smooth muscles are involuntary muscles. This means that they are beyond control of the conscious mind or will, and therefore a child cannot exercise them by his or herself. In so far as the ABR technique is a hands-on application performed by the parent as the therapy provider, the child's body is a recipient of kinetic impact delivered by the application of the hand of the parent (provider). The mode of application causes an automatic reaction from the smooth muscles, gradually building their strength through the absorption of kinetic energy delivered by the parent's compression movement. *This is the same way in which the smooth muscles strengthen naturally when the small child breathes against the body's weight.* (5)

6.2.2 Towels as soft air cushion as transmitter of the ABR movement

The ABR technique aims at internal layers of myofascia (smooth muscles) rather than the external skeletal muscles. Remember when I referred to the internal fascia (connective tissue layers) as being the essential core of our stable body*: It is the network of connective tissue- the pressurized water bags and the tension cables- and not the bones, that bears most of the structural responsibility for stable, upright posture and graceful carriage.* (Chapter II, Connective tissue/tensegrity). That is what ABR is aiming to have impact on- the tissue that originally is developed in order to supply the body with structure and stability.

The question raising here is of course pretty clear: How to reach the deep internal fascia when applying external pressure? Pressure delivered directly by a bare hand, causes only elastic rebound of external muscles and bones, whereby all the kinetic energy of the movement is «wasted» and lost on the body's surface. The task faced by ABR was to find a method of transmitting the external input of kinetic energy to the deeper layers of the body.

The solution was found - unexpectedly enough - through the placement of an «air cushion» between the working hand of the therapy provider and the child's body. Not surprisingly, the first reaction of people was to expect the 'air cushion' to reduce the impact as a pillow would, by simply absorbing the kinetic energy of the hand movement. The thicker the pillow, the greater the energy loss would be. However, the reality is quite the opposite: If such an air cushion is properly shaped (in the lens form explained later on preciously) and compression is done very slowly, then this air cushion maintains near constant thickness throughout the movement. The impact of the hand movement reaches the deep internal smooth muscles and all the kinetic energy of a movement works towards their strengthening, instead of being wasted at body's surface. (4)

6.2.3 Mechanical properties and stimulus

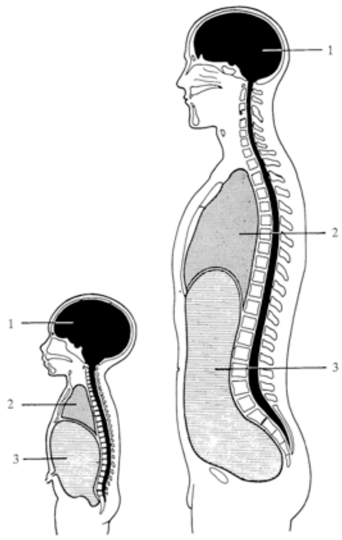
Healthy individuals are characterized by strong properties of the visceral fascia and a therefore consistent incompressible internal volume, which supports the integrity alignment, and all other dynamic properties of more superficial skeletal elements and respectively the muscles attached to it.

We know now that is not the case in CP individuals, as they are characterized by neurological impairment and weak visceral biomechanical core. We also know, that it is fact, that Fascia is able to adapt with its mechanical properties to the mechanical stimulus.

Since we know now as well, that there are two types of responses onto mechanical stimuli, it is important to state, that ABR is not interested in deformation between 3-8% (microtrauma), but instead in the 1-2% slow and non-traumatic remodeling of fascia.

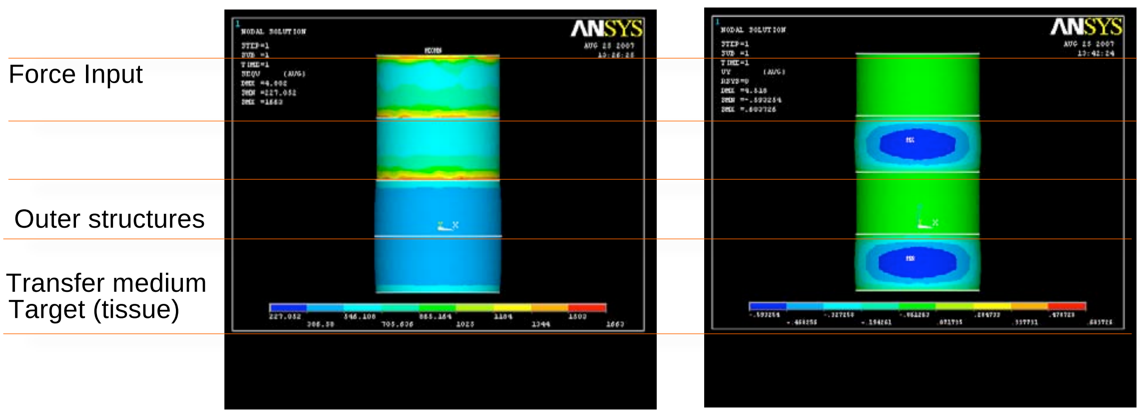
As already said, the internal structure that ABR wants to address is inside while the practitioner is outside. They are involuntary, and spherical instead of longitudinal. ABR was demanded to find away in delivering impact in such a way that one would get some meaningful response and consecutive strengthening over the course of time.

With help of the biomechanical modeling department in the ABR team, the last couple of years brought up a clear idea of what happens in the deep tissue manipulation of the ABR movement: The key idea is that if the applier of ABR is outside, but wants to address and get some minimal stimulus to the internal volume, he has to get pass the outer shell. And the harder the outer shell, the stronger the stress shielding effect.



This is what stress shielding effect is. The softer inside is always protected by the harder outside. If there is impact at the consecutive structure, the harder one would absorb the impact thereby shielding the softer structure from the impact and basically no impact would ever reach the weaker structure.

Lets have a closer look in how this stress shielding effect looks like and how it can be impacted by compressional external force: With the use of the 4-level model, one can understand how the force and manipulative effort of an external device can be transferred onto the desirable medium.



The forth level, is the lowest level which is the target i.e. the weak tissue, the tissue ABR wants to address. The third level is the outer structure, so to say the hard shell which is an analogue of the superficial layer. Hence in our case it is the ribcage, if we speak about the thorax. The second level represents the transfer medium: it is the construction through which the practicioners are trying to deliver the impact to the underlying layers. The first level is the force input: It is the hand. If the density of the Force Transfer Medium is greater than anything that one has on the inside, so what on is basically having with this force input, one is going to be just stopped at the bottom of the Force Transfer Medium.

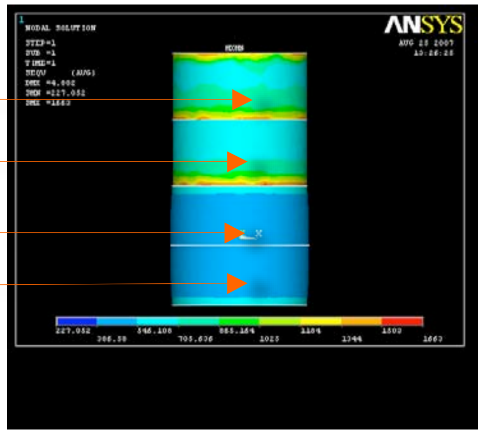
Basically the deeper the blue color, the greater the input is being transferred inside. In the first model (model on the left): when the stiffness of the transfer medium does not match with the target, there is no impact delivered to the inner tissue. In the second model (model on the right): when the transfer medium has the minimal possible density so as to match the weakness of the underlying structure, the force input would by pass the stress shielding effect and reach the inner tissue. (4) This strange stress shielding effect and the way to bypass the rigid is not really surprising and has been applied in other fields but never to manual therapy. The reality is that everything manual, usually by definition is being thrown into the basket of being non-scientific, non-verifiable, and purely subjective. That is as well substantiation of ABR, why to bring in textile constructions in between force input and targeted weak tissue.
For the impact to be transferred into the weak internal structure, the weaker the structure that one is targeting, the softer the medium has to be. And if one is trying to address the weak, or soft, or easily compressible through the hard transfer medium, nothing would ever be able to reach there. That is what this model indicates and in turn helps ABR to reason their clinical thinking and application. Re-translated into the material ABR uses, the following model can be applied:

Force input

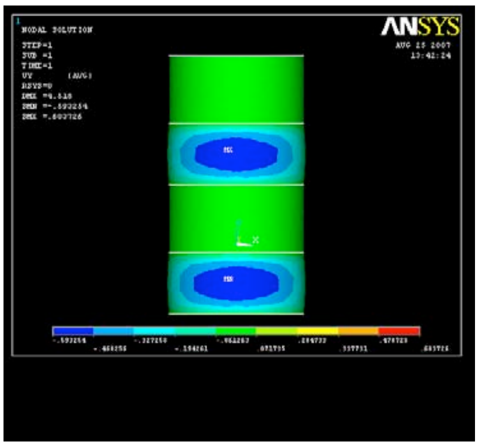
Force transfer medium (towels)

Hard outer shell (ribs/stronger outer membrane)

Target (deficient inner membrane)



Hence the Force Transfer Medium is the towels. If there is a hard outer shell and the transfer medium does not match with the target in density, then one is not getting much impact through.
Getting the right transfer medium is an absolute must in the ABR technique in order to reach the target tissue. But if one is dealing with the soft medium in between, it is important to ensure that the ABR applying person is not going to sink in so that the force transfer medium would continue to remain as our consistent medium of transfer instead of being just elastically depressed.



The other important thing is to recognize that this is the volumetric structure. It's not some selective muscular fiber, not some selective easily identifiable longitudinal threads of muscles;

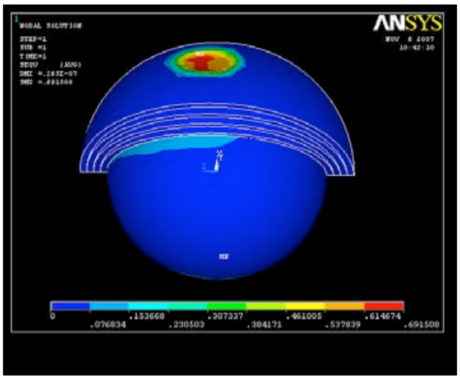
it's the volume with sub-compartments.

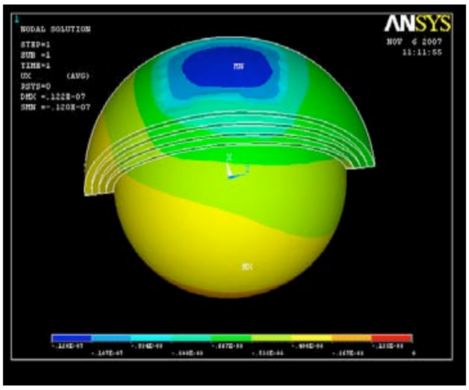
On the other hand, as already mentioned from the literature: It is the slow but non-traumatic remodeling of fascia that lies within ABR`s scope of interest, with deformations of 1% to 2%. Hence, ABR wants to avoid at all cost over compression, or elastic rebound, or any potential traumatic effects, using the so called principle of Triple Q Principle - *Quasi-static, Quasi-spherical, and Quasi-isotropic.*

Quasi-static means super slow movement. We would see in the later model that the way to deliver maximum input inside the weak tissue is through super slow movement.

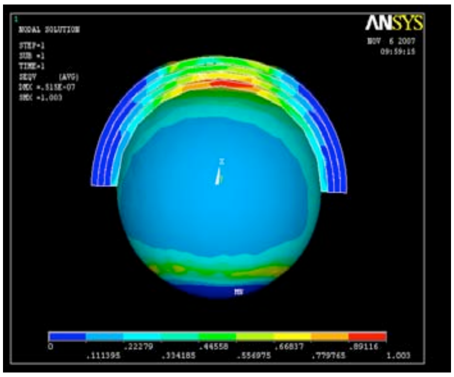
Quasi-spherical means we need to get sufficient area of coverage throughout the entire application so that we would not be sinking through a particular spot on it but would be involving the enlarged volume altogether. It doesn't mean that we have to go all the way around even if we want to address the total volume; it doesn't mean that we have to surround a person in one big hug and squeeze. It simply means that we have to get some minimal sufficient area so as to get the response we'll see through the model.

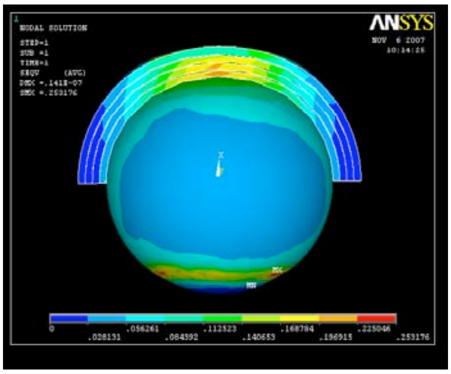
And Quasi-isotropic means that we don't want to deform the surfaces because any deformation of surfaces will cause the loss of that effect.
Let's look at the models that confirm these three basic principles. As represented in the colors of application pressure, it confirms the importance of the widespread application and the Quasi-spherical principle:





The model on the left is the model with the local compression on the surface of the force transfer medium while the model on the right is the model which show that a widespread application that involves the total volume. The figures in the model indicate that the impact generated by the model on the right would be like 600 over times larger than the model on the left. Summarizing one could say that if the impact is local and superficial, no matter how much impact we generate from outside, it's all just going to be lost there and nothing is going to be delivered into those weak visceral membranes that one is targeting through this kind of application. On the other hand, as shown by the model on the right, if one could delivers the widespread application, the efficiency of such a transition increases 600-fold. The same external force can have different impact on the body- through the use of different force transfer media (see figures below).





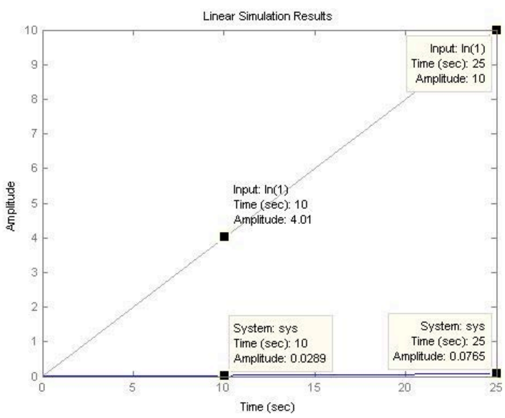
The next model discusses the importance of the relative speed of movement, which supports the principle of quasi static.

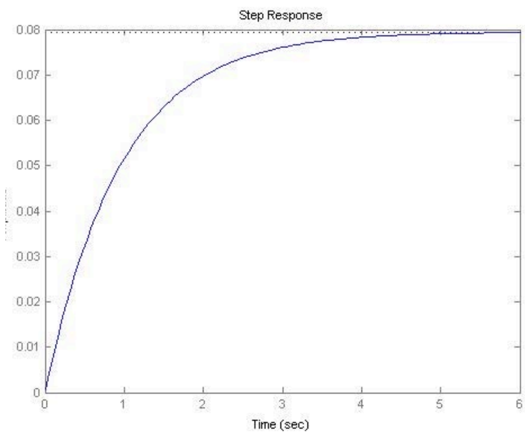
What one can see here is the model used to identify the effect of the rate of motion within ABR. Basically what is used is a variety of springs with different young modulus, i.e. different compressibility.

The outcome is simplified transformed on to the calculations axe below: The model has properties which are similar to the structure of the superficial tissue of the body:

The left column represents a fast movement, whereas the right shows the slow movement.

It becomes clear, that the left column indicates that quick input will cause tissue to withstand compression. But the slow motion on the right will effectively transmit motion to underlying tissues, The slow movement is able to deliver movement up to 19 times more of the impact throughout. This again confirms the specificity of the value of the strange appearance of the super slow ABR movement over 20 to 25 seconds. It becomes obvious that it makes a different when hard work is wasted on the surface, or the specific delivery is reached through the quasi static.





6.2.4 The optimal movement - quasi-static

Equally important to the shape and density of the air cushion, which I will come back to shortly, is the quality of the applied movement. If the movement of the hand is too fast, the hand sinks through the towels and the air cushion thus reacts as an ordinary pillow would, absorbing the impact and not creating a Pneumatic LensTM effect.

The quasistatic motion is a super-slow compression that generates increasing hydrostatic resistance from deep myofascial membranes as the impact reaches increasing number of internal compartments. The speed of the motion is important because it relates to the viscoelastic material properties of the fascial membranes. If the movement is done too fast (elevated strain rate) the outer membranes resist deformation and intended impact is dissipated elsewhere – " surface rebound" or stress-shielding effect. In turn, if done very slow (i.e. velocity ~ 0) the outer membranes allow the transfer of impact to the deeper layers with little loss – bypassing the external stress shielding and achieving internal "hydrostatic response". The quasi-static movement is a movement so smooth and slow, that it has almost no acceleration. The movement begins at an indiscernible speed and proceeds in that mode. (A superficial observer might conclude that the hand is still.) This ensures that the towels themselves are not compressed, but that the «lens» moves as one entire volume - complete with the air in the towels - achieving thereby the desired effect of transmission of movement simultaneously to greater internal bodily volumes.

Several factors define the ABR motion: The motion itself includes several stages of motion that ABR considers as the elementary motional phases of success when applied properly:

The firsts stage is called surface touch, basically establishing the appliers initial contact matching the surface profile. The second stage is Volume touch: Pre-compression that establishes initial tension within the deep myofascial membranes by eliminating a crimp being one of the characteristic of connective tissue that allows for small deformations with minimal restriction (see picture black line indicating the crimp). The third stage is namely the quasistatic compression, meaning the actual super-slow motion that in fact delivers impact to internal myofascial membranes.

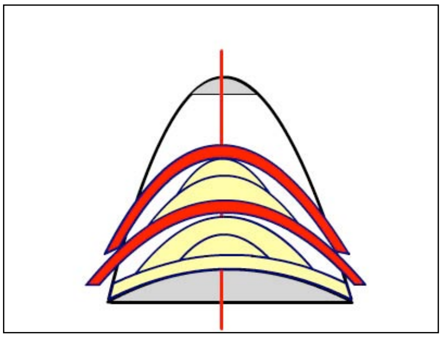
Within the last phase, the consolidation phase, the applier holds at the final position of compression- since although the motion stops, the inner tissues continues to respond as they exhibit a creep characteristic.(~ 5 seconds). On the other hand, ABR emphasizes three essential components that MUST be considered within these stages of ABR motion: controlled and constant rate of motion, (without any accelerating speed), a equivalently dispersed application area, and last but not least a proper established force transfer medium whose outer layer matches the stiffness of inner layer with a proper implemented force direction. Without these aspects, the application of a proper implementation of stages of motion will not be successful and beneficial for the child. Therefore this is an essential feature of ABR implementation.

Personal comment by L. Blyum:
"Most people who first observe the administration of ABR therapy do not see the movement of the hand. If they do see it, they cannot imagine that the person lying under all those towels can feel anything «with such a little movement».
The quasi-static mode of ABR movement typically provokes another reaction. Many people observing ABR applications from a distance for the first time ask me whether the method is really physical or whether it is another popular day «cosmic energy» transfer. Having demonstrated the technique to hundreds of people the world over, the reaction, which is inevitably evoked, is: "Wow, that feels a lot stronger than I expected." The demonstration and direct experience of the ABR method as a recipient is useful in confirming its effect as a tangible and hands-on method.

6.2.5 The optimal shape and density- Pneumatic Lense

When I first experienced the ABR movement, I was amazed how the increase and proper build-up of this air cushion magnifies the impact and feeling on the applied area. The strengthening of the smooth muscles of internal organs requires a source of energy other than the body's own metabolism. This energy comes in kinetic form from the movement of ABR therapist's hand. Another task ABR was confronted with, was to find material, that would «trap» the kinetic energy that is desirable delivered to the deep internal structures of the body. The essence was to first find material whose density ensures having an effect upon the ability of the air-cushion to transmit the kinetic energy from the moving hand of ABR therapist to the target of the smooth muscles in the underlying compartments. Secondly, apparently it was not just the material that matters, but as well the shape, form and therefore build-up density of and air cushion. ABR experimented with a variety of sponge- and foam-like materials to build an air cushion between the force applying hand and the body, when they discovered a surprising «optimal material»: towels. *"Optimal magnification of kinetic input of a working hand was found to be obtainable through constructing a dome shape out of thick, soft towels. This dome shaped towel build-up - which is most recently being supplemented with quilting lining material - is called by the ABR therapy the «Pneumatic LensTM».”*
The towels allow individually for every child's body endless adjustments in constructing an air cushion in a variety of thicknesses and shapes, corresponding to the individual child's body and to the area of application.

Basically, this pneumatic lens is creating the same effect as an architectonically designed dome shape of acoustic speakers does when minimizing the «waste» of sound when projecting it. The pneumatic lens magnifies the movement of the hand from the apex or top of the dome-shaped towel construction to the target - here being the underlying bodily volumes of the child. This is another essential feature of the ABR technique that must be considered to achieve most benefit from ABR treatment.



6.3 The safeness of the ABR technique

ABR uses towels to construct Pneumatic Lenses that address the internal smooth muscles. Moreover, the use of such «air cushions», combined with very slow (quasi-static) mode of hands-on pressure application, ensures that there is no compression of the superficial tissues (skin, bones and superficial muscles) - thus avoiding any mechanical risks.
The softness and gentleness of the ABR method is very relaxing for the patients, as well as being extremely safe.

6.4 Treatment of ABR in theory

Implementation of ABR is based upon the view that sufficient intensity of rehabilitation efforts can only be achieved in a home environment, with the treatment being delivered by a parent/caregiver. It is primarily the parents who possess the sufficient determination and time reserves required for the intensive home rehabilitation program. The task of ABR specialists is to teach the parents/caretakers how to apply ABR technique and also, to provide the strategic guidance as to the bodily areas and the time span of respective applications.

Leonid Blyum elaborates the strategy of the ABR rehabilitation program in each individual case. To attain the information necessary for this supervision, he performs one or two major assessments yearly and the further development of the patient is analyzed and recorded on video. During the assessments the prescriptions for further ABR exercises are prepared.

Parent(s) are invited to come with the child for a training session of 5 days, 2 1/2 hours per day. The training normally takes place in a room with 5 families at a time. The child is evaluated and then the necessary corrective exercises are taught to the caregiver. The caregiver then performs the exercises at home on a regular basis with the child. Your 50 ABR learning hours will be split over (4) four visits per year. The yearly schedule will be given to the parents on their first visit to the clinic in order to facilitate their planning.

Chapter 7 ABR EVALUATION

The largest patient group currently being treated with the ABR method consists of children with cerebral palsy or other birth (brain injury) related illnesses. In addition children and adults are being treated for a large variety of severe chronic disorders, for example Down's Syndrome, Rett Syndrome, spinal injuries, micropcephalis and others, premature babies, hyperactivity and developmental disorders. Children and adults with milder disorders also have the possibility of being treated with ABR.

7.1 General terms of ABR assessment

Every training session is preceded by an ABR musculoskeletal assessment that will help to follow up the treatment strategy and take necessary adaptations regarding insufficient or unexpected changes.

Assessments usually take one hour in length during which time parents are fully informed of the child's musculoskeletal status. Re-evaluations take place every three months, during which time the child is measured at strategic points and videotaped to track improvements.

In most cases, an ABR assessment involves the following:

1. Manual Assessment - whereby the extent of the loss of hydrostatic pressure, or the degree of ensuing rigidities is observed and measured manually in the major bodily cavities and/or limbs.
2. Structural Assessment - is a detailed comparison between the structure of the healthy individual with normal mobility and movement, and that of the patient. The structural abnormalities are described, as well as the changes necessary to achieve improved mobility.
3. Tissue Quality Examination - Even a close look at the skin quality, can provide a great deal of information about the patient's condition. The rapid transformation in skin and underlying tissue quality amongst ABR patients, reveal changes emerging at deeper tissue levels. At the level of the skin one can see for example emerging myofascial segmentation of bodily parts.
4. Mobility and "Shooting Tests" (Elastic springing) - These measure and discern the degree of plasticity and lack of segmentation at the different levels of musculoskeletal system. On hand from these tests, decreasing spasticity and increasing mobility is easily readable.
5. Movement and Postural Analysis - This illustrates the correlation between existing structural malformations and aberrations of movement.

The immediate expected transformations in the patient are outlined in detail for the parents, in reference to the described "tests", as well as in reference to expected improvement in function.

Usually, the ABR team does comparison files in order to visualize the direct outcome of treatments in a comparative version with former performances of their child and therefore its progress within the months. 3 months ahead every visit and re-assessment, the parents are asked to create a home video that covers the most important aspects of the assessments the ABR trainer and team members do when they see the child. In that manner, the ABR team has the ability to get a vague idea of the child's prospective improvements or as well of necessary changes in the exercises that need to be taken care of in order to see further progression. These home videos taken by the parents are only a guideline for what the ABR anyhow will repeat doing in a professional manner, and additionally it helps the parents to understand what to look out for when they observe changes in their child during simple daily life tasks and changes. In that manner, parents share observational as well as treating responsibility for their child- since they are the ones that apply the treatment on their children. Parents become the drivers, instead of passengers in the vehicle of treatment and progress.

Chapter 7 DISCUSSION

Having studied physiotherapy for almost four years now, having learned techniques, methods and principles of classic implementation within the field of physiotherapy, a field that seems to be so variable and beautifully creative in its implementation, made me conclude following: treatment is supposed to be individually and tailor made for the body and mind to be treated. The, as one would call it, ultimate treatment does not exist, neither for low back pain, nor for Cerebral palsy individuals.

Nevertheless I must admit: having learned and worked with deep tissue and myofascial philosophies has definitely opened my mind and broadened the horizon of what I thought I am able to work in. ABR has proven me, as well as I am hoping for, the reader of this paper, that there is more to work for and concentrate on than the classic physiotherapeutic approach and view. The substantiation, reasoning and principles ABR stands for convinced me as fresh and young motivated physio-mind to be open for those kind of working methods. As a matter of fact, having followed many different individuals all over the world approaching ABR treatment, made me hope for those children, as well as for their families, that ABR is able to improve quality of life's, for the child as well as for the care-givers.

But since international care-giving and methods seem to be necessarily evidentially proven, my substantiation, as well as ABR `s at this moment might not be enough to globally convince and influence the possibilities of CP treatment.

Therefore, and I guess I am speaking for all CP individuals, their parents as well as other caregivers currently applying ABR on those children, I am convinced that further research and testing of ABR as an efficient treatment method for CP children is necessary and of great importance in order to add this obviously effective method of deep tissue manipulation and myofasial strengthening to the current list of possible treatment methods for CP individuals.

As our current health systems all over the world are still diminished in their acceptance of official methods and techniques to be used for CP children, one, and especially the parents, still have the great responsibility to choose what treatment seems to be suitable for their own child. And even though one might not be convinced to choose specifically ABR for his or her child, the ability of just considering ABR as one of the possible treatments should be further prosecuted and supported.

ABR is able to help our children. It should be of no question that that is the common thought of international care-giving and treatment, and it therefore should be of no doubt whether or not considering ABR worth, giving it a chance and the attention it deserves.

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Writing this thesis has been a project for me. Collecting and analyzing material and moments in order to be able creating that paper you were reading and studying just now, was both, enriching and difficult for myself. Nevertheless, and even though being very much aware of my own personal effort and work, I am grateful and thankful of the people and individuals that enabled writing and representing this paper in public and school.

I want to thank all ABR families I met for sharing their stories and destinies, their joy and desperation. I appreciate all families and care givers patience and tolerance towards my fresh-blooded and young state of mind. I am positively optimistic that, sharing their destiny and passion will help other individuals having a similar destiny.

Even more I want to show my respect towards all families I have met until now for their strength and love they are sharing and giving to their kids, never loosing their faith and truly loving them.

I also want to thank all members of ABR team, their trainers, friends and families. ABR felt from the very first moment like family, getting to know all of you was enriching and wonderful. I am thankful for being invited joining and accompanying your life’s for a while, experiencing a comfortable and inspiring working atmosphere that I will never forget.

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References

1. Blyum, Leonid (2009) official statement during ABR session July 2009
2. Booth CM, Cortina-Borja MJF, Theologies TM. Collagen accumulation in muscles of children with cerebral palsy and correlation with severity of spasticity. Developmental medicine & child Neurology 2001,43:314-320
3. Botte MJ, Nickel VL, Akeson WH. Spasticity and contractures: physiological aspects of formation. Clinical orthopedics and related research 1988. 233:7-18
4. Boyd R, Graham HK. Botulinum toxin A in the management of children with cerebral palsy: indications and outcome. *Eur J Neurol* 1997;4(Suppl 2):S15-S22.

3\. Brunner, Reinald and Romkes, Jacqueline (2006). Abnormal EMG-activity in pathological gain in patients without neurological diseases. Laboratory for gait analysis, children's university Hospital, Base, Switzerland

4\. Butler DL, Grood ES, Noyes FR. Biomechanics of ligaments and tendons Exerc. Sport Sci Rev. 1978;6:125-181

5\. Carlberg, Eva Brogren; Hadders-Algra, Mijna. Postural dysfunction in children with cerebral palsy: some implications for therapeutic guidance . Neural plasticity, January 1, 2005

6\. Corry IS, Cosgrove AP, Duffy CM, et al. Botulinum toxin A compared with stretching casts in the treatment of spastic equinus: a randomised prospective trial. *J Pediatr Orthop* 1998;18:304-11.

7\. Damiano DL, Abel MF. Functional outcomes of strength training in spastic cerebral palsy. *Arch Phys Med Rehab* 1998;79:119-25.

8\. De Graaf, Jan Willem (2000). Relating New to Old, A classic controversy in developmental psychology.)

9\. Dodd KJ, Taylor NF, Damiano DL. A systematic review of the effectiveness of strength-training programs for people with cerebral palsy. *Arch Phys Med Rehab* 2002;83:1157-64.

10\. Doty, P. "Proteins", Scientific American, Sept 1957

11\. Eble, JN. 1960. Patterns of response of the paravertebral musculature to visceral stimuli. American Journal of Physiology 198:429-433

12\. Ellison PH, Horn JL, Browning CA. Construction of an infant neurological international battery (Infanib) fro the assessment of neurological integrity in infancy. Phys ther 1985;65 (9):1326-1331

13\. Ellison PH, the infanib A reliable method for neuromotor assessment of infants. Therapy skill builders Texas

14\. Erlingheuser, R.F." The circulation of cerebrospinal fluid through the connective tissue system", in the academy of applied osteopathy yearbook, 1959

15\. Gad M. Bialik, Uri Givon. Cerebral palsy: classification and etiology. Acta Orthop Traumatol Turc 2009;43(2):77-80 .doi:10.3944/AOTT.2009.77

16\. Gardner, L.I. "Deprivation Dwarfism". Scientific American, July 1972

17\. Garfin SR, Tipton CM, Mubarak SJ, Woo SL, Hargens AR, Akeson WH., (1981) , Role of fascia in maintenance of muscle tension and pressure. 1981 Aug;51(2):317-20.

18\. Gellhorn, E. 1967. Principles of autonomic-somatic integration: physiological basis and psychological and clinical implication. University of Minnesota Press, Minneapolis, MN

19\. Glazier, Paul S. Davids, Keith. Bartlett' Roger M. (2003) Dynamical system theory: a Relevant Framework for Performance-Oriented Sports Biomechanics Research

20. Gormley ME Jr, Krach LE, Piccini L. Spasticity management of the child with spastic quadriplegia. *Eur J Neurol* 5(Suppl 5):S127- S135.
21. Graham HK, Aoki KR, Autti-Ramo I, et al. Recommendations for the use of Botulinum toxin type A in the management of cerebral palsy. *Gait Posture* 2000;11:67-79
22. Graham, H. Kerr; Selber**.**P. Musculoskeletal aspects of cerebral palsy**.** Journal of Bone & Joint Surgery. (British volume). London: Mar 2003.Vol. 85, Iss. 2; pg. 157, 10 pgs
23. Greene WB, Dietz FR, Goldberg MJ, et al. Rapid progression of hip subluxation in cerebral palsy after selective posterior rhizotomy. *J Pediatr Orthop* 1991;11:494-7.
24. Gross, J., “Collagen”, Scientific American, May 1961
25. Guyton, A.C. textbook of Medical Physiology,6th ed. W.B. Saunders Co, Philadelphia,1981.p.597
26. Juhan, Deane (1987) Job`s body- a handbook for bodywork. Barrytown: Station Hill
27. Kamenetz, H.L. (1980), “History of massage”, in manipulation, traction and massage, 2nd ed., edited by Joseph B. Rogoff, Williams and Wilkins, Baltimore, pp.37-8
28. Krebs A, Strobl WM, Grill F. Neurogenic his dislocation in cerebral palsy: quality of lifeand results after hip reconstruction.J Child Orhtop (2008) 2:125-131
29. Ledermann,E. 1997. Fundamentals of Manual therapy. Churchill Livingstone. Edinburgh.
30. Levin, Stephen M. Continuous tension, discontinuous compression- a model for biomechanical support of the body. The bulletin of structural integration, Vol.8, No.1: spring-summer 1982.
31. Levine,S. “Stimulation of Infancy”, Scientific American, May 1960
32. Little, K.E.,” Toward more effective Manipulative management if chronic myofascial strain and stress syndromes”, in The journal of the American Osteopathic Association, 68:675-685, 1969 March, p.679)
33. Liu JM, Li S, Lin Q, Li Z. Prevelance of cerebral palsy in China. Int J Epidemiol 1999;28:949-54)
34. Lockhart, R.D., Hamilton,G.F. and Fyfe,F.W.,Anatomy of the Human body, J.B. Lippincott Co., Philadeplhia,1969
35. Mac Keith RC, Polani PE. Cerberal Palsy. Lancet 1958;1:61
36. MacLennan A. A template for defining a causal relation between acute intrapartum events and cerebral palsy: international consensus statement. BMJ 1999; 319: 1054-1059
37. Menkes JH, Sarnat HB. Periutal asphyxia and trauma. In Menkes JH, Sarnat HB,edn. Child Neurology. Lippincott Williams and Wilkins 2000;427-436
38. Merleau-Ponty, M. (1945). Phenomenologie de la perception, p. 231, excerpt translated by father Aelrid Squire in chapter 5 of his Asking the fathers, S.P.C.K., London, 1973
39. Miller F, Dabney KW, Rang M. Complications in cerebral palsy treatment. In: Epps CH, Bowen JR, eds. Philadelphia. JB Lippincott Co. *Complications in pediatric orthopaedic surgery* 1995;23.
40. Mitchell JH, Schmidt RF. 1977. Cardiovascular relfec control by afferent fibers from skeletal muscle receptors, In: Shephard JT et al. (eds). Hnadbook of Physiology Section 2, vol III, Part 2,623
41. Montagu, A. (1971) Touching: The Human Significance of the Skin, Harper and Row, New York, 1971, pp.236,317-8)
42. Myers, Thomas. Body3- A therapists anatomy reader. Collection articles published in Massage magazine 1997-2000
43. Ojturk M, Akkus S, Malas M.A. Kisioglu, A.N. Growth status of children with cerebral palsy. Indian Paed 2002;39:834-838)
44. Okan N, Okan M, Eralp O, Aytekin AH. The revelance of neurological disorders among children in

Gemlik (turkey).Dev Med Child Neurol 1995;597-603)

45. Pin T, Dyke P, Chan M. The effectiveness of passive stretching in children with cerebral palsy. Developmental Medicine and Child Neurology 2006; 48(10): 855-862
46. Pirpiris M, Graham HK. Management of spasticity in childhood. In: Barnes MP, Johnson GR, eds. *Upper motor neurone syndrome and spasticity. Clinical management and neurophysiology*. Cambridge: Cambridge University Press 2001:266-305.41.
47. Radzan S, KAul RL, Motta A, KAul S, Bhatt RK. Prevelance and pattern of major neurological disorders in rural Kashmir (India) n 1986. Neuroepidemiology (1994;13:113-9)
48. Rang M, Silver R, De La Garza J. Cerebral Palsy. In: Lovell WW, Winter Rb,eds. Pediatric Orthopaedics 2nd ed, Vol 1. Philadelphia: JB Lippincott,1986
49. Reily,S., Skuse,D. Poblete, X. Perevelance of fedding problems and oral motor dyffunctions in children with cereberal palsy. J Pediatr. 1996;129;877-882)
50. Robbie, D.L. “Tensional Forces in the Human body”, in the Orthopaedic Review, vol.6,no.11, Nov 1977
51. Rolf, Ida P. “Rofling, Dennis-Landmann, Santa Monica ,California,1977,p.180
52. Romanes, G.J., ed., Cunninghma`sTextbook of Anatomy, Oxford University press, London, 1972, p.65-68
53. Rosen MG, Dickinson JC. The incidence of cerebral palsy. AM J Ostet Gynecol 1992;167:417-23)
54. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Daminao D, et al. A report : the definition and classification of cerebral palsy April 2006.Dev Med Child NEurol Suppl 2007;109:8-14
55. Rosenblatt,J.S. and Lehrman,D.S., “Maternal Behavior in the abatory rat”, in H.L.Rehingold (ed.), Maternal behavior in mammals, Wiley, New York, 1963,p.14 (in Montagu,pp.18-9)
56. Rosenzweig, M.R., Benett, and Diamond, E.L., and Diamond,M.C., “Brain Changes in Response to Experience, “Sceintific American, Feb, 1972
57. Ross,R. “Wound Healing”, Scientific American, June 1967
58. Roth,L.L. “Effects of Young and Social Isolation on maternal behavior in the virgin rat”, American Zoologie,vol.7,1967,p.800 (in Montagu,p.33)
59. Sanger T.D., Delgado M.R., Deborah D, Hallett M, Mink J.W., task force on childhood moyro disorders classification and definition of disorders causing hypertonia in childhood. Pediatrics 2003;111(1): e89-e97)
60. Sankar, Chitra; Mundukur, Nandindi..Cerebral palsy-dfinition, classification,etiologa and eayrly diagnosis. Indian journal pediatr 2005;72 (10):865-868) vol.72
61. Schleip, R MA, Rolfing Faculty, European Rolfing Association, Journal of Bodywork and movement therapies (January 2003), Fascial plasticity-a new neurobiological explanation. Part 1.
62. Schleip, R, Lehmann-Horn F, Kliner W (2006); fascia is able to contract in smooth muscle- like manner and therby influence musckuloskeletal emchanics. In Lipsch D: proceedings of the 5th World Congress of Biomechanics, Munich, Germany 2006, ISBN 88-7587-270-8,pp51-54
63. Schleip,R. 1993. Primairy reflexes and structural typology. Rolf Lines 21(3);37-47
64. Sheldrake, R. and Weber, R.V., “ Morphogenic Fields: Nature` Habits?, “in ReVision journal, vol.5, no. 2, fall 1982, p.30
65. Shingi PD, Jagirdar S, Malhi P. Epilepsy in children with cerebral palsy. J Child neurology 2003;18;174-179Sweeney JK, Heriza CB, Markowitz R. The changing profile o pediatric physical therapy: A 10-year analysis of clinical practice.1994, Pediatr Phys Ther. 1194;6:113-118

66. Sperry, R.W. “The Growth Of Nerve Circuits”, Scientific American, Nov. 1959
67. Staubesand J, Li Y. 1996 Zum Feinbau der fascia cruris mit besonderer beruecksichtigung epi-und intrafascialer nerven. Manuelle medizin 34:196-200
68. Staubesand J, Li Y. 1997. Begriff und Substrat der Faziensklerose bei chronisch-venoeser insufficzienz. Phlebologie 26:72-79
69. Sweeny JK, Heriza CB, Markowitz R. The changing profile of pediatric physical therapy: A 10-year analysis of clinical practice. *Pediatr Phys Ther*. 1194;6:113-118
70. Synder, G.E. “Fascia- Applied Anatomy and Physiology”, in The Journal of the American Osteopathic Association, 68:675-685, March 1969, p.677
71. Taylor, R.B., “Bioenergetics of Man”, in academy of applied osteopathic association, 68:675-685, p.679)
72. Threlkeld, J. The effects of manual therapy on connective tissue. Physical therapy, vol. 72, number 12, Dec. 1992
73. Todd, M.E., The thinking body, Dance Horizons Inc., Brooklyn,NY,1979,p.24
74. Vander, A.J., Sherman,J.H. and Luciano, D.S., Human Physology-the mechanisms of body function,2nd ed., Mc Graw-Hill Co., New York,1970,p.217
75. Varela, Francisco J . Thompson, Evan. Rosch, Eleanor. (1992) The Embodied Mind. Cognitive Science and Human Experience
76. Verzar, F. , “The Aging of Collagen”, Scientific American, April 1963
77. Wiley ME, Damiano DL. Lower-extremity strength profiles in spastic cerebral palsy. *Dev Med Child Neurol* 1998;40:100-7
78. Wright FV, Sheil EM, Drake JM, Wedge JH, Naumann S. Evaluation of selective dorsal rhizotomy for the reduction of spasticity in cerebral palsy: a randomized controlled trial. *Dev Med Child Neurol*
79. Wright J, Rang M. The spastic mouse and the search for an animal model of spasticity in human beings. Clinical orthopedics and related research 1990. 253:12-9
80. Yahia LH, Pigeon P, DesRosiers EA: Viscoelastic properties of the human lumbodorsal fascia. J Biomed Eng 15:425-429 (1993)