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# MANUAL THERAPY IN CHILDREN: PROPOSALS FOR AN ETIOLOGIC MODEL

Heiner Biedermann, MD<sup>a</sup>

**M**anual therapy in children (MTC) is receiving greater attention. Several monographs and reviews deal with this subject<sup>1-4</sup>. Although these publications cover the field from the viewpoint of a classic pediatric approach, discussing which diagnoses of pediatric medicine might be successfully treated by MTC, they do not furnish an independent concept for the functional disorders that we see in these children.

This article proposes such a framework through a model: the kinematic imbalances due to suboccipital strain (KISS) concept. This concept groups the symptoms and signs associated with functional disorders of the cervical spine into an entity linked to easily recognizable clinical situations. By using this concept as a term in the communication with other caregivers of infants and children, we may be able to improve the contact between pediatricians and specialists of MTC, thus facilitating the identification of those cases where the use of MTC will be most useful. The definition of a functional disorder that is caused primarily vertebrogenerally enables pediatricians, physiotherapists, speech therapists, and others who address infants and schoolchildren to widen their scope of available therapeutic options and to include the “functional approach”<sup>5</sup> in their therapeutic considerations.

The emphasis of this article is to present the clinical picture and some background information pertaining to the causes and course of KISS and to present a manipulation technique.

## THE SPECIAL SITUATION DURING THE FIRST YEAR

Newborn infants are different from adults or even older children in many ways. With a brain weight of  $\pm 400$  g at birth (rapidly increasing to  $\pm 1000$  g at 1 year),<sup>6</sup> the central nervous system (CNS) of a newborn is small and light. Moreover, its most “human” parts, the prefrontal areas, are not yet myelinated and thus unable to function properly before 2 years of age<sup>7</sup> and develop until the end of the teenage years.

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Sources of support: none.

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Paper submitted January 10, 2004; in revised form December 10, 2004.

J Manipulative Physiol Ther 2005;28:211.e1-211.e15.

0161-4754/2005/\$30.00+0

doi:10.1016/j.jmpt.2005.02.011

But even myelination does not automatically implicate complex capabilities, as several crude yet convincing tests indicate. The electroencephalogram of a newborn, if derived from the scalp of an adult would be considered<sup>8</sup> “. . . sufficiently abnormal to indicate imminent demise.” The metabolic rate at this stage is low.<sup>9</sup> After birth, most of the activities of the newborn are governed by spinal and cerebellar reflexes. These primitive and unconditional reactions are gradually replaced by more complex patterns, parallel to the ripening of the pyramidal tracts and other structures of the suprapontine areas of the CNS.<sup>10,11</sup>

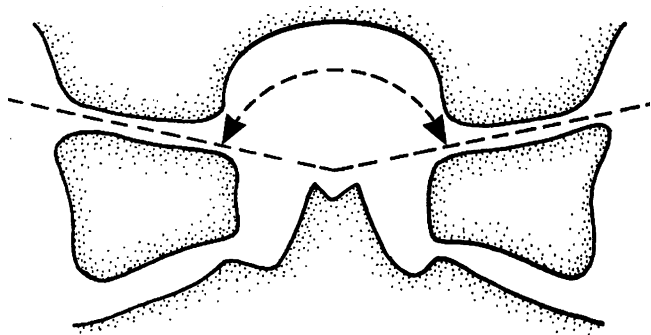
The differentiation of the fine structures of the CNS depends on and is modified by external stimuli on various levels. These influences commence before birth and are documented on the nutritional<sup>12</sup> and acoustic<sup>13</sup> level. Before birth, mothers report marked differences regarding the movement patterns of their babies and they are able to trace these patterns to distinctive events, that is, special food they ate or activities the mothers are performing at a given moment.<sup>13</sup>

There seems to be a correlation between infants which are “lazy” during pregnancy and those infants which display postural or behavioral problems during the first months.<sup>14</sup> These children show postural stereotypes with a fixed lateral bend of the spine or a preference of hyperextension. In most cases these phenomena seem to be limited to a rather short period. Thus, it is not surprising that these cases are regarded as basically self-limiting and not in need of a specific therapy. Some papers dealing with colic hint a “difference in state regulation and control in infants with colic”<sup>15</sup> and mention functional neurologic disorders<sup>16</sup> in these children, whereas other factors like nutrition or allergies are mostly excluded.<sup>17</sup>

We should be aware that the infant’s development, and primarily its acquisition of neuromotor competences, is intimately connected to the optimal functioning of its interface with the external world. The performance of this system depends on a multitude of components, which are beyond our influence. A few of them are accessible to therapy and one of these is the “spinal engine”.<sup>18</sup> At that stage of ontogeny, an important component of this engine is the upper cervical area.

## THE BIOMECHANICS OF THE OCCIPITO-CERVICAL JUNCTION IN NEWBORN

Functional magnetic resonance imaging (MRI) and other tools improved our understanding of the working conditions



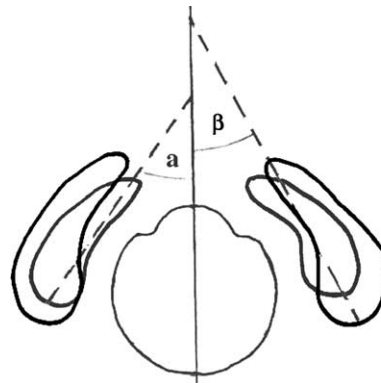
**Fig 1.** The frontal angle of C0/C1. In children it is not easy to measure this angle because the cartilaginous tissue is much thicker during the first years.



**Fig 2.** This 6-month-old infant boy has joint planes that are nearly horizontal, something common during the first year of life.

of the developing CNS in the last decade. Another area where these differences between adults and newborn are important is the development of the suboccipital structures during the first year. These anatomic details can be examined by conventional radiographs that are taken routinely before any treatment of the cervical spine. Our archive of radiographs of newborn and small children (more than 12,000 cases) made it possible to look at some of the data provided by authors who did not have access to our data.<sup>19</sup> One example is the frontal and sagittal angle of the suboccipital joints, that is, the orientation of the condyle-atlas junction (Figs 1-3).

We examined a sample of more than 1000 radiographs and found that the almost horizontal orientation of the frontal angle C0-C1 decreases rapidly during the first year of life.<sup>19</sup> At the age of 11 years the adult configuration is almost attained. As the sagittal angle shows, a comparable trend from an initially shallow configuration to a steeper angle restricts the movement of the structures involved. This crucial region is much less protected against excessive mobility during the first months and years.



**Fig 3.** The sagittal angle C0/C1. The sagittal plane shows development similar to the frontal plane. Here the angle decreases from 36° to 28°, restricting the range of motion.

Two other aspects of the infant's biomechanics confound this situation. The head occupies a larger percentage of the newborn body and the muscles maintaining active control of the connection between head and trunk are weaker than they are later in life.

Three aspects combine to render the suboccipital region vulnerable during the first months: (1) insufficient articular restriction of movements between occipital condyles and the atlas; (2) insufficient active (muscular) fixation between head and trunk; and (3) undeveloped neuromotor control of these structures.

These findings complemented the importance of this area for the proprioceptive control of the entire body and its influence on the sensory integration of the acoustic and optical system. If the newborn does not achieve control over the active positioning of its head it cannot orient its eyes toward a source of interest and acoustic focusing is at least more complicated, if not impossible. The suboccipital region is set apart from other areas of proprioception, and even more so in small children.

#### THE TRAUMA OF BIRTH

Studying the strain exerted on the suboccipital structures during birth, one may be astounded that no lasting injuries are caused. We tend to forget how dangerous these few centimeters are.<sup>20,21</sup> General anesthesia and modern pharmacology provide us with tools to overcome most of the problems mother and child may face during birth. But one should not forget that the older obstetric literature was filled with gruesome procedures to dismember the fetus in utero if the normal birth had not succeeded.

Before the use of general anesthesia and antiseptics, a cesarean delivery almost inevitably led to the death of the mother and was therefore extremely rare. Today, use and abuse of cesarean deliveries are discussed controversially and in some clinics a third of the births are by cesarean delivery.<sup>22-24</sup> From our viewpoint as specialists of functional

disorders of the vertebral spine, the advantages of a broad indication for a cesarean delivery seem obvious.

In research done in the Netherlands, healthy newborns were examined routinely after birth and a noticeable amount of intracerebral lesions were found.<sup>25</sup> In our studies, infants born by cesarean delivery are underrepresented, and even more so if one excludes from this group the breech position, a frequent indication for a cesarean delivery.

A cesarean delivery is no guarantee that the cervical spine was not mechanically strained. Depending on the length of the abdominal incision and the urgency of the operation, the child may have been pulled out forcefully. In most cases the cesarean delivery is at least less demanding on the suboccipital structures than a vaginal delivery.

Phylogenetically, there are 2 main problems regarding the delivery mechanism of the fetus. Firstly, the bipedal gait necessitates a profound alteration of the pelvis. Its function in quadrupeds implies an open and oval construction, connecting the hind member with the vertebral spine at an angle of about 90°; this leaves ample space for the delivery of the fetus. With the upright posture of the trunk the pelvis had to be closed as much as possible to carry the intra-abdominal structures and the ilium had to be bent outward to make room for the gluteal group. These muscles have a different working angle once the trunk sits on top of the hind leg and not in front of it.<sup>18,26,27</sup> The birth channel is in direct contradiction to these constructive principles as the fetus has to pass through this now much smaller aperture. This is one of the reasons why the sexual dimorphism of the pelvis is bigger in human beings than in any other group of mammals.<sup>28</sup>

Another constructive problem adds to this dilemma: the acquisition that upright posture as consequence the femuro-spinal angle of roughly 90° has to be enlarged to almost 180° and beyond. This is achieved by redesigning the lumbosacral junction and it leads to the almost angular promontorium<sup>29</sup> that is a uniquely human achievement and another obstacle for the fetus. No other region of the human musculoskeletal system has such a big interindividual variability as the sacrum and its neighboring structures.<sup>30</sup> Obstetricians were among the first to analyze the pelvic architecture and its consequences for things such as low back pain.<sup>31</sup>

The design of the pelvis to adapt it to its role in bipedal posture is one problem aggravating the situation of the fetus on its way into the world. The second aspect is almost as important and is similar to the constructive dilemma at the caudal pole of the vertebral spine.

In quadrupeds the orientation of the skull (visual axis) is approximately an extension of the vertebral axis. The vertical positioning of the trunk makes it necessary to align the visual axis with the horizon. In most animals who assume a vertical position only for a limited period this is achieved by a lordosis of the cervical spine (eg, bears, prairie dogs, etc)<sup>28</sup> and no further adaptation of the cranial structures ensues.

The evolution of human beings took a different path. Here, the realignment of the visual field with the horizon was accomplished by an angulation between the upper cervical spine and the craniofacial region. The result of this complicated development was a wider base for the neocranium and an angle of  $\pm 90^\circ$  between the orientation of the vertebral spine and the visual axis. One of the side effects of this new relationship between head and spine was the change of the birth mechanism; whereas in most mammals the facial part of the skull is delivered first, in human beings the dome of the skull is the initial structure to enter the birth canal.<sup>32</sup>

The main diameter of the head lies in the sagittal plane, that of the trunk in a frontal orientation. The 2 redesigns of the vertebral poles interact to produce a complicated birth mechanism. The construction of the lower pelvis leads to a semicircular trajectory for the fetus. As the main diameters of head and trunk have to be aligned during delivery, a 90° angle between the two is established while traversing the lower pelvis. This leads to a necessarily asymmetrical positioning of the occipito-cervical junction, which cannot be reversed during the entire delivery.

Studies of the intracranial structures of apparently healthy newborns showed a high percentage of signs of microtrauma of brain stem tissues in the periventricular areas.<sup>33</sup> It seems probable that the exposed structures of the occipito-cervical junction suffer at least as much as the cranium.<sup>34</sup> Wischnik et al<sup>35</sup> have shown this in experimental studies of the biomechanics of delivery, as have others.<sup>36</sup> The injury of the intracranial and subcranial structures is thus the rule, not the exception. The ability of most newborns to overcome and repair these lesions shows the enormous capacity of the not yet fully developed brain to cope with trauma at this stage.

The optimal development of the brain, which persists well beyond the 16th year,<sup>10,37</sup> depends on adequate and consistent sensory input. The importance of proprioceptive unbalances for the efficient repair of cerebral lesions becomes evident.

## VERTICALIZATION

Around 1 year of age, an important transition period occurs. The child pulls himself up, struggles to stand on 2 legs, and finally does his first steps. All movement and sensorimotor development interacts with and fights against gravity. The importance of this transition from the 2-dimensional "way of life" into the third dimension is still widely underestimated. We should consider this transition as an important expansion of the possibilities of the developing child, in connection with all the instabilities that accompany any newly acquired degree of freedom. Before these options can be put to use the child must master the instability of keeping the spine upright. To a major extent this means that

the function of the spine has to be reinvented, as its habitual position in most mammals is horizontal.

The contour of the spine is the result of the intrinsic phylogenetic program<sup>38</sup> and the interaction with the external factors. These latter forces play a much bigger role than previously assumed. Meyer observed that the unilateral torsion of the lying infant turns into a bilateral scoliotic posture after verticalization. Meyer<sup>39</sup> quotes Scheuermann, "After the child started walking the muscular reaction changes completely and we find scoliosis, lumbar hyperlordosis and hyperkyphosis of the dorsal spine."

Like many successful practitioners, Meyer<sup>40</sup> did not publish his results systematically and we have only a few anecdotic sources. But even in this limited material we find many of the observations on the determinative influence of early irritations of the cervical spine for the form and function of the adult spine. The Italian MTC specialist Neumann<sup>41,42</sup> came to similar conclusions.

It is important to be aware of the different patterns of reaction before and after verticalization to interpret the possibilities of corrective measures. As seen in developmental physiology, a certain fixation of the already acquired abilities precedes any new phase in the acquisition of motor skills. Consequently, it is easier and more efficient to treat postural imbalances before verticalization than afterward. In an analysis of the effectiveness of MTC, I was able to show that the incidence of readjustments depends on whether the first treatment was applied before or after verticalization.<sup>43</sup>

It is important to keep the latter concept in mind when communicating the possibilities of manual therapy to pediatricians. Before 1 year of age, the success rate of the initial treatment is between 80% and 90% with about one third of these infants needing further physiotherapy.<sup>44</sup> After the 12th to 14th month, most of the children have to be seen at least twice by a MTC specialist and about half of them need reeducation in the form of physiotherapy or ergotherapy. These numbers reflect the situation in Central Europe and the work-sharing arrangements we have here. It is possible that the different structure of health care in North America shifts the percentage of the professions involved considerably, albeit without changing the underlying qualitative aspect.

## TORTICOLLIS NEONATORUM

Asymmetry in newborn infants is a well-known problem, one which is often considered benign and disappears spontaneously if left alone long enough. It may be true that we have to be patient in the first days and weeks. After having passed through the birth channel, a realignment of the asymmetrical cranial bones and a resorption of soft-tissue edemas and hematomas take time. An initially asymmetrical posture should be noted and observed.

If asymmetry persists after 3 to 4 weeks or additional symptoms appear, it is advisable to check if the range of movement of the head is impaired. This restricted movement may be a sign of a protective immobilization of the upper cervical spine. For a long time this was linked to a malfunction of the sternocleidomastoid muscle, leading to the common diagnosis of muscular torticollis.<sup>45-50</sup> The most visible symptom was thought to be the cause. At least in the early phases the shortened and thick sternocleidomastoid muscle is so prominent that it was a natural culprit. Late cases of infantile torticollis often show a fibrosis of the sternocleidomastoid.<sup>51,52</sup> These 2 facts were then combined: early hematoma results in later fibrosis.

My experiences have led to different conclusions. I have observed that there is no direct and linear connection between the initial hematoma and a late fibrosis. Children with an initial hematoma do not have a bigger chance of developing a late fibrosis than newborns without a palpable tumor of the sternocleidomastoid. The connection between the 2 phenomena may be more intricate than such a linear concept suggests. The sternocleidomastoid is a co-victim of the underlying trauma to the articular structures of the cervical spine and as such not a good starting point for therapy or analysis. It has a far better use as an indicator of the improvement brought about by other therapeutic measures. A correct therapy of the suboccipital joints results in an alignment of the muscular tonus of the sternocleidomastoid.

There is controversy about how to react to a fixed or asymmetric posture in newborn infants. Some consider this a "physiological scoliosis" and think it wears off without treatment.<sup>53,54</sup> Others stress the importance of asymmetries in perception and posture for the development of more severe consequences later on.<sup>55</sup> Buchmann remarked,<sup>56</sup> "... the existence of an asymmetrical range of tilt in the suboccipital region of a child is no big deal. Only if additional signs accompany this an immediate treatment might be necessary." Asymmetry is frequently found in testing newborns<sup>57</sup> and its clinical significance has to be carefully examined. Seifert<sup>58</sup> published data on unselected groups of newborn infants where she found that more than 10% of them show signs of asymmetry of the functioning of the upper cervical spine.

Perhaps nobody would suggest to treat all initially asymmetrical infants routinely, but these infants should be reexamined later and receive therapy if the functional deficit has not subsided spontaneously after 4 to 6 weeks. I would propose to take a large margin, especially because MTC is a low-risk procedure, quite uncomplicated, and has not to be repeated more than once or twice.

Keessen et al<sup>55</sup> show that the accuracy of the proprioception of the upper limb is reduced in cases with idiopathic scoliosis and spinal asymmetry. Because proprioception of the arms depends heavily on a functioning sacro-occipital region,<sup>59</sup> functional deficits in this region should be corrected as soon as possible.

As is seen in the history of medical knowledge, our frame of reference changes over time but basic insights can be found in unexpectedly ancient sources: Andry de Boisregard<sup>60</sup> (who coined the word *orthopedics*) mentioned the treatment of torticollis as one important field of this new discipline in 1727. In going back to these roots, we understand that good posture in children was at the forefront of the orthopedic diagnostics and treatment. Orthopedics (“rightening the young”) was so important for Andry that he used this concept as the definition of the medical procedures he proposed. A significant portion of his book deals with methods we might summarize today as manual therapy.

This fundament of the new discipline was lost in later centuries and the eminently functional approach of Andry had to make way for the mechanistic paradigms which have dominated orthopedics for centuries.

## COLIC

Infants in Western societies cry more in the first 3 months of life than in any other period of their life.<sup>61</sup> This phenomenon has its peak at 6 weeks and declines rapidly thereafter.<sup>62</sup> It is difficult to assess the dividing line between “normal” and “abnormal” crying. Several definitions are proposed to define this crying as pathological. The definition of Wessel, “more than 3 hours per day, more than 3 days per week for more than 3 weeks,<sup>17</sup>” is widely used in publications but may be unrealistic, as it requires stoicism of the parents, which may not be found very often in modern times. “I am still too impressed by the parental feelings of hopelessness and helplessness, their anger and anxiety, their feeling that something is really wrong with their child, to leave them alone with this in nature self-limiting problem,” says Lucassen.<sup>63,64</sup> Although infantile colic is known to subside spontaneously, there are reasons enough to try to shorten this period.

Colic is stressful for parents and may lead to aggressive and violent behavior of parents or babysitters, which may result in lasting communication problems between parents and the child<sup>65</sup> years later. Functional disorders of the school-age period and even later can be traced back to these early signs.<sup>16</sup>

A publication titled *The Enigma of Infantile Colic*, written by a team of colic specialists, discusses the possible origins of this problem. The authors mention,<sup>66-68</sup> “more than half of the babies concerned showed slight to medium deficits in functional neurological tests . . . the quality of spontaneous motor patterns was not normal.” This team did not find convincing evidence of the feeding pattern on the incidence of colic.<sup>69</sup> Can persistent crying in the first months be considered a “benign condition”?<sup>70</sup>

First contact with the effect of manual therapy on infants with colic came through serendipity. A few newborns who

were treated because of their fixed posture also recovered from colic after the treatment administered for the C-scoliosis or the fixed retroflexion. Then, there were only very few observations of functional factors contributing to colic; most authors were looking for clues related to nutrition or mother-child interaction, even something as elusive as the temperament of the infant was considered relevant.

Several publications cover the effects of chiropractic treatment for children with colic.<sup>71-74</sup> Each of these papers have shortcomings. For example, there is no information about the treatment technique or area in one study,<sup>73</sup> small and ill-defined sample groups in another,<sup>72</sup> and lack of blinding described.<sup>71</sup> The methodological weaknesses may not allow their findings to be convincing for some, but a review by Hughes and Bolton<sup>71</sup> reaches a positive resume nevertheless.

The evidence suggests that chiropractic has no benefit over placebo in the treatment of infantile colic. However, there is evidence that taking a colicky infant to a chiropractor may result in fewer reported hours of colic by the parents. In this clinical scenario where the family is under significant strain, where the infant may be at risk for harm and possible long-term repercussions, where there are limited alternative effective interventions, and where the mother has confidence in a chiropractor from other experiences, my advice is to seek chiropractic treatment.

We know about the complex interdependence between the orofacial muscles and the upper cervical spine.<sup>75</sup> So, the next step is to look for factors in the individual case history that might enable us to screen infants with colic for those who profit most from manual therapy. The results of my inquiry were twofold. In the group of successfully treated cases of colic I found infants with a fixed retroflexion of the head and trunk and feeding problems. This led to a cooperation pattern with pediatricians concerning infants with incessant crying. The pediatricians check for other reasons (eg, infections or pylorospasmus) and then for signs of an involvement of functional vertebrogenic factors. This includes the screening of the case history, checking the flexion of the head and the local irritability of the neck, and neurologic tests<sup>76,77</sup> for asymmetry. If they have reason to believe that a functional problem of the upper cervical spine contributes to the problem of colic, the infants are referred to a specialist in MTC.

The appropriate evaluation of the effectiveness of MTC in these cases still has to be demonstrated conclusively. However, its success may be the biggest obstacle to performing this research: pediatricians and parents who are aware of the benefits of MTC may refuse to participate in control groups.

In a pilot study I found that up to 55% of those who said that incessant crying was one of the main reasons their child was brought in for consultation registered an improvement of more than two thirds within 1 week after treatment.

One trigger that may cause pediatricians to send infants to a manual therapy specialist is the sensitivity of the neck



**Fig 4.** KISS I clinical markers. Fixed lateroflexion: torticollis, unilateral microsomnia, asymmetry of the skull, C-scoliosis of neck and trunk, asymmetry of gluteal area, asymmetry of motion of the limbs, retardation of motor development of one side.

region in combination with a restricted range of movement of the head. Those who have observed the success of manual therapy in cases of colic or feeding problems are looking for these signs to help decide if it is advisable to presently refer these infants to a specialist. Others find it easier to first look for signs of asymmetry before they consider manual therapy as a treatment option.

### THE KISS CONCEPT

The KISS concept was devised to incorporate the diverse symptoms I saw and treated in small children. The leading symptom is a fixed posture, sometimes a fixed lateral flexion, sometimes more a fixed retroflexion in combination with hypersensitivity of the upper neck area. For practical reasons it is useful to distinguish between KISS I (mainly fixed lateroflexion) and KISS II (primarily fixed retroflexion). Figs 4 and 5 give an overview of the findings found in these 2 models.

Having treated children and infants for a number of years I was confronted with indications and therapies. Screening the relevant literature resulted in a large collection of publications, which were grouped around standard diagnoses and the various techniques of manual therapy/chiropractic/osteopathy used to treat them<sup>1,2</sup>. Children belong to a “special population,” as the homonymous book implicates,<sup>78</sup> but to assess the impact of functional disorders of vertebrogenic origin on the neuromotor development one has to integrate all these separate findings into a broader concept.



**Fig 5.** KISS II clinical markers. Fixed retroflexion: hyperextension (during sleep), (asymmetric) occipital flattening, shoulders pulled up, fixed supination of the arms, cannot lift trunk from ventral position, orofacial muscular hypotonia, breast-feeding difficult on one side.

In many instances the techniques and indications of manual therapy are similar in children and in adults. The older children and adolescents become, the more their clinical picture is in line with what we know about adults. There are some differences in peripheral functional problems, but the bottom line is the same, such that, a local functional disorder with only limited, albeit sometimes strong, symptoms.

The “pulled elbow” (Chassaignac subluxation) of small children is such an example. A sudden pull at the extended arm of a toddler can result in a subluxation of the proximal head of the radius, which is trapped under the ligament annulare. The child’s arm hangs as if paralyzed and is not used. A simple adjustment is in most cases sufficient to revert this situation. This problem is child-specific, but does not have any impact beyond the local immobilization of the arm.

Other functional vertebrogenic disorders in small children are of different character. The effects of a local problem are felt far from their area of origin and may last much longer. The KISS concept does not intend to cover all instances of treatable spinal disorders, but to highlight those with a long-term harmful potential. This is important as many problems where children profit from an adjustment have unclear symptoms. Infantile headache, attention deficit disorder, or sensorimotor problems may be caused by a multitude of etiologic factors. To focus our efforts on

children who may benefit from manual therapy, it is helpful to compare the individual case history with what is compiled as typical for KISS.

Fixed lateroflexion may be a trigger for pediatricians to ask for help from a manual therapy specialist. Other symptoms may be more important for the family, but these are less obviously connected to a functional vertebrogenic problem. Colic, for example, may be caused by KISS-related problems but pediatricians, midwives, and lactation consultants can only direct the families toward a specialist in MTC if they are aware of this possibility.

In many cases the 2 types of KISS overlap. One has to take into account that it is easier for a pediatrician to recognize the laterally fixed posture as pathological; however, the fixed retroflexion has to be actively searched for. Often it is best seen in the sleeping position of children (Figs 6 and 7). Initially I did not attribute much attention to this posturing. It was only after the parents reported spontaneously that their children slept much calmer and in a markedly more relaxed position that I became aware of the diagnostic importance of a fixed retroflexion of the head.

Through the observations of parents I then thought to check systematically if and how much I was able to relieve the pain of “crybabies” (ie, colic). Initially quite a few of these children were referred for the treatment of postural asymmetries and the accompanying colic was not mentioned by the parents during our interviews. In the questionnaire the parents are asked to return 6 weeks after their visit and they mentioned that the infants were much calmer and slept better.

#### CLINICALLY DIFFERENT PICTURE DURING THE FIRST YEARS

Most KISS cases I see are between 3 months and 12 to 15 months of age. Before this period the symptoms are quite unspecific; feeding problems or signs of “colic” dominate the clinical picture and only those caregivers who are aware of the influences of the vertebrogenic factor consider KISS as one possible reason for these problems. After verticalization, children undergo such a rapid development that most symptoms seem to disappear.

This is followed by a period of seemingly normal development without signs of fixed posture or asymmetry, which lead some pediatricians to the conclusion that the scoliotic posture of the first months was physiological.<sup>79,80</sup> The main concern in proposing the KISS concept was to attract attention to the long-term consequences of untreated postural disorders in infants. The bulk of casuistic evidence clearly shows a link between these early problems one can assemble under the KISS concept and later disorders ranging from headaches to sensorimotor dysfunctions. The structural connection between these 2 clinical entities is still under discussion, but a few clues emerge.



**Fig 6.** A posture of fixed lateroflexion of KISS I. The left arm will be used more; therefore, the motor capabilities of this arm will be more advanced compared with the right arm. Often this asymmetry extends to the lower extremities and lead to an asymmetry of the gluteal furrows, which may be the first symptom observed by the pediatrician.

Any skill that we acquire has a predisposition period to be learned well. Language acquisition is an example. Whereas our children absorb a second (or third) language without any effort through the age of  $\pm 6$  years, language acquisition becomes much more complicated afterward and accent-free mastering of a second language after 11 to 12 years of age is almost impossible.<sup>81-83</sup>

All our capacities, may they concern movement or perception, build on those learned previously. The earlier a basic skill is situated in the normal chain of events, the more problems in its acquisition will interfere with cognitive or motor developments later on. Kinematic imbalances due to suboccipital strain interfere very early on in this process, which is one reason why the long-term consequences are so far-reaching.

It is proposed that successfully treated infants carry the memory of their initial asymmetry with them and in times of exhaustion or after rapid changes they may display the former asymmetrical posture again. In most cases these symptoms subside spontaneously and necessitate no treatment. Only if the asymmetry persists for more than a few days should one intervene therapeutically.

#### KISS-INDUCED DYSPRAXY AND DYSGNOSY

Since the 1980s, awareness of the long-range consequences of prebirth conditioning has risen. British cardiologists were the first to note that children born in poor families with a high incidence of malnutrition have a higher rate of heart failure decades later.<sup>84</sup> Similar results came from epidemiologic studies in the Netherlands and in





**Fig 7.** *The overextended sleeping position of KISS II. These children may have an orofacial hypotonia, which leads to sucking and swallowing problems. If these symptoms are combined with a fixed lateroflexion, these difficulties may lead to unilateral breast-feeding problems.*

Finland.<sup>85</sup> It seems probable that our organism is assigned an “operating mode” early in life according to the environmental conditions reigning during pregnancy and the first months after birth.

Learning about these results made it easier to come forward with observations made with schoolchildren and young adults. In many cases (72%) where I had to treat patients with headaches, postural problems or coordination malfunctions showed KISS-related problems in the first year of life.<sup>86</sup> To find this connection, one should inquire about the typical problems the parents of these children are confronted with. Another valuable source of information is the photo collection from the first years. One may find the infant in the same posture. When asked about other signs associated with a dysfunction of the occipitocervical junction I often received affirmative answers (eg, mentions of colic, feeding problems, or incessant crying). Because of the broad nature of these symptoms it is difficult to put this in a tight diagnostic frame.

Forthcoming research aims at establishing the effectiveness of MTC treating school problems. A sample of schoolchildren in Hagen (Germany) was examined and treated. This group of children between 6 and 10 years of age came from a school specializing in students with learning difficulties. These children were evaluated by their teachers and an initial interview to document the case history was conducted. Two radiographs of the cervical spine were obtained and at a second session the documentation was checked, the radiographs analyzed, and a manipulation of the cervical spine performed. After 4 and 8 weeks, the parents and teachers were asked to evaluate the development of the children.

The students taking part in the pilot phase were assembled in 2 groups. Group I with those children where the case history contained items indicating an underlying KISS syndrome, group II with the other half. Those children where a significant amount of KISS-related problems were found in their case history profited most of MTC. Where there were no marked tendencies for functional vertebrogenic problems the treatment applied did not have much of an effect.

This reflects my previous experiences: if it is possible to establish a case history typical of children who have KISS in a student with learning difficulties, it may be worthwhile to examine and treat such a child with MTC. To prove the influence of functional vertebrogenic disorders on a given sensorimotor problem it is often effective to simply perform a test treatment and evaluate the results, as Lewit and Janda<sup>87</sup> remarked more than 30 years ago. In order not to be overwhelmed by desperate parents, prescreening by a pediatrician who is able to filter out the most promising cases is helpful. A similar approach is used in an ongoing study about MTC as a treatment of headache in schoolchildren.<sup>88</sup>

Once confronted with an individual case it may be better to treat one too much than to let a possible improvement slip away. It is fair to say that there is no risk involved if one limits the treatment to a single manipulation. As I was able to show in an analysis of fatal complications after manual therapy, almost all these cases occurred at the second of third intervention and/or using rotational manipulation.<sup>89</sup> In children we have worked with, there were no adverse effects recorded after manual therapy and our workgroup has an overview over more than 35,000 children treated during the last 15 years.<sup>90</sup>

The different manifestations of functional vertebrogenic disorders in children and adolescents necessitate one to distinguish between 2 main forms. During the first year the most important direct sign of functional problems of the occipitocervical junction is asymmetry and fixed posture. The closer the child gets toward virtualization, the less pronounced these signs become. The additional information furnished by the third dimension obviously helps the child to compensate for the faulty proprioceptive patterns of C0-C2. Similar to the 3-month-old infant who stops crying spontaneously, the problem of asymmetry seems to disappear if we have the nerves to wait long enough. In the second and third year, children enter a phase where they show little or on signs of any functional or motor disorder.

When children are between 4 and 6 years old, other symptoms may appear. Such children are reported as being clumsy or slow; parents tell that they have difficulties to learn to bike or to roller skate. “We were so astonished that she still cannot ride a bike as she was walking at 8 months already,” is a remark we often hear. This is the situation where one has to inquire further: how was the delivery, how were the first months? The relevant questions are listed in [Table 1](#) and contribute to a “KISS score,” which we use to

**Table 1.** *Relevant questions that contribute to a KISS score*

Delivery
Duration of delivery (<1; 1-3; 3-6; >6 h)
Oblique presentation at birth
Twin
Forceps or vacuum delivery
Cesarean delivery
The first months
Bad sleeper during first months, 6 to 12 months, or later
Did/does the child often wake up at night
Crying at night—how often
Fixed sleeping pattern
Problems with breast-feeding on one side
Signs of colic
Orofacial hypotonus
Hypersensitivity of the neck region
General health
Headaches
Mouth is often open
Sensorimotor development slower than expected
Posture and movement
Language
Concentration
Social integration
Asymmetry
Visible immediately after birth or later
Looks only to one side
Moves only one arm/leg
Face is smaller on one side
Back of the head flat on one side
Has a bald spot on the back of the head

improve the accuracy of the diagnosis. Once this sequence of events is established it becomes easier not to get lost in the multitude of signs and symptoms associated with it.

These questions form the base of our interviews with the parents. If used judiciously, this list helps to avoid being too eager when examining potential cases. As already mentioned, it does little harm to treat one child too much, but on the other hand it is not helpful to claim to be able to treat everything with the same method. Once we have found the typical pattern of KISS in the case history we have to ascertain that the problems that brought the children to our consultation are consistent with the “KISS pattern.”

#### CLINICAL EXAMINATION AND DIFFERENTIAL DIAGNOSIS

Asymmetry may be present during a child’s development. However, it is only after having evaluated the eventual result of a manipulation that the relevance of the functional disorders of the occipito-cervical region for a given problem can be assessed.

One of the most important diagnostic problems is the detection of spinal tumors. The severity of these cases and the need for timely intervention attribute much more importance to their detection than the rarity of their occurrence might suggest (5/100,000: of these, 10%-20% in children<sup>91</sup>). Some

of the signs are quite specific such as protrusion of the papilla or impairment of the pyramidal tract. Others are far less specific and can easily be confounded with functional problems. Even specialists note that a wrong initial diagnosis is the rule and not the exception.<sup>92</sup>

Quite often the first symptoms that attract the attention are secondary problems due to functional disorders, such as a torticollis.<sup>93-95</sup> These symptoms are identical to those caused by primary vertebrogenic causes and may even improve at first. Gutmann<sup>96</sup> published such a case of a young boy he treated for headaches and neck pain. After a complete remission the problems reappeared, seemingly after a minor trauma, as happens quite frequently. When the boy came back a third time after another minor trauma, Gutmann insisted on an MRI that resulted in the diagnosis of a tumor.

One caveat is a crescendo of symptoms: most functional disorders show a flat curve of development and are often traceable back to an initial trauma. If the pain pattern or the amount of dysfunction shows a rapid increase, further diagnostic measures are necessary. As much as conventional radiographs of the cervical spine are essential for the evaluation of functional disorders of the spine, they do not furnish the necessary information to diagnose intramedullary tumors. Magnetic resonance imaging scans are a better method. As soon as details are discovered in the case history or in the clinical examination that point toward an origin of the problems beyond the functional level, a neuropediatrician should be consulted.

In a recent publication my coauthors and I summarized the items necessitating further diagnostics as follows: inadequate trauma, late onset of symptoms, multiple treatments before first presentation, crescendo of complaints, “wrong” palpatory findings.<sup>97</sup> This last item is by far the most important and in those cases where I had to diagnose a tumor it was this wrong feeling which alerted me. This impression is difficult to describe; one has to examine many necks to calibrate one’s hands finely enough to filter out these cases. In 2 of them the main area of pain sensitivity was unusually low, in another case the sensitivity was so extreme that even after trying to palpate gently a long time the hyperanesthesia persisted. These 3 children were referred to a neuropediatrician and the preoperative diagnosis was mainly based on MRI.

In 1997 to 1998 we asked for MRI scans in 12 cases of a total of 2316 children examined. In 2 cases a tumor was found (1 hemangioma, 1 astrocytoma). Most of the children we see have already been examined by a pediatrician first and the normal waiting period for an appointment is 2 to 4 weeks. This filters out those cases where the rapid deterioration necessitates immediate action. We cannot rely on initial trauma as an exclusion criterion against tumor if our aim is to find the few cases with a serious background. In several cases where we diagnosed a tumor, it was found that an “appropriate” trauma was originally reported.



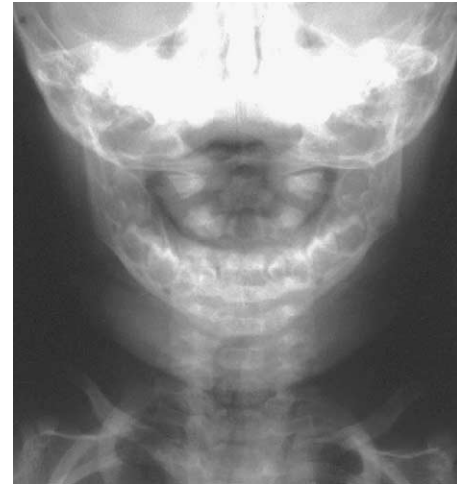
**Fig 8.** A common situation with regular morphology and a shift of C1 to the right. In this case the radiograph helps verify the clinical tests, as we would expect a right-convex posture in this child.

Most of the clinical examination can be replicated from neuropaediatric manuals.<sup>98-101</sup> The evaluation of those findings varies between a purely neurologic approach and one that includes the vertebral function. Asymmetry of posture and movement are the first warning signs that the suboccipital structures should be closely checked. Hypersensitivity and restricted range of movement in this area ideally triggers a referral to a specialist.

Once the child is in the consultation, I routinely repeat the pediatric test scheme based on the proposals of Vojta and Peters.<sup>77</sup> These tests are complemented by a segmental examination of the entire spine and a test of the passive range of movements of the joints of the extremities, thereby comparing the 2 sides.

For older children the situation becomes more complex. Here, the basic pattern of complaints directs the examination toward different focal points. To test the sensorimotor development, one scheme frequently used is the sensory integration and praxis tests.<sup>102</sup> For the functional analysis of the spine, few coordination tests suffice: 1-leg stand on the floor or on a soft support, walking on a line, finger-nose test (with open and closed eyes), tiptoeing, and walking on the heels are our standard tests. These may be complemented by additional procedures. In most cases these rather simple tests supply a solid base of the functional evaluation.

These tests are important and a base for the evaluation. Also important as these tests is the sensitivity for the surrounding details: how does the child react, how tense is it, how is the base of communication, etc. These “nonclassifiable” items have to be taken into account and



**Fig 9.** The right C2 articular facet is dysplastic; thus, the asymmetry of the suboccipital region is not purely functional. Use of manual therapy should take into account that this anatomic situation may lead to recurrent episodes of fixed asymmetry.

they finally form the bedrock on which we have to rely to grasp the gestalt of a clinical problem.

#### RADIOLOGICAL EXAMINATION

Many MTC therapists concur that it is safe and sufficient to rely solely on the palpatory findings and the clinical interview. They consider the classic 2-plane radiography series superfluous exercise. Anybody who has experienced the difficulties encountered in trying to convince infants and children to hold still for diagnostic imaging may be too willing to accept an excuse to eliminate this part of the examination. But the information obtained by the functional and morphologic analysis of these pictures renders the effort worthwhile.

Provided here are a few examples of the interaction between functional and morphologic analysis of the “classic” radiographs of the cervical spine. In addition, there are some helpful books on the radiology of the developing spine, beginning with that of Hadley,<sup>103</sup> monographs like that of Swishuk<sup>104</sup> for children, and that of Wackenheim<sup>105</sup> for the suboccipital region of all ages.

The radiograph complements and verifies clinical findings. If the desymmetrization of the occipito-cervical junction follows the established pattern (Figs 8 and 9) the direction of the impulse is confirmed. This is the case in more than 80% of the newborns and small children.<sup>43,106</sup> In these cases there would be no difference between what happens with and without radiograph.

But it is the other 20% which interests us. We have not yet been able to find conclusive tests that might enable us to sort out the one fifth of our patients who need to



**Fig 10.** Congenital posterior fusion of the C2/C3 vertebra. This finding is not necessarily connected to clinical problems; however, it helps to know about such a morphologic problem beforehand as one can advise, for example, not to do somersaults and to use an inclined work table to prevent unnecessary stress during anteflexion.

have radiographs taken before having examined them. If that was possible, we might first test for these criteria and take radiographs only in those cases which fulfill these (nonexisting) criteria. But as long as we do not have them at our disposal it is by far the lesser evil to screen systematically.

In those 20% of the cases where there is no match between radiological and clinical picture one has to be especially alert to find other discrete signs which might help to explain this discrepancy. It is not always possible to come to a completely satisfactory explanation for this discrepancy but in most of these cases a central neurologic component is present.

The risk of the use of ionizing radiation often triggers highly emotional arguments. Quite frequently a “cancer risk” is quoted to justify avoiding a standard radiological examination. It is true that fetuses and children are about twice as radiosensitive as adults, but not much more than that.<sup>107</sup> It is time to scientifically challenge the old tenet stating that cancer risk is always proportional to dose, no matter how small.<sup>108</sup> If we add to that the fact that the energy density used for plates of the cervical spine of small children is one of the lowest dosages used in conventional radiology it should be obvious that a risk-benefit analysis clearly favors the standard procedure of taking radiographs before any treatment of the cervical spine, regardless of the age of the patient.

By far the most common morphologic finding is the fusion of 2 vertebrae. Its relevance depends mostly on the levels involved and if the symmetry is preserved. A fusion



**Fig 11.** MTC of an infant. The infant lies supine in front of the therapist. In most cases the radiological examination preceded the examination and one is able to compare the radiological and the clinical picture. The treatment may ensue immediately after the examination, which has the additional advantage to avoid unnecessary stress for the nervous mothers. Most of parents do not realize the exact moment when we treated their child, as the protest of the young patient is almost as strong during the examination as during the manipulation.

of the C3 through C4 cervical vertebrae is much less relevant for the individual biography than a fusion of the C2 through C3 vertebrae, which impairs the anteflexion of the head considerably (Fig 10).

A second quite frequent finding is a hypoplasia of the dorsal arc of C1. As this structure does not have a direct static role these variants remain often unnoticed. Statistical evaluation of our material indicates a strong correlation between a hypoplastic arcus dorsalis C1 and asymmetries of the lumbosacral region on one hand and unilateral hypoplasia of one hip joint.<sup>19,109</sup>

Once a nonstandard form of the atlas is noticed it seems at least advisable to check for clinical signs of asymmetry of the pelvic girdle and functional deficits of one of the hip joints. If there are signs of asymmetry found there one can continue the examination with conventional radiographs or computed tomography scans.

Once one learned to overcome the difficulties of obtaining correct projections it is astonishing how much detailed information can be extracted. But it takes time and constant training to get to a satisfactory quality level.

## TREATMENT

Manual therapy is a craft and therefore dependent on the individual. The soft correlation between manual findings

and clinical symptoms make it more difficult to see the causal connection, even more so as these symptoms can be dealt with using different methods.

If C-scoliosis or motor asymmetries often improve under physiotherapy alone, why leave this proven path and try something new. Suboccipital strain is the leading factor. Without its removal, the symptoms can be dealt with by physiotherapy, but the reappearance of symptoms caused by suboccipital strain can later necessitate manipulation at or after entering school. Removal of suboccipital strain is the fastest and most effective way to treat the symptoms of KISS; one session is sufficient in most cases (81% once, another 16% twice). Manipulation of the occipito-cervical region leads to the disappearance of problems not reported by the parents because they did not see any connection with the vertebral spine (Fig 11).

The procedure used is basically an impulse manipulation. The infant lies on the examination table in front of the therapist. After the kinesiologic and neurologic examination, the child is positioned on its back and we check the segments of the cervical spine. These findings are compared with the radiograph analysis. It is important to be patient; especially agitated children are difficult to examine. Careful friction massage of the short muscles of the neck helps manual palpation.

In most cases the direction of the manipulation is determined by the radiological findings. In the other cases the orientation of the torticollis, the palpation of segmental dysfunction, or the local pain reaction helps to find the best approach. The manipulation itself consists of a short thrust of the proximal phalanx of the medial edge of the second finger. It is mostly lateral; in some cases the rotational component can be added.

Selection of the direction of the treatment without radiographs seems the most plausible cause for the less encouraging results of some colleagues. The technique itself needs subtlety and long years of experience in the manual treatment of the upper cervical spine. In the hands of the experienced the risk is minimal; we have not yet encountered any serious complications. Most children cry for a moment, but stop as soon as they are in their mother's arms. In 5 cases (of more than 20,000 infants) the children vomited profusely after the treatment; this had no negative effect on the outcome and is consistent with the concept of MTC as a short-time irritation of the autonomous system.<sup>110</sup>

The most fascinating thing about MTC is its far reach. In my opinion, it determines many different details of an infant's well-being and its later development. This long-distance influence into a fourth dimension (time) distinguishes functional disorders of this biographical period from those encountered later on.

The essence of manual medicine is the restoration of impaired function, albeit in the framework of a preexisting form. This "form" has 2 components: (1) the morphology,

individually expressed on the base of our genetic patterns and their interaction with the environment during growth; and (2) the cybernetic patterns which are morphologically fixed on a microhistologic level in the CNS and as important a base for function as the macromorphology.

In an adult the balance between function and form is far on the side of the latter. A given (micro)anatomic situation determines what one is able to do. In adolescents, children and especially in infants and newborns the reverse is true. Here, function (and malfunction) determines the developing form in the 2 facets mentioned above. This is the essential difference.

Manual therapy in children bears only scant resemblance to the much less dramatic and well-known effects we see in adults. We are aware that we often repair without being able to heal, thus condemning both therapist and patient to repeat this exercise sooner or later.

In schoolchildren and infants one adjustment may be able to stop incessant weeklong crying or relieve a schoolchild of disabling headaches. Not all of these cases profit from MTC, but many more than the average pediatrician or general practitioner might concede spontaneously.

Manual therapy in children is not a scaled-down version of the procedure for adults. It is understandable for someone to regard any non-adult as a child and thus belonging to a group mainly defined by the quality of not yet having reached the status of an adult.

It is easier to find common etiologic patterns in the clinical situation in infants, as the external influences are less complex than in adults. Just comparing the KISS with the much more complex KISS-induced dyspraxia and dysgnosia shows how the influences of family, school, and work confound the picture. In adults we may find repercussions of functional disorders of the first years, but the intervening factors dominate and whereas a prognosis of the outcome of a treatment in infants is fairly reliable, and becomes more unpredictable later on.

The impact of early trauma on development was suggested more than hundred years ago by Palmer and Still; however, they did not define which signs to look for. General conjecture renders this statement almost useless, as everybody encounters accidents while growing up. Only when we are able to look for specific signs in the case history will it be possible to advance our understanding of the impact of the birth trauma on the clinical pattern of complaints of our patients.

The methods for the verification of short-term effects are of only limited use in this case, as the KISS model deals with long-term interdependences that escape any such test. We shall have to use epidemiologic procedures to come to grips with these procedural problems.

The concepts that I present here will need to be scrutinized in detail. After more than 15 years of use, we can hope that the general structure stood the test of time. Our observations have given us a tool to better select those

cases where manual therapy has the biggest chance of succeeding. My hopes are that the KISS and KISS-induced dyspraxia and dysgnosy tools may facilitate the interprofessional dialogue between pediatricians, neurologists, and manual therapists in the best interest of our young patients.

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