THE DEVELOPMENT OF POSTURE

IN

VERY LOW BIRTHWEIGHT INFANTS (< 1500 grams)

A Research Project

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by

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TO

NORMAN, ANDREI AND TANYA

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I, Vivien Adele Magasiner hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other University.

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ABSTRACT

The aims of the study were to examine postural development in very low birthweight and normal birthweight infants and to determine whether deviant postures were predictive of adverse neurodevelopmental outcome.

In the first part of the study the 7 postural responses selected by Vojta to evaluate neuromotor development were applied to 69 very low birthweight (VLBW < 1500 grams) infants and to 28 healthy fullterm infants of normal birthweight (> 2500 grams). Of the 69 VLBW infants, 43 were small for gestational age and 26 appropriate for gestational age. All infants were examined at term and 4 months corrected age. They were all later assessed on the Griffiths Mental Development Scale at 12 and 18 months corrected age.

There were significant differences in postural reactions between the 2 groups which confirmed the lower tone and greater extension previously described in VLBW infants. An important finding in the study was that poor head and trunk righting noted at 4 months corrected age in VLBW infants, was associated with less developed locomotion at 12 and 18 months as assessed by the Griffiths Mental Development Scale. Thus a delay in maturation in VLBW infants which was apparent from the assessment of postural responses was still identifiable on the locomotor sub-scales at 12 and 18 months. Five of Vojta's responses were shown to be useful as part of the neurological assessment of high risk infants.

In the second part of the study, the 5 useful Vojta responses were incorporated into the Infant Neurodevelopmental Assessment (INA) which was used to assess 76 high risk VLBW infants. The 76 infants consisted of 34 infants with intracranial lesions on ultrasound and 42 without intracranial lesions. All infants were assessed at term and 4½ months corrected age using the INA. At 12 months corrected age they were all assessed on the Griffiths Mental Development Scale.

Six infants were diagnosed as having cerebral palsy, all of whom had intracranial lesions. Several clinical signs indicative of cerebral palsy were significant at 4½ months corrected age and will be useful in future studies to diagnose cerebral palsy early.

The association between lack of head and trunk control at 4½ months corrected age and a lower locomotor score at 12 months corrected age proved to be significant again and reinforces the finding that early delay in maturation is identifiable on the locomotor scale at 12 months corrected age.

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Abd.	Abduction
Add.	Adduction
AGA	Average Gestational Age
AN	Asphyxia Neonatorum
BBA	Born Before Arrival
Br	Breech delivery
BW	Birthweight
CP	Cerebral Palsy
C/S	Caesarian Section
Del	Delivery
Ext.	Extension
FAS	Fetal Alchohol Syndrome
Fcps	Forceps
Fl.	Flexion
g	Grams
GA	Gestational Age
HMD	Hyaline Membrane Disease
INA	Infant Neurodevelopmental Assessment
IPPV	Intermittent Positive Pressure Ventilation
IVH	Intra-ventricular Haemorrhage
kg	Kilogram
L	Left
Leuc	Leucomalacia
Movt.	Movement
n	Number
ns	Not significant
NVD	Normal Vertex Delivery
Prot.	Protective
R	Right
secs	Seconds
SES	Socio-Economic Status
SGA	Small for Gestational Age
Tone	Muscle Tone
VLBW	Very Low Birthweight
Wt	Weight

Griffiths Test of Mental Development

DQ	Developmental Quotient (general quotient)
GQ	General Quotient (developmental quotient)
Loc/LS	Locomotor Score
PerS	Personal and Social
HeS	Hearing and Speech
EH	Eye Hand Co-ordination
Perf	Performance

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APPENDICES

THE DEVELOPMENT OF POSTURE
IN
VERY LOW BIRTHWEIGHT VLBW INFANTS (< 1500 grams)

1.00 INTRODUCTION

The quality of neonatal intensive care has greatly improved so that more immature infants are surviving who would otherwise have died. Pooled institutional neonatal mortality rates for inborn very low birthweight (VLBW) infants published in the Office of Technology Assessment (OTA 1987 quoted by Yu 1991) of the United States Congress show that for infants between 1001 - 1500 grams in birthweight, mortality dropped from 51,8% in the period 1961 - 65 to 9,9% between 1981 - 85.

However, these infants are at risk of developing long term neuro-developmental handicap because the immature brain is exposed to certain potentially damaging insults. The VLBW infant is prone to hypoxia because of an increased incidence of asphyxia neonatorum, respiratory disease due to hyaline membrane disease and apnoeic spells caused by an immature respiratory centre (Molteno 1984). In addition, 45% of VLBW infants develop intra - ventricular haemorrhages (Papile et al 1978). Many of these haemorrhages are small and do not cause problems. However, 10% VLBW infants develop neurodevelopmental problems (Kitchen et al 1986). It is therefore imperative that a neurological assessment should form part of the long term follow up of these infants.

Several neurological assessments are currently being used. Prechtl (1977) clusters abnormal signs together into diagnostic syndromes. Amiel Tison (1976) emphasizes tone. The assessment of Dubowitz and Dubowitz (1981) is more descriptive than diagnostic and Brazelton (1984) and Als et al (1986) concentrate on neurobehaviour. No clinical method of assessment has been universally accepted and all assessments have proved disappointing in early diagnosis. Despite these difficulties many believe that early diagnosis and treatment of cerebral palsy can lead to an improved long term outcome (Irwin - Carruthers 1981, Kanda et al 1984).

Early treatment usually refers to treatment within the first year (Bax 1988). Palmer et al (1988) showed no beneficial results of treating CP infants. However, these infants were all 12 - 19 months at the commencement of treatment. In a review of 27 studies describing early intervention for physically disabled infants, Simeonsson et al (1982) found that

although 93% of the studies reported subjective improvement in their infants, only 59% of the studies used statistical procedures. Forty-eight percent of the latter number of studies reported statistical support for the effectiveness of early intervention. Goodman et al in South Africa (1985) and Piper et al in Canada (1986), showed no beneficial results of early treatment of at - risk infants. However in her thesis, Goodman (1987) states that "it is only by careful assessment and frequent follow up that the decision to embark on intervention programmes can be made" p.55.

In 1976 Vojta grouped together 7 postural reactions of normal healthy term infants and charted neuromotor development to 12 months of age. As Bax (1964) has defined cerebral palsy as a disorder of movement and posture due to a lesion of the immature brain it would therefore be logical to use Vojta's postural responses to evaluate VLBW infants. No systematic evaluation of Vojta's postural responses has been applied to VLBW infant development.

The aims of the study were to examine postural development in VLBW and normal birthweight infants and to determine whether deviant postures were predictive of adverse neurodevelopmental outcome.

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2.00 HYPOTHESIS AND OBJECTIVES OF STUDY

2.10 HYPOTHESIS

Postural responses in early infancy correlate with neurodevelopmental outcome in very low birthweight infants.

2.20 OBJECTIVES

The objectives of the study are:

1. To compare postural responses in very low birthweight (VLBW) infants and normal birthweight infants.
2. To use the findings in objective one to detect abnormal neurodevelopmental outcome (cerebral palsy) in a group of high risk VLBW infants.
3. To correlate postural responses with the developmental progress of VLBW infants using the developmental quotient (general quotient) and the locomotor score of the Griffiths Mental Development Scale.

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3.00 REVIEW OF LITERATURE

3.10 INTRODUCTION

In order to assess infant neuromotor development, a thorough knowledge of normal and abnormal neurodevelopment is essential. Neurological mechanisms which may underlie normal postural development will be reviewed first. Pathology applicable to the VLBW infant will also be dealt with.

3.20 NEUROANATOMY AND PHYSIOLOGY IN PRETERM INFANTS

Sarnat (1984) described anatomical and physiological mechanisms that may explain changes in muscle tone and posture.

The neural tube is formed during the first few weeks of embryonic life, after which development depends on 4 neuroanatomic processes:

1. Neuronogenesis

Neuronogenesis is at its maximum during the second trimester of gestation. The process consists of the mitotic division of neuroepithelial cells of the periventricular germinal matrix leading to the formation of immature neurons. The germinal matrix is an active area with a rich blood supply. Neurons of the central nervous system lose the ability to regenerate before birth. This is an important phenomenom distinguishing the brain from other organs which are able to regenerate cells. Hence good neonatal care is imperative.

2. Neuronal Migration

According to Sarnat (1984) neuronal migration from the subependymal germinal zone to the periphery of the cerebral cortex begins at 2 months gestation and is not complete until 5 months postnatally in the term infant. Heidelise Als (1986) stated that "each brain cell migrates through the thickness of the cortex to a specific precise spot on its surface. These migrations occur in waves and begin at 8 weeks, tapering off at 26 weeks of pregnancy" (p.5).

3. Synaptogenesis

Development of synapses between neurons establishes circuits for integrated cerebral function. This is an ongoing process throughout life. Proliferation of dendritic branchlets and spines and synaptogenesis in the cerebral cortex is most active in the viable perinatal period after 28 weeks gestation.

4. **Myelination**

Myelination of nervous pathways occurs in a predictable and time linked sequence. Myelin has 2 functions:

a) Myelin insulates each nerve fibre to prevent short circuits.

b) Without myelination to increase the rate of conduction the number of circuits would be severely restricted and only primitive stereotyped responses would be possible. Peak activity for myelination occurs at term but continues significantly until 9 years. Myelination can be disturbed by meningitis, severe dehydration or undernutrition.

Biosynthesis of neurotransmitters is the most important function of a neuron. Without this function the neuron would not be able to communicate with other nerve cells.

Maturation of the central nervous system depends on the anatomic processes of neuronogenesis, neuronal migration, synaptogenesis and myelination which allow the physiological processes of neural conduction, excitation and inhibition to proceed in predictable spatial and temporal sequences. The speed of neuronal migration or of myelination does not change with delivery from the uterus.

According to Sarnat (1984) postural changes in the preterm infant reflect the development of passive muscle tone. He stated that "dynamic changes in tone and posture are related to anatomic parameters such as the sequence of myelination in the developing human brain"(p.8). Hence many clinical neurological features of healthy preterm infants can be explained in terms of maturational changes. However any adverse conditions associated with preterm infants e.g. viral infection, anoxia, ischaemia or maternal undernutrition could possibly affect all the processes of maturation (Amiel Tison and Larroche 1987).

Prechtl (1981) described neural plasticity as the "capacity of the nervous system to change under particular environmental conditions. It also covers a series of compensatory mechanisms in the damaged nervous system"(p.211). Dubowitz et al (1984) used neural plasticity to explain newborn infants with abnormal signs who turn out to be normal.

Ferry (1981) questioned the whole concept of neural plasticity which has been predominantly confined to animal research. Ferry queried whether the same principles apply to infants who have a highly sophisticated neurological structure. In a more recent article Prechtl (1990) commented that the "change from pathology into normality is not necessarily based on neural plasticity as a compensatory mechanism, the widespread

existence of which has been placed in doubt" (p.156). Despite uncertainty with the underlying process, it is well known that abnormal clinical signs can disappear and that infants with brain damage do improve.

Heidelise Als (1986) believed the preterm infant was in a "mismatch situation"(p.7) because the infant had left the intrauterine environment with a nervous system that was still "geared for many more weeks of intrauterine specific inputs"(p.7). Als contended that medical technology was advanced enough to allow the infant to survive and that attention should shift to the quality of survival. The preterm infant's brain was the most important organ because it initiated and influenced all aspects of development.

Als put forward a synactive model of neonatal behavioural organisation. She believed that the dominant feature of newborn functioning was the ability to interact with the environment. This was dependent on five subsystems:

1. Autonomic system - behaviour is observed in respiratory pattern, colour changes and visceral signs e.g. bowel movements, gagging and hiccoughing.
2. Motor system - behaviour is observed in posture, tone and movements.
3. State organisational system - behaviour is observed in the range of states of consciousness available (from sleeping to alert to arousal states).
4. The attention and interacting system - the ability to take in and modify cognitive and social information from the environment.
5. Self regulatory system - behaviour is observed in the strategies the infant uses to maintain or regain a state of balance and relaxation.

"The infant's functioning is seen in a model of continuous subsystem interaction. The infant is also in continuous interaction with the environment"(p.17).

This view of development is synactive because the subsystems are completely interdependent. Hence Als believed the preterm infant must be considered globally from the beginning.

3.30 NEUROPATHOLOGY OF PRETERM INFANTS

According to Quinn and Levene (1991) the major neonatal factors for predicting poor outcome in VLBW infants are:

1. Leucomalacia - periventricular and subcortical
2. Haemorrhage - periventricular and intraventricular

1. Leucomalacia

Leucomalacia is a softening of the white matter which is caused by cerebral ischaemia. This develops in the watershed areas of the periventricular and subcortical white matter.

De Vries et al (1987) described leucomalacia as

> "the occurrence of areas of increased echogenicity on ultrasound occurring in the periventricular or subcortical white matter 24 to 48 hours after a perinatal acute episode such as birth asphyxia, severe hyaline membrane disease or pneumothorax with subsequent evolution into cystic lesions two to four weeks later" (p.62).

Levene (1987) defined a watershed area as a narrow band that occurs between 2 drainage areas. Subcortical leucomalacia occurs in the watershed area between the anterior, middle and posterior cerebral arteries. Wigglesworth (1984) described periventricular leucomalacia as occurring in the boundary zones between the terminal branches of the inward flowing ventriculopetal and the outward flowing ventriculofugal arteries within the brain, usually developing with recurrent apnoea. Quinn and Levene (1991) stated that the causes are multifactorial but the main problem is decreased cerebral bloodflow. According to De Vries and Dubowitz (1985) periventricular leucomalacia occurs in preterm infants below 32 weeks gestation and subcortical leucomalacia develops in older preterm infants.

2. Haemorrhage - periventricular and intraventricular

Goldstein and Donn (1984) described the subependymal germinal matrix as a "proliferative zone of tissue immediately underlying the ependymal wall of the lateral ventricle"(p.83). Cortical neurons migrate from this area which is a temporary structure. According to Volpe (1989) the matrix decreases in size from 24 weeks, is half the size by 32 weeks and nearly completely involuted by 36 weeks. The matrix is most prominent in the groove between the caudate nucleus and the thalamus at 28 to 32 weeks and therefore this is the commonest site of haemorrhage. The matrix is a richly vascular area full of tiny fragile blood vessels unsupported by muscle and collagen walls (Guzzeta 1991). These blood

vessels are susceptible to haemorrhage.

Goldstein and Donn (1984) listed two causes for haemorrhage:

1. Blood brain barrier

   Endothelial cells in brain capillaries are joined together by tight junctions which prevent cellular and fluid components from leaving the blood vessel. Sudden increases in volume or pressure result in damage to the endothelial cells in the brain capillary and therefore haemorrhage.

2. Autoregulation of cerebral circulation

   a) Changes in blood pressure.

      In order to keep a constant blood pressure, brain blood vessels react to changes in systemic blood pressure:

      i. With an increase in blood pressure the brain arteries constrict.

      ii. With a decrease in blood pressure the brain arteries dilate.

      When the blood pressure increases beyond the limit, blood flows throughout the capillary bed, endothelial cells are damaged and haemorrhage results. When the blood pressure falls too low, dilatation of the blood vessels cannot maintain cerebral blood flow, ischaemia occurs in the watershed area of the periventricular white matter, endothelial cells are damaged and haemorrhage results.

   b) Change in blood gas levels.

      Too much carbon dioxide or too little oxygen causes the cerebral arteries to dilate, bloodflow increases and haemorrhage results. Too little carbon dioxide causes the cerebral arteries to constrict, bloodflow decreases and ischaemia and haemorrhage result. Respiratory illness causes frequent change in blood gas levels.

   c) Metabolic activity.

      There is no reserve of oxygen and glucose in the brain.Blood flow to an area has to increase to cope with greater metabolic demand e.g. as in seizures. Regional arteries dilate, pressure in the large vessels decreases

and damage occurs in the watershed areas.

According to Quinn and Levene (1991) respiratory distress syndrome (RDS) is the most consistent risk factor for haemorrhage in the VLBW preterm infant. Complications of RDS rather than the disease itself are predisposing factors i.e. hypercapnia, acidosis, pneumothorax and blood pressure lability.

Papile et al (1978) stated that the majority of haemorrhages occur within the first 72 hours of life. They classified haemorrhages as follows:

Grade 1 - Subependymal haemorrhage i.e.in the germinal matrix

Grade 2 - Intraventricular haemorrhage without ventricular dilatation. Blood from the germinal matrix ruptures into the lateral ventricles.

Grade 3 - Intraventricular haemorrhage with ventricular dilatation. Potential for hydrocephalus exists.

Grade 4 - Parenchymal haemorrhage with intraventricular haemorrhage and ventricular enlargement.

Writing in 1978, Papile et al stated that if the haemorrhage was large enough it might extend into parenchymal tissue adjacent to the germinal matrix. Volpe (1989) disputed this.

> "Commonly and mistakenly the parenchymal haemorrhagic lesion is described as an extension of an intraventricular haemorrhage. Several neuropathologic studies have shown that simple extension of blood into cerebral white matter from germinal matrix or lateral ventricle does not account for the periventricular haemorrhagic necrosis. Microscopic study of this necrosis indicates the lesion is a haemorrhagic infarction which usually develops after an intraventricular haemorrhage" (p.364).

According to Levene (1987) this is a controversial issue.

3.40 NORMAL NEUROMOTOR DEVELOPMENT

Two major contributors to the understanding of normal development were Gesell and Illingworth. Illingworth (1972) listed six principles of normal development:

1. Development is a continuous process from conception to maturity.
2. The sequence of development is the same in all children but the rate of development varies from child to child.
3. Development is dependent on maturation of the nervous system.
4. Generalised mass activity is replaced by specific individual responses.
5. Directions of development are cephalocaudal and proximodistal i.e. development progresses downwards from the head and from the midline to the extremities.
6. Certain primitive reflexes e.g. grasp and walking reflex, must no longer be present before corresponding voluntary movement develops.

Gesell (1952) believed that the development of behaviour could be described in terms of posture. "The human action system is a postural mechanism. By posture is meant the posture assumed by the body as a whole or by its members in order to execute a movement or to maintain an attitude"(p.65).

Holt (1965) refers to the following definitions of posture :

Jakob (1925) defined it as a state of arrested movement.

Sherrington (1906) linked movement and posture together and defined posture as the state from which each movement began and ended.

Hellebrandt and Franseen (1943) said that posture was a constantly adjusting equilibrium.

Holt stressed that all the definitions emphasized the temporary nature of posture.

Karel and Berta Bobath were major contributors to our understanding of normal neuromotor development. Karel Bobath (1980) described the "normal postural reflex mechanism"(PRM p.5) as the basis for our ability to move and perform skilled activities while maintaining our posture and equilibrium. The PRM consists of two groups of automatic reactions:

1. Righting Reactions - These are automatic but active responses which interact with one another very closely to maintain the normal position of the head in space and realign the position of the trunk in space.
2. Equilibrium Reactions - According to Bobath (1980) these are "highly integrated and complex automatic responses to changes of posture and movement, aimed to

restore disturbed balance"(p.8).

The PRM provides:-

1. Normal postural tone i.e. high enough to resist gravity and low enough to allow for movement.
2. Reciprocal innervation of opposing muscle groups for:
   a) Proximal stability to allow distal function.
   b) Graded muscle work which allows appropriate timing and direction of movement.

With the understanding that the postural reflex mechanism underlies normal movement, the Bobaths' concentrated on the developmental sequence of motor milestones. It was the English physiotherapist, Mary Quinton (1976,1978) who first began analysing the components of movement necessary for the attainment of motor milestones. Lois Bly (1983) expanded and published the theory of the components of movement as the basis for normal motor development.

The infant develops both trunk flexion and extension; balance of these two components establishes symmetry and midline orientation with control of movement in the sagittal plane. As lateral control begins the infant moves away from the midline with lateral weight shift i.e. elongation on the weight bearing side and lateral flexion on the non weight bearing side to establish control of movement in the coronal plane. Once the infant is able to combine trunk flexion and extension, diagonal patterns of movement are possible and trunk rotation develops. Once rotation is fully established the infant is free to select any pattern of movement.

3.50 ABNORMAL NEUROMOTOR DEVELOPMENT

Cerebral palsy (CP)

Bax (1964) defined cerebral palsy as a disorder of movement and posture due to a lesion of the immature brain. Casaer (1979) described abnormal motor development in children as "deviant postural behaviour". Bly (1983) discusses the many normal components of movement that are missing in cerebral palsy. Instead of antigravity head and trunk extension being followed by antigravity flexion, cerebral palsied infants develop an abnormal quality of extension.Antigravity flexion does not develop or does not adequately counter balance extension. As a result the infant is left with abnormal tone, abnormal

quality of movement and very often a hypotonic trunk. In order to move, the infant compensates for the postural instability by "fixing" (Bly,1983:p.42) the trunk into abnormal postures. Mary Quinton (1976, 1978) referred to the latter as "blocks" to normal movement. Lois Bly (1983) described four blocks which occur in abnormal motor development. These are present in the neck, shoulder girdle, pelvis and hips.

1. **Neck Block**
   Lack of neck flexion leads to neck hyperextension as the infant is unable to tuck the chin. The infant is also unable to bring the head to the midline.

2. **Shoulder block**
   Dynamic scapular stability does not develop and the infant compensates with shoulder elevation to "fix" the shoulder girdle.

3. **Pelvic - Hip block : Anterior pelvic tilt**
   In the cerebral palsied infant the pelvis remains in an anterior tilt because of the unopposed action of the trunk extensors. In prone he compensates with the "frog" position of the legs blocking lateral weight shift and the progressive development of normal movement patterns.

4. **Pelvic - Hip block: Posterior pelvic tilt**
   The severely affected cerebral palsied infant with strong extension is functionless. When placed in sitting, the hip extensors stretch to cause a posterior pelvic tilt. This leads to compensatory hip and knee flexion. If any function is possible he develops abnormal patterns of "W" sitting and "bunny hopping".

In conclusion, Bly (1983) stated that these blocks may lead to a variety of compensatory patterns depending on the severity of the brain damage.

Preterm infant

In contrast to the cerebral palsied infant who develops pathological extension, many researchers comment on the development of physiological extension that occurs in the preterm infant compared with the fullterm infant who develops from a predominantly flexed position initially.

Dubowitz (1988) commented that the reduced flexor tone of the preterm infant did not imply delayed development but showed that the preterm infant followed a different path

of development. Thom (1988) stated that "different from fullterm development does not necessarily mean abnormal. What is normal or optimal for the developing preterm infant may vary considerably from what is optimal for the fullterm infant" (p.86).

Neuromotor dysfunction

Drillien (1972), Amiel Tison (1976) and Tudehope et al (1981) describe the syndrome of transient dystonia in which more than the normal physiological extension occurs during the first year.

This extensor posturing is accompanied by other soft neurological signs:

Persistence of primitive reflexes
Head lag on arm traction
Developmental delay
Increased adductor tone
Hypertonia
Delay in postural responses

Tudehope et al (1981) label the syndrome transient dystonia when the extensor posturing is accompanied by three of the above signs.All three researchers agree that the syndrome occurs more frequently in preterm infants <1500 grams in birthweight. The results of their studies indicate that should these signs persist during the first year and then disappear these infants are at risk for intellectual and behavioural problems at school age.

3.60 EXAMINATION OF NEUROMOTOR DEVELOPMENT

"The history tells of a risk, but only the neurological examination can tell the state of the brain's functioning."

R.Mac Keith (1977)

The goal of neurological assessment of the high risk neonate is early diagnosis of neuromotor deficits so that the advantages of early therapy can be achieved. Assessment usually focuses either on neonatal examination or the later infant motor examination.

Neonatal Examination

Historically the neonatal assessment developed from separate medical and psychological perspectives. The medical model examined neurological function and the psychological model assessed behaviour. Subsequently with the realisation that both aspects were interdependent, collaboration developed between the two disciplines.

Neurological assessment

In the preface to the first edition of his book "Cerebral Function in Infancy" published in 1949, Albrecht Peiper stated that his motivation for writing was the fact that since paediatrics had become a speciality, pediatricians were only interested in infant feeding and neurologists with adult neurology. It was Albrecht Peiper (1963) who collected together single items of infant behavioural and neurological development, available in the world literature at the time.

Peiper believed the infant's highest functional levels were located in the pallidum of the brain and that the cerebral hemispheres were neurologically inactive at birth. He was interested in neonatal reflexes and likened them to those seen in adult pathological states and experimental brain lesions in animals. He believed that normal body posture was achieved through central regulation of certain brain stem centres and not through a balance of reflexes. During the first year the infant developed from the animal to the human stage but was at no time a "mere reflex creature" who existed only in the "phantasy of the theorist" (1963:p.652). Peiper was aware that available neurological testing procedures did not fully encompass infant behaviour. Dubowitz and Dubowitz (1981) wrote that Peiper "tried to draw together the various aspects of behaviour of the newborn infant and although he did not evolve a systematic neurological examination, he paved the way for one" (p.1).

Andre Thomas et al (1960) are credited with having developed the first standardised neurological assessment of the newborn infant. A detailed English description of the examination routine was published in 1960. In the foreword written by P.E.Polani and R.C.Mac Keith, the newborn infant was described as a " tonic animal with oropharyngeal and other automatisms and neuro-vegetative mechanisms" (p.2). As Thomas had been involved in adult neurology, his approach to the newborn was strongly affected by his concepts of the adult nervous system.

The examination was intended for neonates up to 10 days old and concentrated on normal responses which would then lead to recognition of abnormality. The assessment consisted of an evaluation of "reflexes - stereotyped obligatory responses, reactions - complex obligatory responses easily modified by varying associated physiological states " (p.2) and an evaluation of muscle tone. Thomas and his French colleagues conceptualised tone as "tonus de repos or tonus passif" and "tonus d'action or tonus actif" (p.2).

When passive tone was assessed the examiner manipulated the infant and the infant remained quiet. The three tests for passive tone were:

Consistency	-	palpation of muscle
Extensibilité	-	slow passive movements of the limbs indicating the capacity of the muscles to be lengthened.
Passivité	-	rapid shaking of various segments of the limbs or head.

Active tone was evaluated through observation of spontaneous movements and recoil of the limbs.

Thomas et al (1960) were aware that behaviour was affected by "pathological states and physiological states - sleep, hunger, contentment" (p.4) but they did not include the state of the infant as part of their formal assessment.

One of the disadvantages of the examination was the subjective assessment of muscle tone. It was only much later that Claudine Amiel Tison (1976) improved Thomas' assessment of tone by making it objective and quantitative. She measured the angles formed by the limbs with passive movements.

Saint - Anne Dargassies (1977) also refined Thomas' assessment by studying the neurological development of 150 healthy fullterm infants whom she examined between the

fifth and seventh day post delivery. She studied 106 items in each infant. She also charted the development of 100 preterm infants from 28 weeks gestational age to term.

Another problem with the Thomas assessment was that an examination based on adult neurology proved to be unsatisfactory and it was Prechtl and Beintema (1964) who developed an evaluation specifically for the fullterm newborn infant. They systematically studied the various neurological responses in the newborn period. They stressed that abnormal signs in the neonatal period were not predictive of future outcome, but were a strong indication for frequent follow-up to achieve early diagnosis. Their major contribution to the development of a neurological assessment was the inclusion of the behavioural state of the infant during the examination. They realised that "state" was a crucial variable which had to be controlled. The intensity of many responses was determined by the infant's behavioural state. The optimum behavioural state for each item was one in which a response of medium intensity was found. As state was dependent on time since the last feed, they advised assessing the infant 2 to 3 hours after the last feed. Assessments developed subsequent to this one have all taken cognisance of the state of the infant.

The examination was valid for infants of 38 to 42 weeks gestational age and for preterm infants once they reached that post conceptual age. In standardising the assessment for fullterm infants, Prechtl and Beintema assumed that the preterm infant, if normal, would behave similarly at 40 weeks to a fullterm infant. Dubowitz and Dubowitz (1981) disputed this assumption as they believed there was evidence that neuronal maturation in and ex utero might not be the same and there might therefore be developmental differences between fullterm and preterm infants at term.

Prechtl and Beintema recognised clustering of signs and divided these into three diagnostic syndromes:

1. Hyperkinesis involving increased resistance to passive movements, prolonged crying and instability of states.
2. An apathetic syndrome involving low intensity and high threshold responses, many absent responses, decreased resistance to passive movements and a difficult to arouse infant.
3. Hemisyndrome involving three asymmetrical items of motility, posture and motor system or responses.

With reflexes and responses scored on a four point scale and the infant's state continually monitored, this meticulous examination is a good research tool. The examiner needs to

spend time learning the assessment which takes about 30 minutes to administer. Capute et al (1978) commented that it was an "objective and quantitative evaluation of newborns with no provision for assessing the infant during the first year of life" (p.7).According to Dubowitz and Dubowitz (1981) it was difficult to apply clinically to ill or preterm infants.

Parmelee and Michaelis (1971) developed an examination based on the work of Thomas and Prechtl. They simplified the scoring system, and defined individual responses with the aid of diagrams. The assessment was geared for fullterm infants and preterm infants at 40 weeks post menstrual age. According to Dubowitz and Dubowitz (1981) the main problem was that it produced a total score. As neurologic abnormality results in both stronger and weaker responses, the abnormal infant could be assigned a normal score. The predictive validity was therefore weak.

Behavioural assessment

Although Peiper (1963) was aware that the infant was not reflex bound, he did believe that consciousness was only possible by the end of the first year. The assessment of Thomas et al (1960) consisted of reflexes, reactions and muscle tone but he queried whether the higher centres were not functioning earlier than was previously thought. Some motor activity he claimed involved gestures and facial expressions. Prechtl and Beintema (1964) were the first to introduce a behavioural perspective into an essentially neurological assessment.

Graham (1956) is credited with development of the first behavioural assessment of the newborn infant. Graham's method was to quantify newborn behavioural responses in order to distinguish brain injured from normal infants. Rosenblith modified Graham's examination (1961) in order to identify infants at risk. Rosenblith did extensive research and was able to predict specific outcomes from very specific conditions at birth e.g. unusual hypersensitivity to light in the newborn period was related to neurological abnormalities during the first year.

Neurobehavioural assessment - Combination of medical and psychological perspectives.

At about the time of Rosenblith's research, a more global behavioural assessment was being developed by Brazelton (1973), involving collaboration of paediatricians and psychologists. The examination was based on the work of Andre Thomas, Graham and associates and Prechtl and Beintema. Brazelton provided the major breakthrough when he was able to show, with his assessment, the interactive behaviour of the newborn infant.

This therefore confirmed the involvement of the higher centres right from birth. According to Brazelton the neonatal behavioural assessment scale (NBAS) scores the infant's available responses to the environment i.e. interactive behaviour. He believed that the underlying neurological condition was important for behaviour. He therefore included some neurological items in the assessment but did stress that his assessment was not a formal neurological assessment. This needed to be assessed separately. Brazelton's assessment consisted of clusters of items: habituation, orientation, motor performance, range of state, regulation of state, autonomic regulation and reflexes. Another concept he introduced was that of consolability. An upset infant is given an opportunity to self quiet before graded consoling measures are used. This is a much broader approach to assessing newborn infants. It improves the overall quality of caring and determines the development of mother -father -infant relationships.

Brazelton's assessment is essentially neurobehavioural. Dubowitz and Dubowitz (1981) found the assessment complex and time consuming, with 27 items scored on a 9 point scale. They felt it was far more suited to research than clinical use. Over a period of 8 years, Als et al (1982) refined the method for use in preterm infants with the assessment of the preterm infant's behaviour (APIB). Als (1986) later stipulated that the examiner needed extensive training.

After reviewing all the neonatal assessments available and finding none of them satisfactory, Lily and Victor Dubowitz (1981) decided that an examination should be applicable to normal and ill fullterm and preterm infants, be simple and reliable and include higher neurological function. They included items from the examinations of Prechtl, Dargassies and Brazelton and adopted the Parmelee diagramatic recording system. They graded each item from its minimum to its maximum response in order to establish an overall pattern of clinical signs rather than relating all responses to a norm. As a result of this design, the assessment is more descriptive than diagnostic. Reviewing the assessment, Pelletier and Lydic (1986) found that although the examination could be carried out by inexperienced staff, intepretation required clinical skill and expertise with newborns. Specific inter - rater reliability co - effecients and test - retest reliabilities have not been determined. Content validity was based on previous work of the original authors. Only prominent items from major assessments were used. The examination was therefore more useful as a screening tool than a full assessment. Harris and Brady (1986) stated that more normative data on preterm and fullterm infants would allow comparison of infant's performance with an age related standard.

Infant Motor Examination

Milani - Comparetti and Gidoni (1967) designed a developmental screening scale using the "function of standing" as the parameter of study. "Funzione statica" actually means anti - gravity control of the body axis which includes head control, sitting and standing (p.631). Essential components of this function are the righting, parachute and tilting reactions. The examination only takes two to three minutes and is proposed as a rapid screening for young children because finding a full function means the underlying reflex responses are present. It is therefore unnecessary to perform the total examination. Milani - Comparetti and Gidoni contended that reflexes must disappear before specific functions appear e.g.the plantar grasp must disappear before an infant can stand up and the Moro response must have dissolved before parachute and placing reactions occur. In a study of 51 low risk infants studied every four weeks until they were able to take 7 paces alone Touwen (1976) found no significant correlations on computation. Ellison (1984a) found the method suitably reliable in a study of 1000 infants to develop a scoring system. Van der Linden (1985), in a retropective study of 15 high risk and 3 low risk infants, found the accuracy of this screening tool was low in predicting motor outcome at 2 to 3 years of age.

In 1974 Vojta grouped together 7 postural reactions of normal, healthy, term infants and charted neuromotor development to 12 months of age. Deviations from normal patterns could be considered as either delayed or pathological. According to Jones (1975), Vojta suggested that children with developmental delay or abnormality had a "disorder of postural reactability reflecting a central co - ordination dysfunction" (p.112). Infants with developmental delay in up to five reactions did not require treatment but infants with delay in more than five reactions or with any pathological responses, should be referred for therapy.

Vojta's assessment has been accepted positively. Brandt (1974) believed that "Vojta's diagnostic tool is a good one" (p.696). Jones (1975) confirmed that assessment abnormality reflected neurological abnormality present at the time of the examination. He stated that the assessment method could be a useful screening tool as it only took about 10 minutes to apply and was easily learned by junior staff. Noren and Franzen (1981) asserted that postural reactions provided neurological information about motor delay, asymmetry and abnormal patterns. They also found it useful to compare postural reactions from one examination to another.

However, Vojta's controversial treatment claims have been criticised. According to Brandt et al (1980), Vojta divided cerebral palsy (CP) into "uncomplicated CP" i.e. infants without

cerebral atrophy and "complicated CP" i.e. infants with extensive brain lesions. Vojta believed that daily treatment could prevent "uncomplicated CP" (p.285). Brandt (1974) stated that infants recovering from CP would do so anyway because of the adaptability of the infant's brain in response to damage. Both Brandt (1974) and Jones (1975) questioned Vojta's research methodology showing that with treatment an infant might not develop CP. Too many variables were neglected and numbers were too small to be significant.

The French "Angles" assessment method which was developed by Thomas et al (1960) was extended by Amiel Tison (1976) through the first year of life. She was interested in an examination which would identify qualitative differences in performance. She stressed the importance of monthly evaluations to "elicit the pattern of evolution of tone for a given child" (p.31). Ellison et al (1983) used a shortened version of this assessment in a study of 583 infants aged 10 months to 36 months. They found the most useful range of movement items were the scarf sign, popliteal angle, heel to ear, adduction and foot to leg. In a second study (1984a) of 340 infants from the neonatal intensive care unit, these five items were included in the examination. All were statistically significant ($P<0,001$) in separating normal, transiently abnormal and abnormal infants from ages 6 to 22 months. Harris and Brady (1986) however pointed out that the lack of normative data to support the ranges of normal and abnormal movement was a serious limitation for fullterm and preterm infants.

Capute et al (1978) designed the primitive reflex profile (PRP) in which they stressed the importance of grading reflexes which should not only be described as absent or present. They quantified 7 reflexes with maximum development at 6 months of age. This was sufficiently early to allow for diagnosis under one year of age but outside the newborn period when neurologic signs tend to be transitory. In 1984 Capute et al provided normative data for the reflexes which were collected on 381 clinically normal fullterm infants. They were able to show that as reflex responses decreased early motor milestones emerged. Harris et al (1984) studied the predictive ability of primitive reflexes using another neuromotor assessment i.e. the movement assessment of infants (MAI) and found that primitive reflexes had the lowest predictive ability. Harris and Brady (1986) also pointed out that as the PRP only assessed reflexes it could be limited in its ability to identify early motor problems.

The Movement Assessment of Infants (MAI 1980) was developed by Chandler, Andrews and Swanson, three American physiotherapists, to identify motor dysfunction in infants during the first 12 months of life. Sixty-five test items scored individually with their own

criteria are grouped into 4 sections - muscle tone, primitive reflexes, automatic reactions and volitional movement. The authors advised allowing 1½ hours for testing and scoring; in addition examiners must have skill and experience in infant development and frequent inter - rater reliability checks are encouraged for both new and experienced examiners. The MAI was not normed but a profile for normal four - month old motor behaviour was developed. According to Thom (1988), the MAI was still under development and testing for normative values and validity was in the final stages. Harris and Brady (1986) stated that Campbell (1982) identified several clinical limitations: "lengthy administration time, excessive handling of the infant and need for skilled assessors may limit the tool's use in a clinical setting" (p.138).

3.70 CONCLUSIONS

As can be seen from the literature review no neurological assessment has been universally accepted. All have been subjected to constructive criticism. Still lacking is an assessment which:

1. Is quick and easy to apply to stressed infants in a clinical setting.
2. Can be interpreted by relatively unskilled staff.
3. Is standardised or normed so that early diagnosis into normal, abnormal or suspect groups can be achieved.
4. Has used thorough research methodology.
5. Can be used to follow infants throughout the first year.

To expect one assessment to meet all these requirements is difficult as large numbers of infants are necessary to establish norms.

Postural development in the fullterm infant is well documented but that of the preterm infant is difficult to define as more infants of lower gestational ages are surviving.

As discussed earlier, Bax and Casaer claim that the study of postural behaviour is the key to the understanding of normal and abnormal neuromotor development. Vojta's assessment is different from all the others because he focuses predominantly on infant postural development from term to 12 months. As the assessment has never been applied to VLBW infants it was decided to compare the postural development of fullterm normal birthweight infants with that of VLBW infants using this assessment method to establish norms. In order to detect abnormal development early, some of Vojta's postural responses were subsequently included as part of a larger assessment which constituted the second part of the study.

O------O

4.00 POSTURAL DEVELOPMENT IN VERY LOW BIRTH WEIGHT AND NORMAL BIRTHWEIGHT INFANTS

4.10 METHODS

Definitions

The following definitions conform to the World Health Organisation International Classification of Disease (1977).

Term	:	from 37 to less than 42 completed weeks
Preterm	:	less than 37 completed weeks
Low birthweight	:	less than 2500 grams

According to Battaglia and Lubchenco (1967) a small for gestational age (SGA) infant is an infant with a birthweight for gestational age below the 10th centile for birthweight. This definition has been internationally accepted. Alternative terms are :

Underweight for gestational age (UGA)

Small for dates (SFD)

Intra - uterine growth retarded infant (IUGR).

Patients and Procedure

Between August 1984 and June 1985 I used the 7 postural responses of Vojta to assess 69 very low birthweight (VLBW) infants i.e. <1500 grams and 28 healthy fullterm infants of normal birthweight at term corrected age. I repeated the assessment on 68 VLBW infants and 28 fullterm infants at 4 months corrected age.

The Ballard score (1979) was used to assess the gestational age of all newborn infants. The 69 VLBW infants consisted of 43 infants small for gestational age (SGA) and 26 infants appropriate for gestational age (AGA) according to Lubchenco growth charts (1966). See Figure 4.1. Sixty - three VLBW infants were preterm and 6 of the SGA infants were term infants. In this study, the phrase "fullterm infant" refers to the infant of normal birthweight.

All the infants were white or coloured born within the Peninsula Maternal and Neonatal Service, which forms part of the University of Cape Town teaching hospitals. The VLBW infants were chosen from the neonatal intensive care unit at Groote Schuur Hospital or Mowbray Maternity Hospital. The fullterm infants were born at Mowbray Maternity Hospital

and Saint Monica's Hospital.

Two VLBW infants and one fullterm infant were selected each week. The 2 VLBW infants selected were those with the lowest birthweight and the most complicated birth history i.e. asphyxia requiring IPPV, convulsions or intraventricuar haemorrhage (IVH). The sickest VLBW infants were deliberately chosen for the study as they were the ones most likely to yield cerebral palsy, but all these infants were well when examined at term corrected age. The full term infant selected was the first fullterm infant born each week that satified the inclusion criteria i.e. normal vertex delivery, birthweight over 2500 grams and at least 3 days post delivery.

Details of the infants are given in Table 4.1 and Appendices I/I and I/II. At the time of the first examination the mean weight at term corrected age of the VLBW infants was 1940 grams, S.D. 240 and for the fullterm infants it was 3105 grams, S.D. 534. See Figure 4.2.

The social backgrounds of all the infants were assessed on the "levels of living" of Riley et al (1984). The scale is based on parental education, occupation, family income and housing density. This assessment has been compiled for the city of Cape Town using census data and yields scores of 0-60, with the lower scores being most favourable.

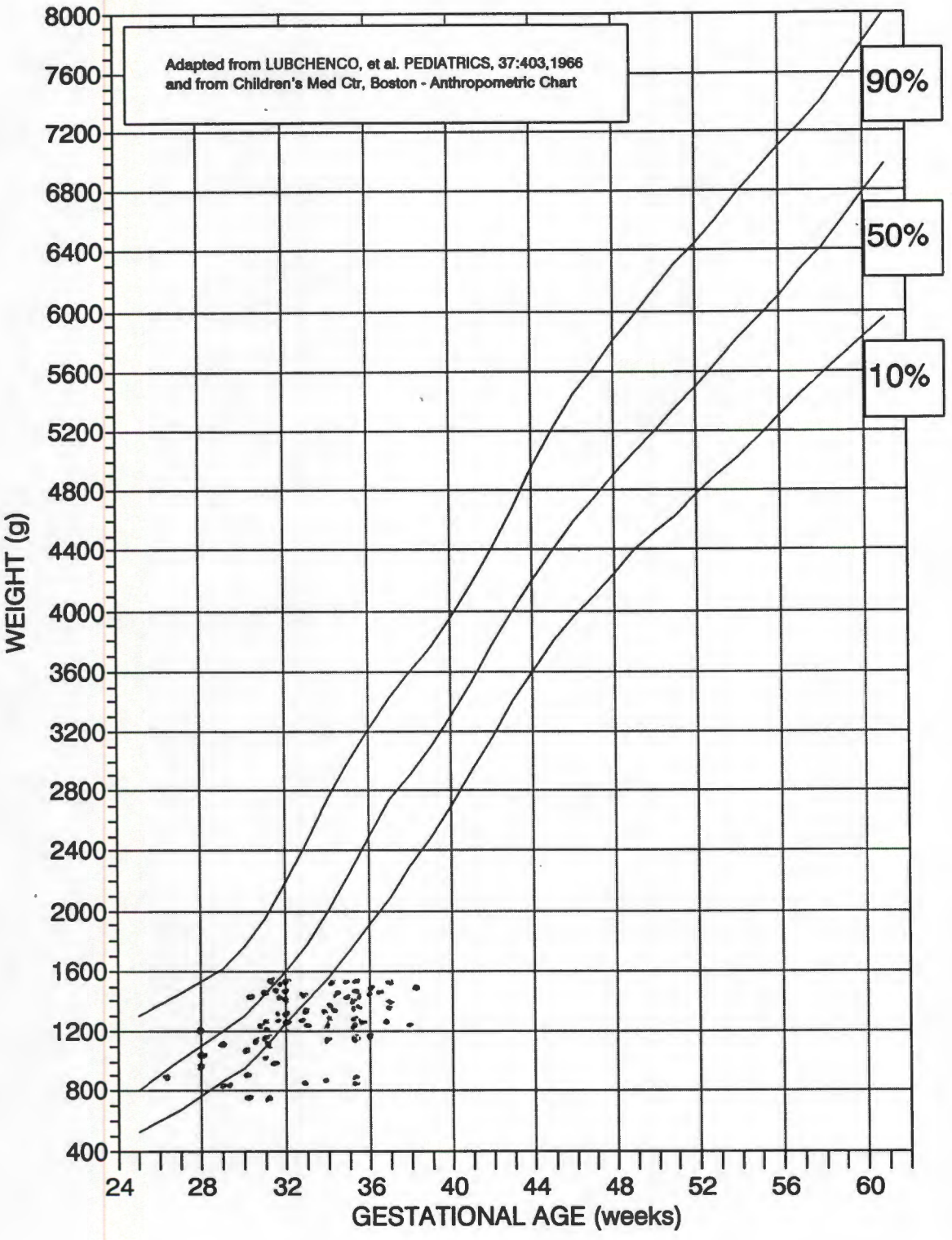


Figure 4.1 : Neonatal Growth Chart

VLBW infants postural response study

		VLBW		FULL TERM
		SGA	AGA	
Number		43	26	28
Mean Birth weight	grams	1200	1299	3330
S.D.		245	118	130
Mean gestational age	weeks	33.8	30.7	38.9
S.D.		2.3	1.7	0.86
Delivery :				
NVD	n	14	13	28
Other	n	27	14	28
Apgar Scores (mean):				
1 minute		5.3	5.9	8.96
SD		2.6	2.7	0.48
5 minutes		7.6	8.0	9.93
SD		2.3	1.7	0.07

Table 4.1 : Postural Response Study : Birth Data

All VLBW infants were assessed at term corrected age i.e. 37-42 weeks post conceptual age. All assessments at term were performed midway between feeds for the infant to be in the best possible quiet state.

At the second assessment, the fullterm infants were 4 months chronological age and the VLBW infants were 4 months corrected age i.e. 56 weeks post conception. The mean assessment weight of the VLBW infants was 5230 grams and 6780 grams for the fullterm infants. See Figure 4.2. I assessed all the infants at both time intervals.

All infants were assessed subsequently at 12 and 18 months corrected age by Dr. C. Molteno using the Griffiths Scales of Mental Development (1954). Dr Molteno was unaware of the groups to which the infants belonged.

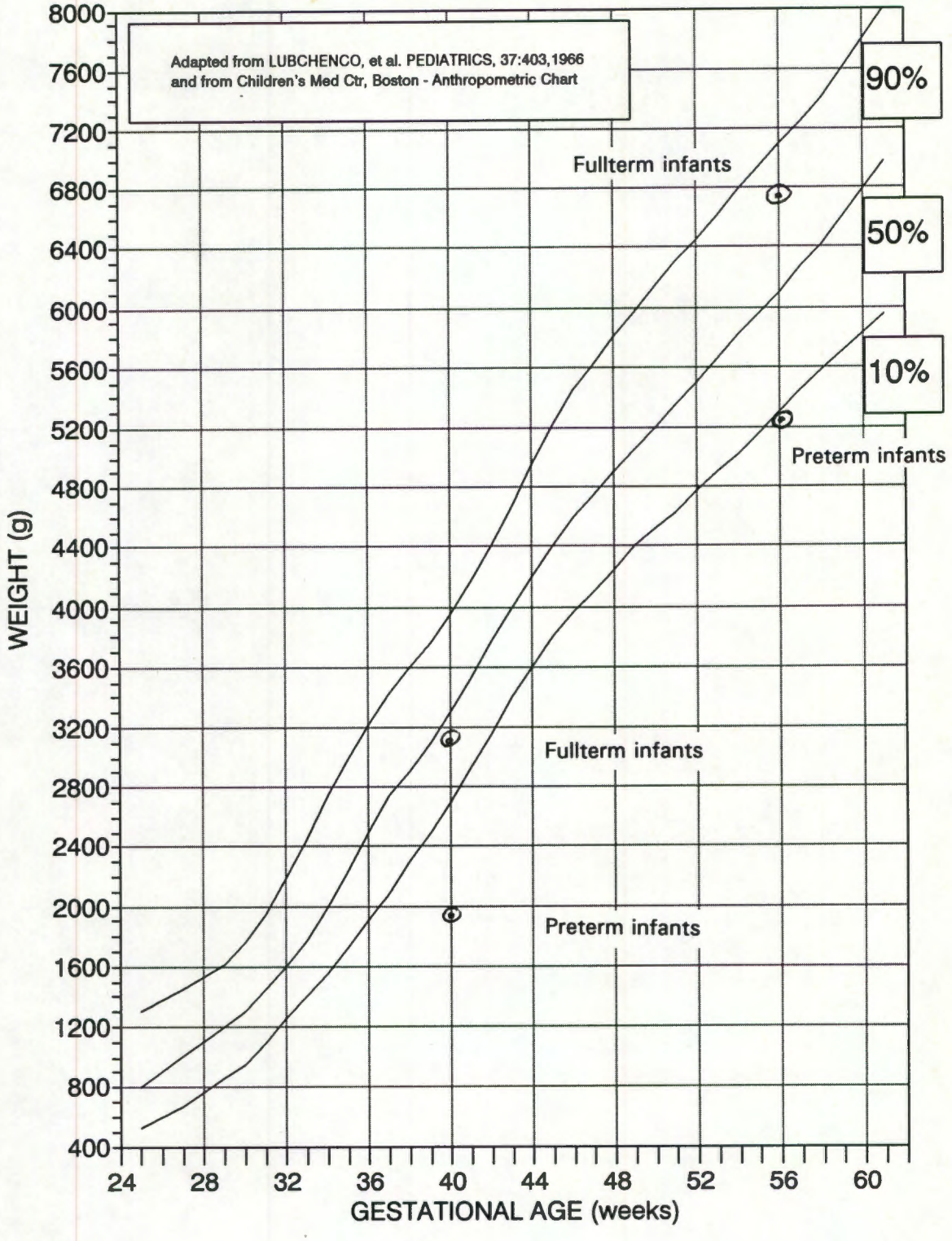


Figure 4.2 : Neonatal Growth Chart

VLBW and Fullterm infants mean assessment weight

Preparatory studies

In 1983 I spent 3 weeks in the Department of Neonatology at Soroka Hospital, Beer Sheva, Israel studying the technique of Vojta's postural responses. Vojta's original assessment form was modified to include preterm responses with which the Israeli therapists were familiar. Thereafter in Cape Town a pilot study of 40 VLBW infants resulted in the design of and practical proficiency with a simple effective evaluation using Vojta's postural responses.

The assessment form was divided into 2 parts - the dataform and the key which consisted of all the anticipated responses for each reaction (see Appendices X/I and X/II). The anticipated responses were those expected at term and 4 months corrected age, together with abnormal responses. Each response was numbered so that it could be entered on the datasheet.

The behavioural state of the infant was recorded for each reaction. Four states were recognised:

asleep

quiet - awake with eyes open and minimal movement

irritable - awake and fussing

crying

Statistical Analysis

All the results were recorded on the prescribed proforma and entered for computer analysis. The Chi -squared and the Fishers' exact tests were used to test:

1. the differences between VLBW and fullterm infants for each of the postural reactions
2. the association between the assessment of postural reactions and the developmental quotient (or general quotient) of the Griffiths Mental Developmental Scale
3. the association between the assessment of postural reactions and the locomotor subtest score of the Griffiths Mental Development Scale

Developmental quotients were compared using the Student's t-test.

POSTURAL RESPONSES OF VOJTA (see Figure 4.3)

Technique and anticipated responses of fullterm infants.

Traction Response

With the infant supine, traction was applied to both arms until the trunk formed an angle of 45 degrees with the examination plane. The degree of head lag, arm flexion and position of the legs was noted.

At term

Head	Head lag
Legs	Moderate hip and knee flexion
Arms	Elbow extension
Hands	Grasp reflex

At 4 months

Head & trunk	Head in one line with trunk
Legs	Hip and knee in strong flexion. Foot lifted.
Arms	Elbow in strong flexion
Hands	Grasp reflex

Landau Response

The infant was held in a prone horizontal position with the examiner's hand supporting the lower chest and upper abdomen. The position of the head, spinal curvature and degree of flexion of arms and legs was noted.

At term

Head & Trunk	Flexed
	No asymmetry
Arms	Flexed
Legs	Moderate flexion

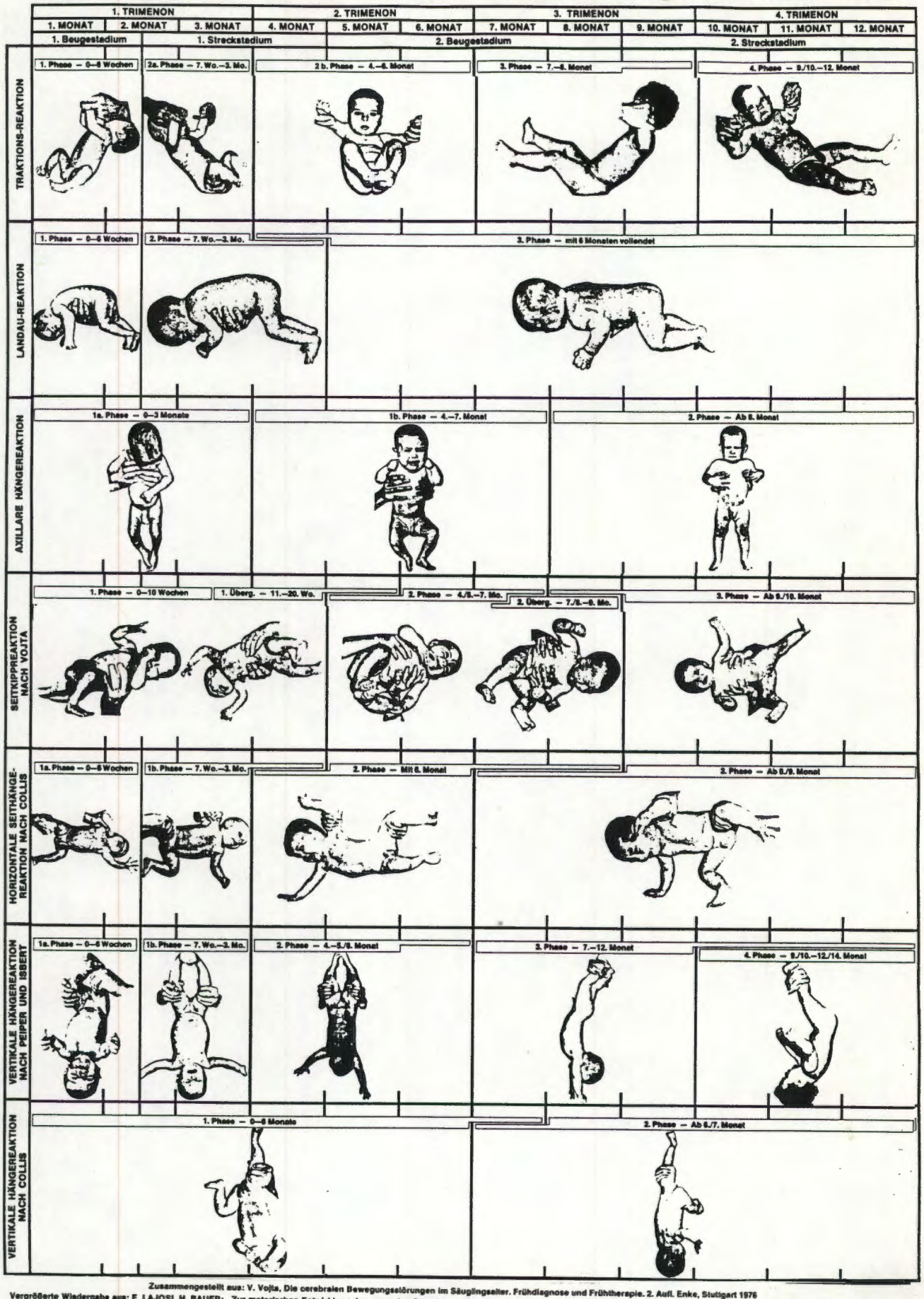


Figure 4.3 : Postural Responses of Vojta

At 4 months

Head & Trunk	Head, cervical and thoracic regions extended forming one horizontal plane
	No asymmetry
Arms	Elbow flexed and retracted
Legs	Hip and knee in strong flexion

Axillary hanging

The infant was held from behind, below the axillae and suspended vertically with the feet just clear of the table. Care was taken not to exert pressure on the back, which could have stimulated trunk extension. The position of the head and legs was noted.

At term

Legs	Hip and knee in loose flexion

At 4 months

Legs	Hip and knee in strong flexion

Vojta side tilting response

The infant was held vertically with the back to the examiner and tilted suddenly into the lateral horizontal position. The position of the head, trunk, upper arms and both legs was noted.

At term

Head & Trunk	Moderate flexion with gravity
Arms	Moro-like response in upper arm
	i.e. abduction -> extension -> flexion
Hands	Open
Legs	Upper leg flexed, lower leg extended

At 4 months

Head & Trunk	Head and trunk righting
Arms	Upper arm in loose flexion

Hands	Open
Legs	Both legs flexed

Collis horizontal suspension

With the infant lying on one side and the back to the examiner, the uppermost shoulder and hip joints were grasped, taking hold of the whole joint to avoid stretching the ligaments. The infant was then lifted just off the table. The position of the head, trunk and free arm and leg was noted.

At term

Head & Trunk	Suspension of head, neck and trunk
Arms	Flexion
Legs	Hip and knee in loose flexion

At 4 months

Head & Trunk	Righting of head, neck and trunk
Arms	Arm in partial weight bearing
Hands	Open
Legs	Leg in loose flexion

Peiper response

The infant was placed supine with the head in the midline to prevent the influence of an ATNR. The examiner grasped the legs at the level of the knees, lifting the infant suddenly into inverted vertical suspension. The position of the head, trunk, arms and hands was noted.

At term

Head & Trunk	Suspended
	No asymmetry
Arms	Moro-like response
	i.e Abduction -> Extension -> Flexion
Hands	Open

At 4 months

Head & Trunk	Head and neck in extension - pelvis flexed
	No asymmetry
Arms	Arm in horizontal abduction. Elbow fully extended
Hands	Open

Collis vertical response

Following the Peiper response with the infant still in the vertical position, one leg was released and the position it took was noted. This leg was then grasped again and the same procedure was repeated with the other leg.

At term

Legs	Flexion hip and knee

At 4 months

Legs	Flexion of hip and knee

If the response noted was unclear, it was repeated a second or third time.

Prolonged leg extension in all responses was timed by counting in seconds with a wristwatch placed alongside the infant.

4.20 RESULTS

COMPARISON BETWEEN VLBW (SGA AND AGA) AND FULL TERM INFANTS

See Table 4.2, Figures 4.4 - 4.10 and Appendix II/I.

Postural responses and state at term (0 months corrected age).

Traction

Head and Trunk : The VLBW infant had significantly more head lag than the fullterm infant although many of the fullterm infants had more head lag than expected.

Legs : The VLBW infants extended their legs and then flexed them or adopted the "frog" position of maximum hip abduction and loose knee flexion. Some VLBW infants exhibited the moderate hip and knee flexion of the fullterm infant.

Arms : Both fullterm and VLBW infants extended their arms when pulled to sit.

Landau

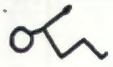
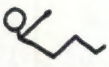
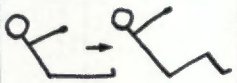
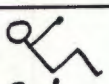
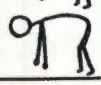
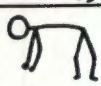
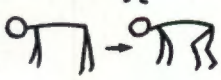
Head and Trunk : The VLBW infant's trunk was significantly more extended than that of the fullterm.

Arms : The VLBW infant's arms were predominantly held in suspension while the fullterm infant's arms were in loose flexion.

Legs : The VLBW infants moved their legs from extension to flexion or held them in prolonged loose suspension while the fullterm infants held their legs in moderate flexion with abduction.

Axillary Hanging

Legs : Significantly more VLBW infants extended their legs and then flexed them or held the legs in prolonged suspension while the fullterm infants predominantly flexed the hips and knees loosely.

POSTURAL RESPONSES (significant results only)		0 Months Corrected Age (n = 97)						4 Months Corrected Age (n = 96)					
		VLBW (69)		FULL TERM (28)		P		VLBW (68)		FULL TERM (28)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION		%		%				%		%			
Marked head lag		93		68				24		7			
Moderate head lag		7		32		<0.005		47		18			
Full head control		0		0				29		75		<0.001	
Hip & knee ext. -> fl.		62	65	7	7			10	11	0	0		
or													
Hip & knee abd. + knee fl.		12	12	0	0			6	6	0	0		
Hip & knee in moderate fl.		26	23	93	93	<0.001	<0.001	13	12	0	0	<0.005	<0.005
Hip & knee in strong fl.		-	-	-	-			71	71	100	100		
Leg ext. time: 0 secs		61	58	96	96								
1 to 60 secs		27	29	1	1	<0.001	<0.001						
Elbow ext								59	59	25	21		
Elbow flex								41	41	75	79	<0.005	<0.001
2. LANDAU													
Head & trunk fl.		59		86									
Head fl., trunk only slightly fl.		41		14		<0.01							
Ext. head & thoracic spine		-		-									
Ext. head thoracic spine & pelvis		-		-									
Arm: fl.		33	33	79	79								
ext.		67	67	21	21	<0.001	<0.001						
Leg in moderate fl.		19	19	100	100								
Leg in ext. -> fl.		49	49	0	0	<0.001	<0.001						
Leg in suspension		32	32	0	0								
Leg in strong fl.		0	0	0	0								
Leg ext. time: 0 secs		28	28	100	100								
1 to 60 secs		72	72	0	0	<0.001	<0.001						

CONTINUED

Table 4.2 : Comparison of Postural Responses

VLBW with Fullterm Infants

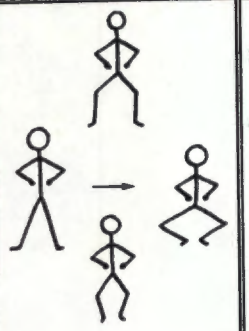
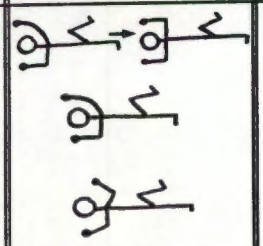
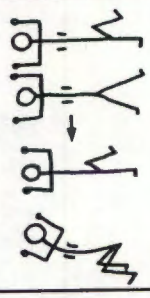
POSTURAL RESPONSES (significant results only)		0 Months Corrected Age (n = 97)						4 Months Corrected Age (n = 96)					
		VLBW (69)		FULL TERM (28)		P		VLBW (68)		FULL TERM (28)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
3. AXILLARY HANGING		%		%				%		%			
Hip & knee in loose fl.		10	12	82	82								
Leg ext -> fl.		75	75	18	16								
or													
Leg in suspension		15	13	0	0	<0.001	<0.001						
Hip & knee in strong fl.		0	0	0	0								
Leg ext. time: 0 secs		35	35	89	89								
1 to 60 secs		65	65	11	11	<0.001	<0.001						
4. VOJTA SIDE TILTING													
Head & trunk: side fl with gravity								22	18	0	0	<0.005	<0.05
Head and trunk righting								78	82	100	100		
Arm in Moro response: Abd. -> ext. -> fl.								84		68			
Arm in partial Moro response: Abd. -> ext.								10		7		<0.05	
Arm in loose fl.								6		25			
Upper leg fl, lower leg ext.		43	41	71	75				10		0		
Upper leg ext. -> fl, lower leg ext.		57	59	29	25	<0.05	<0.005		9		0		<0.01
Both legs fl. or ext. -> fl.		-	-	-	-				81		100		
Leg ext. time: 0 secs		74	75	96	93								
1 to 60 secs		26	25	4	7	<0.01	<0.05						
State: quiet		81	84	50	54								
crying		19	16	50	46	<0.005	<0.005						

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Table 4.2 : Comparison of Postural Responses
VLBW with Fullterm Infants

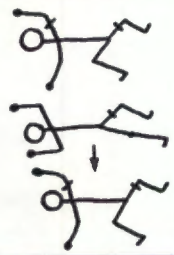
POSTURAL RESPONSES (significant results only)		0 Months Corrected Age (n = 97)						4 Months Corrected Age (n = 96)					
		VLBW (69)		FULL TERM (28)		P		VLBW (68)		FULL TERM (28)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
5. COLLIS HORIZONTAL		%		%				%		%			
Suspension head, neck & trunk								32	32	4	0		
Righting of head, neck & trunk								68	68	96	100	<0.005	<0.001
Hip & knee in loose fl.		45	42	75	71								
Hip & knee ext. -> fl.		55	58	25	29	<0.01	<0.01						
Leg ext. time: 0 secs		57	48	86	86								
1 to 60 secs		43	52	14	14	<0.01	<0.001						
State: quiet		74		39									
crying		26		61		<0.005							
6. PEIPER RESPONSE													
Hand: open		90	90	67	67								
fisted		10	10	13	13	<0.05	<0.05						
State: quiet		78		36									
crying		22		64		<0.001							
7. COLLIS VERTICAL													
State: quiet		75		32									
crying		25		68		<0.001							

Table 4.2 : Comparison of Postural Responses

VLBW with Fullterm Infants

Vojta side tilting

There were no differences between the 2 groups for head and trunk, arms and hands.

Legs : Some VLBW infants adopted the fullterm posture of flexion of the upper leg and extension of the lower leg but the majority extended the upper leg first before flexing.

Collis horizontal

There were no differences between the 2 groups for head and trunk, arms and hands.

Legs : The lower leg was extended first and then flexed by the majority of VLBW infants but some did flex the leg immediately as in the fullterm infant's response.

Peiper Response

There were no differences in the responses of the head, trunk and arms.

Hands : The VLBW infants' hands were predominantly open whereas some fullterm infants' hands were only partially open.

Collis vertical

There were no differences between the 2 groups.

Leg extension time

The VLBW infant held both legs in prolonged extension with

Traction ($p < 0,001$)
Landau ($p < 0,001$)
Axillary hanging ($p < 0,001$)
Vojta - left leg ($p < 0,01$)
- right leg ($p < 0,05$)
Collis horizontal - left leg ($p < 0,01$)
- right leg (0,001).

State of the infant

During the Vojta and Collis horizontal ($p<0,005$) and Peiper and Collis vertical ($p<0,001$) the fullterm infant cried more than the VLBW infant.

Postural Responses and state at 4 months corrected age

Traction

Head and Trunk : The majority of VLBW infants still had a head lag.

Legs : There were significantly more preterm infants whose legs were not yet in strong flexion.

Arms : On traction the VLBW infant's arms were predominantly extended while the fullterm infant predominantly flexed his elbows strongly.

Landau

There were no difference between the 2 groups.

Axillary hanging

There were no difference between the 2 groups.

Vojta side tilting

Head and Trunk : Some VLBW infants showed delay in head and trunk righting.

Arms : Only the left arm demonstrated a significantly delayed Moro-like response although a large number of fullterm infants also exhibited this response.

Legs : The right leg showed a delayed response with unilateral flexion of the upper leg as opposed to bilateral flexion of the legs as in the fullterm infant.

Collis Horizontal

Head and trunk : Some VLBW infants showed delayed head and trunk righting.

Leg extension time

There were no significant differences in leg extension time between the 2 groups.

State

There were no significant differences in state at 4 months.

Fullterm infant at term : Head lag, slight elbow flexion. Hips in moderate flexion and abduction with legs lifted

VLBW infant at term : Marked head lag, elbows extended. Left knee in extension. Right knee in loose flexion.

Figure 4.4

Fullterm infant at term : Head flexed. Trunk curved. Arms and legs flexed.

VLBW infant at term : Head flexed. Trunk curved. Arms and legs extended.

Figure 4.5

Fullterm infant at term :

Flexion of hips and knees

VLBW infant at term :

Extension of hips and knees

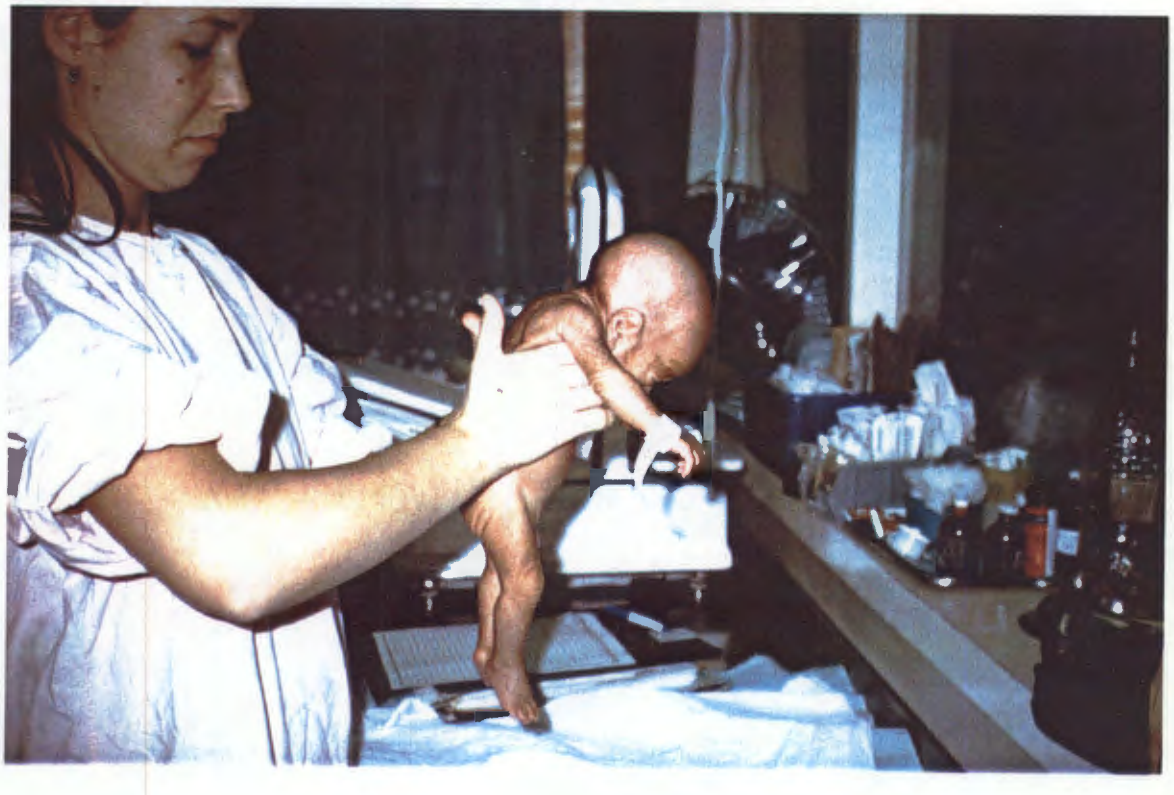


Figure 4.6

Fullterm infant at term :

Upper leg flexed.

Upper arm flexed. No trunk righting.

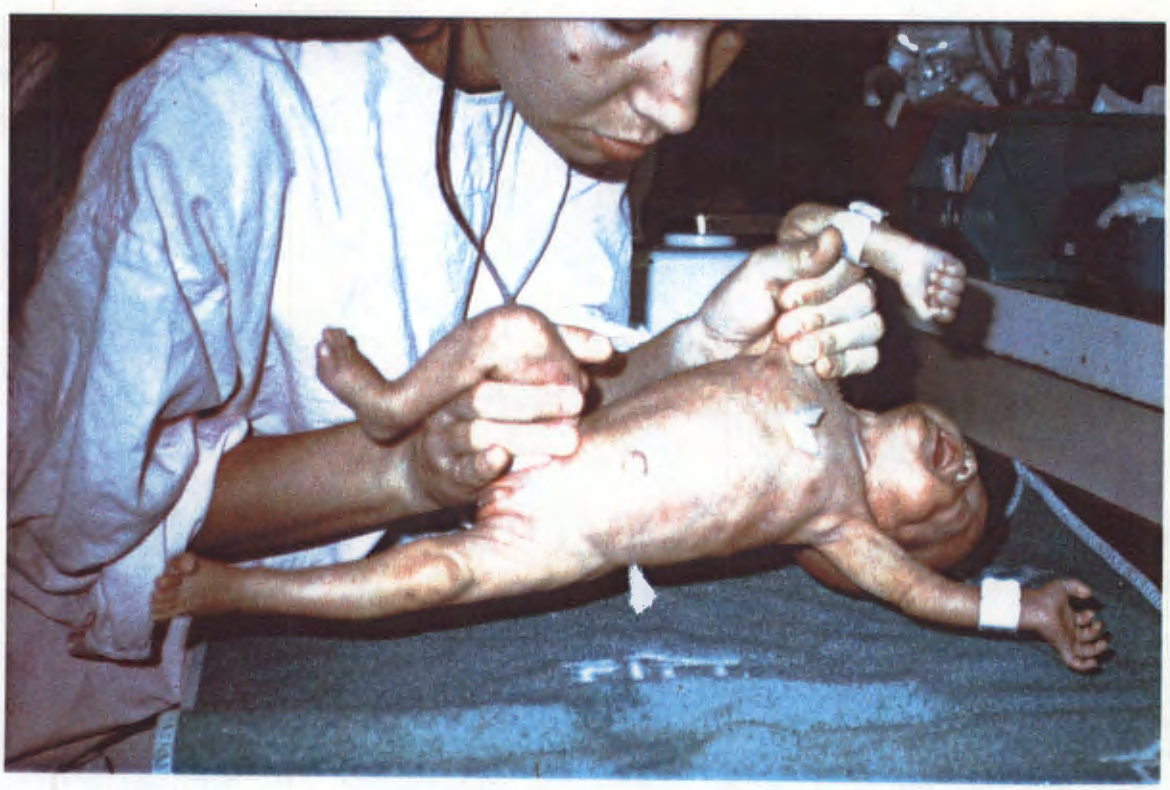
VLBW infant at term :

Upper leg extended.

Upper arm extended. No trunk righting

Figure 4.7

Fullterm infant at term : Free arm and leg flexed



VLBW infant at term : Free arm and leg extended

Figure 4.8

Fullterm infant at 4 months : Head in line with trunk. Elbows flexed. Hips and knees strongly flexed. Feet lifted

VLBW infant at 4 months corrected age : Moderate Head lag. Elbows extended. Hips and knees moderately flexed. Feet on the table

Figure 4.9

VLBW infant at 4 months corrected age : To the left : Flexion boths legs, flexion upper arm. Head and trunk righting

VLBW infant at 4 months corrected age : To the right : Extension upper leg, moderate flexion upper arm. Lack of head and trunk righting

Figure 4.10

Some infants showed responses more typical of preterm infants at term and at 4 months. For example at term 21,4 % held their arms in suspension during the Landau and 17,9 % had initial leg extension during axillary hanging. At 4 months 25% still showed head lag and 21.4% had arm extension on the traction response. These responses would have been more typical of VLBW infants.

COMPARISON OF AGA AND SGA INFANTS CORRECTED TO TERM AND 4 MONTHS.

See Table 4.3 and Appendix II/III

There were no significant differences between SGA and AGA VLBW infants at 40 weeks post menstrual age. The SGA infants at 4 months corrected age had less head control on the traction response ($p < 0,05$) and cried more during the Vojta side tilting ($p < 0,05$) than the AGA infants.

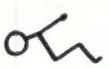
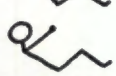
POSTURAL RESPONSES(significant results only)		0 Months Corrected Age (n = 69)						4 Months Corrected Age (n = 68)					
		AGA (26)		SGA (43)		P		AGA (25)		SGA (43)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION		%		%				%		%			
Marked head lag								16		28			
Moderate head lag								36		53			
Full head control								48		19		<0.05	
4. VOJTA SIDE TILTING													
State: quiet								92	92	72	77		
crying								8	8	28	23	<0.05	ns

Table 4.3 : Comparison of Postural Responses
AGA with SGA VLBW Infants

COMPARISON OF FULL TERM AND AGA VLBW INFANTS CORRECTED TO TERM AND FOUR MONTHS. See Table 4.4 and Appendix II/II.

The differences between the fullterm and AGA infants with regard to lower tone and extension were the same as those between the fullterm infants and the preterm group as a whole, apart from 5 exceptions :

At term, in the traction response there was no difference in the amount of head lag between the AGA and fullterm infant. On the Landau the head and trunk were not more extended. With Collis horizontal, the right arm of the AGA infant was suspended.

At four months corrected age, leg flexion on the traction response was not significantly different between the AGA and fullterm infants. In the Vojta response the left arm and right leg showed no significant differences between the two groups of infants.

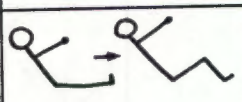
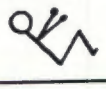
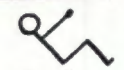
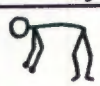
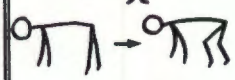
POSTURAL RESPONSES (significant results only)		0 Months Corrected Age (n = 54)						4 Months Corrected Age (n = 53)					
		AGA VLBW (26)		FULL TERM (28)		P		AGA VLBW (25)		FULL TERM (28)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION		%		%				%		%			
Marked head lag								16		7			
Moderate head lag						ns 1		36		18			
Full head control								48		75		<0.05	
Hip & knee ext. -> fl.		66	62	7	7								
or													
Hip & knee abd. + knee fl.		15	15	0	0								
Hip & knee in moderate fl.		19	23	93	93	<0.001	<0.001						
Hip & knee in strong fl.		-	-	-	-							ns 3	ns 3
Leg ext. time: 0 secs		50	54	96	96								
1 to 60 secs		50	46	4	4	<0.001	<0.001						
Elbow: ext.								52	52	25	21		
fl.								48	48	75	79	<0.05	<0.05
2. LANDAU													
Head & trunk fl.													
Head fl., trunk only slightly fl.						ns 2							
Ext. head & thoracic spine													
Ext. head thoracic spine & pelvis													
Arm: fl.		23	23	79	79								
ext.		77	77	21	21	<0.001	<0.001						
Leg in moderate fl.		19	19	100	100								
Leg in ext. -> fl.		50	50	0	0								
Leg in suspension		31	31	0	0	<0.001	<0.001						
Leg in strong fl.		-	-	-	-								
Leg ext. time: 0 secs		23	23	100	100								
1 to 60 secs		77	77	0	0	<0.001	<0.001						

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Table 4.4 : Comparison of Postural Responses

AGA - VLBW Infants with Fullterm Infants

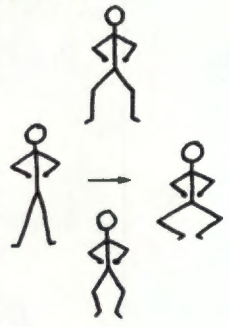
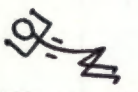
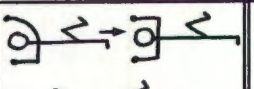
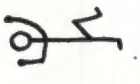
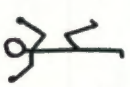
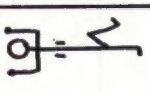
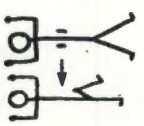
POSTURAL RESPONSES (significant results only)		0 Months Corrected Age (n = 54)						4 Months Corrected Age (n = 53)					
		AGA VLBW (26)		FULL TERM (28)		P		AGA VLBW (25)		FULL TERM (28)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
3. AXILLARY HANGING		%		%				%		%			
Hip & knee in loose fl.		4	4	79	79								
Leg ext -> fl.		92	92	18	18								
or													
Leg in suspension		4	4	3	3	<0.001	<0.001						
Hip & knee in strong fl.		-	-	-	-								
Leg ext. time: 0 secs		31	31	89	89								
1 to 60 secs		69	69	11	11	<0.001	<0.001						
4. VOJTA SIDE TILTING													
Head & trunk: side fl. with gravity								32	24	0	0		
Head & trunk righting								68	76	100	100	<0.005	<0.01
Arm in Moro response Abd. -> ext. -> fl.													
Arm in partial Moro response Abd. -> ext.													
Arm in loose fl.												ns 4a	
Upper leg fl, lower leg ext.		42	42	71	75								
Upper leg ext. -> fl, lower leg ext.		58	58	29	25	<0.05	<0.05						
Both legs fl. or ext. -> fl.		-		-	-								ns 4b
Leg ext. time: 0 secs		69	65	96	93								
1 to 60 secs		31	35	4	7	<0.01	<0.05						
State: quiet		85	88	50	54								
crying		15	12	50	46	<0.01	<0.01						

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Table 4.4 : Comparison of Postural Responses

AGA - VLBW Infants with Fullterm Infants

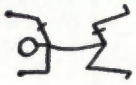
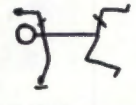
POSTURAL RESPONSES (significant results only)		0 Months Corrected Age (n = 54)				4 Months Corrected Age (n = 53)					
		AGA VLBW (26)		FULL TERM (28)		P		AGA VLBW (25)		FULL TERM (28)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
5. COLLIS HORIZONTAL		%		%				%		%			
Suspension head, neck & trunk								32	24	4	0		
Righting of head, neck & trunk								68	76	96	100	<0.01	<0.01
Arm in fl.			73		96								
Arm in suspension			27		4		<0.05						
Arm in partial weight bearing			-		-								
Hip & knee in loose fl.		38	42	75	71								
Hip & knee ext. -> fl.		62	58	25	29	<0.01	<0.05						
Leg ext. time: 0 secs		50	46	86	86								
1 to 60 secs		50	54	14	14	<0.01	<0.005						
State: quiet		73		39									
crying		27		61		<0.05							
6. PEIPER RESPONSE													
Hand: open		92	92	68	68								
fisted		8	8	32	32	<0.05	<0.05						
State: quiet		85		36									
crying		15		64		<0.005							
7. COLLIS VERTICAL													
State: quiet		81		32									
crying		19		68		<0.005							

Table 4.4 : Comparison of Postural Responses

AGA - VLBW Infants with Fullterm Infants

GRIFFITHS ASSESSMENT AT 12 AND 18 MONTHS CORRECTED AGE.

See Table 4.5

The VLBW infants performed less well on the Griffiths assessment at 12 and 18 months

At 12 months

There were significant differences in the development quotient and the subscales of locomotion, eye/hand coordination and performance.

At 18 months

Statistical significance was found in the development quotient and subscales of personal/social, hearing/speech and performance.

	FULL TERM n = 28		VLBW n = 68		P value equal to
12 MONTHS					
Development quotient	106	+/- 8	101	+/- 8	0.001
Sub-scale quotients					
Locomotion	110	+/- 13	104	+/- 13	0.025
Personal/Social	104	+/- 5	101	+/- 8	ns
Hearing/Speech	103	+/- 7	101	+/- 11	ns
Eye/Hand	106	+/- 7	101	+/- 7	0.003
Performance	108	+/- 10	98	+/- 9	0.001
18 MONTHS					
Development quotient	104	+/- 6	99	+/- 8	0.007
Sub-scale quotients					
Locomotion	104	+/- 10	100	+/- 13	ns
Personal/Social	101	+/- 6	96	+/- 10	0.015
Hearing/Speech	104	+/- 10	97	+/- 12	0.015
Eye/Hand	103	+/- 7	100	+/- 8	ns
Performance	107	+/- 6	102	+/- 10	0.005

Table 4.5 : Postural Responses Study

Griffiths Assessment at 12 and 18 months

CROSS CORRELATION OF THE POSTURAL RESPONSES AT TERM WITH DEVELOPMENTAL QUOTIENT (DQ).

See Table 4.6 and Appendix III/I.

At 12 months

In the Landau significant association was found between trunk extension and a lower DQ ($P<0,001$) while arm extension bilaterally was associated with a higher DQ ($P<0,005$).

At 18 months

There were no significant associations between postural responses and DQ.

POSTURAL RESPONSES(significant results only)		0 Months Corrected Age (n = 68)						0 Months Corrected Age (n = 65)					
		DQ at 12 Months						DQ at 18 Months				P	
		<100 (29)		>100 (39)		P		<100 (31)		>100 (34)			
		L	R	L	R	L	R	L	R	L	R	L	R
2. LANDAU		%		%				%		%			
Head & trunk fl.		41		74		<0.001							
Head fl., trunk only slightly fl.		59		26									
Ext. head & thoracic spine		-		-									
Ext. head thoracic spine & pelvis		-		-									
Arm: fl.		52	52	18	18								
ext.		48	48	82	82	<0.005	<0.00						

Table 4.6 : VLBW Infants : Association of Postural Responses at 0 Months Corrected Age with DQ at 12 and 18 Months Corrected Age

CROSS CORRELATION OF THE POSTURAL RESPONSES AT TERM CORRECTED AGE WITH LOCOMOTION.

See Table 4.7 and Appendix IV/I.

At 12 months

Arm extension on the Landau and an open right hand on the Vojta side tilting was associated with a higher locomotor score (P<0,05).

At 18 months

With traction, reflex grasp of the left hand and the Vojta open right hand was associated with enhanced locomotion (P<0,05).

POSTURAL RESPONSES(significant results only)		0 Months Corrected Age (n = 68)						0 Months Corrected Age (n = 65)					
		LS at 12 Months						LS at 18 Months					
		<100 (26)		>100 (42)		P		<100 (25)		>100 (40)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION		%		%				%		%			
Hand: reflex grasp								76		98			
weak grasp								24		2		<0.05	
2. LANDAU													
Arm: fl.		50	50	21	21								
ext.		50	50	79	79	<0.05	<0.05						
4. VOJTA SIDE TILTING													
Hand: open			73		93				72		93		
fisted			27		7		<0.05		28		7		<0.05

Table 4.7 : VLBW Infants : Association of Postural Responses at 0 Months Corrected Age With Griffiths Locomotion Score (LS) at 12 and 18 Months Corrected Age

CROSS CORRELATION OF THE POSTURAL RESPONSES AT 4 MONTHS CORRECTED AGE WITH LOCOMOTION. See Table 4.8 and Appendix IV/II.

At 12 months

Delayed head and trunk righting on Vojta side tilting to the left and on both sides in the Collis horizontal was associated with a lower locomotor score ($P<0,05$).

On the Peiper response extended and abducted arms were associated with a higher score ($p < 0,005$) as was a zero for extension time on both legs in the Collis vertical ($P<0,05$).

The infants who cried more on axillary hanging ($p < 0,05$) and the Vojta response ($p < 0,01$) had lower scores ($P<0,05$).

At 18 months

Vojta side tilting to the left and Collis horizontal on the right again showed that head and trunk righting delay was associated with a lower locomotor score ($P<0,05$).

The extended and abducted arms of the Peiper also showed a higher score ($P<0,05$).

Lower locomotor scores were associated with crying during the Landau and Vojta responses ($P<0,05$).

Cerebral Palsy

Three VLBW infants had neuro-developmental handicap (evidence of cerebral palsy and/or a DQ < 80).

One had mild spastic diplegia and a normal DQ, a second spastic quadriplegia and a DQ of 65 and the third a DQ of 69 at twelve months.

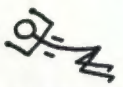
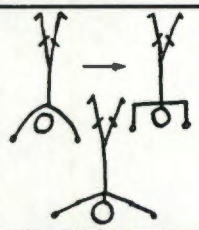
POSTURAL RESPONSES(significant results only)		4 Months Corrected Age (n = 67)						4 Months Corrected Age (n = 64)					
		LS at 12 Months						LS at 18 Months				P	
		<100 (25)		>100 (42)		P		<100 (24)		>100 (40)			
		L	R	L	R	L	R	L	R	L	R	L	R
2. LANDAU		%		%				%		%			
State: quiet								87		100			
crying								13		0		<0.05	
3. AXILLARY HANGING													
State: quiet		84		100									
crying		16		0		<0.05							
4. VOJTA SIDE TILTING													
Head & trunk: side fl. with gravity		36	28	14	12			33	25	12	12		
Head & trunk righting		64	72	86	88	<0.05	ns	67	75	88	88	<0.05	ns
State: quiet		64	68	90	93			62	67	88	90		
crying		36	32	10	7	<0.01	<0.01	38	33	12	10	<0.05	<0.05
5. COLLIS HORIZONTAL													
Suspension head, neck & trunk		48	48	19	19			38	46	28	20		
Righting of head, neck & trunk		52	52	81	81	<0.05	<0.05	62	54	72	80	ns	<0.05
6. PEIPER RESPONSE													
Arm in Moro response:													
Abd. -> ext. -> fl.		24	24	0	0			21	21	3	3		
Arm in abd., elbow ext.		76	76	100	100	<0.005	<0.005	79	79	97	97	<0.05	<0.05
7. COLLIS VERTICAL													
Leg ext. time: 0 secs		92	88	100	100								
1 to 60 secs		8	12	0	0	<0.05	<0.05						

Table 4.8 : VLBW Infants : Association of Postural Responses at 4 Months Corrected Age with Griffths Locomotion Score (LS) at 12 and 18 Months Corrected Age

Socio economic status. See Figure 4.11

Although all infants were drawn from the same hospital delivery population, the social backgrounds of the VLBW infants (level of living scores, mean 35,6, S.D. 26) were significantly less favourable than those of the fullterm infants (level of living scores, mean 20, S.D.15,9; $t = 3,88$, $p < 0,01$).

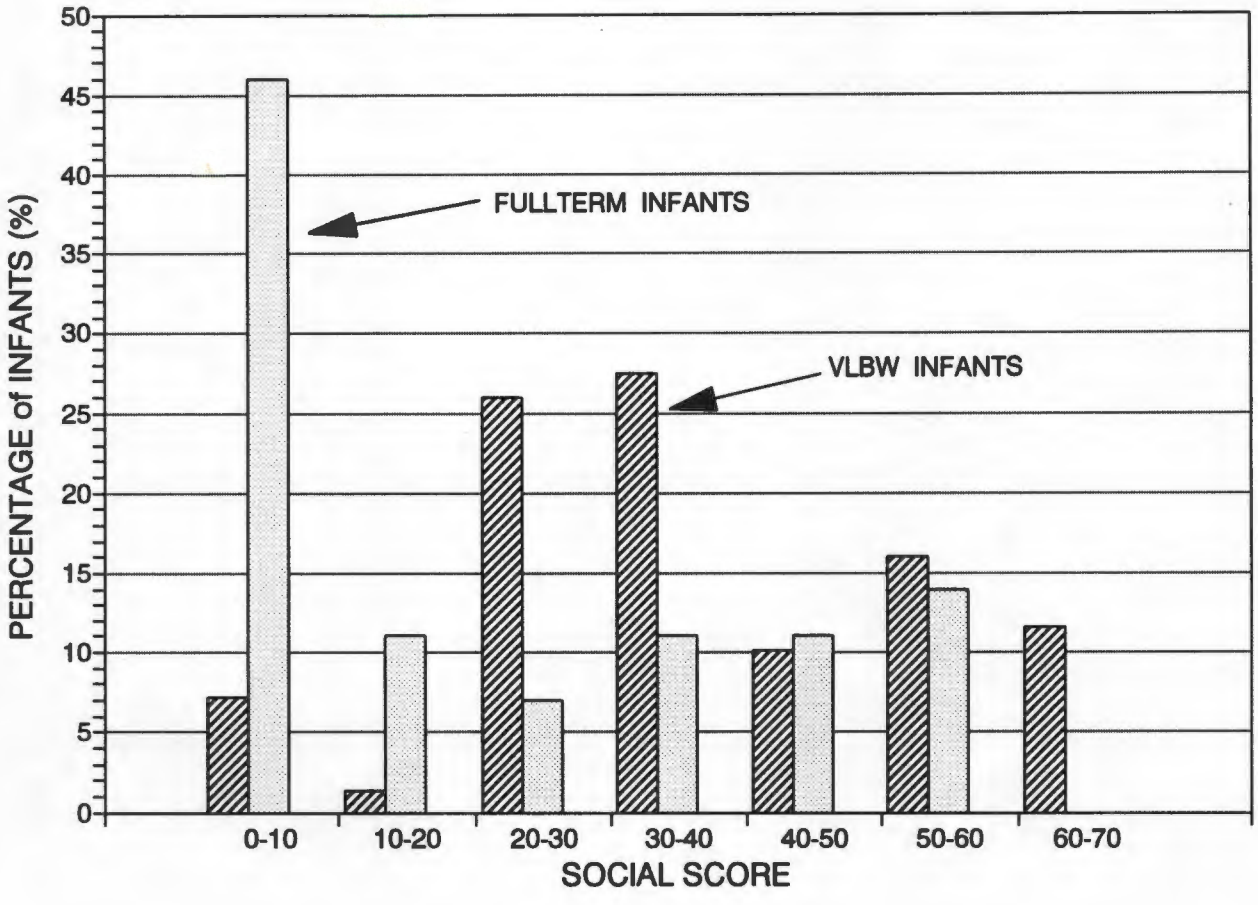


Figure 4.11 : Socio Economic Status
VLBW and Full Term Infants

4.30 DISCUSSION

To my knowledge this is the first time Vojta's postural responses have been used to assess infants with birthweight less than 1500 grams (VLBW). The finding of significantly lower tone and extension present at term in the VLBW infant is supported by several studies using other assessment methods.

Howard et al (1976) found that the predominantly AGA low birthweight infants (mean birthweight 1994 grams) had weaker responses than the fullterm infants in items involving muscle tone.

Saint - Anne Dargassies (1977) found less passive tone with wider angles and dangling of larger amplitude.

In their study of infants <37 weeks or <2250 grams at birth, Kurtzberg et al (1979) demonstrated lower tone and a very significant head lag when compared with fullterm infants.

Palmer et al (1982a) compared 80 mixed AGA and SGA preterm infants (45 of whom were <1500 grams) with 40 fullterm infants and found on ventral suspension (Landau), extension of the legs was a common feature of the preterm infant not seen in the fullterm infant. Altogether the preterm infant did not develop the flexor tone of the fullterm infant.

Forslund and Bjerre (1983) similarly found lower tone and more head lag on traction in their low birthweight infants.

Ferrari et al (1983) showed that low risk preterm infants demonstrated inferior motor performances with poorer scores genererally. Gorga et al (1988) compared 3 groups of infants - healthy fullterms, healthy preterms and sick preterms. The latter 2 groups were all < 2500 grams. The preterms as a group showed poorer quality of movement.

Compared with the above studies, this investigation comprises the largest group of VLBW infants analysed i.e. 69 infants

Several explanations have been put forward for the finding of lower tone and extension at term in the VLBW infant.

Saint - Anne Dargassies (1977) gave 2 reasons. The preterm infant develops unrestrictedly in an incubator while the fullterm infant becomes increasingly compressed into flexion in utero. Nutritional factors may also influence development as the preterm infant never reaches the weight of the fullterm infant at term.

Prechtl and Nolte (1984) also commented that differences in bodyweight could affect muscle power and therefore motor performance because the muscle bulk of preterm infants was less than that of the fullterm infant. In this study the mean weight of the VLBW infants at the first assessment was below the tenth centile. See Figure 4.2.

Touwen et al (1988) referred to a major part of muscle development occurring after birth and therefore different nutritional conditions might have interfered with differentiation of muscle fibres.

Other researchers supported Saint - Anne Dargassies view on the influence of the incubator. Carter and Campbell (1975) commented on the effect of gravity on the postural extensor musculature resulting in strong extensor muscles relative to flexor muscles. Thom (1988) commented on the increased time spent outside the constraints of the uterus to practise skills without having to overcome the flexor tone and tightness the term infant had to deal with. Dubowitz(1988) believed that the decreased flexor tone might be due in part to the infant's position in the incubator i.e. whether the infant spent most time in supine, prone or side lying.

Brown (1974) maintained that anatomical brain maturation led to increasing motor function and divided motor development into four stages, a first flexor and first extensor stage followed by a second flexor and extensor stage. The extension of the preterm infant could be associated with a prolonged secondary extensor developmental stage.

Sarnat (1984) related changes in posture and tone to the sequence of myelination in the developing brain based on the observations of Lawrence and Kuypers (1968) on newborn monkeys. They concluded that all descending motor tracts could be grouped into three pathways physiologically.

Pathway	Stimulation of Proximal Joints	Stimulation of Distal Joints
Medial subcortico-spinal	Extension / Abduction	Flexion
Lateral subcortico-spinal	Inhibits extension	--------
Corticospinal	Flexion / Adduction	Extension

Sarnat explained the preterm infant's extension or abduction being due to the myelination of the medial pathways sooner than the lateral tracts. He also postulated an absence of tone in both flexors and extensors rather than strong extensor tone. The "frog" position of the legs on the traction response could be explained by Sarnat's comment that the hips might be abducted rather than extended because of the physical structure of the immature hip joint.

As can be seen from Table 4.2 some VLBW infants did show flexor responses and some fullterm infants were more extended. This has been commented on by others. Valvano and De Gangi (1986) found increased extensor tone in their preterm infants but many fullterm infants also demonstrated atypical movement qualities. Prechtl and Nolte (1984) also commented on this finding by quoting Parmelee (1975) "It should be recalled that the discussion of similarities and differences of prematures at term and term newborns are mainly group differences. Individual premature infants may show advanced development that persists and others continued retardation in development. All investigators stressed the wide range of individual variability in their measures" (p.508).

This may also account for the deviations found by other researchers using Vojta's postural responses on fullterm infants. Yamori et al (1978) showed both low risk and high risk infants to have extensor responses on axillary hanging, Landau, Collis horizontal and Collis vertical. Kadama et al (1978) examined 200 normal newborn infants, many of whom showed extensor responses on the legs in the Vojta and Collis vertical. In a small study of 25 infants, Noren and Franzen (1981), found most differences in the Vojta and the least number on traction. They did not describe the deviations they found. Hellstrom et al (1982) examined 23 normal fullterm infants whose responses frequently differed on traction to a minor degree. The Landau and Collis reactions followed those expected for age.

When considering the state of the infant, the fullterm infants cried more than the VLBW infants during 4 of the postural responses. This is in contrast to Howard et al (1976) who found their preterm infants more difficult to soothe during the neurological examination. Kurtzberg et al (1979) found a higher incidence of crying and a longer time for crying to cease in their preterm infants. This could perhaps be attributed to the fact that in this study VLBW infants had a mean birthweight of 1239 grams while the infants in the studies of Howard and Kurtzberg had mean birth weights of 1994 and 1690 grams respectively.

At term the VLBW group as a whole showed more head lag on traction and more trunk extension on the Landau response. However, when comparing the AGA with the fullterm infants no significance was found on these 2 variables and the comparison between SGA and AGA infants produced no statistical significance. In their study Howard et al found (1976) that as the birthweight decreased in both AGA and SGA infants the number of weaker responses increased. This relationship was greatest in the SGA infants. In this study it was only at 4 months corrected age that the SGA infants demonstrated more headlag.

At four months corrected age neither leg extension so prevalent at term nor trunk extension on the Landau were significant any longer. In both the Yamori (1978) and Kadama (1978) studies the extensor responses gradually disappeared leading the authors to conclude that the extensor response at term was not pathological but physiological. There was significant delay and asymmetry in the left arm and right leg on the Vojta response showing a Moro-like response on the arm as well as flexion of only the upper leg. Howard et al(1976) found more asymmetry at term amongst their LBW infants and Ellenberg and Nelson (1981) in their study comparing infants <2500 grams with fullterm infants showed that asymmetrical movements were not statistically significant.

The most striking feature of the 4 month assessment is the persistent lack of head and trunk control which Gorga et al (1988) also found prevalent in their group of sick preterm infants. The delayed development of head and trunk control was well demonstrated in the head lag, arm extension and moderate leg flexion on traction together with the lack of trunk righting of the Vojta and Collis horizontal responses.

Association of Vojta responses at term and 4 months with Griffiths scores at 12 and 18 months.

As can be seen from the results on p.52, term infants demonstrating extension of the trunk on the Landau response were less mature in overall development at 12 months i.e. they had lower DQ scores at 12 months. However arm extension on the Landau response at term did not lower overall or locomotor scores at 12 months. Perhaps this is already an indication of the importance of trunk control affecting overall development. Reflex grasp on traction and an open hand on the Vojta response influenced gross motor development favourably at 12 and 18 months, indicating that the hand responses on traction and the Vojta response are normal at term.(p.53)

Significant association was found between head and trunk righting at 4 months and the Griffiths locomotion subscale at both 12 and 18 months suggesting a persistent maturational delay even though the locomotion subtest quotients for both the preterm and term infants were still within normal limits. According to Bly (1983) lateral righting (which is demonstrated so well in the Collis horizontal and Vojta responses) is possible when trunk extensors and flexors balance each other. Hence poor head and trunk righting is a strong indication of lack of trunk control which is a basic requirement for gross motor development.

Integration of the Moro reaction of the arms on the Peiper response by 4 months, indicated more mature gross motor development at 12 and 18 months. Immediate flexion of the leg on Collis vertical also indicated more mature gross motor development at 12 months.

Crying on axillary hanging and the Vojta response was associated with delayed motor development at 12 months. Crying on the Vojta and Landau responses were associated with delayed motor development at 18 months. These findings confirm the importance of state as a variable when assessing infants neurodevelopmentally.

The Griffiths Scales of Mental Development have been used by Goodman et al (1985) in VLBW follow up. At 12 months the locomotion subscales in both of their study groups (viz. " at risk" and "normal" VLBW infants) were higher than the other subscales. In this study the locomotion subscales in both VLBW and control groups were higher than other subscales at 12 but not at 18 months. The social disadvantage of the VLBW infants could have accounted for some of the developmental differences at follow-up. McCall (1979), has postulated that both genetic and environmental factors have minor correlations with mental

performance before 18 to 24 months. Thus, although social class may have accounted for some of the differences in the personal/social and hearing/speech subtests at 18 months, social background is unlikely to have been responsible for the developmental differences at 12 months, which were on the locomotion, eye/hand and performance subtests.

Only 2 of the VLBW infants developed cerebral palsy. The mild diplegic showed no abnormal postures at term or 4 months. The quadriplegic had no abnormal postures at term and was ill at 4 months so could not be examined. It would seem therefore that the postural responses alone could not detect early cerebral palsy although the number of cerebral palsy infants was too small to draw definite conclusions.

4.40 CONCLUSIONS

Based on the findings of this study it can be concluded that :

1. **At term corrected age:**
   VLBW infants demonstrate lower tone and more extension.
2. **Four months corrected age:**
   Extension is fully integrated but there is marked delay in head and trunk control in the VLBW infant.
3. **At one year corrected age:**
   The Griffiths Tests indicate that the overall development of the VLBW infant is less mature than that of the fullterm infant.
   Delay in head and trunk control at four months corrected age is associated with motor delay at one year.
   Gross motor development appears to be more advanced than all other areas of development in both VLBW and fullterm infants at 12 months but by 18 months this is no longer the case.

Using the 7 postural responses of Vojta, objective one was successfully achieved. Norms were established for the fullterm and preterm infants.

0------0

5.00 ASSESSMENT OF NEURODEVELOPMENTAL OUTCOME IN HIGH RISK VLBW INFANTS

On evaluation of the 7 Vojta postural responses it was found that the first 5 responses provided statistical significance and useful information as part of a neurological assessment. The Peiper and Collis vertical responses were discarded as they did not contribute any additional information to the assessment. In these 2 responses the infant is turned upside down which is traumatic for parents to see and could be hazardous for the VLBW infants as many of them have intracranial lesions.

Following on the first project, an Infant Neurodevelopmental Assessment (INA) was created. This assessment consists of the first 5 postural responses of Vojta and also includes spontaneous posture, passive muscle tone and specific primitive reflexes.

It was decided to use the INA to test a group of high risk infants for deviant neurodevelopmental patterns.

5.10 METHOD

Patients

Between July 1988 and September 1989, all infants with a birthweight of less than 1500 grams were accepted into the study. Dr. C. van der Elst scanned all the infants ultrasonically and assigned the infants into groups depending on the ultrasound diagnosis. There were 44 VLBW infants with intracranial lesions on ultrasound and 60 VLBW infants without abnormalities on ultrasound i.e. a total of 104 high risk infants. The Papile grading system was used to classify those infants with intraventricular haemorrhages. The relevant medical history and ultrasound findings were only made known to me after I had completed my assessments at 4½ months corrected age.

Of the 104 infants, 2 were excluded because they were identified as having fetal alchohol syndrome (FAS), 16 were lost to follow up and 10 died during the course of the study. The remaining 76 infants formed the basis of the study.

The infants were chosen from the neonatal intensive care unit at Groote Schuur hospital. All infants were assessed using the Ballard score for gestational age and the Lubchenco growth chart. See Table 5.1, Figure 5.1 and Appendix V/I for details.

Number		76	
Mean Birth weight	grams	1092	
S.D.		208	
Mean gestational age	weeks	31.5	
S.D.		2.4	
Delivery :			
NVD	%	42	
Caesarian section	%	43	
Breech	%	8	
Born before arrival	%	7	
Apgar Scores (mean):			
1 minute		5.1	
SD		2.6	
5 minutes		7.5	
SD		1.9	
AGA	%	46	(n = 35)
SGA	%	54	(n = 41)

Table 5.1 : INA Study - Infants Birth Data

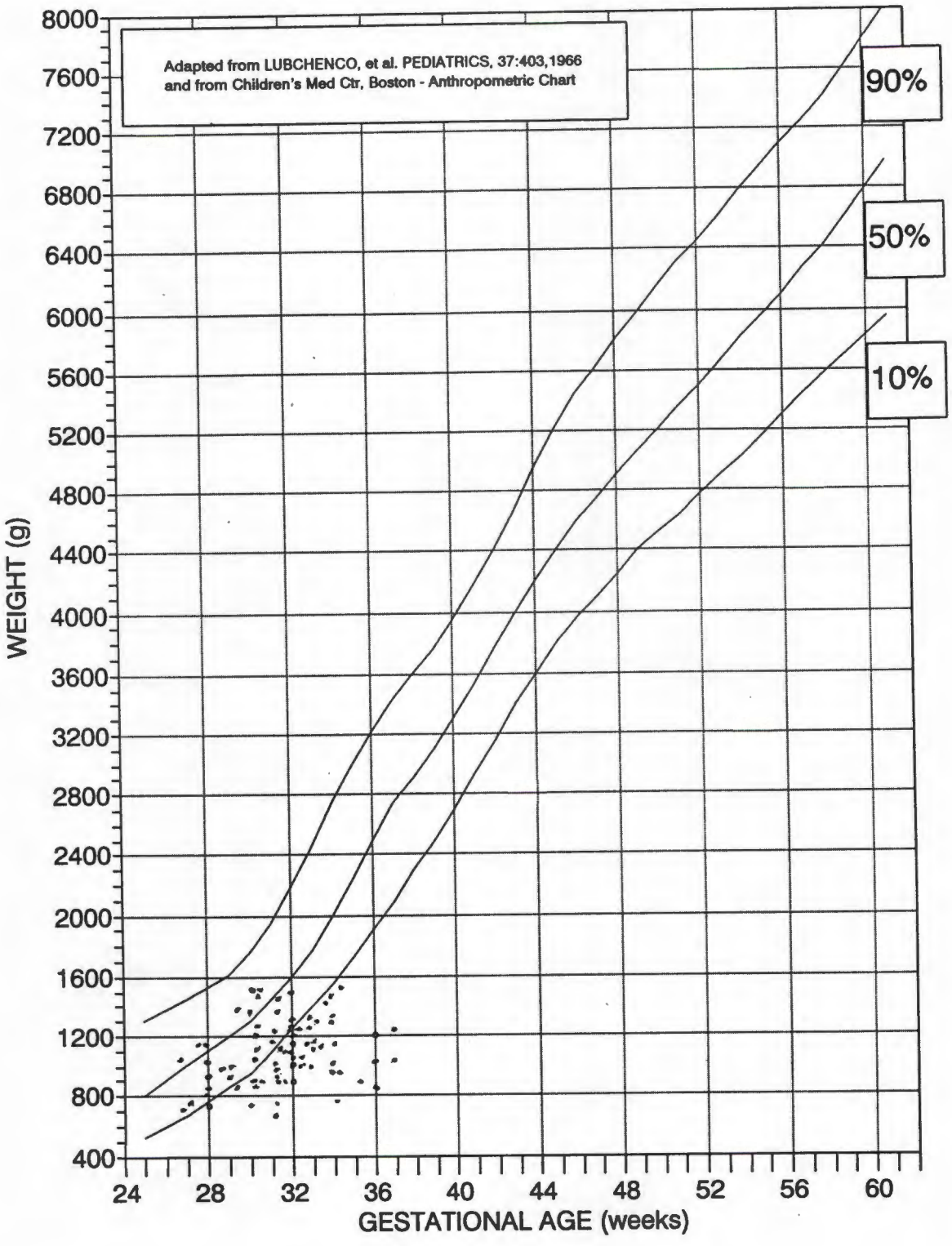


Figure 5.1 : Neonatal Growth Chart

VLBW Infants INA Study

Using the INA I assessed all infants between 37 and 42 weeks post conception and at 58 weeks post conception i.e. at term and 4½ months corrected age.

According to Lois Bly (1983), trunk control was not complete by four months but matured rapidly thereafter. Therefore as so many normal infants in the first study had delayed responses at 4 months corrected age i.e. lack of head and trunk control, it was decided to assess the infants 2 weeks later at 4½ months corrected age. All infants were followed up at 12 months corrected age by Dr. Buccimazza when a neurological examination and an assessment using the Griffiths Scales of Mental Development was carried out. Dr. Buccimazza was unware of the infants' medical history.

Procedure

The assessment form was divided into 2 parts, i.e. a dataform and a key with all possible responses for each test item. (Appendix XI/I and XI/II).

Figure No. 5.2 illustrates the test items with progessive responses.This is the format of the clinical assessment and therefore sequencing of the responses differed from the initial dataform and key.

The assessment followed a definite sequence from gentle to more vigorous movement. This reduced the likelihood of crying which leads to increased tone.

The test items are described below:

1. **Supine at term:**

   With the infant lying supine, facing the examiner, the position of the head, arms and legs was noted. (In Figure 5.2 (1) "Head asymm" (head asymmetrical) means the infant lay with his head turned to one side. "Head symm" (head symmetrical) means the infant lay with his head in the midline). With the head in the midline, eye following was tested by moving a loose red wool pom-pom through an arc of 90 degees to either side about 20 centimetres above the infant's face. If eye following was unsuccessful in this position, the infant was swaddled in a "bunny" blanket, held horizontally in front of the examiner and the pom-pom was moved through the infant's line of vision (as demonstrated by Lily Dubowitz - personal communication).

   Supine at 4½ months:

   The assessment was divided into 2 stages: In the first stage the infant was assessed fully dressed while sitting facing forward on the mother's lap:

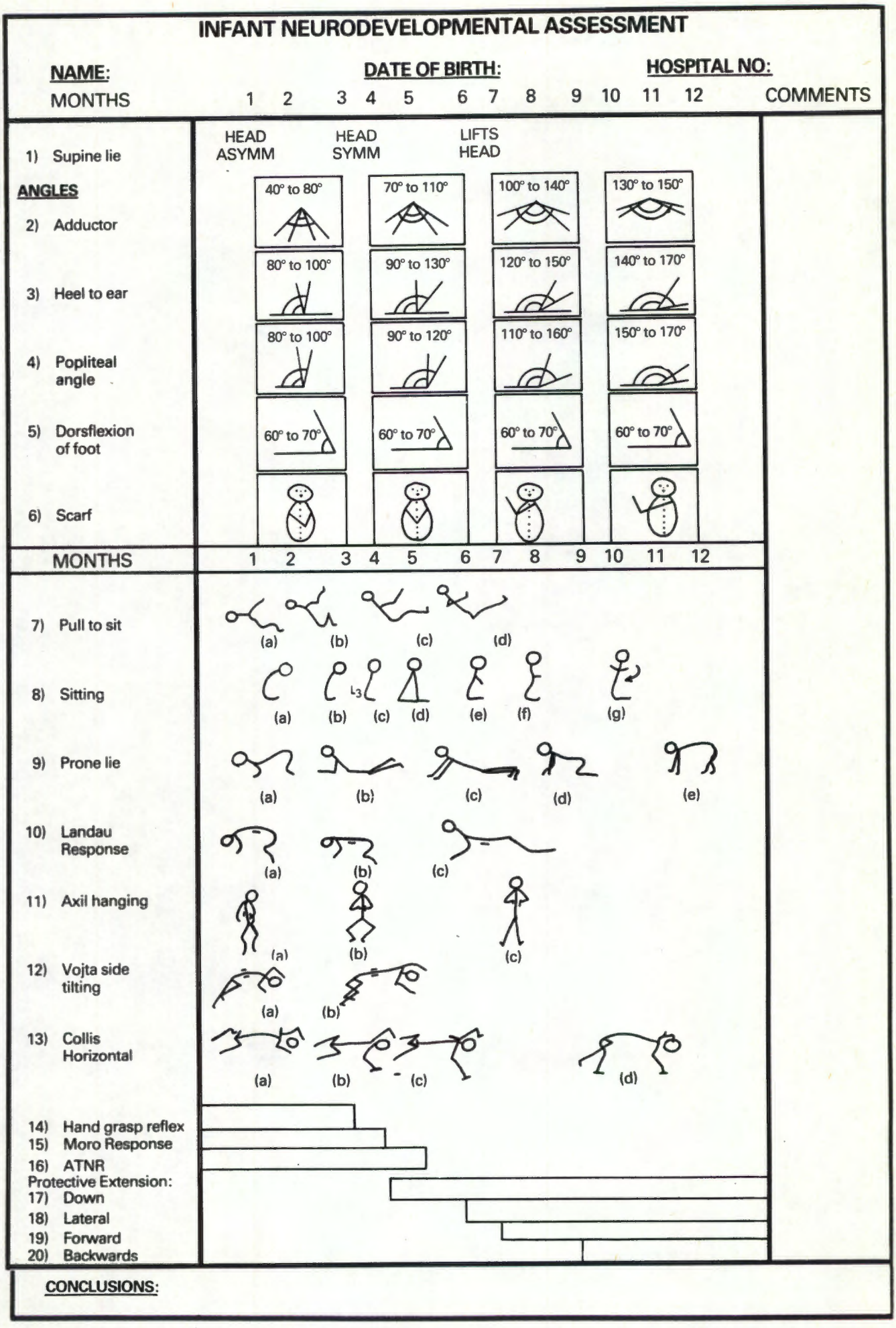


Figure 5.2 : Infant Neurodevelopmental Assessment

a) The red pom-pom was held in front of the infant's face about 20 centimetres away and moved to each side to assess eye following.

b) A ring was positioned within the infant's grasp to test midline hand function and symmetry.

In the second stage, the infant was undressed and placed in the supine position. Various items were noted:

a) Was the head in the midline?

b) Were the hands brought to the mouth?

c) Did the infant kick his legs reciprocally?

Still in supine:

The "Angles"method (according to Ellison 1984b) tested range of movement and tone in legs and arms by moving the limbs in a set pattern. (See Figure 5.2 (2) - (6) and Figures 5.3 - 5.6)

2. **Adductor angle:**

The legs were abducted as far as possible. The angle formed by the legs was measured with a goniometer. The goniometer fulcrum was placed on the infant's umbilicus and the goniometer arms were placed down the middle of the thighs to centre on mid patellae.

3. **Heels to ear:**

With the buttocks on the table the legs were kept straight and moved towards the ears. When resistance to this movement was felt, the angle formed from table surface to legs was measured. The goniometer fulcrum was placed against the greater trochanter of the femur. One goniometer arm remained on the table and the other was placed along the shaft of the femur. The latter arm was moved with the legs as they were raised off the table.

4. **Popliteal angle:**

With the buttocks on the table the hips were flexed to bring the knees to either side of the abdomen until there was resistance. Then the legs were extended.When resistance to this movement was felt, the angle formed between the femur and tibia was measured. The goniometer fulcrum was placed on the lateral condyle of the femur. The goniometer arms were placed along the lateral side of the femur and tibia respectively.

Adductor angle

Figure 5.3

Heel to ear

Figure 5.4

Popliteal Angle

Figure 5.5

Dorsiflexion of the ankle

Scarf sign

Figure 5.6

5. **Dorsiflexion angle of the foot:**

The knee was extended. The foot was dorsiflexed and the angle between the foot and leg was measured. The goniometer fulcrum was placed on the lateral malleolus and the goniometer arms along the lateral side of the distal end of the tibia and the lateral border of the foot.

6. **Scarf sign:**

The infant's hand was grasped and the arm was pulled across the infant's chest until there was resistance. The position of the elbow was noted in relation to the midline. The scarf sign tested the movement of the scapula around the chest wall.

7. **Traction Response - Pull to Sit:**

With the infant supine, traction was applied to both arms until the trunk formed an angle of 45 degrees with the examination plane. The degree of head lag, arm flexion and position of the legs was noted.

8. **Sitting:**

The infant was brought up into sitting through traction and the position of the trunk was noted.

9. **Prone lie:**

The position of the arms, legs and pelvis was noted according to Figure 5.2.

10. **Landau Response:**

The infant was held in a prone horizontal position with the examiner's hand supporting the lower chest and upper abdomen. The position of the head, spinal curvature and degree of flexion of arms and legs was noted.

11. **Axillary hanging:**

The infant was held from behind, below the axillae and suspended vertically with the feet just clear of the table. Care was taken not to exert pressure on the back, which could have stimulated trunk extension. The position of the head and legs was noted.

12. **Vojta side tilting response:**

The infant was held vertically with the back to the examiner and tilted suddenly into the lateral horizontal position. The positionof the head, trunk, upper arms and

both legs was noted.

13. **Collis horizontal suspension:**
With the infant lying on one side and the back to the examiner, the uppermost shoulder and hip joints were grasped, taking hold of the whole joint to avoid stretching the ligaments. The infant was then lifted just off the table. The position of the head, trunk and free arm and leg was noted.

14. **Hand Grasp:**
The examiner's index finger was placed in the infant's palm from the ulna side.

15. **Moro response:**
The infant was supported on the examiner's forearm with the head held in the hand. The head was allowed to fall back.

16. **ATNR** (Asymmetrical tonic neck reflex):
This was tested when observing following or by turning the head. The position of the arm and leg was noted i.e. whether the arm and leg on the occipital side flexed and on the face side extended.

17. **Protective extension - downwards:**
The infant was held vertically and rapidly lowered. The position of the feet was noted i.e. whether the infant took weight on flat feet or on the toes.

18. **Sideways Propping:**
The infant was placed in the sitting position and gently pushed sideways to take weight on the arms. In this study the infant was assessed at term and four and a half months corrected age therefore mature protective extension laterally, forwards and backwards was not tested (Figure 5.2 (18),(19),(20)).

Statistical Analysis

All the results were entered onto the prescribed proforma and entered for computer analysis.

The Chi - squared and the Fishers' exact test were used to test:

1. the differences between cerebral palsied and non-cerebral palsied infants

2. the differences between those infants with intraventricular haemorrhages and those without
3. the differences between infants with no intraventricular haemorrhages, those with Grade I and II intraventricular haemorrhages and those with Grade III and IV intraventricular haemorrhages
4. the associations between the INA and the developmental (or general) quotient of the Griffiths Mental Development Scale for the VLBW study group as a whole
5. the associations between the INA and the locomotor subtest score of the Griffiths Mental Development Scale for the VLBW study group as a whole

The Student's t-test was used to compare:

1. the ranges of movement measured on the INA
2. the development quotient and subtests of the Griffiths Mental Development Scale for cerebral palsied and non-cerebral palsied infants

5.20 RESULTS

Seventy-six high risk infants were included in the study. See Figure 5.7 for assessment distribution flowchart. At the first assessment at term there were 34 infants with intracranial lesions detected on ultrasound and 42 without. See Table 5.2 for details of the ultrasound findings.

At the second assessment at 4½ months corrected age 72 cases were analysed, 32 infants with intracranial lesions and 40 without.

At one year corrected age 76 infants underwent a neurological examination and completed the Griffiths test for Mental Development (four infants who missed the second assessment returned at one year).

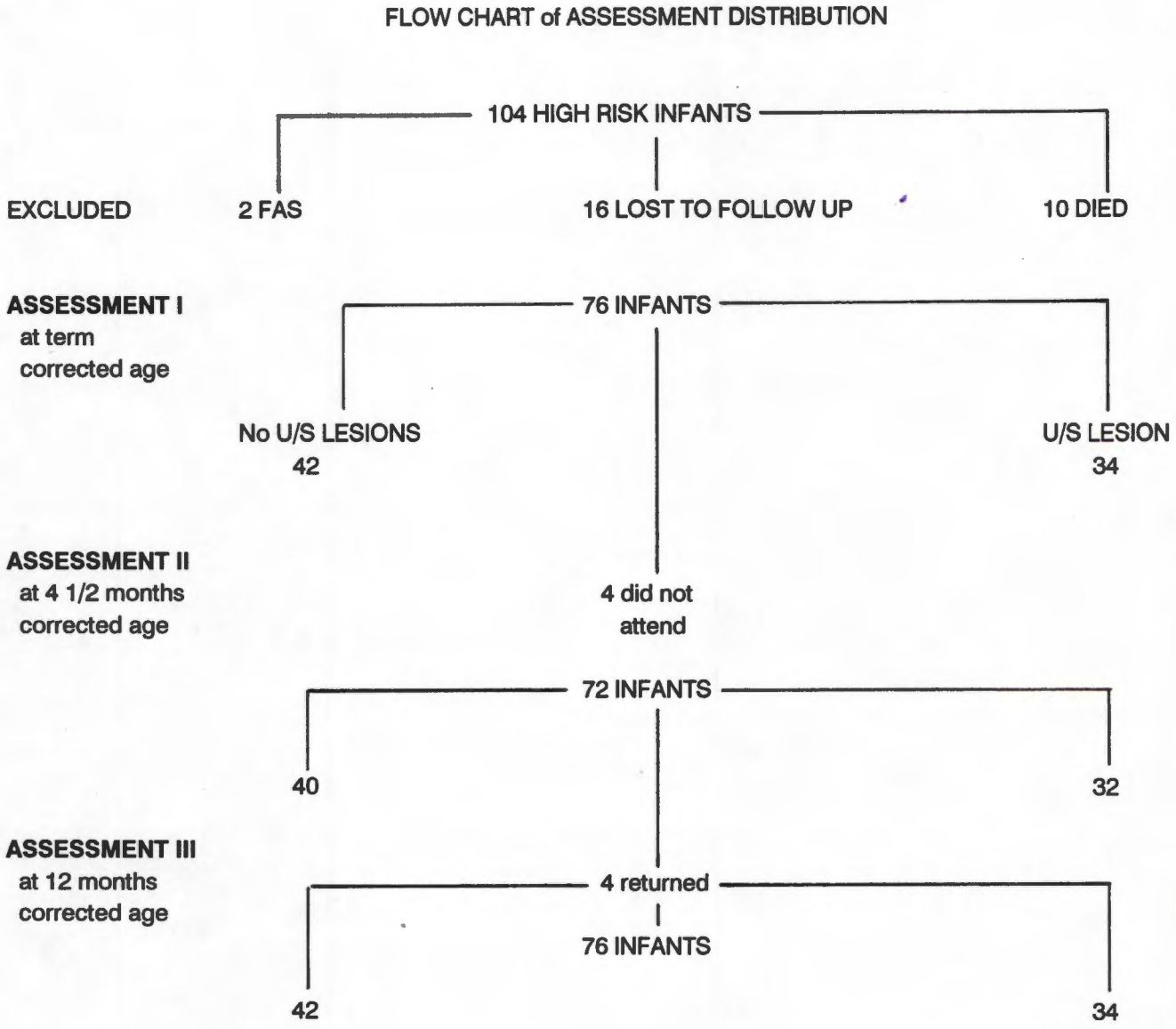


Figure 5.7 : Infant Neurodevelopmental Assessment
Flowchart of Assessment Distribution

ULTRASOUND FINDINGS (n = 76)

LESIONS	NUMBER		%
No lesions	42		55
Grade I	16		21
Grade II	9	(1 leucomalacia included)	12
Grade III	3		4
Grade IV	4	(2 leucomalacia included)	5
Leucomalacia only	2		3

Table 5.2 : Ultrasound Findings

Altogether in this study of 76 infants, 5 infants were diagnosed with cerebral palsy and 1 had soft neurological signs that indicated mild CP. All the CP infants had intracranial lesions. See Figure 5.8 and Table 5.3 for details of the CP infants.

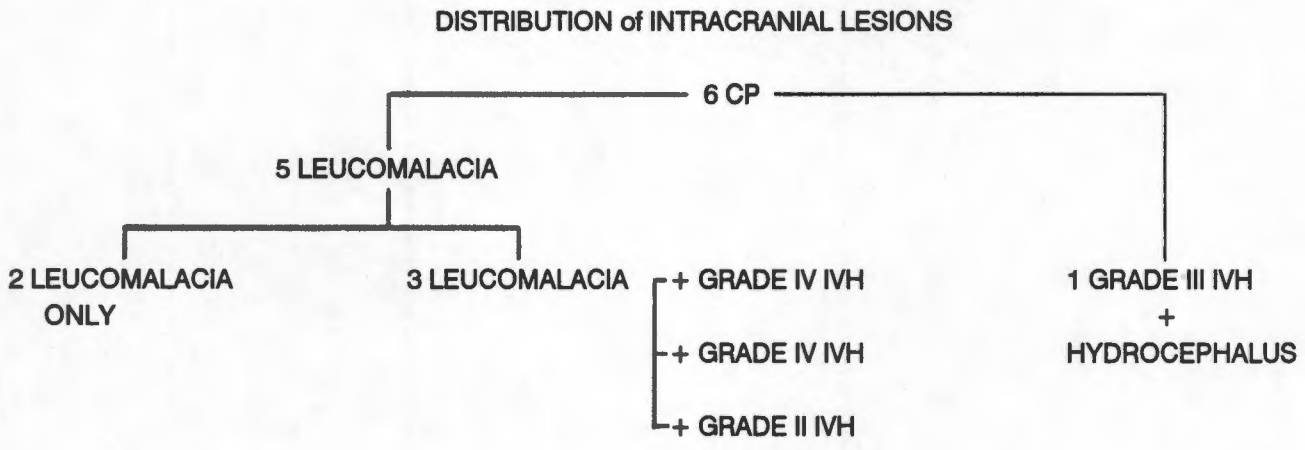


Figure 5.8 : Cerebral Palsied Infants (CP)
Distribution of Intracranial Lesions

CASE No	DELIVERY	BIRTH WEIGHT g	GESTATIONAL AGE	VENTILATION No of DAYS	MEDICAL CONDITIONS	ULTRA SOUND	DIAGNOSIS
9	Normal Vertex Delivery	1290	32	12	Pneumothoraces (bilateral) Pneumonia	Leucomalacia Grade II IVH	Spastic Quadriplegia
13	Twin A: Caesarian Section Twin B: Still born	1090	33	19	Pneumothorax Pneumonia Necrotising Enterocolitis	Leucomalacia	Spastic Quadriplegia
42	Triplet B: Triplet C: Normal Triplet A: Died In vitro fertilisation	1499	30	4	Hyaline Membrane Disease Hydrocephalus + Shunt	Leucomalacia Grade IV IVH	Right Hemiparesis
55	Caesarian Section for gestational proteinuric hypertension (Previous Caesarian)	840	30	2	Hyaline Membrane Disease Pneumothorax Pneumonia	Right Leucomalacia	Left Hemiparesis
56	Breech	1120	34	12	Pneumonia Necrotising Enterocolitis Hydrocephalus	Grade III IVH	Severe Spastic Quadriplegia
70	Born before arrival	1260	30	8	Pneumonia Septicaemia Meningitis	Leucomalacia Grade IV IVH	Mild Cerebral Palsy

Table 5.3 : Cerebral Palsied Infants - Medical History

1. **COMPARISON OF CP WITH NON-CP INFANTS.** See Table 5.4 and Appendix VI/I

At term:

Significance was found in the adductor angle ($P<0,005$) where the CP infants demonstrated a smaller angle. There were no significant differences in posture.

At 4½ months corrected age:

The angle test of heel-to-ear was significant ($P<0,01$) with the CP infants demonstrating a reduced range of movement. Observation of posture in supine produced significant difference in head and hand symmetry in that many of the CP infants did not lie with their heads in the midline ($P<0,05$) and the right hand tended to be held alongside the body and was not brought to the midline ($P<0,01$). The CP infants exhibited less leg movements ($P<0,05$).

Of the postural responses the Landau showed significance with head and trunk and legs:

The CP infants more often extended their heads above the horizontal and extended the thoracic spine and pelvis whereas those infants without CP usually held the head, shoulders and thoracic spine in one line ($P<0,05$). The legs were also often held in prolonged extension ($P<0,05$).

Protective extension downwards onto the toes was significant for the CP infant (left leg $P<0,05$ and right leg $P<0,005$) as was the scarf sign. The CP infant frequently did not allow the elbow to be brought round to the midline (left arm $P<0,05$ and right arm $P<0,005$).

The CP infants cried more during the responses of:

Traction	($P < 0,005$)
Landau	($P < 0,05$)
Vojta	($P < 0,01$)
Collis horizontal	($P < 0,01$)

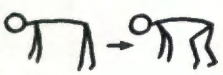
I N A (significant results only)		0 Months Corrected Age (n = 78)						4 1/2 Months Corrected Age (n = 74)					
		No CP (72)		CP (6)		P		No CP (68)		CP (6)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
1. SUPINE		%		%				%		%			
Head asymmetrical								13	13	50	50		
Head symmetrical								87	87	50	50	<0.05	<0.05
Hand alongside body with elb. fl.									6		50		
Hand to mouth or midline									94		50		<0.01
Kicks leg								97	97	67	67		
No leg movements								3	3	33	33	<0.05	<0.05
2. TRACTION													
State: quiet								90		33			
crying								10		67		<0.005	
5. LANDAU													
Head & trunk fl.								-		-			
Head fl., trunk only slightly fl.								-		-			
Ext. head & thoracic spine								76		33			
Ext. head, thoracic spine and pelvis								24		67		<0.05	
Leg in moderate fl.								-	-	-	-		
Leg in ext. -> fl.													
or								13	13	50	50		
Leg in suspension													
Leg in strong fl.								87	87	50	50	<0.05	<0.05
Leg ext. time: 0 secs								90	90	50	50		
1 to 60 secs								10	10	50	50	<0.05	<0.05
State: quiet								88		50			
crying								12		50		<0.05	

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Table 5.4 : Comparison of CP with Non-CP VLBW Infants

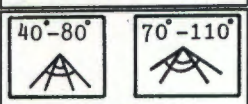
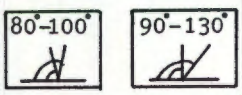
I N A (significant results only)		0 Months Corrected Age (n = 78)					4 1/2 Months Corrected Age (n = 74)					
		No CP (72)		CP (6)		P	No CP (68)		CP (6)		P	
		L	R	L	R	L R	L	R	L	R	L	R
6. AXILLARY HANGING		%		%			%		%			
State: quiet		75		33								
crying		25		67		<0.05						
7. VOJTA SIDE TILTING												
State: quiet							85		33			
crying							15		67		<0.01	
8. COLLIS HORIZONTAL												
State: quiet							85		33			
crying							15		67		<0.01	
12. PROT. EXT.-DOWNWARDS												
Flat feet							93	93	50	33		
On toes							7	7	50	67	<0.05	<0.005
Absent							-	-	-	-		
14. RANGE OF MOVT.												
Adductor angle - mean (degrees)		108		95		<0.005						
Heel to ear - mean (degrees)							97		91		<0.01	
Scarf sign:												
Elbow before the midline							4	1	33	50		
Elbow at the midline							96	99	67	50	<0.05	<0.005

Table 5.4 : Comparison of CP with Non-CP VLBW Infants

At 12 months corrected age

At 12 months corrected age the cerebral palsied infants scored lower than the non-cerebral palsied infants on DQ and all subtests of the Griffiths Assessment.

Table 5.5 : INA Study : Griffiths Assessment at 12 months corrected age

	CP (n = 6)		no CP (n = 70)	
	$\bar{X}$	Range	$\bar{X}$	Range
DQ	79	31-104	104	78-117
Locomotion	78	42-106	104	73-135
Personal and Social	81	33-106	106	76-138
Language	93	29-118	108	80-125
Eye hand co-ordination	73	16-104	101	68-129
Performance	71	22-104	100	71-124

CP infants : Griffiths Test Results

Case No.	Diagnosis	GQ	Loc	PerS	HeS	EH	Perf
9	Spastic Quadriplegia	92	63	91	118	102	85
13	Spastic Quadriplegia	55	74	58	104	16	22
42	Right Hemiparesis	100	99	99	96	104	104
55	Left Hemiparesis	104	106	106	110	95	101
56	Spastic Quadriplegia	31	42	33	29	29	23
70	Mild CP	93	86	99	98	89	93

2. All the items on the INA at term and 4½ months corrected age were correlated with DQ and Locomotor scores at 12 months corrected age and were analysed for the VLBW study group as a whole.

ASSOCIATIONS BETWEEN INA AND DQ. See Table 5.6 and Appendix VII/I

Higher DQ scores were associated with those infants who were able to:

At term:

- visually track a red pompom through 45 degrees to the left and to the right ($P < 0,05$).
- had a flexed head and trunk on the Landau ($P < 0,05$).

At 4½ months:

- bring the right ($P<0,01$) and the left hand ($P<0,05$) to the mouth or midline.
- with traction, have some head control ($P<0,01$),
- strongly flex both legs ($P<0,05$) with no extension time ($P<0,05$).
- support themselves on flexed forearms in prone with the head lifted i.e. "puppy prone" ($P<0,05$).
- with the Vojta response, show head and trunk righting to the right side ($P<0,05$)
- with the Collis horizontal, show head and trunk righting on the right side ($P<0,05$).
- protective extension down onto flat feet ($P<0,05$).
- extend the right ($P<0,005$) and the left ($P<0,05$) arm to weight bear in sideways propping.
- absent Moro response ($P<0,05$).
- bring the right elbow to the midline on the scarf sign ($P<0,05$).

Lower DQ scores were associated with infants who cried during the traction, Vojta ($P<0,05$) and Collis horizontal responses ($P<0,005$).

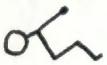
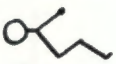
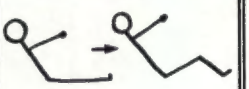
I N A (significant results only)		0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
		DQ at 12 Months				P		DQ at 12 Months				P	
		<100 (19)		>100 (57)				<100 (17)		>100 (55)			
		L	R	L	R	L	R	L	R	L	R	L	R
1. SUPINE		%		%				%		%			
Follows from midline to 45 ^		42	42	70	72								
Follows from midline to 90 ^		-	-	-	-								
No following		58	58	30	28	<0.05	<0.05						
Hand alongside body with elb. fl.								24	29	4	4		
Hand to mouth or midline								76	71	96	96	<0.05	<0.05
2. TRACTION													
Marked head lag								29		15			
Moderate head lag								29		7			
Full head control								42		78		<0.01	
Hip & knee ext. -> fl.													
or								-	-	-	-		
Hip & knee abd. + knee fl.													
Hip & knee in moderate fl.								59	49	27	27		
Hip & knee in strong fl.								41	41	73	73	<0.05	<0.05
Leg ext. time: 0 secs								82	82	91	100		
1 to 60 secs								18	18	9	0	<0.05	<0.05
State: quiet								65		91			
crying								35		9		<0.05	
4. PRONE LYING													
Posterior tilt pelvis, knees fl.								29		2			
Pelvis flat, abd. "frog" legs								12		13			
Puppy prone wt. bearing on fl.													
or ext elbs.								59		85		<0.05	

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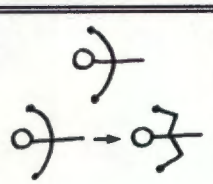
Table 5.6 : VLBW Infants : Association of INA at 0 and 4½ Months Corrected Age with DQ at 12 Months Corrected Age

Table 5.6 : VLBW Infants : Association of INA at 0 and 4½ Months Corrected Age with DQ at 12 Months Corrected Age

I N A (significant results only)		0 Months Corrected Age (n = 76)				4 1/2 Months Corrected Age (n = 72)					
		DQ at 12 Months			P	DQ at 12 Months			P		
		<100 (19)		>100 (57)		<100 (17)		>100 (55)			
		L	R	L	R	L	R	L	R	L	R
5. LANDAU		%		%		%		%			
Head & trunk fl.		32		63							
Head fl., trunk only slightly fl.		68		37						<0.05	
Ext. head & thoracic spine		-		-							
Ext. head, thoracic spine and pelvis		-		-							
7. VOJTA SIDE TILTING											
Head & trunk: side fl. with gravity											
Head & Trunk righting											
State: quiet						53		89			
crying						47		11		<0.005	
8. COLLIS HORIZONTAL											
Suspension head, neck & trunk											
Righting of head, neck & trunk											
State: quiet						53		89			
crying						47		11		<0.005	
10. MORO RESPONSE											
Partial											
Complete						0		4			
Absent						24		51		<0.05	
12. PROT. EXT. - DOWNWARDS											
Flat feet											
On toes						29		7			
Absent						24		9		<0.05	
13. SIDEWAYS PROPPING											
Ext. arm to wt. bear						35	29	65	69		
Absent						65	71	35	31	<0.05	<0.00
14. RANGE OF MOVEMENT											
Scarf sign:											
Elbow before the midline											
Elbow at the midline											

ASSOCIATIONS BETWEEN INA AND LOCOMOTION.

See Table 5.7 and Appendix VIII/I

Higher scores were associated with those infants who were able to:

At term:

- visually track a red pompom through 45 degrees to the left and to the right ($P<0,05$).
- extend arms on the Landau response ($P<0,05$).

At 4½ months corrected age :

- strongly flex both legs on traction ($P<0,05$)
- "puppy" prone ($P<0,005$).
- strongly flex both legs ($P<0,05$) with no extension time on axillary hanging ($P<0,005$).
- head and trunk righting to the right on the Vojta response ($P<0,05$).
- head and trunk righting on the right and left with Collis horizontal ($P<0,05$).
- extend the right and left arm to weight bear in sideways propping ($P<0,05$).
- bring the right arm to the midline with the scarf sign ($P<0,05$).

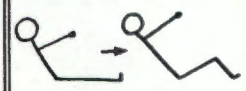
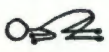
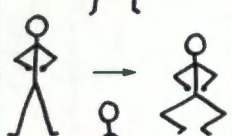
I N A (significant results only)		0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
		LS at 12 Months				P		LS at 12 Months				P	
		<100 (33)		>100 (43)				<100 (30)		>100 (42)			
		L	R	L	R	L	R	L	R	L	R	L	R
1. SUPINE		%		%				%		%			
Follows from midline to 45 ^		52	55	28	74								
Follows from midline to 90 ^		-	-	-	-								
No following		48	45	72	26	<0.05	<0.05						
2. TRACTION													
Hip & knee ext. -> fl.													
or								-	-	-	-		
Hip & knee abd. + knee fl.													
Hip & knee in moderate fl.								50	50	24	24		
Hip & knee in strong fl.								50	50	76	76	<0.05	<0.05
4. PRONE LYING													
Posterior tilt pelvis, knees fl.								16		2			
Pelvis flat, abd. "frog" legs								20		7			
Puppy prone wt. bearing on fl.													
or ext. elbs.								64		91		<0.005	
5. LANDAU													
Arm: fl.		58	61	33	33								
ext.		42	39	67	67	<0.05	<0.05						
6. AXILLARY HANGING													
Hip & knee in loose fl.								3	3	5	5		
Leg ext -> fl.													
or								50	50	24	24		
Leg in suspension													
Hip & knee in strong fl.								47	47	71	71	<0.05	<0.05
Leg ext. time: 0 secs								50	50	86	86		
1 to 60 secs								50	50	14	14	<0.005	<0.005

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Table 5.7 : VLBW Infants : Association of INA at 0 and 4½ months corrected age with the Griffiths Locomotor Score (LS) at 12 months corrected age

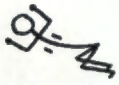
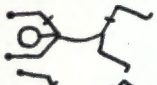
I N A (significant results only)		0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
		LS at 12 Months				P		LS at 12 Months				P	
		<100 (33)		>100 (43)				<100 (30)		>100 (42)			
		L	R	L	R	L	R	L	R	L	R	L	R
7. VOJTA SIDE TILTING		%		%				%		%			
Head & trunk: side fl. with gravity								47		24			
Head & trunk righting								53		76			<0.05
8. COLLIS HORIZONTAL													
Suspension head, neck & trunk								40	43	19	21		
Righting of head, neck & trunk								60	57	81	79	<0.05	<0.05
13. SIDEWAYS PROPPING													
Ext. arm to wt. bear								43	43	69	71		
Absent								57	57	31	29	<0.05	<0.05
14. RANGE OF MOVEMENT													
Scarf sign:													
Elbow before the midline								10		2			
Elbow at the midline								90		98			<0.05

Table 5.7 : VLBW Infants : Association of INA at 0 and 4½ months corrected age with the Griffiths Locomotor Score (LS) at 12 months corrected age

3a. COMPARISON BETWEEN THE GROUP OF INFANTS WITH INTRAVENTRICULAR HAEMORRHAGES AND THOSE INFANTS WITHOUT HAEMORRHAGES AT TERM AND 4½ MONTHS CORRECTED AGE.

The only significant finding was the popliteal angle on the right leg at term, where the infants with IVH demonstrated a smaller angle. See Table 5.8 and Appendix IX/I

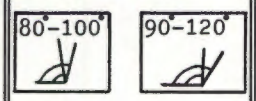
I N A (significant results only)		0 Months Corrected Age (n = 71)						4 1/2 Months Corrected Age (n = 67)					
		No IVH (42)		IVH (29)		P		No IVH (40)		IVH (27)		P	
		L	R	L	R	L	R	L	R	L	R	L	R
14. RANGE OF MOVT.													
Popliteal angle - mean (degrees)		110	114	110	111	ns	0.03	-	-	-	-	-	-

Table 5.8 : Comparison between VLBW Infants with IVH (all grades) and those with no IVH

3b. COMPARISON AT TERM AND 4½ MONTHS CORRECTED AGE BETWEEN :

Infants with no intraventricular haemorrhage.
Infants with grade I and II intraventricular haemorrhages.
Infants with grade III and IV intraventricular haemorrhages.

No statistical significance could be found between the three groups. See Appendix IX/II.

4. COMPARISON OF HEAD AND TRUNK CONTROL IN INFANTS WITH NO INTRACRANIAL LESIONS AT 4½ MONTHS CORRECTED AGE.

Using traction, Vojta side tilting and Collis horizontal responses, between 25 - 30% of the group of infants with no intracranial lesions on ultrasound displayed delay in head and trunk control at 4½ months corrected age. See Figure 5.9 and Appendix IX/I.

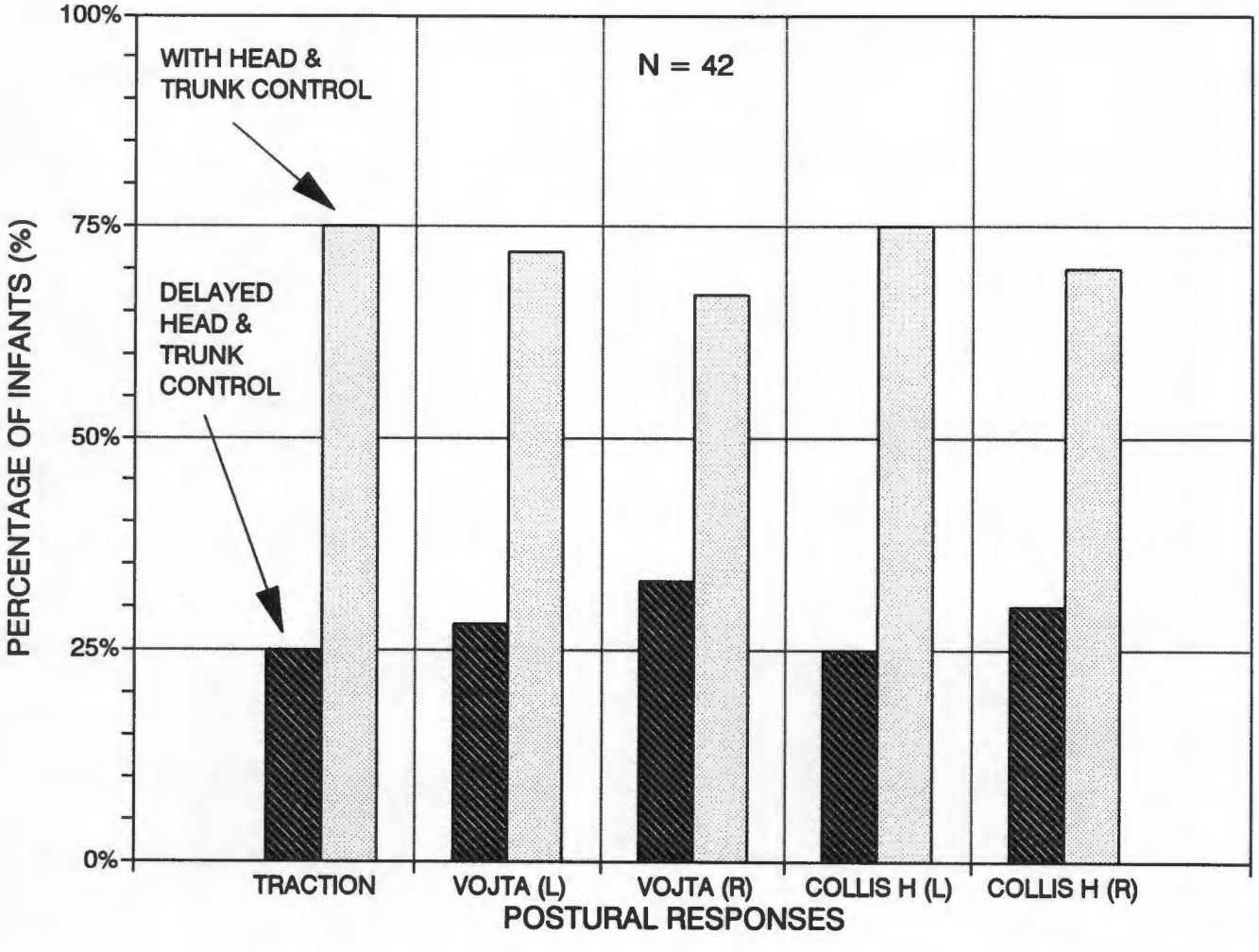


Figure 5.9 : INA Study : Delay in Head and Trunk Control

VLBW 4½ Months : No Intracranial Lesions

5.30 DISCUSSION

1. Cerebral Palsy

When comparing cerebral palsied infants with non-cerebral palsied infants significance was shown in several well known clinical signs indicating increased tone and persistent asymmetry in the cerebral palsied infant. Illingworth (1982) includes all the clinical signs listed below, when discussing the diagnosis of cerebral palsy.

Using the "Angles" method (according to Ellison, 1984b) to test range of movement and tone proved to be useful. By measuring angles with a goniometer important findings were made. The adductor angle was significant at term and the "heel to ear" showed significance at 4½ months corrected age indicating increased tone in the low back extensors, glutei and hamstring muscles.

According to Bly (1983) the fourth month is one of "strong symmetry" because of the balance between extensors and flexors. This applies particularly to the neck muscles so that the infant lies with his head in the midline. The cerebral palsied infant demonstrated increased tone in the neck extensors and was not able to bring his head into the midline. Significance in the scarf sign indicated increased tone in the scapula retractors which prevented the infant's elbow from being brought to the midline and as a result the infant was unable to bring his own hand to the mouth.

Increased tone in the legs prevented the infant from kicking his legs spontaneously. Protective extension down on to the toes could indicate increased tone in the legs, tendo achilles, or an abnormal positive supporting reflex (Goodman 1987).

It is interesting to note that with the Landau response it was only the cerebral palsied infant who extended the head above the horizontal and the trunk was extended all the way to the pelvis. This indicates that it is only the cerebral palsied infant who demonstrates excessive head and trunk extension against gravity at 4½ months corrected age. Georgieff et al (1986) found that truncal hypertonicity on the Landau was associated with a worse developmental outcome.

The cerebral palsied infants were significantly more irritable. De Vries and Dubowitz (1985) found irritability a dominant, persistent sign amongst their infants with

quadriplegia.

Although the number of cerebral palsied infants was small, the INA identified several clinical neurological signs distinguishing the cerebral palsied infant from the non-cerebral palsied infant. Only one clinical sign i. e. the adductor angle proved to be significant at term corrected age. This is not sufficient to diagnose cerebral palsy at term. At 4½ months corrected age several signs were significant and will prove very useful in future studies to diagnose cerebral palsy early, so that all the benefits of early treatment can be achieved. According to Bobath and Bobath (1984) "it is not possible to recognise suspected cases of cerebral palsy with any certainty before four months of age" (p.14).

The fact that 25 - 30% of infants without intracranial lesions displayed lack of trunk control at 4½ months corrected age, demonstrates how difficult it is to diagnose cerebral palsy early.

The DQ Griffiths mean scores and the subtest mean scores were all reduced in the CP infants. However two of the 6 infants, both spastic quadriplegics, had extremely low scores on many of the subtests. This tended to reduce the mean scores. The remaining infants had normal subtest scores or a profile more in keeping with a diagnosis of CP.

2. **Associations between INA and Griffiths scores**

At term visual tracking proved to be an important clinical sign related to overall and locomotor development at one year corrected age. This is supported by Dubowitz et al (1981) who found visual tracking diagnostically useful with intracranial lesions.

A flexed trunk and suspended arms on the Landau at term were associated with mature development.

In this part of the study, the assessment was performed at 4½ months corrected age and not 4 months corrected age as in the previous study. At 4½ months corrected age lack of head and trunk control was associated with delay in general and gross motor development at one year corrected age. Qualitatively lack of head and trunk control was not as marked but was still associated with lower locomotor

and general development scores at one year. Support for this finding was the significant association between the ability to maintain "puppy prone" and later development particularly gross motor development.

According to Bly (1983) the infant of 4 months

> "utilizes bilateral controls of extensor and flexor muscles. In the prone position strong trunk extension is being balanced by equal antigravity flexor activity i. e. the chest muscles . This balance is observed in the forearm weight bearing position. The head and chest are lifted and maintained in midline. Shoulder control has increased sufficiently to bring the arms closer to the body and thus helps to maintain some of the weight during this elevation" (p.6).

Sideways propping which is described by Touwen (1976) as the lateral supporting reaction because it occurs before the infant is able to sit unsupported does indicate some degree of shoulder control. This variable is also associated with motor delay and general developmental delay at one year if not present at 4½ months corrected age.

Both "puppy prone" and sideways propping indicate the importance of upper trunk stability which supports the association between trunk control and later development.

Full integration of leg extension on traction and axillary hanging at 4½ months was associated with gross motor development at one year corrected age. Leg flexion on traction was also associated with overall development.

Increased tone in the arms preventing the infant from bringing the hands to the midline or mouth and the elbow to the midline on the scarf sign was associated with delay in development.

Protective extension down on to the toes also was associated with delay in development.

Persistence of the Moro response was associated with delay developmentally. According to Milani - Comparetti and Gidoni (1967) no protective extension is

possible until the Moro reflex has been fully integrated.

In this study of VLBW infants the significant associations between the INA variables and the Griffiths scores for overall and gross motor development raises the possibility that delay in the components of movement at 4½ months corrected age will predict delay in later development. Two studies discuss the issue.

Goodman (1987) found a significant correlation between a total neurodevelopmental score at 6, 9, and 12 months and the Griffiths general quotient (GQ) at one year; the more abnormal (higher) the score the lower the GQ. In her study of VLBW infants, at the 6 month assessment there was significant delay in prone development between the normal group of infants and the at-risk group. Goodman cautions against assuming that delay at 6 months in prone is indicative of poor neurodevelopmental outcome at one year because almost one third of the normal group of VLBW infants had delay in prone development. She comments that there are many normal infants who dislike prone and therefore may be delayed in the development of this position.

Irwin-Carruthers (1986) in a cross sectional study of normal motor development, found that preterm infants were slower than fullterm infants in acquiring head control and sitting but "overtook the fullterm infants on standing alone well, stooping and recovering and walking well" (p.147). This contradicts the findings of the present study. However 77% of the preterm infants in Irwin-Carruthers' study were 4 weeks or less preterm, whereas in this study only 6.5% of the preterm infants fell into this category. Carruthers found that infants weighing below the tenth centile at birth were noticeably delayed in acquiring gross motor skills. In the present study 54% of the infants were less than the tenth centile. Irwin-Carruthers also used a different locomotor assessment; the Denver developmental screening test.

Irwin - Carruthers recommends longitudinal studies of fullterm and low risk preterm infants to determine the predictive value of components of movement for future motor development.

3. **Intracranial Lesions**

The only significant finding was that of slightly increased tone in the right popliteal angle at term in the infants with IVH compared with those without IVH. Dubowitz et al (1981) did find the popliteal angle tight in infants with IVH, but their infants were all examined before 35 weeks. They also commented that an angle of 110 degrees or less in infants older than 35 weeks was normal. The popliteal angle in this study was measured at 40 weeks and the mean was 111 degrees in infants with IVH. This clinical sign would therefore appear to be more relevant at an earlier age.

In the present study, 25 out of 34 (74%) infants had grade I and II intraventricular haemorrhages (IVH) leaving only nine infants with grade III and IV haemorrhages. This could be the reason for the lack of significant data between the infants with haemorrhages and those without as several studies have shown that grade I and II haemorrhages do not exhibit clinical neurological signs and have a good prognosis. Larroche and Amiel Tison (1987) in reviewing IVH comment that 40 - 50% VLBW infants <1500 grams have IVH with a predominance of grade I and II. They quote Stewart (1985) who found infants with grade I and II haemorrhages "carried a good prognosis, just as good as a group of VLBW infants without IVH" (p.279).

Amongst the cerebral palsied infants 5 out of 6 had leucomalacia detected on ultrasound. This is in agreement with several studies which also found handicaps could be ascribed to large cystic periventricular leucomalacia and prolonged flare (Appleton et al, 1990; Cooke, 1987; De Vries et al, 1988; Fawer et al, 1985; Grahahm et al, 1987).

4. **Infant Neurodevelopmental Assessment (INA)**

As was pointed out in the literature review no neurological assessment has been universally accepted. The INA includes items from several assessments:

1. Five of Vojta's postural responses which were found to be most useful in the first part of the study.
2. Ellison's adaptation of Amiel Tison's measurement of tone.
3. Four of Milani-Comparetti's postural reactions.
4. Three of the primitive reflexes which Capute had found important to include

in his assessment.

5. The interactive behaviour and state of the infant, which was stressed by Brazelton and Prechtl, is also noted when assessing the infant.

Incorporation of the above items promises to allow the INA to be useful in the assessment of the infant at 4½ months corrected age. Items flow from one to another smoothly and the entire assessment can be completed in 10 minutes. The INA easily divides infants into normal, abnormal and suspect groups.

5.40 CONCLUSIONS

1. The INA promises to be effective in the early diagnosis of cerebral palsy at 4½ months corrected age in the VLBW high risk infant. Using the norms established in the first study, significant deviant neurodevelopmental patterns were detected in infants at 4½ months corrected age who were later diagnosed to have cerebral palsy. Advantage can then be taken of all the benefits of early treatment.
2. Five of Vojta's postural responses, included as part of a wider assessment i.e. the INA, were useful in indicating neurodevelopmental outcome in preterm infants.
3. Although not as marked qualitatively as in the first study there was still an association between lack of head and trunk control at 4½ months corrected age and developmental delay at one year corrected age in the VLBW infant.
4. Cerebral palsy occurred predominantly in infants with leucomalacia on ultrasound.
5. No significant clinical neurological signs distinguished infants with intraventricular haemorrhage from those without haemorrhage on ultrasound.

6.00 CONCLUSION AND RECOMMENDATIONS

All three objectives were achieved :-

1. Postural responses were compared between VLBW and fullterm infants and norms were established. The preterm infants demonstrated lower tone and more extension at term. At 4 months, extension was fully integrated but there was marked delay in head and trunk control.
2. Five postural responses were included in the Infant Neurodevelopmental Assessment (INA). Several clinical neurological signs were significant in infants who were later diagnosed to have cerebral palsy.
3. Delay in postural responses associated with head and trunk control were indicative of lower locomotor scores at one year. Both studies reinforced this finding.

This study has proved to be of value in a clinical setting. When assessing infants it is important to distinguish between fullterm and VLBW infants because their norms are different. One must be careful of making a diagnosis of cerebral palsy too early in the VLBW infant because many VLBW infants who turn out to be normal, display delay in neuromotor development. The infant neuromotor assessment which includes postural responses, primitive reflexes and righting responses is a more effective assessment than an assessment of postural responses alone. This assessment is now used at some high risk follow up clinics in the Peninsula Maternal and Neonatal Service. As a result of the study all high risk infants are assessed at 4½ months corrected age.

A problem in both studies was the small number of infants with cerebral palsy. This made statistical analysis difficult. Larger numbers need to be studied in order to make the findings clearer. As 5 of the 6 infants with cerebral palsy had leucomalacia on ultrasound, it is necessary to assess infants with these lesions very carefully.

More infants with Grade III and Grade IV intraventricular haemorrhages need to be studied in order to decide whether early clinical neurological signs do appear in these infants.

Central to the theory of neurodevelopmental therapy of infants is the importance of head and trunk control. However this theory has still to be adequately substantiated with controlled studies. The findings of the present study suggest the possibility that there is a relationship between central control and neurodevelopment and this needs to be studied more thoroughly.

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APPENDICES

POSTURAL RESPONSE STUDY - VLBW INFANTS (n = 69)
MEDICAL HISTORY and GRIFFITHS TEST RESULTS

Case No.	BW	GA	SGA	AGA	Del	HMD	AN	IPPV	SES	Wt @ Term	Wt @ 16 W	GQ		Loc		PerS		HeS		EH		Perf	
												12	18	12	18	12	18	12	18	12	18	12	18
	g									g	kg	mth	mth	mth	mth	mth	mth	mth	mth	mth	mth	mth	mth
1	1250	33	Y	N	C/S	N	N	N	31	2040	6.50	101	99	108	102	103	99	108	96	103	96	91	102
2	1130	34	Y	N	NVD	Y	N	N	4	1800	5.00	94	96	96	96	96	91	100	101	92	98	88	93
3	1380	35	Y	N	C/S	Y	N	N	30	1980	5.50	99	103	94	98	103	102	99	102	103	102	100	111
4	1400	37	Y	N	C/S	N	N	N	61	1870	4.50	86	-	91	-	88	-	82	-	88	-	82	-
5	1340	34	Y	N	C/S	N	Y	N	53	1950	-	93	97	94	103	94	93	92	80	102	106	99	100
6	1360	34	Y	N	NVD	N	N	N	26	2000	-	105	106	106	105	102	105	89	92	106	105	118	121
7	1420	36	Y	N	C/S	N	Y	N	34	1880	6.50	111	106	136	114	105	95	101	95	114	110	110	114
8	1210	35	Y	N	C/S	N	N	N	38	1850	4.50	107	102	109	105	114	101	104	98	104	101	109	105
9	1340	33	Y	N	NVD	N	N	N	24	2340	5.20	115	108	120	111	111	105	115	111	111	105	115	110
10	1250	35	Y	N	C/S	N	Y	N	59	1860	5.00	107	-	115	-	110	-	110	-	100	-	98	-
11	1500	35	Y	N	BR	Y	N	N	22	1850	-	106	100	124	106	109	97	100	97	100	100	98	100
12	1225	38	Y	N	C/S	N	N	N	61	1900	4.50	94	91	88	88	88	79	104	88	96	100	98	97
13	1500	37	Y	N	NVD	N	Y	N	61	1830	4.50	91	86	95	85	99	87	90	85	90	85	81	90
14	1430	35	Y	N	C/S	N	Y	N	4	1900	5.00	98	100	96	106	96	95	94	103	110	98	92	98
15	1175	35	Y	N	C/S	N	N	N	24	1840	5.50	100	103	103	105	104	95	104	95	100	108	87	105
16	1250	33	Y	N	C/S	Y	Y	N	46	2000	2.00	98	96	102	103	103	87	96	90	98	94	98	106
17	1220	34	Y	N	C/S	N	N	Y	31	1940	4.60	98	101	94	105	94	95	100	101	103	101	100	102
18	1500	35	Y	N	C/S	Y	Y	N	61	2000	6.60	94	93	96	94	92	91	97	94	99	97	92	91
19	1480	36	Y	N	C/S	N	Y	N	53	1760	5.25	113	111	114	123	114	99	115	109	110	106	106	119
20	1500	34	Y	N	BR-C/S	Y	Y	Y	24	1830	6.40	105	101	106	94	105	103	110	112	101	97	88	97
21	1380	35	Y	N	NVD	N	N	N	31	2050	-	106	100	115	103	115	97	111	93	97	97	97	100
22	1280	34	Y	N	NVD	Y	N	N	51	1760	3.75	101	101	114	105	99	98	100	105	99	105	99	91
23	1450	36	Y	N	C/S	Y	N	Y	31	1880	-	100	101	98	94	103	97	99	104	104	101	99	107
24	1240	37	Y	N	FCPS	N	N	N	41	1750	4.00	100	-	100	-	95	-	99	-	99	-	95	-
25	1140	36	Y	N	FCPS	N	N	N	53	1800	5.25	105	98	100	82	100	98	110	101	110	105	110	105
26	1440	35	Y	N	BR	N	Y	N	31	1840	5.50	101	105	110	103	101	99	102	113	97	99	97	113
27	1350	34	Y	N	NVD	N	N	N	39	1850	4.16	99	91	99	96	99	81	99	93	99	90	99	96
28	1480	38	Y	N	NVD	N	Y	N	45	1850	4.50	107	106	110	101	105	105	110	111	105	105	111	108
29	1440	34	Y	N	BR	N	N	N	53	1780	5.30	110	105	105	104	105	101	119	104	105	104	114	111
30	1250	35	Y	N	C/S	N	N	N	24	1850	6.25	98	-	106	-	97	-	97	-	98	-	89	-
31	1390	37	Y	N	C/S	N	Y	N	24	1920	5.50	94	89	101	92	97	92	92	89	92	87	89	92
32	1450	35	Y	N	C/S	N	Y	N	53	1800	4.50	84	85	90	74	79	74	76	83	86	98	90	98
33	950	30	Y	N	C/S	N	N	N	34	1820	-	-	90	-	96	-	99	-	99	-	87	-	84
34	850	35	Y	N	C/S	N	Y	N	16	1370	3.50	97	97	94	100	91	90	82	87	107	103	110	106
35	1000	31	Y	N	C/S	Y	Y	Y	50	1880	-	103	105	101	104	105	104	105	101	101	107	105	110
36	840	34	Y	N	NVD	N	N	N	39	1780	5.50	102	103	105	105	102	95	110	98	106	108	93	105
37	840	29	Y	N	C/S	Y	Y	N	24	1860	4.50	107	101	114	109	110	103	102	86	105	106	101	103
38	750	31	Y	N	NVD	N	Y	N	24	1840	5.10	102	101	103	105	108	101	98	101	103	105	98	98
39	850	35	Y	N	NVD	N	Y	N	53	1890	-	96	88	101	92	97	87	97	84	92	89	89	87
40	750	30	Y	N	NVD	N	Y	N	24	1810	5.00	101	94	100	100	100	90	104	90	100	97	101	90
41	820	29	Y	N	NVD	Y	N	Y	61	2000	5.75	113	105	126	112	104	98	109	105	113	91	113	115
42	990	31	Y	N	C/S	Y	Y	N	40	1700	5.00	97	104	98	106	102	100	107	108	93	98	87	111
43	1450	32	N	Y	C/S	N	Y	N	23	2000	7.00	105	107	102	105	111	101	111	111	111	105	103	111
44	1100	31	N	Y	C/S	N	N	N	23	1860	6.10	104	109	102	105	111	101	106	111	106	108	95	117
45	1200	28	N	Y	BR-BBA	Y	N	Y	61	1930	5.00	103	91	110	94	105	86	98	77	105	94	105	103
46	1200	32	N	Y	C/S	N	N	N	53	1860	5.75	112	117	127	118	102	121	122	124	106	108	110	114
47	1500	32	N	Y	NVD	N	Y	N	53	1900	-	101	99	100	99	100	95	109	95	105	102	88	102
48	1400	33	N	Y	C/S	N	Y	N	32	1820	-	103	109	114	119	105	105	110	119	100	108	101	94
49	1420	32	N	Y	NVD	N	N	N	39	2000	-	104	103	119	101	108	95	94	105	105	108	96	108
50	1200	31	N	Y	NVD	Y	N	N	24	1890	5.50	104	99	105	106	110	97	105	97	105	100	98	97
51	1440	31	N	Y	NVD	N	N	N	59	2000	4.75	104	97	109	101	109	91	100	91	100	97	101	104
52	1040	30	N	Y	NVD	Y	N	Y	24	1850	5.50	100	105	102	108	92	108	99	93	105	108	102	109

CONT 2

POSTURAL RESPONSE STUDY - VLBW INFANTS (n = 69)
MEDICAL HISTORY and GRIFFITHS TEST RESULTS

Case No.	BW	GA	SGA	AGA	Del	HMD	AN	IPPV	SES	Wt @ Term	Wt @ 16 W	GQ		Loc		PerS		HeS		EH		Perf	
												12	18	12	18	12	18	12	18	12	18	12	18
	g									g	kg	mth	mth	mth	mth	mth	mth	mth	mth	mth	mth	mth	mth
53	1270	32	N	Y	BR-C/S	N	Y	Y	45	2100	6.30	104	97	114	101	105	101	94	80	101	98	107	106
54	1250	32	N	Y	NVD	N	N	N	31	1840	6.40	102	100	96	97	105	103	110	103	101	97	98	100
55	1300	32	N	Y	BR	N	N	N	31	1900	7.00	102	101	96	97	105	103	110	100	101	106	96	100
56	1500	31	N	Y	BR-C/S	Y	Y	Y	24	2400	6.25	99	87	103	82	103	88	99	91	99	94	94	82
57	1100	29	N	Y	NVD	N	Y	N	61	2100	-	104	95	112	107	103	88	98	85	98	101	98	94
58	1250	31	N	Y	NVD	Y	N	Y	33	2000	5.50	104	108	108	113	99	100	94	113	108	105	113	116
59	1080	31	N	Y	C/S	Y	Y	Y	24	1860	6.00	112	91	104	94	104	86	112	88	111	91	116	94
60	1250	31	N	Y	NVD	Y	N	N	24	2000	5.50	97	106	96	113	100	111	93	102	105	111	96	106
61	1100	31	N	Y	NVD	N	N	N	24	1850	6.50	105	-	116	-	102	-	103	-	111	-	98	-
62	1040	28	N	Y	NVD	N	N	N	61	2800	4.75	105	108	100	112	104	98	109	105	104	115	109	115
63	1420	31	N	Y	NVD	Y	N	N	6	2240	5.50	99	105	107	108	98	101	102	108	93	101	98	108
64	1460	31	N	Y	BR	N	N	Y	31	2510	6.00	106	104	112	106	108	103	103	103	112	100	99	110
65	980	28	N	Y	NVD	Y	Y	Y	46	2200	3.50	75	69	77	78	77	63	74	66	74	71	74	68
66	880	26	N	Y	C/S	Y	Y	N	34	1925	6.00	100	95	117	101	104	85	97	85	95	97	91	110
67	1430	32	N	Y	C/S	N	N	N	8	2040	-	98	101	88	95	102	95	97	112	99	94	107	103
68	820	33	Y	N	NVD	N	Y	N	6	1240	3.00	96	106	92	105	103	111	105	111	92	101	92	101
69	1400	30	N	Y	NVD	N	N	N	46	2100	-	65	77	38	27	79	84	47	87	85	75	76	78
Mean	1236	33							35.6	1921	5.23	101	99	104	100	101	96	101	97	101	100	98	102
Total N (No)			26	43		47	39	56															
Total Y (Yes)			43	26		22	30	13															
Total NVD					28																		
Other Deliveries					41																		

POSTURAL RESPONSE STUDY FULL TERM INFANTS (n = 28)
MEDICAL HISTORY and GRIFFITHS TEST RESULTS

Case No.	BW	GA	Del	Wt @ Term	Wt @ 16 W	SES	GQ		Loc		PerS		HeS		EH		Perf	
							12 mth	18 mth	12 mth	18 mth	12 mth	18 mth	12 mth	18 mth	12 mth	18 mth	12 mth	18 mth
	g			g	kg													
1	3660	42	NVD	3500	5.60	17	111	111	111	108	106	102	101	124	111	108	125	111
2	3520	40	NVD	3280	7.50	51	116	101	135	118	107	95	117	115	112	108	108	111
3	3430	40	NVD	2400	7.00	53	110	107	126	119	107	100	107	103	117	100	98	113
4	3720	40	NVD	3460	6.00	18	107	101	115	103	107	100	102	97	106	100	112	110
5	3300	40	NVD	3120	5.00	31	103	100	102	99	104	99	102	102	102	99	97	105
6	3280	40	NVD	3120	7.20	33	108	105	103	104	107	101	107	104	112	108	112	108
7	2980	40	NVD	2970	6.50	8	108	109	118	114	106	105	98	105	106	108	110	114
8	3150	40	NVD	3080	-	46	103	102	101	104	101	95	106	101	101	101	106	107
9	2820	40	NVD	2780	6.00	32	94	104	82	102	103	98	105	115	93	105	89	98
10	3260	40	NVD	3140	6.50	50	109	108	112	115	112	112	103	105	103	102	122	105
11	3310	40	NVD	3160	7.75	53	100	98	97	96	97	93	87	83	101	109	111	109
12	3240	40	NVD	3120	-	48	110	114	109	103	109	114	109	114	114	114	110	118
13	3260	38	NVD	3100	6.75	8	110	107	106	99	106	105	106	117	116	105	98	108
14	2860	40	NVD	2640	-	16	109	104	114	110	104	97	109	100	114	106	105	106
15	4320	40	NVD	4160	7.50	24	107	101	126	107	100	101	100	104	100	97	109	97
16	3320	40	NVD	3200	6.60	7	95	99	103	100	95	94	95	97	99	97	91	106
17	3140	40	NVD	2300	7.00	9	104	101	114	102	106	105	101	92	100	99	101	105
18	3380	38	NVD	3220	7.00	53	104	101	106	105	102	98	97	95	97	108	112	101
19	2500	38	NVD	3000	-	28	106	99	96	90	100	99	105	102	105	93	112	106
20	3470	40	NVD	3860	7.90	3	95	87	86	89	96	91	101	97	102	91	92	88
21	3200	38	NVD	3500	6.80	8	101	101	109	108	100	91	87	80	98	105	105	111
22	3840	40	NVD	3100	-	6	110	107	112	106	112	106	107	113	103	100	113	110
23	3700	40	NVD	3080	7.40	7	109	103	110	115	105	99	101	99	105	92	124	111
24	3200	39	NVD	3410	6.80	9	105	115	110	102	102	105	106	105	110	102	93	102
25	2780	40	NVD	3680	-	6	106	106	103	99	112	102	103	115	103	102	110	109
26	3500	42	NVD	3240	-	6	106	102	121	102	102	99	95	96	107	99	105	114
27	3800	40	NVD	3180	7.00	7	116	101	122	99	104	96	109	108	117	96	126	102
28	3250	40	NVD	3000	6.60	4	118	114	140	116	93	113	116	116	116	120	120	105
Mean	3330	38.9		3171.4	6.781	20	106	104	110	104	104	101	103	104	106	103	108	107

COMPARISON of POSTURAL RESPONSES
VLBW with FULL TERM INFANTS

POSTURAL RESPONSES	0 Months Corrected Age (n = 97)						4 Months Corrected Age (n = 96)					
	VLBW (69)		FULL TERM (28)		P		VLBW (68)		FULL TERM (28)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION												
Marked head lag	64		19				16		2			
Moderate head lag	5		9		<0.005		32		5			
Full head control	0		0				20		21		<0.001	
Hip & knee ext. -> fl.	43	45	2	2			7	8	0	0		
or												
Hip & knee abd. + knee fl.	8	8	0	0			4	4	0	0		
Hip & knee in moderate fl.	18	16	26	26	<0.001	<0.001	9	8	0	0	<0.005	<0.005
Hip & knee in strong fl.	-	-	-	-			48	48	28	28		
Leg ext. time: 0 secs	42	40	27	27			68	67	28	28		
1 to 60 secs	27	29	1	1	<0.001	<0.001	0	1	0	0	ns	ns
Elbow: ext.	67	67	24	24			40	40	7	6		
fl.	2	2	4	4	ns	ns	28	28	21	22	<0.005	<0.001
Hand: reflex grasp	62	61	27	27			62	63	24	25		
weak grasp	7	8	1	1	ns	ns	6	5	4	3	ns	ns
State: quiet	58		21				65		28			
crying	11		7		ns	ns	3		0		ns	ns
2. LANDAU												
Head & trunk fl.	41		24				-		-			
Head fl., trunk only slightly fl.	28		4		<0.01		-		-			
Ext. head & thoracic spine	-		-				55		23		ns	
Ext. head thoracic spine & pelvis	-		-				13		5			
Head & trunk: asymmetry	8	2	1	1			4	4	1	0		
no asymmetry	61	67	27	27	ns	ns	64	64	27	28	ns	ns
Arm: fl.	23	23	22	22			60	59	26	25		
ext.	46	46	6	6	<0.001	<0.001	8	9	2	3	ns	ns
Leg in moderate fl.	13	13	28	28			4	4	0	0		
Leg in ext. -> fl.	34	34	0	0	<0.001	<0.001	15	15	4	5	ns	ns
Leg in suspension	22	22	0	0			0	0	0	0		
Leg in strong fl.	0	0	0	0			49	49	24	23		
Leg ext. time: 0 secs	19	19	28	28			60	60	26	26		
1 to 60 secs	50	50	0	0	<0.001	<0.001	8	8	2	2	ns	ns
State: quiet	55		21				65		27			
crying	14		7		ns		3		1		ns	
3. AXILLARY HANGING												
No head control	69		26				0		0			
Some head control	0		2		ns		68		28		ns	
Hip & knee in loose fl.	7	8	23	23			0	0	0	0		
Leg ext -> fl.	52	52	5	5			33	33	8	8		
or												
Leg in suspension	10	9	0	0	<0.001	<0.001	0	0	2	2	ns	ns
Hip & knee in strong fl.	0	0	0	0			35	35	18	18		
Leg ext. time: 0 secs	24	24	25	25			46	48	21	22		
1 to 60 secs	45	45	3	3	<0.001	<0.001	22	20	7	6	ns	ns
State: quiet	50		17				63		27			
crying	19		11		ns		5		1		ns	

CONT 2

COMPARISON of POSTURAL RESPONSES
VLBW with FULL TERM INFANTS

POSTURAL RESPONSES	0 Months Corrected Age (n = 97)						4 Months Corrected Age (n = 96)					
	VLBW (69)		FULL TERM (28)		P		VLBW (68)		FULL TERM (28)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
4. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	69	69	28	28	ns	ns	15	12	0	0	<0.005	<0.05
Head & Trunk righting	0	0	0	0			53	56	28	28		
Arm in Moro response:												
Abd. -> ext. -> fl.	35	39	15	16	ns	ns	57	50	19	22		
Arm in partial Moro response:												
Abd. -> ext.	34	30	13	12			7	13	2	1	<0.05	ns
Arm in loose fl.	-	-	-	-			4	5	7	5		
Hand: open	60	59	22	22			46	30	12	10		
fisted	9	10	6	6	ns	ns	23	38	16	18	ns	ns
Upper leg fl, lower leg ext.	30	28	20	21			4	7	1	0		
Upper leg ext. -> fl, lower leg ext.	39	41	8	7	<0.05	<0.005	5	6	0	0	ns	<0.01
Both legs fl. or ext. -> fl.	-	-	-	-			59	55	27	28		
Leg ext. time: 0 secs	51	52	27	26			64	63	26	28		
1 to 60 secs	18	17	1	2	<0.01	<0.05	4	5	2	0	ns	ns
State: quiet	56	58	14	15			54	56	23	24		
crying	13	11	14	13	<0.005	<0.005	14	12	5	4	ns	ns
5. COLLIS HORIZONTAL												
Suspension head, neck & trunk	67	67	27	27			22	22	1	0		
Righting of head, neck & trunk	2	2	1	1	ns	ns	46	46	27	28	<0.005	<0.001
Arm in fl.	59	58	27	27			11	11	4	5		
Arm in suspension	10	11	1	1	ns	ns	1	1	0	0	ns	ns
Arm in partial weight bearing	0	0	0	0			56	56	24	23		
Hand: open	63	58	24	24			52	50	25	22		
fisted	6	11	4	4	ns	ns	16	18	3	6	ns	ns
Hip & knee in loose fl.	31	29	21	20			61	63	26	27		
Hip & knee ext. -> fl.	38	40	7	8	<0.01	<0.01	7	5	2	1	ns	ns
Leg ext. time: 0 secs	39	33	24	24			68	68	28	28		
1 to 60 secs	30	36	4	4	<0.01	<0.001	0	0	0	0	ns	ns
State: quiet	51		11				45		20			
crying	18		17		<0.005		23		8		ns	
6. PEIPER RESPONSE												
Head & trunk in suspension	56		24				12		8			
Head & neck in ext., pelvis fl.	13		4		ns		31		8		ns	
Head & trunk ext., pelvis fl.	0		0				25		12			
Head & trunk: asymmetry	1	1	0	0			0	0	0	0		
no asymmetry	68	68	28	28	ns	ns	68	68	28	28	ns	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	18	17	10	10			1	1	0	0		
Arm in partial Moro response:												
Abd. -> ext.	51	52	18	18	ns	ns	0	0	0	0		
Arm in abd., elbow ext.	-	-	-	-			67	67	28	28	ns	ns
Hand: open	62	62	19	19			23	23	9	9		
fisted	7	7	9	9	<0.05	<0.05	45	45	19	19	ns	ns
State: quiet	54		10				40		15			
crying	15		18		<0.001		28		13		ns	
7. COLLIS VERTICAL												
Leg: fl.	60	58	26	26			49	49	24	25		
ext. -> fl.	9	11	2	2	ns	ns	19	19	4	3	ns	ns
Leg ext. time: 0 secs	66	64	27	27			66	65	27	27		
1 to 60 secs	3	5	1	1	ns	ns	3	3	1	1	ns	ns
State: quiet	52		9				33		14			
crying	17		19		<0.001		35		14		ns	

COMPARISON of POSTURAL RESPONSES AGA-VLBW with FULL TERM INFANTS

POSTURAL RESPONSES	0 Months Corrected Age (n = 54)						4 Months Corrected Age (n = 53)					
	VLBW (26)		FULL TERM (28)		P		VLBW (25)		FULL TERM (28)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION												
Marked head lag	23		19				4		2			
Moderate head lag	3		9		ns		9		5			
Full head control	-		-				12		21		<0.05	
Hip & knee ext. -> fl.	17	16	2	2			1	1	0	0		
or												
Hip & knee abd. + knee fl.	4	4	0	0			1	1	0	0		
Hip & knee in moderate fl.	5	6	26	26	<0.001	<0.001	1	1	0	0		
Hip & knee in strong fl.	-	-	-	-			22	22	28	28	ns	ns
Leg ext. time: 0 secs	13	14	27	27			25	25	28	28		
1 to 60 secs	13	12	1	1	<0.001	<0.001	0	0	0	0	ns	ns
Elbow: ext.	26	26	24	24			13	13	7	6		
fl.	0	0	4	4	ns	ns	12	12	21	22	<0.05	<0.05
Hand: reflex grasp	23	23	27	27			24	24	24	25		
weak grasp	3	3	1	1	ns	ns	1	1	4	3	ns	ns
State: quiet	22		21				25		28			
crying	4		7		ns		0		0		ns	
2. LANDAU												
Head & trunk fl.	18		24				-		-			
Head fl., trunk only slightly fl.	8		4		ns		-		-			
Ext. head & thoracic spine	-		-				20		23			
Ext. head thoracic spine & pelvis	-		-				5		5		ns	
Head & trunk: asymmetry	2	0	1	1			1	0	1	0		
no asymmetry	24	26	27	27	ns	ns	24	25	27	28	ns	ns
Arm: fl.	6	6	22	22			21	20	26	25		
ext.	20	20	6	6	<0.001	<0.001	4	5	2	3	ns	ns
Leg in moderate fl.	5	5	28	28			2	2	0	0		
Leg in ext. -> fl.	13	13	0	0			2	2	4	5		
Leg in suspension	8	8	0	0	<0.001	<0.001	0	0	0	0		
Leg in strong fl.	-	-	-	-			21	21	24	23	ns	ns
Leg ext. time: 0 secs	6	6	28	28			24	24	26	26		
1 to 60 secs	20	20	0	0	<0.001	<0.001	1	1	2	2	ns	ns
State: quiet	22		21				25		27			
crying	4		7		ns		0		1		ns	
3. AXILLARY HANGING												
No head control	26		26				0		0			
Some head control	0		2		ns		25		28		ns	
Hip & knee in loose fl.	1	1	22	22			0	0	0	0		
Leg ext -> fl.	24	24	5	5			10	10	8	8		
or												
Leg in suspension	1	1	1	1	<0.001	<0.001	0	0	2	2	ns	ns
Hip & knee in strong fl.	-	-	-	-			15	15	18	18		
Leg ext. time: 0 secs	8	8	25	25			19	19	21	22		
1 to 60 secs	18	18	3	3	<0.001	<0.001	6	6	7	6	ns	ns
State: quiet	19		17				24		27			
crying	7		11		ns		1		1		ns	

CONT 2

COMPARISON of POSTURAL RESPONSES AGA-VLBW with FULL TERM INFANTS

POSTURAL RESPONSES	0 Months Corrected Age (n = 54)						4 Months Corrected Age (n = 53)					
	VLBW (26)		FULL TERM (28)		P		VLBW (25)		FULL TERM (28)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
4. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	26	26	28	28	ns	ns	8	6	0	0		
Head & trunk righting	-	-	-	-			17	19	28	28	<0.005	<0.01
Arm in Moro response:												
Abd. -> ext. -> fl.	13	14	15	16			22	21	19	22		
Arm in partial Moro response:												
Abd. -> ext.	13	12	13	12	ns	ns	1	2	2	1	ns	ns
Arm in loose fl.	-	-	-	-			2	2	7	5		
Hand: open	22	22	22	22			10	11	12	10		
fisted	4	4	6	6	ns	ns	15	14	16	18	ns	ns
Upper leg fl, lower leg ext.	11	11	20	21			1	1	1	0		
Upper leg ext. -> fl, lower leg ext.	15	15	8	7	<0.05	<0.05	2	2	0	0		
Both legs fl. or ext. -> fl.	-		-	-			22	22	27	28	ns	ns
Leg ext. time: 0 secs	18	17	27	26			25	25	26	28		
1 to 60 secs	8	9	1	2	<0.01	<0.05	0	0	2	0	ns	ns
State: quiet	22	23	14	15			23	23	23	24		
crying	4	3	14	13	<0.01	<0.01	2	2	5	4	ns	ns
5. COLLIS HORIZONTAL												
Suspension head, neck & trunk	26	26	27	27			8	6	1	0		
Righting of head, neck & trunk	0	0	1	1	ns	ns	17	19	27	28	<0.01	<0.01
Arm in fl.	23	19	27	27			2	3	4	5		
Arm in suspension	3	7	1	1	ns	<0.05	1	1	0	0		
Arm in partial weight bearing	-	-	-	-			22	21	24	23	ns	ns
Hand: open	23	19	24	24			17	16	25	22		
fisted	3	7	4	4	ns	ns	8	9	3	6	ns	ns
Hip & knee in loose fl.	10	11	21	20			22	24	26	27		
Hip & knee ext. -> fl.	16	15	7	8	<0.01	<0.05	3	1	2	1	ns	ns
Leg ext. time: 0 secs	13	12	24	24			25	25	28	28		
1 to 60 secs	13	14	4	4	<0.01	<0.005	0	0	0	0	ns	ns
State: quiet	19		11				19		20			
crying	7		17		<0.05		6		8		ns	
6. PEIPER RESPONSE												
Head & trunk in suspension	23		24				6		8			
Head & neck in ext., pelvis fl.	3		4		ns		11		8		ns	
Head & trunk ext., pelvis fl.	-		-				8		12			
Head & trunk: asymmetry	0	0	0	0			0	0	0	0		
no asymmetry	26	26	28	28	ns	ns	25	25	28	28	ns	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	6	6	10	10			3	3	0	0		
Arm in partial Moro response:												
Abd. -> ext.	20	20	18	18	ns	ns	0	0	0	0		
Arm in abd., elbow ext.	-	-	-	-			22	22	28	28	ns	ns
Hand: open	24	24	19	19			12	12	9	9		
fisted	2	2	9	9	<0.05	<0.05	13	13	19	19	ns	ns
State: quiet	22		10				18		15			
crying	4		18		<0.005		7		13		ns	
7. COLLIS VERTICAL												
Leg: fl.	23	24	26	26			20	20	24	25		
ext. -> fl.	3	2	2	2	ns	ns	5	5	4	3	ns	ns
Leg ext. time: 0 secs	25	25	27	27			24	24	27	27		
1 to 60 secs	1	1	1	1	ns	ns	1	1	1	1	ns	ns
State: quiet	21		9				15		14			
crying	5		19		<0.005		10		14		ns	

COMPARISON of POSTURAL RESPONSES
AGA with SGA VLBW INFANTS

POSTURAL RESPONSES	0 Months Corrected Age (n = 69)						4 Months Corrected Age (n = 68)					
	VLBW (26)		FULL TERM (43)		P		VLBW (25)		FULL TERM (43)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION												
Marked head lag	23		41				4		12			
Moderate head lag	3		2		ns		9		23			
Full head control	-		-				12		8		<0.05	
Hip & knee ext. -> fl.	17	16	26	29			1	1	6	7		
or												
Hip & knee abd. + knee fl.	4	4	4	4			1	1	3	3		
Hip & knee in moderate fl.	5	6	13	10	ns	ns	1	1	8	7		
Hip & knee in strong fl.	-	-	-	-			22	22	26	26	ns	ns
Leg ext. time: 0 secs	13	14	29	26			25	25	41	41		
1 to 60 secs	13	12	14	17	ns	ns	0	0	2	2	ns	ns
Elbow: ext.	26	26	41	41			13	13	27	27		
fl.	0	0	2	2	ns	ns	12	12	16	16	ns	ns
Hand: reflex grasp	23	23	39	38			24	24	38	39		
weak grasp	3	3	4	5	ns	ns	1	1	5	4	ns	ns
State: quiet	22		36				25		40			
crying	4		7		ns	ns	0		3		ns	ns
2. LANDAU												
Head & trunk fl.	18		23				-		-			
Head fl., trunk only slightly fl.	8		20		ns		-		-			
Ext. head & thoracic spine	-		-				20		35			
Ext. head thoracic spine & pelvis	-		-				5		8		ns	
Head & trunk: asymmetry	2	0	6	2			1	0	3	4		
no asymmetry	24	26	37	41	ns	ns	24	25	40	39	ns	ns
Arm: fl.	6	6	17	17			21	20	39	39		
ext.	20	20	26	26	ns	ns	4	5	4	4	ns	ns
Leg in moderate fl.	5	5	8	8			2	2	3	3		
Leg in ext. -> fl.	13	13	21	21			2	2	12	12		
Leg in suspension	8	8	14	14	ns	ns	0	0	0	0		
Leg in strong fl.	-	-	-	-			21	21	28	28	ns	ns
Leg ext. time: 0 secs	6	6	13	13			24	24	35	35		
1 to 60 secs	20	20	30	30	ns	ns	1	1	8	8	ns	ns
State: quiet	22		33				25		40			
crying	4		10		ns		0		3		ns	
3. AXILLARY HANGING												
No head control	26		43				0		0			
Some head control	0		0		ns		25		43		ns	
Hip & knee in loose fl.	1	1	7	6			0	0	0	0		
Leg ext -> fl.	24	24	28	28			10	10	22	22		
or												
Leg in suspension	1	1	8	9	ns	ns	0	0	0	0		
Hip & knee in strong fl.	-	-	-	-			15	15	21	21	ns	ns
Leg ext. time: 0 secs	8	8	16	16			19	19	27	29		
1 to 60 secs	18	18	27	27	ns	ns	6	6	16	14	ns	ns
State: quiet	19		31				24		39			
crying	7		12		ns		1		4		ns	

CONT 2

COMPARISON of POSTURAL RESPONSES
AGA with SGA VLBW INFANTS

POSTURAL RESPONSES	0 Months Corrected Age (n = 69)						4 Months Corrected Age (n = 68)					
	VLBW (26)		FULL TERM (43)		P		VLBW (25)		FULL TERM (43)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
4. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	26	26	43	43			8	6	7	6		
Head & Trunk righting	-	-	-	-	ns	ns	17	19	36	37	ns	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	13	14	22	25			22	21	35	33		
Arm in partial Moro response:												
Abd. -> ext.	13	12	21	18	ns	ns	1	2	6	7		
Arm in loose fl.	-	-	-	-			2	2	2	3	ns	ns
Hand: open	22	22	38	37			10	11	22	19		
fisted	4	4	5	6	ns	ns	15	14	21	24	ns	ns
Upper leg fl, lower leg ext.	11	11	19	17			1	1	3	6		
Upper leg ext. -> fl, lower leg ext.	15	15	24	26	ns	ns	2	2	3	4		
Both legs fl. or ext. -> fl.	-	-	-	-			22	22	37	33	ns	ns
Leg ext. time: 0 secs	18	17	33	35			25	25	38	37		
1 to 60 secs	8	9	10	8	ns	ns	0	0	5	6	ns	ns
State: quiet	22	23	34	35			23	23	31	33		
crying	4	3	9	8	ns	ns	2	2	12	10	<0.05	ns
5. COLLIS HORIZONTAL												
Suspension head, neck & trunk	26	26	41	41			8	6	14	16		
Righting of head, neck & trunk	0	0	2	2	ns	ns	17	19	29	27	ns	ns
Arm in fl.	23	19	36	39			2	3	9	8		
Arm in suspension	3	7	7	4	ns	ns	1	1	0	0		
Arm in partial weight bearing	-	-	-	-			22	21	34	35	ns	ns
Hand: open	23	19	40	39			17	16	35	34		
fisted	3	7	3	4	ns	ns	8	9	8	9	ns	ns
Hip & knee in loose fl.	10	11	21	18			22	24	39	39		
Hip & knee ext. -> fl.	16	15	22	25	ns	ns	3	1	4	4	ns	ns
Leg ext. time: 0 secs	13	12	26	21			25	25	42	42		
1 to 60 secs	13	14	17	22	ns	ns	0	0	3	3	ns	ns
State: quiet	19		32				19		26			
crying	7		11		ns		6		17		ns	
6. PEIPER RESPONSE												
Head & trunk in suspension	23		33				6		6			
Head & neck in ext., pelvis fl.	3		10		ns		11		20			
Head & trunk ext., pelvis fl.	-		-				8		17		ns	
Head & trunk: asymmetry	0	0	1	1			0	0	0	0		
no asymmetry	26	26	42	42	ns	ns	25	25	43	43	ns	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	6	6	20	20			3	3	1	1		
Arm in partial Moro response:												
Abd. -> ext.	20	20	23	23	ns	ns	0	0	0	0		
Arm in abd., elbow ext.	-	-	-	-			22	22	42	42	ns	ns
Hand: open	24	24	38	38			6	6	17	17		
fisted	2	2	5	5	ns	ns	19	19	26	26	ns	ns
State: quiet	22		32				18		22			
crying	4		11		ns		7		21		ns	
7. COLLIS VERTICAL												
Leg: fl.	23	24	37	34			20	20	29	29		
ext. -> fl.	3	2	6	9	ns	ns	5	5	14	14	ns	ns
Leg ext. time: 0 secs	25	25	41	39			24	24	42	41		
1 to 60 secs	1	1	2	4	ns	ns	1	1	1	2	ns	ns
State: quiet	21		31				15		18			
crying	5		12		ns		10		25		ns	

VLBW INFANTS: ASSOCIATION of POSTURAL RESPONSES at 0 MONTHS CORRECTED AGE with DQ at 12 & 18 MONTHS CORRECTED AGE

POSTURAL RESPONSES	0 Months Corrected Age (n = 68)						0 Months Corrected Age (n = 65)					
	DQ at 12 Months				P		DQ at 12 Months				P	
	<100 (29)		>100 (39)				<100 (31)		>100 (34)			
	L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION												
Marked head lag	25		38				27		33			
Moderate head lag	4		1		ns		4		1		ns	
Full head control	-		-				-		-			
Hip & knee ext. -> fl.	18	21	23	22			18	19	20	21		
or												
Hip & knee abd. + knee fl.	2	2	7	7			5	5	4	4		
Hip & knee in moderate fl.	9	6	9	10	ns	ns	8	7	10	9	ns	ns
Hip & knee in strong fl.	-	-	-	-			-	-	-	-		
Leg ext. time: 0 secs	18	14	24	26			21	19	18	18		
1 to 60 secs	11	15	15	13	ns	ns	10	12	16	16	ns	ns
Elbow: ext.	27	27	39	39			29	29	34	34		
fl.	2	2	0	0	ns	ns	2	2	0	0	ns	ns
Hand: reflex grasp	26	26	35	34			25	25	33	32		
weak grasp	3	3	4	5	ns	ns	6	6	1	2	ns	ns
State: quiet	23		34				25		29			
crying	6		5		ns		6		5		ns	
2. LANDAU												
Head & trunk fl.	12		29		<0.001		15		23			
Head fl., trunk only slightly fl.	17		10				16		11		ns	
Ext. head & thoracic spine	-		-				-		-			
Ext. head thoracic spine & pelvis	-		-				-		-			
Head & trunk: asymmetry	5	0	3	2			3	0	5	1		
no asymmetry	24	29	36	37	ns	ns	28	31	29	33	ns	ns
Arm: fl.	15	15	7	7			11	11	11	11		
ext.	14	14	32	32	<0.005	<0.005	20	20	23	23	ns	ns
Leg in moderate fl.	6	6	7	7			3	3	9	9		
Leg in ext. -> fl.	19	19	14	14			16	16	16	16		
Leg in suspension	4	4	18	18	ns	ns	12	12	9	9	ns	ns
Leg in strong fl.	-	-	-	-			-	-	-	-		
Leg ext. time: 0 secs	6	6	13	13			7	7	10	10		
1 to 60 secs	23	23	26	26	ns	ns	24	24	24	24	ns	
State: quiet	23		31				25		26			
crying	6		8		ns		6		8		ns	
3. AXILLARY HANGING												
No head control	29		39				31		34			
Some head control	0		0		ns		0		0		ns	
Hip & knee in loose fl.	4	4	2	3			3	3	4	5		
Leg ext -> fl.	23	23	29	29			23	23	26	26		
or												
Leg in suspension	2	2	8	7	ns	ns	5	5	4	3	ns	ns
Hip & knee in strong fl.	-	-	-	-			-	-	-	-		
Leg ext. time: 0 secs	12	12	11	11			11	11	12	12		
1 to 60 secs	17	17	28	28	ns	ns	20	20	22	22	ns	ns
State: quiet	21		28				22		24			
crying	8		11		ns		9		10		ns	

CONT 2

VLBW INFANTS: ASSOCIATION of POSTURAL RESPONSES at 0 MONTHS CORRECTED AGE with DQ at 12 & 18 MONTHS CORRECTED AGE

POSTURAL RESPONSES	0 Months Corrected Age (n = 68)						0 Months Corrected Age (n = 65)					
	DQ at 12 Months				P		DQ at 12 Months				P	
	<100 (29)		>100 (39)				<100 (31)		>100 (34)			
	L	R	L	R	L	R	L	R	L	R	L	R
4. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	28	28	36	36			28	28	33	33		
Head & Trunk righting	1	1	3	3	ns	ns	3	3	1	1	ns	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	17	15	18	23			16	17	16	18		
Arm in partial Moro response:												
Abd. -> ext.	12	13	21	16			15	13	18	16		
Arm in loose fl.	0	1	0	0	ns	ns	0	1	0	0	ns	ns
Hand: open	23	22	36	36			28	27	28	28		
fisted	6	7	3	3	ns	ns	3	4	6	6	ns	ns
Upper leg fl, lower leg ext.	16	13	14	15			13	11	14	15		
Upper leg ext. -> fl, lower leg ext.	13	16	25	24	ns	ns	18	20	20	19	ns	ns
Both legs fl. or ext. -> fl.	-	-	-	-			-	-	-	-		
Leg ext. time: 0 secs	24	25	26	26			24	22	25	28		
1 to 60 secs	5	4	13	13	ns	ns	7	9	9	6	ns	ns
State: quiet	22	22	32	34			26	26	26	28		
crying	7	7	6	4	ns	ns	5	5	8	6	ns	ns
5. COLLIS HORIZONTAL												
Suspension head, neck & trunk	28	28	38	38			31	31	33	33		
Righting of head, neck & trunk	1	1	1	1	ns	ns	0	0	1	1	ns	ns
Arm in fl.	26	25	31	31			28	27	29	28		
Arm in suspension	3	4	8	8	ns	ns	3	4	5	6	ns	ns
Arm in partial weight bearing	-	-	-	-			-	-	-	-		
Hand: open	15	16	25	21			28	28	31	26		
fisted	14	13	14	18	ns	ns	3	3	3	8	ns	ns
Hip & knee in loose fl.	14	12	17	17			11	15	18	13		
Hip & knee ext. -> fl.	15	17	22	22	ns	ns	20	16	16	21	ns	ns
Leg ext. time: 0 secs	20	15	19	18			16	17	21	15		
1 to 60 secs	9	14	20	21	ns	ns	15	14	13	19	ns	ns
State: quiet	19		32				22		27			
crying	10		7		ns		9		7		ns	
6. PEIPER RESPONSE												
Head & trunk in suspension	22		33				24		28			
Head & neck in ext., pelvis fl.	7		6		ns		7		6		ns	
Head & trunk ext., pelvis fl.	-		-				-		-			
Head & trunk: asymmetry	0	0	1	1			0	0	1	1		
no asymmetry	29	29	38	38	ns	ns	31	31	33	33	ns	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	8	7	10	10			8	7	8	8		
Arm in partial Moro response:												
Abd. -> ext.	21	22	29	29	ns	ns	23	24	26	26	ns	ns
Arm in abd., elbow ext.	-	-	-	-			-	-	-	-		
Hand: open	25	25	36	36			28	28	30	30		
fisted	4	4	3	3	ns	ns	3	3	4	4	ns	ns
State: quiet	23		31				24		27			
crying	6		8		ns		7		7		ns	
7. COLLIS VERTICAL												
Leg: fl.	25	25	34	32			27	27	30	28		
ext. -> fl.	4	4	5	7	ns	ns	4	4	4	6	ns	ns
Leg ext. time: 0 secs	27	27	38	36			31	30	32	31		
1 to 60 secs	2	2	1	3	ns	ns	0	1	2	3	ns	ns
State: quiet	22		30				24		25			
crying	7		9		ns		7		9		ns	

VLBW INFANTS: ASSOCIATION of POSTURAL RESPONSES at 0 MONTHS CORRECTED AGE with GRIFFITHS LOCOMOTION SCORE (LS) at 12 & 18 MONTHS CORRECTED AGE

POSTURAL RESPONSES	0 Months Corrected Age (n = 68)						0 Months Corrected Age (n = 65)					
	LS at 12 Months				P		LS at 18 Months				P	
	<100 (26)		>100 (42)				<100 (25)		>100 (40)			
	L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION												
Marked head lag	22		41				21		39			
Moderate head lag	4		1		ns		4		1		ns	
Full head control	-		-				-		-			
Hip & knee ext. -> fl.	16	17	25	26			14	14	24	26		
or												
Hip & knee abd. + knee fl.	4	4	5	5			4	4	5	5		
Hip & knee in moderate fl.	6	5	12	11	ns	ns	7	7	11	9	ns	ns
Hip & knee in strong fl.	-	-	-	-			-	-	-	-		
Leg ext. time: 0 secs	12	12	28	28			15	15	24	22		
1 to 60 secs	14	14	14	14	ns	ns	10	10	16	18	ns	ns
Elbow: ext.	24	24	42	42			23	23	40	40		
fl.	2	2	0	0	ns	ns	2	2	0	0	ns	ns
Hand: reflex grasp	21	21	40	39			19	19	39	38		
weak grasp	5	5	2	3	ns	ms	6	6	1	2	<0.05	ns
State: quiet	20		37				20		34			
crying	6		5		ns		5		6		ns	
2. LANDAU												
Head & trunk fl.	12		29				12		26			
Head fl., trunk only slightly fl.	14		13		ns		13		14		ns	
Ext. head & thoracic spine	-		-				-		-			
Ext. head thoracic spine & pelvis	-		-				-		-			
Head & trunk: asymmetry	4	0	4	2			3	0	5	1		
no asymmetry	22	26	38	40	ns	ns	22	25	35	39	ns	ns
Arm: fl.	13	13	9	9			11	11	11	11		
ext.	13	13	33	33	<0.05	<0.05	14	14	29	29	ns	ns
Leg in moderate fl.	6	6	7	7			3	3	9	9		
Leg in ext. -> fl.	13	12	20	21			12	11	20	21		
Leg in suspension	7	8	15	14	ns	ns	10	11	11	10	ns	ns
Leg in strong fl.	-		-				-		-			
Leg ext. time: 0 secs	7	7	12	12			5	5	12	12		
1 to 60 secs	19	19	30	30	ns	ns	20	20	28	28	ns	ns
State: quiet	20		34				20		31			
crying	6		8		ns		5		9		ns	
3. AXILLARY HANGING												
No head control	26		42				25		40			
Some head control	0		0		ns		0		0		ns	
Hip & knee in loose fl.	4	4	2	3			4	4	3	4		
Leg ext -> fl.	19	19	33	33			16	16	33	33		
or												
Leg in suspension	3	3	7	6			5	5	4	3		
Hip & knee in strong fl.	-	-	-	-	ns	ns	-	-	-	-	ns	ns
Leg ext. time: 0 secs	10	10	13	13			10	10	13	13		
1 to 60 secs	16	16	29	29	ns	ns	15	15	27	27	ns	ns
State: quiet	19		30				19		27			
crying	7		12		ns		6		13		ns	

CONT 2

VLBW INFANTS: ASSOCIATION of POSTURAL RESPONSES at 0 MONTHS CORRECTED AGE with GRIFFITHS LOCOMOTION SCORE (LS) at 12 & 18 MONTHS CORRECTED AGE

POSTURAL RESPONSES	0 Months Corrected Age (n = 68)						0 Months Corrected Age (n = 65)					
	LS at 12 Months				P		LS at 18 Months				P	
	<100 (26)		>100 (42)				<100 (25)		>100 (40)			
	L	R	L	R	L	R	L	R	L	R	L	R
4. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	24	24	40	40			22	22	39	39		
Head & Trunk righting	2	2	2	2	ns	ns	3	3	1	1	ns	ns
Arm in Moro response: Abd. -> ext. -> fl.	15	15	20	24			14	14	18	22		
Arm in partial Moro response: Abd. -> ext.	11	11	22	18	ns	ns	11	11	22	18	ns	ns
Arm in loose fl.	-	-	-	-			-	-	-	-		
Hand: open	20	19	39	39			19	18	37	37		
fisted	6	7	3	3	ns	<0.05	6	7	3	3	ns	<0.05
Upper leg fl, lower leg ext.	13	12	17	16			12	11	15	15		
Upper leg ext. -> fl, lower leg ext.	13	14	25	26	ns	ns	13	14	25	25	ns	ns
Both legs fl. or ext. -> fl.	-	-	-	-			-	-	-	-		
Leg ext. time: 0 secs	19	20	31	31			19	18	30	32		
1 to 60 secs	7	6	11	11	ns	ns	6	7	10	8	ns	ns
State: quiet	20	20	35	37			20	20	32	34		
crying	6	6	7	5	ns	ns	5	5	8	6	ns	ns
5. COLLIS HORIZONTAL												
Suspension head, neck & trunk	25	25	41	41			23	23	40	40		
Righting of head, neck & trunk	1	1	1	1	ns	ns	2	2	0	0	ns	ns
Arm in fl.	24	22	34	35			21	21	36	34		
Arm in suspension	2	4	8	7	ns	ns	4	4	4	6	ns	ns
Arm in partial weight bearing	-	-	-	-			-	-	-	-		
Hand: open	24	24	38	33			22	23	37	31		
fisted	2	2	4	9	ns	ns	3	2	3	9	ns	ns
Hip & knee in loose fl.	12	11	19	18			10	12	19	16		
Hip & knee ext. -> fl.	14	15	23	24	ns	ns	15	13	21	24	ns	ns
Leg ext. time: 0 secs	17	15	22	18			15	15	22	17		
1 to 60 secs	9	11	20	24	ns	ns	10	10	18	23	ns	ns
State: quiet	17		34				16		33			
crying	9		8		ns		9		7		ns	
6. PEIPER RESPONSE												
Head & trunk in suspension	22		33				20		32			
Head & neck in ext., pelvis fl.	4		9		ns		5		8		ns	
Head & trunk ext., pelvis fl.	-		-				-		-			
Head & trunk: asymmetry	0	0	1	1			0	0	1	1		
no asymmetry	26	26	41	41	ns	ns	25	25	39	39	ns	ns
Arm in Moro response: Abd. -> ext. -> fl.	7	6	11	11			7	6	9	9		
Arm in partial Moro response: Abd. -> ext.	19	20	31	31	ns	ns	18	19	31	31	ns	ns
Arm in abd., elbow ext.	-	-	-	-			-	-	-	-		
Hand: open	22	22	39	39			21	21	37	37		
fisted	4	4	3	3	ns	ns	4	4	3	3	ns	ns
State: quiet	20		34				20		31			
crying	6		8		ns		5		9		ns	
7. COLLIS VERTICAL												
Leg: fl.	23	23	36	34			24	24	33	31		
ext. -> fl.	3	3	6	8	ns	ns	1	1	7	9	ns	ns
Leg ext. time: 0 secs	24	24	41	39			25	25	38	36		
1 to 60 secs	2	2	1	3	ns	ns	0	0	2	4	ns	ns
State: quiet	19		33				20		29			
crying	7		9		ns		5		11		ns	

VLBW INFANTS: ASSOCIATION of POSTURAL RESPONSES at 4 MONTHS CORRECTED AGE with GRIFFITHS LOCOMOTION SCORE (LS) at 12 & 18 MONTHS CORRECTED AGE

POSTURAL RESPONSES	4 Months Corrected Age (n = 67)						4 Months Corrected Age (n = 64)					
	LS at 12 Months				P		LS at 18 Months				P	
	<100 (25)		>100 (42)				<100 (24)		>100 (40)			
	L	R	L	R	L	R	L	R	L	R	L	R
1. TRACTION												
Marked head lag	7		8				5		10			
Moderate head lag	13		19				14		16			
Full head control	5		15		ns		5		14		ns	
Hip & knee ext. -> fl.	2	3	4	4			3	4	3	3		
or												
Hip & knee abd. + knee fl.	1	1	3	3			1	1	3	3		
Hip & knee in moderate fl.	4	3	5	5			5	4	3	3		
Hip & knee in strong fl.	18	18	30	30	ns	ns	15	15	31	31	ns	ns
Leg ext. time: 0 secs	25	24	41	41			24	23	40	40		
1 to 60 secs	0	1	1	1	ns	ns	1	2	0	0	ns	ns
Elbow: ext.	17	17	22	22			16	16	22	22		
fl.	8	8	20	20	ns	ns	8	8	18	18	ns	ns
Hand: reflex grasp	23	23	40	41			21	22	39	39		
weak grasp	2	2	2	1	ns	ns	3	2	1	1	ns	ns
State: quiet	23		42				21		40			
crying	2		0		ns		3		0		ns	
2. LANDAU												
Head & trunk fl.	-		-				-		-			
Head fl., trunk only slightly fl.	-		-				-		-			
Ext. head & thoracic spine	23		31				20		32			
Ext. head thoracic spine & pelvis	2		11		ns		4		8		ns	
Head & Trunk: asymmetry	2	2	2	2			1	1	3	3		
no asymmetry	23	23	40	40	ns	ns	23	23	37	37	ns	ns
Arm: fl.	24	25	35	34			23	23	33	32		
ext.	1	0	7	8	ns	ns	1	1	7	8		
Leg in moderate fl.	3	3	1	1			2	2	2	2		
Leg in ext. -> fl.	6	6	9	9			6	6	9	9		
Leg in suspension	0	0	0	0			0	0	0	0		
Leg in strong fl.	16	16	32	32	ns	ns	16	16	29	29	ns	ns
Leg ext. time: 0 secs	21	21	38	38			21	21	35	35		
1 to 60 secs	4	4	4	4	ns	ns	4	4	5	5		
State: quiet	23		42				21		40			
crying	2		0		ns		3		0		<0.05	
3. AXILLARY HANGING												
No head control	0		0				0		0			
Some head control	25		42		ns		24		40		ns	
Hip & knee in loose fl.	0	0	0	0			0	0	0	0		
Leg ext -> fl.	12	12	21	21			13	13	19	19		
or												
Leg in suspension	0	0	0	0			0	0	0	0		
Hip & knee in strong fl.	13	13	21	21	ns	ns	11	11	21	21	ns	ns
Leg ext. time: 0 secs	16	16	29	31			15	15	27	29		
1 to 60 secs	9	9	13	11	ns	ns	10	10	13	11	ns	ns
State: quiet	21		42				20		39			
crying	4		0		<0.05		4		1		ns	

CONT 2

VLBW INFANTS: ASSOCIATION of POSTURAL RESPONSES at 4 MONTHS CORRECTED AGE with GRIFFITHS LOCOMOTION SCORE (LS) at 12 & 18 MONTHS CORRECTED AGE

POSTURAL RESPONSES	4 Months Corrected Age (n = 67)						4 Months Corrected Age (n = 64)					
	LS at 12 Months				P		LS at 18 Months				P	
	<100 (25)		>100 (42)				<100 (24)		>100 (40)			
	L	R	L	R	L	R	L	R	L	R	L	R
4. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	9	7	6	5			8	6	5	5		
Head & Trunk righting	16	18	36	37	<0.05	ns	16	18	35	35	<0.05	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	24	24	32	30			18	18	28	28		
Arm in partial Moro response:												
Abd. -> ext.	1	1	6	8			6	5	7	7		
Arm in loose fl.	0	0	4	4	ns	ns	0	1	5	5	ns	ns
Hand: open	12	11	19	19			12	10	19	19		
fisted	13	14	23	23	ns	ns	12	14	21	21	ns	ns
Upper leg fl, lower leg ext.	3	2	1	5			2	1	2	5		
Upper leg ext. -> fl, lower leg ext.	2	3	3	3			2	3	2	2		
Both legs fl. or ext. -> fl.	20	20	38	34	ns	ns	20	20	36	33	ns	ns
Leg ext. time: 0 secs	25	25	37	36			23	23	37	36		
1 to 60 secs	0	0	5	6	ns	ns	1	1	3	4	ns	ns
State: quiet	16	17	38	39			15	16	35	36		
crying	9	8	4	3	<0.01	<0.01	9	8	5	4	<0.05	<0.05
5. COLLIS HORIZONTAL												
Suspension head, neck & trunk	12	12	8	8			9	11	11	8		
Righting of head, neck & trunk	13	13	34	34	<0.05	<0.05	15	13	29	32	ns	<0.05
Arm in fl.	7	5	4	6			5	7	6	4		
Arm in suspension	1	1	0	0			1	1	0	0		
Arm in partial weight bearing	17	19	38	36	ns	ns	18	16	34	36	ns	ns
Hand: open	20	21	31	28			17	16	33	32		
fisted	5	4	11	14	ns	ns	7	8	7	8	ns	ns
Hip & knee in loose fl.	23	24	37	38			20	22	38	38		
Hip & knee ext. -> fl.	2	1	5	4	ns	ns	4	2	2	2	ns	ns
Leg ext. time: 0 secs	25	25	42	42			24	24	40	40		
1 to 60 secs	0	0	0	0	ns	ns	0	0	0	0	ns	ns
State: quiet	14		31				13		28			
crying	11		11		ns		11		12		ns	
6. PEIPER RESPONSE												
Head & trunk in suspension	4		8				2		9			
Head & neck in ext., pelvis fl.	14		16				13		16			
Head & trunk ext., pelvis fl.	7		18		ns		9		15		ns	
Head & trunk: asymmetry	0	0	0	0			0	0	0	0		
no asymmetry	25	25	42	42	ns	ns	24	24	40	40	ns	ns
Arm in Moro response:												
Abd. -> ext. -> fl.	6	6	0	0			5	5	1	1		
Arm in partial Moro response:												
Abd. -> ext.	-	-	-	-			-	-	-	-		
Arm in abd., elbow ext.	19	19	42	42	<0.005	<0.005	19	19	39	39	<0.05	<0.05
Hand: open	17	17	28	28			17	17	27	27		
fisted	8	8	14	14	ns	ns	7	7	13	13	ns	ns
State: quiet	14		26				13		25			
crying	11		16		ns		11		15		ns	
7. COLLIS VERTICAL												
Leg: fl.	18	16	30	32			18	15	28	30		
ext. -> fl.	7	9	12	10	ns	ns	6	9	12	10	ns	ns
Leg ext. time: 0 secs	23	22	42	42			22	22	40	39		
1 to 60 secs	2	3	0	0	<0.05	<0.05	2	2	0	1	ns	ns
State: quiet	13		20				11		20			
crying	12		22		ns		13		20		ns	

INA STUDY - VLBW INFANTS (n = 76)
MEDICAL HISTORY and GRIFFITHS TEST RESULTS

Case No.	BW g	GA	SGA	AGA	Del	HMD	AN	IVH	LEUC	CP	SES	GQ 12 mth	Loc 12 mth	PerS 12 mth	HeS 12 mth	EH 12 mth	Perf 12 mth
1	1050	33	Y	N	C/S	Y	N	N	N	N	16	104	99	104	113	99	97
2	1250	33	Y	N	C/S	Y	N	N	N	N	24	112	123	108	123	107	97
3	1340	31	N	Y	NVD	N	N	I	N	N	53	88	86	86	90	80	96
4	1230	32	N	Y	C/S	N	Y	II	N	N	24	100	99	107	104	89	99
5	1170	32	Y	N	C/S	N	N	N	N	N	4	106	99	113	118	97	103
6	880	35	Y	N	C/S	N	N	N	N	N	24	114	110	108	120	123	110
7	1500	30	N	Y	NVD	Y	N	N	N	N	4	111	101	119	121	111	101
8	720	27	N	Y	NVD	Y	N	II	N	N	39	109	109	109	114	109	104
9	1290	32	N	N	NVD	Y	N	II	Y	Y	-	92	63	91	118	102	85
10	1225	37	Y	N	BBA	N	Y	N	N	N	24	80	94	86	80	68	71
11	1050	31	Y	N	C/S	Y	N	N	N	N	47	108	117	111	111	108	94
12	1260	34	Y	N	NVD	Y	Y	N	N	N	45	95	97	85	95	102	97
13	1045	32	N	Y	NVD	Y	N	N	Y	Y	59	55	74	58	104	18	22
14	1090	33	Y	N	NVD	N	Y	I	N	N	50	100	99	102	105	94	97
15	900	31	Y	N	C/S	N	N	N	N	N	48	111	91	123	97	120	124
16	1025	37	Y	N	C/S	N	N	I	N	N	46	108	107	119	116	100	96
17	1310	34	Y	N	C/S	Y	N	N	N	N	47	106	102	107	116	93	112
18	1145	33	Y	N	C/S	N	Y	N	N	N	45	103	96	109	123	97	89
19	880	30	Y	N	NVD	N	N	III	N	N	24	103	102	97	106	106	103
20	1010	31	Y	N	NVD	N	Y	I	N	N	24	117	122	132	108	108	114
21	900	29	N	Y	NVD	N	Y	II	N	N	45	112	107	101	125	110	115
22	1165	32	N	Y	NVD	N	Y	N	N	N	45	110	111	115	111	116	95
23	1160	33	Y	N	C/S	Y	N	N	N	N	46	94	88	94	104	94	91
24	980	29	N	Y	BR	N	Y	N	N	N	47	106	100	109	124	93	105
25	1335	30	N	Y	NVD	N	Y	N	N	N	24	103	117	108	97	97	93
26	1050	29	N	Y	C/S	N	N	N	N	N	46	119	124	118	114	129	111
27	710	30	Y	N	NVD	N	N	I	N	N	24	109	113	104	106	104	119
28	1095	30	N	Y	C/S	Y	Y	N	N	N	53	116	111	114	121	111	121
29	1180	31	N	Y	NVD	N	N	N	N	N	47	113	106	130	112	109	107
30	1460	32	N	Y	C/S	Y	N	N	N	N	-	96	95	96	105	95	89
31	1030	30	N	Y	NVD	N	N	N	N	N	24	103	98	105	106	102	106
32	750	31	Y	N	FCPS	Y	N	N	N	N	41	100	96	103	102	103	97
33	1200	32	N	Y	BBA	N	N	N	N	N	24	105	103	103	108	108	108
34	940	31	Y	N	C/S	Y	N	N	N	N	39	107	103	118	108	106	105
35	1160	28	N	Y	NVD	N	Y	N	N	N	50	110	104	128	112	103	103
36	1015	26	N	Y	NVD	Y	N	II	N	N	45	98	98	97	109	95	89
37	1330	33	Y	N	C/S	N	Y	N	N	N	46	111	123	113	114	108	99
38	1115	32	Y	N	BBA	N	N	III	N	N	3	102	101	101	115	96	98
39	915	30	N	Y	NVD	Y	Y	I	N	N	24	105	104	108	108	102	104
40	950	34	Y	N	C/S	N	N	N	N	N	50	108	104	104	104	113	117
41	1400	33	N	Y	C/S	N	N	N	N	N	8	117	126	116	116	115	112
42	1499	30	N	Y	C/S	Y	Y	IV	Y	Y	4	100	99	99	96	104	104
43	1450	30	N	Y	C/S	Y	Y	I	N	N	4	111	104	103	119	114	114
44	1040	32	Y	N	NVD	N	Y	I	N	N	61	103	115	98	99	102	99
45	780	28	Y	N	NVD	Y	Y	IV	N	N	24	108	96	109	111	115	111
46	1020	32	Y	N	NVD	N	N	N	N	N	45	116	132	107	105	113	124
47	1250	32	N	Y	BR	N	Y	I	N	N	53	102	99	116	107	97	92
48	850	36	Y	N	C/S	N	N	N	N	N	24	104	108	100	111	109	92
49	1055	32	Y	N	NVD	Y	N	I	N	N	4	112	110	124	122	103	99
50	915	28	N	Y	BR	N	Y	II	N	N	47	98	73	110	109	101	96
51	880	30	Y	N	NVD	Y	N	N	N	N	47	107	96	103	115	110	110
52	1050	28	N	Y	NVD	Y	N	I	N	N	47	106	105	112	107	100	107
53	1120	28	N	Y	NVD	Y	N	I	N	N	47	102	108	105	105	94	97
54	840	28	N	Y	BR	Y	Y	I	N	N	47	104	114	107	104	100	94
55	840	30	Y	N	C/S	N	Y	N	Y	Y	47	104	108	106	110	95	101
56	1120	34	Y	N	BR	Y	Y	III	N	Y	47	31	42	33	29	29	23

CONT 2

INA STUDY - VLBW INFANTS (n = 76)
MEDICAL HISTORY and GRIFFITHS TEST RESULTS

Case No.	BW g	GA	SGA	AGA	Del	HMD	AN	IVH	LEUC	CP	SES	GQ 12 mth	Loc 12 mth	PerS 12 mth	HeS 12 mth	EH 12 mth	Perf 12 mth
57	900	31	Y	N	C/S	Y	Y	II	N	N	31	107	98	100	118	106	113
58	1100	31	Y	N	C/S	N	Y	N	N	N	24	105	119	107	115	93	93
59	1300	33	N	Y	NVD	Y	Y	N	N	N	46	105	115	105	111	99	94
60	900	32	Y	N	NVD	N	N	IV	N	N	24	111	110	118	119	108	100
61	1499	34	N	Y	NVD	N	N	N	N	N	30	111	108	116	118	107	105
62	1440	33	N	Y	C/S	N	N	N	N	N	48	122	135	138	117	111	102
63	700	27	Y	N	NVD	N	N	I	N	N	30	94	96	90	94	96	94
64	1340	30	N	Y	C/S	Y	N	II	N	N	51	104	99	96	115	104	106
65	960	34	Y	N	NVD	N	N	N	N	N	39	104	102	115	107	102	94
66	1140	33	Y	N	C/S	Y	Y	I	N	N	47	102	99	109	109	93	98
67	930	34	Y	N	C/S	N	N	N	N	N	61	103	98	104	110	96	107
68	650	31	N	Y	BBA	Y	N	N	N	N	32	96	102	95	95	92	95
69	1210	31	Y	N	BR	N	N	N	N	N	31	102	98	92	112	103	106
70	1260	30	N	Y	BBA	Y	N	IV	Y	Y	47	93	86	99	98	89	93
71	1200	36	Y	N	C/S	N	N	I	N	N	47	104	99	104	115	104	96
72	880	29	Y	N	NVD	Y	N	N	N	N	61	120	135	124	116	112	112
73	1450	31	N	Y	C/S	Y	Y	II	N	N	47	100	112	102	93	101	91
74	1000	36	Y	N	C/S	N	N	N	N	N	-	104	97	111	108	111	91
75	1200	30	N	Y	C/S	N	N	I	N	N	31	107	118	104	109	101	100
76	790	34	Y	N	NVD	N	N	N	N	N	47	78	76	76	82	73	84
Mean	1104	32									37.5	105	105	107	110	102	101
Total N (No)			35	41		42	48	44	71	70							
Total Y (Yes)			41	35		34	28	32	5	6							
Total NVD					32												
Other Deliveries					44												

COMPARISON of CP with NON CP VLBW INFANTS USING the I N A.

APPENDIX VI/I.1

I N A at	0 Months Corrected Age (n = 78)						4 1/2 Months Corrected Age (n = 74)					
	NO CP (72)		CP (6)		P		NO CP (68)		CP (6)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
1. SUPINE												
Head asymmetrical	25	47	1	5	ns	ns	9	9	3	3		
Head symmetrical	-	-	-	-			59	59	3	3	<0.05	<0.05
Follows from midline to 45 ^	46	46	3	3			2	1	1	1		
Follows from midline to 90 ^	-	-	-	-			65	67	5	5	ns	ns
No following	26	26	3	3	ns	ns	-	-	-	-		
Hand alongside body with elb. fl.	70	70	6	6			4	4	2	3		
Hand to mouth or midline	2	2	0	0	ns	ns	64	64	4	3	ns	<0.01
Kicks leg	69	69	5	5			66	66	4	4		
No leg movements	3	3	1	1	ns	ns	2	2	2	2	<0.05	<0.05
2. TRACTION												
Marked head lag	65		6									
Moderate head lag	7		0		ns		20 }		4 }			
Full head control	-		-				48		2		ns	
Hip & knee ext. -> fl. or	24	24	3	3			-	-	-	-		
Hip & knee abd. + knee fl.							-	-	-	-		
Hip & knee in moderate fl.	48	48	3	3	ns	ns	23	23	3	3		
Hip & knee in strong fl.	-	-	-	-			45	45	3	3	ns	ns
Leg ext. time: 0 secs	54	53	5	5			66	66	5	5		
1 to 60 secs	18	19	1	1	ns	ns	2	2	1	1	ns	ns
Elbow: ext.	69	69	6	6			44	44	3	3		
fl.	3	3	0	0	ns	ns	24	24	3	3	ns	ns
State: quiet	58		3				61		2			
crying	14		3		ns		7		4		<0.005	
3. SITTING												
Trunk fl.	64		5				7		2			
Trunk ext.	5		1		ns		61		4		ns	
4. PRONE LYING												
Posterior tilt pelvis, knees fl.	33		4				13 }		2 }			
Pelvis flat, abd. "frog" legs	39		2		ns							
Puppy prone wt. bearing on fl. or ext. elbs.	-		-				55		4		ns	
5. LANDAU												
Head & trunk fl.	40		2				-		-			
Head fl., trunk only slightly fl.	32		4		ns		-		-			
Ext. head & thoracic spine	-		-				52		2			
Ext. head, thoracic spine and pelvis	-		-				16		4		<0.05	
Head & trunk: asymmetry	1	2	0	0			1	1	1	1		
no asymmetry	71	70	6	6	ns	ns	67	67	5	5	ns	ns
Arm: fl.	30	31	5	5			57	57	6	6		
ext.	42	41	1	1	ns	ns	11	11	0	0	ns	ns
Leg in moderate fl.	7	7	2	2			-	-	-	-		
Leg in ext. -> fl. or Leg in suspension	65	65	4	4	ns	ns	9	9	3	3		
Leg in strong fl.	-	-	-	-			59	59	3	3	<0.05	<0.05
Leg ext. time: 0 secs	8	8	2	2			61	61	3	3		
1 to 60 secs	64	64	4	4	ns	ns	7	7	3	3	<0.05	<0.05
State: quiet	54		3				60		3			
crying	18		3		ns		8		3		<0.05	

} Delayed responses added together.

CONT 2

COMPARISON of CP with NON CP VLBW INFANTS USING the I N A

APPENDIX VI/I.2

I N A at	0 Months Corrected Age (n = 78)						4 1/2 Months Corrected Age (n = 74)					
	NO CP (72)		CP (6)		P		NO CP (68)		CP (6)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
6. AXILLARY HANGING												
No head control	67		5				4		2			
Some head control	5		1		ns		64		4		ns	
Hip & knee in loose fl.	4	4	1	1			-	-	-	-		
Leg ext -> fl. or Leg in suspension	68	68	5	5			28	28	2	2		
Hip & knee in strong fl.	-	-	-	-			40	40	4	4	ns	ns
Leg ext. time: 0 secs	7	8	2	2			50	50	2	2		
1 to 60 secs	65	64	4	4	ns	ns	18	18	4	4	ns	ns
State: quiet	54		2				61		4			
crying	18		4		<0.05		7		2		ns	
7. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	72	72	6	6			19	22	2	4		
Head & trunk righting	-	-	-	-	ns	ns	49	46	4	2	ns	ns
Arm in Moro response: Abd. -> ext. -> fl.	30	30	3	3			15 }	15	0	0		
Arm in partial Moro response: Abd. -> ext.	37	37	2	2								
Arm in loose fl.	5	5	1	1	ns	ns	53	53	6	6	ns	ns
Hand: open	50	50	3	3			12	12	1	1		
fisted	22	22	3	3	ns	ns	56	56	5	5	ns	ns
Upper leg fl, lower leg ext.	46	41	2	2								
Upper leg ext. -> fl, lower leg ext.	26	31	4	4	ns	ns	8 }	8	2 }	2		
Both legs fl. or ext. -> fl.	-	-	-	-			60	60	4	4	ns	ns
Leg ext. time: 0 secs	53	51	5	5			62	63	4	4		
1 to 60 secs	19	21	1	1	ns	ns	6	5	2	2	ns	ns
State: quiet	54		3				58		2			
crying	18		3		ns		10		4		<0.01	
8. COLLIS HORIZONTAL												
Suspension head, neck & trunk	72	72	6	6	ns	ns	19	20	3	3		
Righting of head, neck & trunk	-	-	-	-			49	48	3	3	ns	ns
Arm in fl.	53	54	5	5								
Arm in suspension	19	18	1	1	ns	ns	18 }	15	3 }	2		
Arm in partial weight bearing	-	-	-	-			50	53	3	4	ns	ns
Hand: open	27	28	0	0			5	5	1	1		
fisted	45	44	6	6	ns	ns	63	63	5	5	ns	ns
Hip & knee in loose fl.	35	31	3	4			64	65	6	6		
Hip & knee ext. -> fl.	37	41	3	2	ns	ns	4	3	0	0	ns	ns
Leg ext. time: 0 secs	39	37	3	5			67	68	6	6		
1 to 60 secs	33	35	3	1	ns	ns	1	0	0	0	ns	ns
State: quiet	52		3				58		2			
crying	20		3		ns		10		4		<0.01	
9. HAND GRASP												
Reflex grasp	71	71	6	6			65	65	6	5		
Weak grasp	1	1	0	0	ns	ns	-	-	-	-		
Voluntary grasp	-	-	-	-			3	3	0	1	ns	ns

} Delayed responses added together.

CONT 3

COMPARISON of CP with NON CP VLBW INFANTS USING the I N A

I N A at	0 Months Corrected Age (n = 78)						4 1/2 Months Corrected Age (n = 74)					
	NO CP (72)		CP (6)		P		NO CP (68)		CP (6)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
10. MORO RESPONSE												
Partial	19		2									
Complete	53		4		ns		37 }		4 }			
Absent	-		-				31		2		ns	
11. A T N R												
Absent	69	67	6	6			64	63	5	5		
Present	3	5	0	0	ns	ns	4	5	1	1	ns	ns
12. PROT. EXT. - DOWNWARDS												
Flat feet	0	0	0	0			63	63	3	2		
On toes	0	0	1	1			5	5	3	4	<0.05	<0.005
Absent	72	72	5	5	ns	ns	-	-	-	-		
13. SIDEWAYS PROPPING												
Ext. arm to wt. bear	-	-	-	-			41	43	3	2		
Absent	72	72	6	6	ns	ns	27	25	3	4	ns	ns
14. RANGE OF MOVEMENT												
Adductor angle - mean (degrees)	108		95		<0.005		98		85		ns	
Heel to ear - mean (degrees)	100		96		ns		97		91		<0.01	
Popliteal angle - mean (degrees)	110	113	104	106	ns	ns	108	111	107	109	ns	ns
Ankle dorsiflexion - mean (degrees)	55	55	52	55	ns	ns	66	65	68	70	ns	ns
Scarf sign:												
Elbow before the midline	4	4	1	1			3	1	2	3		
Elbow at the midline	68	68	5	5	ns	ns	65	67	4	3	<0.05	<0.005

} Delayed responses added together.

VLBW INFANTS: ASSOCIATION of I N A at 0 & 4 1/2 MONTHS CORRECTED AGE with DQ at 12 MONTHS CORRECTED AGE

I N A at	0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
	DQ at 12 Months				P		DQ at 12 Months				P	
	<100 (19)		>100 (57)				<100 (17)		>100 (55)			
	L	R	L	R	L	R	L	R	L	R	L	R
1. SUPINE												
Head asymmetrical	7	12	19	38	ns	ns	5	5	6	6		
Head symmetrical	-	-	-	-			12	12	49	49	ns	ns
Follows from midline to 45 ^	8	8	40	41			0	0	1	1		
Follows from midline to 90 ^	-	-	-	-			15	15	54	54		
No following	11	11	17	16	<0.05	<0.05	2	2	0	0	ns	ns
Hand alongside body with elb. fl.	19	19	55	55			4	5	2	2		
Hand to mouth or midline	0	0	2	2	ns	ns	13	12	53	53	<0.05	<0.05
Kicks leg	18	18	55	55			15	15	53	53		
No leg movements	1	1	2	2	ns	ns	2	2	2	2	ns	ns
2. TRACTION												
Marked head lag	18		52				5		8			
Moderate head lag	1		5		ns	ns	5		4			
Full head control	-		-				7		43		<0.01	
Hip & knee ext. -> fl.	4	5	17	17								
or							-	-	-	-		
Hip & knee abd. + knee fl.	1	1	2	2								
Hip & knee in moderate fl.	14	13	38	38	ns	ns	10	10	15	15		
Hip & knee in strong fl.	-	-	-	-			7	7	40	40	<0.05	<0.05
Leg ext. time: 0 secs	17	16	42	42			14	14	50	55		
1 to 60 secs	2	3	15	15	ns	ns	3	3	5	0	<0.05	<0.05
Elbow: ext.	19	19	54	56			11	11	35	35		
fl.	0	0	3	1	ns	ns	6	6	20	20	ns	ns
State: quiet	14		47				11		50			
crying	5		10		ns		6		5		<0.05	
3. SITTING												
Trunk fl.	17		54				4		5			
Trunk ext.	2		3		ns		13		50		ns	
4. PRONE LYING												
Posterior tilt pelvis, knees fl.	10		26				5		1			
Pelvis flat, abd. "frog" legs	9		31		ns		2		7			
Puppy prone wt. bearing on fl. or ext. elbs.	-		-				10		47		<0.05	
5. LANDAU												
Head & trunk fl.	6		36				-		-			
Head fl., trunk only slightly fl.	13		21		<0.05		-		-			
Ext. head & thoracic spine	-		-				10		42			
Ext. head, thoracic spine and pelvis	-		-				7		13		ns	
Head & trunk: asymmetry	1	1	0	1			2	3	0	1		
no asymmetry	18	18	57	56	ns	ns	15	14	55	54	ns	ns
Arm: fl.	11	11	22	23			16	16	45	45		
ext.	8	8	35	34	ns	ns	1	1	10	10	ns	ns
Leg in moderate fl.	3	3	6	6			2	2	0	0		
Leg in ext. -> fl.												
or	16	16	51	51	ns	ns	4	4	6	6		
Leg in suspension												
Leg in strong fl.	-	-	-	-			11	11	49	49	ns	ns
Leg ext. time: 0 secs	4	4	6	6			14	14	50	50		
1 to 60 secs	15	15	51	51	ns	ns	3	3	5	5	ns	ns
State: quiet	13		44				12		49			
crying	6		13		ns		5		6		ns	

CONT 2

VLBW INFANTS: ASSOCIATION of I N A. at 0 & 4 1/2 MONTHS CORRECTED AGE with DQ at 12 MONTHS CORRECTED AGE

I N A at	0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
	DQ at 12 Months				P		DQ at 12 Months				P	
	<100 (19)		>100 (57)				<100 (17)		>100 (55)			
	L	R	L	R	L	R	L	R	L	R	L	R
6. AXILLARY HANGING												
No head control	18		52				3		3			
Some head control	1		5		ns		14		52		ns	
Hip & knee in loose fl.	1	1	4	4			0	0	3	3		
Leg ext -> fl. or Leg in suspension	18	18	53	53	ns	ns	7	7	18	18		
Hip & knee in strong fl.	-	-	-	-			10	10	34	34	ns	ns
Leg ext. time: 0 secs	2	3	7	7			10	10	41	41		
1 to 60 secs	17	16	50	50	ns	ns	7	7	14	14	ns	ns
State: quiet	13		43				13		50			
crying	6		14		ns		4		5		ns	
7. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	19	19	57	57	ns	ns	6	10	13	14		
Head & trunk righting	-	-	-	-			11	7	42	41	ns	<0.05
Arm in Moro response: Abd. -> ext. -> fl.	12	13	21	26			1	1	3	3		
Arm in partial Moro response: Abd. -> ext.	5	4	33	28			3	3	8	8		
Arm in loose fl.	2	2	3	3	ns	ns	13	13	44	44	ns	ns
Hand: open	13	13	39	39			2	2	9	9		
fisted	6	6	18	18	ns	ns	15	15	46	46	ns	ns
Upper leg fl, lower leg ext.	12	11	36	32			1	1	2	3		
Upper leg ext. -> fl, lower leg ext.	7	8	21	25	ns	ns	1	1	4	3		
Both legs fl. or ext. -> fl.	-	-	-	-			15	15	49	49	ns	ns
Leg ext. time: 0 secs	14	15	43	40			15	15	51	52		
1 to 60 secs	5	4	14	17	ns	ns	2	2	4	3	ns	ns
State: quiet	13		44				9		49			
crying	6		13		ns		8		6		<0.005	
8. COLLIS HORIZONTAL												
Suspension head, neck & trunk	19	19	57	57	ns	ns	8	9	12	13		
Righting of head, neck & trunk	-	-	-	-			9	8	43	42	ns	<0.05
Arm in fl.	14	15	44	44			8	7	13	9		
Arm in suspension	5	4	13	13	ns	ns	0	0	0	1		
Arm in partial weight bearing	-	-	-	-			9	10	42	45	ns	ns
Hand: open	3	4	22	23			2	2	4	4		
fisted	16	15	35	34	ns	ns	15	15	51	51	ns	ns
Hip & knee in loose fl.	8	10	29	25			17	17	52	53		
Hip & knee ext. -> fl.	11	9	28	32	ns	ns	0	0	3	2	ns	ns
Leg ext. time: 0 secs	10	14	31	28			17	17	54	55		
1 to 60 secs	9	5	26	29	ns	ns	0	0	1	0	ns	ns
State: quiet	13		42				9		49			
crying	6		15		ns		8		6		<0.005	
9. HAND GRASP												
Reflex grasp	19	19	56	56			16	16	52	52		
Weak grasp	0	0	1	1			0	0	0	0		
Voluntary grasp	-	-	-	-	ns	ns	1	1	3	3	ns	ns

CONT 3

VLBW INFANTS: ASSOCIATION of I N A at 0 & 4 1/2 MONTHS CORRECTED AGE with DQ at 12 MONTHS CORRECTED AGE

I N A at	0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
	DQ at 12 Months				P		DQ at 12 Months				P	
	<100 (19)		>100 (57)				<100 (17)		>100 (55)			
	L	R	L	R	L	R	L	R	L	R	L	R
10. MORO RESPONSE												
Partial	5		14				13		25			
Complete	14		42				0		2			
Absent	0		1		ns		4		28		<0.05	
11. A T N R												
Absent	19	19	54	52			16	16	51	51		
Present	0	0	3	5	ns	ns	1	1	4	4	ns	ns
12. PROT. EXT. - DOWNWARDS												
Flat feet	1	1	0	0			10	8	46	46		
On toes	0	0	0	0			4	5	4	4		
Absent	18	18	57	57	ns	ns	3	4	5	5	ns	<0.05
13. SIDEWAYS PROPPING												
Ext. arm to wt. bear	-	-	-	-			6	5	36	38		
Absent	19	19	57	57	ns	ns	11	12	19	17	<0.05	<0.005
14. RANGE OF MOVEMENT												
Adductor angle - mean (degrees)												
Heel to ear - mean (degrees)												
Popliteal angle - mean (degrees)												
Ankle dorsiflexion - mean (degrees)												
Scarf sign:												
Elbow before the midline	2	2	2	2			3	3	2	1		
Elbow at the midline	17	17	55	55	ns	ns	14	14	53	54	ns	<0.05

VLWB INFANTS: ASSOCIATION of I N A at 0 & 4 1/2 MONTHS CORRECTED AGE with the GRIFFITHS LOCOMOTOR SCORE at 12 MONTHS CORRECTED AGE

I N A at	0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
	LS at 12 Months				P		LS at 12 Months				P	
	<100 (33)		>100 (43)				<100 (30)		>100 (42)			
	L	R	L	R	L	R	L	R	L	R	L	R
1. SUPINE												
Head asymmetrical	12	21	14	29	ns	ns	7	7	4	4		
Head symmetrical	-	-	-	-			23	23	38	38	ns	ns
Follows from midline to 45 ^	17	18	12	32			2	1	1	1		
Follows from midline to 90 ^	-	-	-	-			27	28	41	41		
No following	16	15	31	11	<0.05	<0.05	1	1	0	0	ns	ns
Hand alongside body with elb. fl.	32	32	42	42			4	5	3	3		
Hand to mouth or midline	1	1	1	1	ns	ns	26	25	39	39	ns	ns
Kicks leg	32	32	41	41			27	27	41	41		
No leg movements	1	1	2	2	ns	ns	3	3	1	1	ns	
2. TRACTION												
Marked head lag	32		38				7		6			
Moderate head lag	1		5		ns	ns	4		5			
Full head control	-		-				19		31		ns	
Hip & knee ext. -> fl.	9	9	12	13								
or							-	-	-	-		
Hip & knee abd. + knee fl.	1	1	2	2								
Hip & knee in moderate fl.	23	23	29	28	ns	ns	15	15	10	10		
Hip & knee in strong fl.	-	-	-	-			15	15	32	32	<0.05	<0.05
Leg ext. time: 0 secs	27	27	32	31			28	28	41	41		
1 to 60 secs	6	6	11	12	ns	ns	2	2	1	1	ns	ns
Elbow: ext.	32	32	41	41			22	22	24	24		
fl.	1	1	2	2	ns	ns	8	8	18	18	ns	ns
State: quiet	28		33				23		37			
crying	5		10		ns		7		5		ns	
3. SITTING												
Trunk fl.	30		38				6		3			
Trunk ext.	3		5		ns		24		39		ns	
4. PRONE LYING												
Posterior tilt pelvis, knees fl.	18		18				5		1			
Pelvis flat, abd. "frog" legs	15		35		ns		6		3			
Puppy prone wt. bearing on fl. or ext. elbs.	-		-				19		38		<0.005	
5. LANDAU												
Head & trunk fl.	15		27				-		-			
Head fl., trunk only slightly fl.	18		16		ns		-		-			
Ext. head & thoracic spine	-		-				19		33			
Ext. head, thoracic spine and pelvis	-		-				11		9		ns	
Head & trunk: asymmetry	1	1	1	2			2	3	0	1		
no asymmetry	32	32	42	41	ns	ns	28	27	42	41	ns	ns
Arm: fl.	19	20	14	14			28	28	33	33		
ext.	14	13	29	29	<0.05	<0.05	2	2	9	9	ns	ns
Leg in moderate fl.	4	4	5	5			2	2	0	0		
Leg in ext. -> fl.												
or	29	29	38	38	ns	ns	6	6	4	4		
Leg in suspension												
Leg in strong fl.	-	-	-	-			22	22	38	38	ns	ns
Leg ext. time: 0 secs	4	4	6	6			25	25	39	39		
1 to 60 secs	29	29	37	37	ns	ns	5	5	3	3	ns	ns
State: quiet	25		32				24		37			
crying	8		11		ns		6		5		ns	

CONT 2

VLWB INFANTS: ASSOCIATION of I N A at 0 & 4 1/2 MONTHS CORRECTED AGE with the GRIFFITHS LOCOMOTOR SCORE at 12 MONTHS CORRECTED AGE

I N A at	0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
	LS at 12 Months				P		LS at 12 Months				P	
	<100 (33)		>100 (43)				<100 (30)		>100 (42)			
	L	R	L	R	L	R	L	R	L	R	L	R
6. AXILLARY HANGING												
No head control	31		39				4		2			
Some head control	2		4		ns		26		40		ns	
Hip & knee in loose fl.	1	1	4	4			1	1	2	2		
Leg ext -> fl. or Leg in suspension	32	32	39	39	ns	ns	15	15	10	10		
Hip & knee in strong fl.	-	-	-	-			14	14	30	30	<0.05	<0.05
Leg ext. time: 0 secs	3	4	6	6			15	15	36	36		
1 to 60 secs	30	29	37	37	ns	ns	15	15	6	6	<0.005	<0.005
State: quiet	24		31				25		38			
crying	9		12		ns		5		4		ns	
7. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	33	33	43	43	ns	ns	10	14	9	10		
Head & trunk righting	0	0	0	0			20	16	33	32	ns	<0.05
Arm in Moro response: Abd. -> ext. -> fl.	30	30	41	41			2	2	1	1		
Arm in partial Moro response: Abd. -> ext.	3	3	2	2	ns	ns	3	3	9	9		
Arm in loose fl.	-	-	-	-			25	25	32	32	ns	ns
Hand: open	19	19	33	33			4	4	7	7		
fisted	14	14	10	10	ns	ns	26	26	35	35	ns	ns
Upper leg fl, lower leg ext.	17	15	31	27			4	1	4	3		
Upper leg ext. -> fl, lower leg ext.	16	18	12	16	ns	ns	0	3	0	1		
Both legs fl. or ext. -> fl.	-	-	-	-			26	26	38	38	ns	ns
Leg ext. time: 0 secs	23	23	34	32			25	26	41	41		
1 to 60 secs	10	10	9	11	ns	ns	5	4	1	1	ns	ns
State: quiet	25		32				22		36			
crying	8		11		ns		8		6		ns	
8. COLLIS HORIZONTAL												
Suspension head, neck & trunk	33	33	43	43			12	13	8	9		
Righting of head, neck & trunk	0	0	0	0	ns	ns	18	17	34	33	<0.05	<0.05
Arm in fl.	22	25	36	34			12	10	6	6		
Arm in suspension	11	8	7	9	ns	ns	0	0	3	1		
Arm in partial weight bearing	-	-	-	-			18	20	33	35	ns	ns
Hand: open	10	12	15	15			2	2	4	4		
fisted	23	21	28	28	ns	ns	28	28	38	38	ns	ns
Hip & knee in loose fl.	24	26	31	31			28	30	39	40		
Hip & knee ext. -> fl.	9	7	12	12	ns	ns	2	0	3	2	ns	ns
Leg ext. time: 0 secs	15	20	26	22			30	30	41	42		
1 to 60 secs	18	13	17	21	ns	ns	0	0	1	0	ns	ns
State: quiet	26		29				22		36			
crying	7		14		ns		8		6		ns	
9. HAND GRASP												
Reflex grasp	33	33	42	42			29	29	39	39		
Weak grasp	0	0	1	1			0	0	0	0		
Voluntary grasp	-	-	-	-	ns	ns	1	1	3	3	ns	ns

CONT 3

VLWB INFANTS: ASSOCIATION of I N A at 0 & 4 1/2 MONTHS CORRECTED AGE with the GRIFFITHS LOCOMOTOR SCORE at 12 MONTHS CORRECTED AGE

I N A at	0 Months Corrected Age (n = 76)						4 1/2 Months Corrected Age (n = 72)					
	LS at 12 Months				P		LS at 12 Months				P	
	<100 (33)		>100 (43)				<100 (30)		>100 (42)			
	L	R	L	R	L	R	L	R	L	R	L	R
10. MORO RESPONSE												
Partial	9		10				17		18			
Complete	23		33				2		1			
Absent	1		0		ns		11		23		ns	
11. A T N R												
Absent	33	33	39	37			28	28	39	39		
Present	0	0	4	6	ns	ns	2	2	3	3	ns	ns
12. PROT. EXT. - DOWNWARDS												
Flat feet	1	1	0	0			21	19	35	35		
On toes	0	0	0	0			4	5	4	4		
Absent	32	32	43	43	ns	ns	5	6	3	3	ns	ns
13. SIDEWAYS PROPPING												
Ext. arm to wt. bear	0	0	0	0			13	13	29	30		
Absent	33	33	43	43	ns	ns	17	17	13	12	<0.05	<0.05
14. RANGE OF MOVEMENT												
Adductor angle - mean (degrees)												
Heel to ear - mean (degrees)												
Popliteal angle - mean (degrees)												
Ankle dorsiflexion - mean (degrees)												
Scarf sign:												
Elbow before the midline	2	2	2	2			3	3	2	1		
Elbow at the midline	31	31	41	41	ns	ns	27	27	40	41	ns	<0.05

COMPARISON BETWEEN VLBW INFANTS WITH I V H (all grades) and THOSE WITH NO I V H

I N A at	0 Months Corrected Age (n = 71)						4 1/2 Months Corrected Age (n = 67)					
	No I V H (42)		I V H (29)		P		No I V H (40)		I V H (27)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
1. SUPINE												
Head asymmetrical	16	26	9	20	ns	ns	5	5	4	4		
Head symmetrical	-	-	-	-			35	35	23	23	ns	ns
Follows from midline to 45 ^	23	25	21	21			2	0	2	3		
Follows from midline to 90 ^	-	-	-	-			38	40	25	24	ns	ns
No following	19	17	8	8	ns	ns	-	-	-	-		
Hand alongside body with elb. fl.	40	40	29	29			4	4	1	2		
Hand to mouth or midline	2	2	0	0	ns	ns	36	36	26	25	ns	ns
Kicks leg	41	41	27	27			38	38	27	27		
No leg movements	1	1	2	2	ns	ns	2	2	0	0	ns	ns
2. TRACTION												
Marked head lag	40		25				-		-			
Moderate head lag	2		4		ns		10 }		9 }			
Full head control	-		-				30		18		ns	
Hip & knee ext. -> fl. or Hip & knee abd. + knee	15	14	7	9			-	-	-	-		
Hip & knee in moderate fl.	27	28	22	20	ns	ns	14	14	9	9	ns	ns
Hip & knee in strong fl.	-	-	-	-			26	26	18	18		
Leg ext. time: 0 secs	31	32	24	22			38	38	27	27		
1 to 60 secs	11	10	5	7	ns	ns	2	2	0	0	ns	ns
Elbow: ext.	39	39	29	29			28	28	15	15		
fl.	3	3	0	0	ns	ns	12	12	12	12	ns	ns
State: quiet	33		25				35		23			
crying	9		4		ns		5		4		ns	
3. SITTING												
Trunk fl.	39		28				7		1			
Trunk ext.	3		1		ns		33		26		ns	
4. PRONE LYING												
Posterior tilt pelvis, knees fl.	18		14				11 }		3 }			
Pelvis flat, abd. "frog" legs	24		15		ns							
Puppy prone wt. bearing on fl. or ext. elbs.	-		-				29		24		ns	
5. LANDAU												
Head & trunk fl.	23		17				-		-			
Head fl., trunk only slightly fl.	19		12		ns		-		-			
Ext. head & thoracic spine	-		-				32		19			
Ext. head, thoracic spine and pelvis	-		-				8		8		ns	
Head & trunk: asymmetry	1	1	0	1			0	0	1	1		
no asymmetry	41	41	29	28	ns	ns	40	40	26	26	ns	ns
Arm: fl.	18	19	11	11			32	32	24	24		
ext.	24	23	18	18	ns	ns	8	8	3	3	ns	ns
Leg in moderate fl.	3	3	5	5			-	-	-	-		
Leg in ext. -> fl. or Leg in suspension	39	39	24	24	ns	ns	5	5	3	3		
Leg in strong fl.	-	-	-	-			35	35	24	24	ns	ns
Leg ext. time: 0 secs	4	4	5	5			36	36	25	25		
1 to 60 secs	38	38	24	24	ns	ns	4	4	2	2	ns	ns
State: quiet	29		25				35		23			
crying	13		4		ns		5		4		ns	

} Delayed responses added together.

CONT 2

COMPARISON BETWEEN VLBW INFANTS WITH I V H (all grades) and THOSE WITH NO I V H

I N A at	0 Months Corrected Age (n = 71)						4 1/2 Months Corrected Age (n = 67)					
	No I V H (42)		I V H (29)		P		No I V H (40)		I V H (27)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
6. AXILLARY HANGING												
No head control	40		26				3		2			
Some head control	2		3		ns		37		25		ns	
Hip & knee in loose fl.	4	4	1	1			-	-	-	-		
Leg ext -> fl. or Leg in suspension	38	38	28	28	ns	ns	15	15	12	12		
Hip & knee in strong fl.	-	-	-	-			25	25	15	15	ns	ns
Leg ext. time: 0 secs	7	8	1	1			30	30	19	19		
1 to 60 secs	35	34	28	28	ns	ns	10	10	8	8	ns	ns
State: quiet	29		25				36		23			
crying	13		4		ns		4		4		ns	
7. VOJTA SIDE TILTING												
Head & trunk: side fl. with gravity	42	42	29	29	ns	ns	11	13	7	8		
Head & trunk righting	0	0	0	0			29	27	20	19	ns	ns
Arm in Moro response: Abd. -> ext. -> fl.	18	3	17	2			7 }	7	8 }	8		
Arm in partial Moro response: Abd. -> ext.	24	39	12	27	ns	ns						
Arm in loose fl.	-	-	-	-			33	33	19	19	ns	ns
Hand: open	26	26	23	23			7	7	3	3		
fisted	16	16	6	6	ns	ns	33	33	24	24	ns	ns
Upper leg fl, lower leg ext.	28	26	17	14			-	-	-	-		
Upper leg ext. -> fl, lower leg ext.	14	16	12	15	ns	ns	6	6	1	1		
Both legs fl. or ext. -> fl.	-	-	-	-			34	34	26	26	ns	ns
Leg ext. time: 0 secs	33	31	20	20			38	38	25	25		
1 to 60 secs	9	11	9	9	ns	ns	2	2	2	2	ns	ns
State: quiet	29		25				35		21			
crying	13		4		ns		5		6		ns	
8. COLLIS HORIZONTAL												
Suspension head, neck & trunk	42	42	29	29			10	12	8	8		
Righting of head, neck & trunk	0	0	0	0	ns	ns	30	28	19	19	ns	ns
Arm in fl. Arm in suspension	33 / 9	31 / 11	19 / 10	22 / 7	ns	ns	12 }	12	7 }	4		
Arm in partial weight bearing	-	-	-	-			28	28	20	23	ns	ns
Hand: open	16	17	9	10			4	3	1	2		
fisted	26	25	20	19	ns	ns	36	37	26	25	ns	ns
Hip & knee in loose fl.	21	18	14	14			38	39	26	26		
Hip & knee ext. -> fl.	21	24	15	15	ns	ns	2	1	1	1	ns	ns
Leg ext. time: 0 secs	24	22	15	16			39	40	27	27		
1 to 60 secs	18	20	14	13	ns	ns	1	0	0	0	ns	ns
State: quiet	27		25				35		21			
crying	15		4		ns		5		6		ns	
9. HAND GRASP												
Reflex grasp	42	42	28	28			39	38	25	26		
Weak grasp	0	0	1	1	ns	ns	0	0	0	0		
Voluntary grasp	-	-	-	-			1	2	2	1	ns	ns

} Delayed responses added together.

CONT 3

COMPARISON BETWEEN VLBW INFANTS WITH I V H (all grades) and THOSE WITH NO I V H

I N A at	0 Months Corrected Age (n = 71)						4 1/2 Months Corrected Age (n = 67)					
	No I.V H (42)		I V H (29)		P		No I V H (40)		I V H (27)		P	
	L	R	L	R	L	R	L	R	L	R	L	R
10. MORO RESPONSE												
Partial	13		6				19 }		17 }			
Complete	29		23		ns							
Absent	-		-				21		10		ns	
11. A T N R												
Absent	38	38	29	27			37	36	26	27		
Present	4	4	0	2	ns	ns	3	4	1	0	ns	ns
12. PROT. EXT. - DOWNWARDS												
Flat feet	0	0	0	0			38	38	23	23		
On toes	0	0	0	0			2	2	4	4	ns	ns
Absent	42	42	29	29	ns	ns	-	-	-	-		
13. SIDEWAYS PROPPING												
Ext. arm to wt. bear	0	0	0	0			20	22	19	19		
Absent	42	42	29	29	ns	ns	20	18	8	8	ns	ns
14. RANGE OF MOVEMENT												
Adductor angle - mean (degrees)	107		108		ns		97		98		ns	
Heel to ear - mean (degrees)	100		100		ns		98		97		ns	
Popliteal angle - mean (degrees)	110	114	110	111	ns	0.03	109	112	108	110	ns	ns
Ankle dorsiflexion - mean (degrees)	55	53	56	57	ns	ns	66	66	66	65	ns	ns
Scarf sign:												
Elbow before the midline	1	1	2	2			2	1	2	1		
Elbow at the midline	41	41	27	27	ns	ns	38	39	25	26	ns	ns

} Delayed responses added together.

COMPARISON BETWEEN VLBW INFANTS WITH NO I V H., Grade 1 & 2 I V H and Grade 3 & 4 I V H

I N A at	0 Months Corrected Age (n = 71)							4 1/2 Months Corrected Age (n = 67)						
	No I V H (42)		I V H Gr. 1 & 2 (24)		I V H Gr. 3 & 4 (5)		P	No I V H (40)		I V H Gr. 1 & 2 (22)		I V H Gr. 3 & 4 (5)		P
	L	R	L	R	L	R		L	R	L	R	L	R	
1. SUPINE														
Head asymmetrical	16	26	6	18	3	2	ns	5	5	2	2	2	2	
Head symmetrical	-	-	-	-				35	35	20	20	3	3	ns
Follows from midline to 45 ^	24	26	17	17	4	4		2	0	0	1	1	1	
Follows from midline to 90 ^	-	-	-	-	-	-		38	40	22	21	4	4	ns
No following	18	16	7	7	1	1		-	-	-	-	-	-	
Hand alongside body with elb. fl.	40	40	24	24	5	5		3	3	0	0	1	2	
Hand to mouth or midline	2	2	0	0	0	0	ns	37	37	22	22	4	3	ns
Kicks leg	41	41	23	23	4	4		39	39	22	22	5	5	
No leg movements	1	1	1	1	1	1	ns	1	1	0	0	0	0	ns
2. TRACTION														
Marked head lag	40		21		4									
Moderate head lag	2		3		1		ns	10		7		2		ns
Full head control	-		-		-			30		15		3		
Hip & knee ext. -> fl. or Hip & knee abd. + knee	15	14	6	8	1	1		-	-	-	-	-	-	
Hip & knee in moderate fl.	27	28	18	16	4	4	ns	14	14	7	7	2	2	
Hip & knee in strong fl.	-	-	-	-	-	-		26	26	15	15	3	3	ns
Leg ext. time: 0 secs	31	32	19	17	5	5		38	38	22	22	5	5	
1 to 60 secs	11	10	5	7	0	0	ns	2	2	0	0	0	0	ns
Elbow: ext.	39	39	24	24	5	5		28	28	12	12	3	3	
fl.	3	3	0	0	0	0	ns	12	12	10	10	2	2	ns
State: quiet	33		21		4			36		19		4		
crying	9		3		1		ns	4		3		1		ns
3. SITTING														
Trunk fl.	39		23		5			7		0		1		
Trunk ext.	3		1		0		ns	33		22		4		ns
4. PRONE LYING														
Posterior tilt pelvis, knees fl.	18		13		1			11		2		1		
Pelvis flat, abd. "frog" legs	24		11		4		ns							
Puppy prone wt. bearing on fl. or ext. elbs.	-		-		-			29		20		4		ns
5. LANDAU														
Head & trunk fl.	23		15		2			-		-		-		
Head fl., trunk only slightly fl.	19		9		3		ns	-		-		-		
Ext. head & thoracic spine	-		-		-			32		17		2		
Ext. head, thoracic spine and pelvis	-		-		-			8		5		3		ns
Head & trunk: asymmetry	1	1	1	1	0	0		0	0	1	1	0	0	
no asymmetry	41	41	23	23	5	5	ns	40	40	21	21	5	5	ns
Arm: fl.	18	19	8	8	3	3		32	32	19	19	5	5	
ext.	24	23	16	16	2	2	ns	8	8	3	3	0	0	ns
Leg in moderate fl.	3	3	3	3	2	2		-	-	-	-			
Leg in ext. -> fl. or Leg in suspension	39	39	21	21	3	3	ns	5	5	2	2	1	1	
Leg in strong fl.	-	-	-	-	-	-		35	35	20	20	4	4	ns
Leg ext. time: 0 secs	4	4	3	3	2	2		36	36	21	21	4	4	
1 to 60 secs	38	38	21	21	3	3	ns	4	4	1	1	1	1	ns
State: quiet	29		21		4			35		19		4		
crying	13		3		1		ns	5		3		1		ns

} Delayed responses added together.

CONT 2

COMPARISON BETWEEN VLBW INFANTS WITH NO I V H , Grade 1 & 2 I V H and Grade 3 & 4 I V H

I N A at	0 Months Corrected Age (n = 71)							4 1/2 Months Corrected Age (n = 67)						
	No I V H (42)		I V H Gr. 1 & 2 (24)		I V H Gr. 3 & 4 (5)		P	No I V H (40)		I V H Gr. 1 & 2 (22)		I V H Gr. 3 & 4 (5)		qq
	L	R	L	R	L			L	R	L	R	L		
6. AXILLARY HANGING														
No head control	40		21		0			3		1		1		
Some head control	2		3		5		ns	37		21		4		ns
Hip & knee in loose fl.	4	4	0	0	1	1		-	-	-	-	-	-	
Leg ext -> fl. or Leg in suspension	38	38	24	24	4	4	ns	15	15	10	10	2	2	
Hip & knee in strong fl.	-	-	-	-	-	-		25	25	12	12	3	3	ns
Leg ext. time: 0 secs	7	8	0	0	1	1		30	30	16	16	3	3	
1 to 60 secs	35	34	24	24	4	4	ns	10	10	6	6	2	2	ns
State: quiet	29		21		4			36		19		4		
crying	13		3		1		ns	4		3		1		ns
7. VOJTA SIDE TILTING														
Head & trunk: side fl. with gravity	42	42	24	24	5	5	ns	11	13	6	7	1	1	
Head & trunk righting	-	-	-	-	-	-		29	27	16	15	4	4	ns
Arm in Moro response: Abd. -> ext. -> fl.	18	15	15	14	2	1		7	7	7	7			
Arm in partial Moro response: Abd. -> ext.	24	27	9	10	3	4	ns					1	1	
Arm in loose fl.	-	-	-	-	-	-		33	33	15	15	4	4	ns
Hand: open	26	26	19	19	4	4		7	7	2	2	1	1	
fisted	16	16	5	5	1	1	ns	33	33	20	20	4	4	ns
Upper leg fl, lower leg ext.	28	26	13	10	4	4		-	-	-	-	-	-	
Upper leg ext. -> fl, lower leg ext.	14	16	11	14	1	1	ns	6	6	0	0	1	1	
Both legs fl. or ext. -> fl.	-	-	-	-	-	-		34	34	22	22	4	4	ns
Leg ext. time: 0 secs	33	31	15	15	5	5		38	38	21	22	4	4	
1 to 60 secs	9	11	9	9	0	0	ns	2	2	1	0	1	1	ns
State: quiet	29		21		4			35		17		4		
crying	13		3		1		ns	5		5		1		ns
8. COLLIS HORIZONTAL														
Suspension head, neck & trunk	42	42	24	24	5	5	ns	10	12	7	7	1	1	
Righting of head, neck & trunk	-	-	-	-	-	-		30	28	15	15	4	4	ns
Arm in fl.	33	31	17	19	2	3								
Arm in suspension	9	11	7	5	3	2	ns	12	12	6	3	1	1	
Arm in partial weight bearing	-	-	-	-	-	-		28	28	16	19	4	4	ns
Hand: open	16	17	8	9	1	1		4	3	1	2	0	0	
fisted	26	25	16	15	4	4	ns	36	37	21	20	5	5	ns
Hip & knee in loose fl.	21	18	11	10	3	4		38	39	21	21	5	5	
Hip & knee ext. -> fl.	21	24	13	14	2	1	ns	2	1	1	1	0	0	ns
Leg ext. time: 0 secs	24	22	12	12	3	4		39	40	22	22	5	5	
1 to 60 secs	18	20	12	12	2	1	ns	1	0	0	0	0	0	ns
State: quiet	27		21		4			35		17		4		
crying	15		3		1		ns	5		5		1		ns
9. HAND GRASP														
Reflex grasp	42	42	23	23	5	5		39	38	20	21	5	5	
Weak grasp	0	0	1	1	0	0	ns	-	-	-	-	-	-	
Voluntary grasp	-	-	-	-	-	-		1	2	2	1	0	0	ns

} Delayed responses added together.

CONT 3

COMPARISON BETWEEN VLBW INFANTS WITH NO I V H , Grade 1 & 2 I V H and Grade 3 & 4 I V H

I N A at	0 Months Corrected Age (n = 71)							4 1/2 Months Corrected Age (n = 67)						
	No I V H (42)		I V H Gr. 1 & 2 (24)		I.V H Gr. 3 & 4 (5)		P	No I V H (40)		I V H Gr. 1 & 2 (22)		I V.H Gr. 3 & 4 (5)		P
	L	R	L	R	L	R		L	R	L	R	L	R	
10. MORO RESPONSE														
Partial	13		5		1			19		15		2		
Complete	29		19		4		ns					-		
Absent	-		-		-			21		7		3		ns
11. A T N R														
Absent	39	39	24	22	5	5		37	36	22	22	5	5	
Present	3	3	0	2	0	0	ns	3	4	0	0	0	0	ns
12. PROT. EXT. - DOWNWARDS														
Flat feet	-	-	-	-	-	-		38	38	20	20	3	3	
On toes	-	-	-	-	-	-		2	2	2	2	2	2	ns
Absent	42	42	24	24	5	5	ns	-	-	-	-	-	-	
13. SIDEWAYS PROPPING														
Ext. arm to wt. bear	-	-	-	-	-	-		20	22	16	16	3	3	
Absent	42	42	24	24	5	5	ns	20	18	6	6	2	2	ns
14. RANGE OF MOVEMENT														
Adductor angle - mean (degrees)														
Heel to ear - mean (degrees)														
Popliteal angle - mean (degrees)														
Ankle dorsiflexion - mean (degrees)														
Scarf sign:														
Elbow before the midline	1	1	2	2	0	0		2	1	1	0	1	1	
Elbow at the midline	41	41	22	22	5	5	ns	38	39	21	22	4	4	ns

} Delayed responses added together.

APPENDIX X/I : POSTURAL RESPONSE STUDY : KEY TO ASSESSMENT

TRACTION RESPONSE

HEAD & TRUNK

1. COMPLETE HEAD LAG
2. MODERATE HEAD LAG
3. HEAD FLEXION ATTEMPTED BUT NOT SUSTAINED
4. HEAD IN ONE LINE WITH TRUNK
5. HEAD FLEXED FORWARDS
6. LIMP HEAD DROP
7. OPISTHOTONUS
8. OTHER RESPONSES

LEGS

1. HIP IN MODERATE FLEXION AND ABDUCTION. KNEE IN LOOSE FLEXION.
2. HIP AND KNEE FIRST EXTENDED THEN INTO LOOSE FLEXION AND ABDUCTION.
3. HIP AND KNEE IN STRONG FLEXION. HIP IN MODERATE ABDUCTION. FOOT LIFTED.
4. HIP IN MODERATE FLEXION AND ABDUCTION WITH LEG LIFTED. KNEE HALF EXTENDED.
5. LEG IN LIMP EXTENSION AND ABDUCTION.
6. LEG IN STIFF EXTENSION AND ABDUCTION.
7. HIP IN STIFF ABDUCTION. KNEE IN STIFF EXTENSION. FOOT IN PLANTARFLEXION. POSSIBLE SCISSORING AND INTERNAL ROTATION.
8. HIP IN MAXIMAL ABDUCTION. KNEE IN LOOSE FLEXION.
9. HIP IN STIFF FLEXION AND ABDUCTION. KNEE IN STIFF EXTENSION. FOOT IN PLANTARFLEXION. LEG LIFTED.
10. OTHER RESPONSES.

ARMS

1. ELBOW EXTENDED.
2. ELBOW IN SLIGHT FLEXION.
3. ELBOW IN STRONG FLEXION.
4. ELBOW IN STIFF FLEXION.
5. OTHER RESPONSES.

HANDS

1. GRASP.
2. WEAK GRASP.
3. VOLUNTARY GRASP.
4. NO GRASP.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

LANDAU RESPONSE

HEAD AND TRUNK

1. HEAD FLEXED. TRUNK CURVED.
2. HEAD FLEXED. THORACIC SEGMENT ONLY SLIGHLTLY CURVED.
3. HEAD EXTENDED FORMING ONE HORIZONTAL PLANE WITH NECK AND SHOULDER. TRUNK MODERATELY CURVED.
4. HEAD, CERVICAL AND THORACIC REGIONS EXTENDED FORMING ONE HORIZONTAL PLANE.
5. EXT. HEAD ABOVE HORIZONTAL. EXT. THORACIC REGION.
6. EXTENSION OF HEAD ABOVE THE HORIZONTAL. FULL EXTENSION OF TRUNK AND PELVIS.
7. HEAD DROP. TRUNK HANGS LIMP.
8. OPISTHOTONUS.
9. OTHER RESPONSES.

HEAD AND TRUNK ASYMMETRY

1. HEAD IN ROTATION.
2. HEAD IN ROTATION WITH SIDE FLEXION OF TRUNK.
3. SIDE FLEXION OF HEAD AND TRUNK.
4. NO ASYMMETRY.

ARMS

1. ARM IN LOOSE FLEXION.
2. ARM IN SUSPENSION.
3. ELBOW FLEXED AND RETRACTED.
4. ELBOW IN STIFF FLEXION. SHOULDER RETRACTED.
5. ELBOW IN STIFF EXTENSION.
6. OTHER RESPONSES.

LEGS

1. HIP IN MODERATE FLEXION WITH ABDUCTION. KNEE IN LOOSE FLEXION.
2. HIP IN FLEXION AND ABDUCTION. KNEE IN STRONG FLEXION.
3. HIP AND KNEE IN EXTENSION THEN LOOSE FLEXION.
4. LEG IN LOOSE SUSPENSION.
5. LEG IN LIMP SUSPENSION.
6. HIP AND KNEE IN STIFF EXTENSION.
7. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

AXILLARY HANGING RESPONSE

HEAD

1. NO HEAD CONTROL.
2. SOME HEAD CONTROL.
3. GOOD HEAD CONTROL.

LEGS

1. HIP AND KNEE IN LOOSE FLEXION.
2. LEG IN EXTENSION THEN FLEXION OF HIP AND KNEE.
3. LEG IN SUSPENSION.
4. HIP AND KNEE IN STRONG FLEXION. FOOT IN DORSIFLEXION.
5. HIP IN EXTENSION AND ABDUCTION. KNEE IN EXTENSION.
6. HIP IN STIFF EXTENSION AND ABDUCTION. KNEE IN STIFF EXTENSION. LEG PARALLEL WITH OR WITHOUT INTERNAL ROTATION. FOOT IN PLANTARFLEXION.
7. LEG IN SCISSORING POSITION.
8. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

VOJTA SIDE TILTING RESPONSE

HEAD AND TRUNK

1. MODERATE FLEXION WITH GRAVITY.
2. HEAD AND TRUNK RIGHTING.
3. LIMP FLEXION.

ARMS (UPPER ARM)

1. MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> FLEXION.
2. MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> SOME FLEXION.
3. PARTIAL MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> NO FLEXION.
4. ARM IN LOOSE FLEXION.
5. ARM IN SUSPENSION.
6. ARM IN LOOSE ANTERIOR EXTENSION.
7. ELBOW IN STIFF FLEXION. SHOULDER RETRACTION.
8. ARM IN STIFF ABDUCTION. ELBOW IN STIFF EXTENSION.
9. OTHER RESPONSES.

HANDS

1. OPEN.
2. PARTIALLY FISTED.
3. FISTED.

LEGS

1. UPPER LEG: HIP AND KNEE IN LOOSE FLEXION.
   UNDERLYING LEG: EXTENDED.
2. UPPER LEG: HIP AND KNEE FIRST IN EXTENSION, THEN MODERATE FLEXION.
3. UPPER LEG: HIP AND KNEE IN STRONG FLEXION. FOOT IN DORSIFLEXION.
   UNDERLYING LEG: EXTENDED.
4. BOTH LEGS: HIPS AND KNEES IN EXTENSION THEN FLEXED.
5. BOTH LEGS: HIPS AND KNEES IN FLEXION.
6. BOTH LEGS: IN STIFF EXTENSION.
7. UPPER LEG: HIP AND KNEE IN STIFF EXTENSION.
   FOOT IN PLANTAR FLEXION.
   POSSIBLE LEG IN INTERNAL ROTATION.
   UNDERLYING LEG: EXTENDED.
8. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

COLLIS HORIZONTAL

HEAD AND TRUNK

1. SUSPENSION OF HEAD, NECK AND TRUNK.
2. SUSPENSION OF HEAD AND NECK.
3. RIGHTING OF HEAD AND NECK.
4. RIGHTING HEAD, NECK AND TRUNK.

ARMS

1. MORO-LIKE REACTION.
2. ARM IN LOOSE FLEXION.
3. ARM SUSPENDED.
4. ELBOW IN LOOSE EXTENSION. FOREARM IN PRONATION. WRIST IN DORSIFLEXION.
5. ELBOW EXTENDED. PASM SUPPORTS BODY WEIGHT.
6. ELBOW IN STIFF FLEXION. SHOULDER RETRACTED.
7. ELBOW IN STIFF EXTENSION.
8. OTHER RESPONSES.

HANDS

1. OPEN.
2. PARTIALLY OPEN.
3. FISTED.

LEGS

1. HIP IN LOOSE FLEXION AND ABDUCTION. KNEE IN LOOSE FLEXION.
2. HIP AND KNEE IN LOOSE EXTENSION WITH ABDUCTION. THEN 1.
3. PARTIAL EXTENSION OF KNEE, ABDUCTION OF HIP. SOME WEIGHT SUPPORT ON LATERAL EDGE OF FOOT-SOLE.
4. PARTIAL EXTENSION OF KNEE. ABDUCTION OF HIP. WEIGHT SUPPORT ON FOOT SOLE.
5. HIP AND KNEE IN STIFF EXTENSION. FOOT IN PLANTAR FLEXION. POSSIBLE LEG IN PRONATION. POSSIBLE TOES IN FANNING POSITION.
6. HIP AND KNEE: SLOW RIGID MOVEMENTS OF FLEXION AND EXTENSION.
7. HIP AND KNEE IN STIFF EXTENSION. TIP OF FOOT SUPPORTS WEIGHT.
8. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

PEIPER

HEAD AND TRUNK

1. HEAD AND TRUNK SUSPENDED.
2. HEAD AND NECK IN EXTENSION - PELVIS FLEXED.
3. HEAD AND TRUNK IN EXTENSION - PELVIS FLEXED.
4. HEAD AND TRUNK IN FLEXION.
5. HEAD AND TRUNK IN LIMP SUSPENSION.
6. OPISTOTONUS.
7. OTHER RESPONSES.

HEAD AND TRUNK ASYMMETRY

1. HEAD AND/OR TRUNK IN SIDE FLEXION.
2. ROTATION OF HEAD.
3. NO ASYMMETRY.

ARMS

1. MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> FLEXION.
2. MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> SOME FLEXION.
3. MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> NO FLEXION.
4. ARM IN HORIZONTAL ABDUCTION. ELBOW FULLY EXTENDED.
5. ARM EXTENDED TOWARDS THE FLOOR WITH SOME ABDUCTION. ELBOW FULLY EXTENDED.
6. ARM EXTENDED VERTICALLLY TOWARDS THE FLOOR.
7. ARM IN STIFF FORWARD EXTENSION. ELBOW IN STIFF EXTENSION.
8. ARM IN STIFF EXTENSION ABOVE HEAD. ELBOW IN STIFF FLEXION. SHOULDER RETRACTION.
9. ARM IN LIMP SUSPENSION.
10. OTHER RESPONSES.

HANDS

1. OPEN.
2. PARTIALLY FISTED.
3. FISTED.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

COLLIS VERTICAL

LEGS

1. BRISK FLEXION OF HIP, KNEE AND ANKLE JOINT.
2. HIP, KNEE AND ANKLE GO INTO BRISK EXTENSION. THEN FLEXION OF THESE JOINTS.
3. 1. -> 2.
4. FLEXION OF HIP. LOOSE EXTENSION OF KNEE.
5. LEG DROP IN SUSPENSION.
6. HIP, KNEE AND ANKLE IN STIFF EXTENSION.
7. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

APPENDIX X/II : POSTURAL RESPONSE STUDY : DATAFORM

POSTURAL RESPONSE STUDY - DATA FORM

Appendix X/II.1

MOTHER'S SURNAME : _____

FIRST NAME : _____

FATHER'S NAME : _____

BABY'S NAME : _____

STUDY NUMBER : _____ | | | |

HOSPITAL FOLDER NO : _____

ADDRESS: _____

_____

_____

CLINIC : _____ SISTER : _____ PHONE : _____

TELEPHONE NO : _____

DATE OF BIRTH : | | | | | | |

BIRTHWEIGHT (GRAMS) : | | | | |

AGA OR SGA (AGA = 1, SGA = 2) |

GESTATIONAL AGE (WEEKS) : | | |

HISTORY : _____

_____

_____

_____

NAME OF THERAPIST : _____

DATE OF FIRST EXAMINATION : | | | | | | |

CHRONOLOGICAL AGE (WEEKS) : | | |

CORRECTED AGE (WEEKS) : | | |

WEIGHT (GRAMS) : | | |

DATE OF SECOND EXAMINATION : | | | | | | |

CHRONOLOGICAL AGE (WEEKS) : | | |

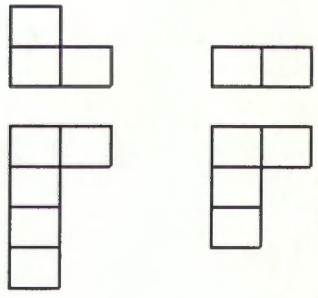
CORRECTED AGE (WEEKS) : | | |

1ST ASSESSMENT OF POSTURAL RESPONSES

TRACTION

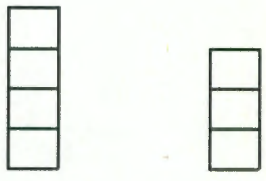
HEAD AND TRUNK _____
LEGS _____

EXT. TIME (SECS) _____
ARMS _____
HANDS _____
STATE _____



LANDAU

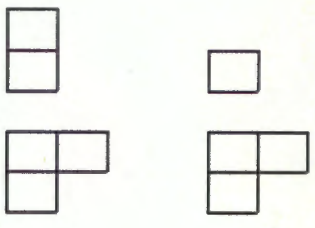
HEAD AND TRUNK _____
HEAD AND TRUNK ASYMMETRY _____
ARMS _____
LEGS _____



AXILLARY HANGING

HEAD _____
LEGS _____

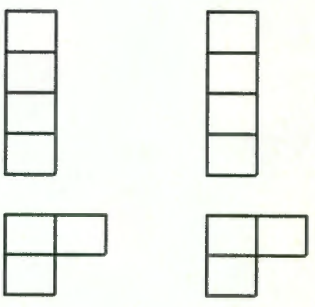
EXT. TIME (SECS) _____
STATE _____



VOJTA

HEAD AND TRUNK _____
ARMS _____
HANDS _____
LEGS _____

EXT. TIME (SECS) _____
STATE _____



1ST ASSESSMENT OF POSTURAL RESPONSES

COLLIS HORIZONTAL

		Rt.	Lt.
HEAD AND TRUNK			
ARMS			
HANDS			
LEGS			
	EXT. TIME (SECS)		
STATE			

PEIPER

HEAD AND TRUNK			
HEAD AND TRUNK ASYMMETRY			
ARMS			
HANDS			
STATE			

COLLIS VERTICAL

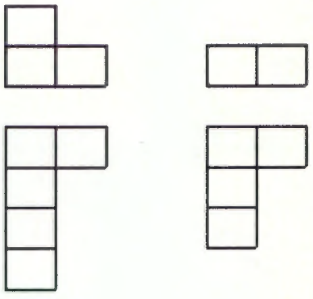
LEGS			
	EXT. TIME (SECS)		
STATE			

2ND ASSESSMENT OF POSTURAL RESPONSES

TRACTION

HEAD AND TRUNK _____
LEGS _____

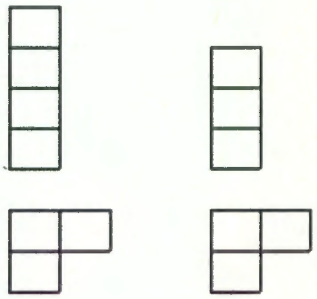
EXT. TIME (SECS) _____
ARMS _____
HANDS _____
STATE _____



LANDAU

HEAD AND TRUNK _____
HEAD AND TRUNK ASYMMETRY _____
ARMS _____
LEGS _____

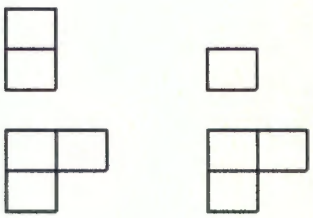
EXT. TIME (SECS) _____
STATE _____



AXILLARY HANGING

HEAD _____
LEGS _____

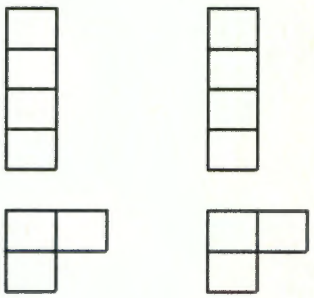
EXT. TIME (SECS) _____
STATE _____



VOJTA

HEAD AND TRUNK _____
ARMS _____
HANDS _____
LEGS _____

EXT. TIME (SECS) _____
STATE _____



2ND ASSESSMENT OF POSTURAL RESPONSES

COLLIS HORIZONTAL

		Rt.	Lt.
HEAD AND TRUNK			
ARMS			
HANDS			
LEGS			
	EXT. TIME (SECS)		
STATE			

PEIPER

		Rt.	Lt.
HEAD AND TRUNK			
HEAD AND TRUNK ASYMMETRY			
ARMS			
HANDS			
STATE			

COLLIS VERTICAL

		Rt.	Lt.
LEGS			
	EXT. TIME (SECS)		
STATE			

GRIFFITHS 12 MNTHS

D.Q.
LOCOMOTION
PERSONAL & SOCIAL
LANGUAGE
EYE HAND CO-ORDINATION
PERFORMANCE

GRIFFITHS 18 MNTHS

D.Q.
LOCOMOTION
PERSONAL & SOCIAL
LANGUAGE
EYE HAND CO-ORDINATION
PERFORMANCE

APPENDIX XI/I : INA STUDY : KEY TO ASSESSMENT

SUPINE LIE

1. HEAD ASYMMETRICAL
2. HEAD SYMMETRICAL
3. FOLLOWS THROUGH 45°
4. FOLLOWS THROUGH 90°
5. HAND ALONGSIDE BODY WITH ELBOW FLEXION OR EXT.
6. HAND TO MOUTH OR MIDLINE
7. KICKS LEG
8. NO LEG MOVEMENTS
9. OTHER RESPONSES

TRACTION RESPONSE

HEAD & TRUNK

1. COMPLETE HEAD LAG
2. MODERATE HEAD LAG
3. HEAD FLEXION ATTEMPTED BUT NOT SUSTAINED
4. HEAD IN ONE LINE WITH TRUNK
5. HEAD FLEXED FORWARDS
6. LIMP HEAD DROP
7. OPISTOTONUS
8. OTHER RESPONSES

LEGS

1. HIP IN MODERATE FLEXION AND ABDUCTION. KNEE IN LOOSE FLEXION.
2. HIP AND KNEE FIRST EXTENDED THEN INTO LOOSE FLEXION AND ABDUCTION
3. HIP AND KNEE IN STRONG FLEXION. HIP IN MODERATE ABDUCTION. FOOT LIFTED.
4. HIP IN MODERATE FLEXION AND ABDUCTION WITH LEG LIFTED. KNEE HALF EXTENDED.
5. LEG IN LIMP EXTENSION AND ABDUCTION.
6. LEG IN STIFF EXTENSION AND ABDUCTION.
7. HIP IN STIFF ABDUCTION. KNEE IN STIFF EXTENSION. FOOT IN PLANTARFLEXION. POSSIBLE SCISSORING AND INTERNAL ROTATION.
8. HIP IN MAXIMAL ABDUCTION. KNEE IN LOOSE FLEXION.
9. HIP IN STIFF FLEXION AND ABDUCTION. KNEE IN STIFF EXTENSION. FOOT IN PLANTARFLEXION. LEG LIFTED.
10. OTHER RESPONSES.

ARMS

1. ELBOW EXTENDED.
2. ELBOW IN SLIGHT FLEXION.
3. ELBOW IN STRONG FLEXION.
4. ELBOW IN STIFF FLEXION.
5. OTHER RESPONSES.

INFANTS STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

SITTING

1. FULL FLEXION HEAD AND TRUNK.
2. PARTIAL EXTENSION HEAD AND TRUNK.
3. EXTENSION DOWN TO L3.
4. PROP SITTING - HANDS ON KNEES.
5. SITTING UNAIDED.

PRONE LIE

1. ARMS FLEXED UNDER INFANT.
   POSTERIOR TILT PELVIS.
   KNEES FLEXED UNDER BODY.
2. ARMS ABDUCTED AT SHOULDERS AND ELBOW FLEXION.
   PELVIS FLAT.
   ABDUCTED "FROGS LEGS".
3. PUPPY PRONE : HEAD LIFTED.
   WT. BEARING ON FLEXED FOREARMS.
   PELVIS FLAT.
   LEGS EXTENDED.

HEAD AND TRUNK

1. HEAD FLEXED. TRUNK CURVED.
2. HEAD FLEXED. THORACIC SEGMENT ONLY SLIGHLTLY CURVED.
3. HEAD EXTENDED FORMING ONE HORIZONTAL PLANE WITH NECK AND SHOULDER. TRUNK MODERATELY CURVED.
4. HEAD, CERVICAL AND THORACIC REGIONS EXTENDED FORMING ONE HORIZONTAL PLANE.
5. EXT. HEAD ABOVE HORIZONTAL. EXT. THORACIC REGION.
6. EXTENSION OF HEAD ABOVE THE HORIZONTAL. FULL EXTENSION OF TRUNK AND PELVIS.
7. HEAD DROP. TRUNK HANGS LIMP.
8. OPISTHOTONUS.
9. OTHER RESPONSES.

HEAD AND TRUNK ASYMMETRY

1. HEAD IN ROTATION.
2. HEAD IN ROTATION WITH SIDE FLEXION OF TRUNK.
3. SIDE FLEXION OF HEAD AND TRUNK.
4. NO ASYMMETRY.

ARMS

1. ARM IN LOOSE FLEXION.
2. ARM IN SUSPENSION.
3. ELBOW FLEXED AND RETRACTED.
4. ELBOW IN STIFF FLEXION. SHOULDER RETRACTED.
5. ELBOW IN STIFF EXTENSION.
6. OTHER RESPONSES.

LEGS

1. HIP IN MODERATE FLEXION WITH ABDUCTION. KNEE IN LOOSE FLEXION.
2. HIP IN FLEXION AND ABDUCTION. KNEE IN STRONG FLEXION.
3. HIP AND KNEE IN EXTENSION THEN LOOSE FLEXION.
4. LEG IN LOOSE SUSPENSION.
5. LEG IN LIMP SUSPENSION.
6. HIP AND KNEE IN STIFF EXTENSION.
7. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

AXILLARY HANGING

HEAD

1. NO HEAD CONTROL.
2. SOME HEAD CONTROL.
3. GOOD HEAD CONTROL.

LEGS

1. HIP AND KNEE IN LOOSE FLEXION.
2. LEG IN EXTENSION THEN FLEXION OF HIP AND KNEE.
3. LEG IN SUSPENSION.
4. HIP AND KNEE IN STRONG FLEXION. FOOT IN DORSIFLEXION.
5. HIP IN EXTENSION AND ABDUCTION. KNEE IN EXTENSION.
6. HIP IN STIFF EXTENSION AND ABDUCTION. KNEE IN STIFF EXTENSION. LEG PARALLEL WITH OR WITHOUT INTERNAL ROTATION. FOOT IN PLANTARFLEXION.
7. LEG IN SCISSORING POSITION.
8. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

VOJTA SIDE TILTING RESPONSE

HEAD AND TRUNK

1. MODERATE FLEXION WITH GRAVITY.
2. HEAD AND TRUNK RIGHTING.
3. LIMP FLEXION.

ARMS (UPPER ARM)

1. MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> FLEXION
2. MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> SOME FLEXION
3. PARTIAL MORO-LIKE REACTION: ABDUCTION -> EXTENSION -> NO FLEXION
4. ARM IN LOOSE FLEXION.
5. ARM IN SUSPENSION.
6. ARM IN LOOSE ANTERIOR EXTENSION.
7. ELBOW IN STIFF FLEXION. SHOULDER RETRACTION.
8. ARM IN STIFF ABDUCTION. ELBOW IN STIFF EXTENSION.
9. OTHER RESPONSES.

HANDS

1. OPEN.
2. PARTIALLY FISTED.
3. FISTED.

LEGS

1. UPPER LEG: HIP AND KNEE IN LOOSE FLEXION.
   UNDERLYING LEG: EXTENDED.
2. UPPER LEG: HIP AND KNEE FIRST IN EXTENSION, THEN MODERATE FLEXION.
3. UPPER LEG: HIP AND KNEE IN STRONG FLEXION. FOOT IN DORSIFLEXION.
   UNDERLYING LEG: EXTENDED.
4. BOTH LEGS: HIPS AND KNEES IN EXTENSION THEN FLEXED.
5. BOTH LEGS: HIPS AND KNEES IN FLEXION.
6. BOTH LEGS: IN STIFF EXTENSION.
7. UPPER LEG: HIP AND KNEE IN STIFF EXTENSION.
   FOOT IN PLANTAR FLEXION.
   POSSIBLE LEG IN INTERNAL ROTATION.
   UNDERLYING LEG: EXTENDED.
8. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

COLLIS HORIZONTAL

HEAD AND TRUNK

1. SUSPENSION OF HEAD, NECK AND TRUNK.
2. SUSPENSION OF HEAD AND NECK.
3. RIGHTING OF HEAD AND NECK.
4. RIGHTING HEAD, NECK AND TRUNK.

ARMS

1. MORO-LIKE REACTION.
2. ARM IN LOOSE FLEXION.
3. ARM SUSPENDED.
4. ELBOW IN LOOSE EXTENSION. FOREARM IN PRONATION. WRIST IN DORSIFLEXION.
5. ELBOW EXTENDED. PASM SUPPORTS BODY WEIGHT.
6. ELBOW IN STIFF FLEXION. SHOULDER RETRACTED.
7. ELBOW IN STIFF EXTENSION.
8. OTHER RESPONSES.

HANDS

1. OPEN.
2. PARTIALLY OPEN.
3. FISTED.

LEGS

1. HIP IN LOOSE FLEXION AND ABDUCTION. KNEE IN LOOSE FLEXION.
2. HIP AND KNEE IN LOOSE EXTENSION WITH ABDUCTION. THEN 1.
3. PARTIAL EXTENSION OF KNEE, ABDUCTION OF HIP. SOME WEIGHT SUPPORT ON LATERAL EDGE OF FOOT-SOLE.
4. PARTIAL EXTENSION OF KNEE. ABDUCTION OF HIP. WEIGHT SUPPORT ON FOOT SOLE.
5. HIP AND KNEE IN STIFF EXTENSION. FOOT IN PLANTAR FLEXION. POSSIBLE LEG IN PRONATION. POSSIBLE TOES IN FANNING POSITION.
6. HIP AND KNEE: SLOW RIGID MOVEMENTS OF FLEXION AND EXTENSION.
7. HIP AND KNEE IN STIFF EXTENSION. TIP OF FOOT SUPPORTS WEIGHT.
8. OTHER RESPONSES.

INFANT'S STATE

1. SLEEPY.
2. QUIET.
3. IRRITABLE.
4. CRYING.

HAND GRASP

1. REFLEX GRASP.
2. WEAK GRASP.
3. NO GRASP.
4. VOLUNTARY GRASP.

MORO

1.	ARMS EXT.	ABDUCTION.	
2.	ARMS EXT.	ABDUCTION	PARTIAL FLEXION.
3.	ARMS EXT.	ABDUCTION	FULL FLEXION.
4.	PARTIAL EXT.	ABDUCTION	FULL FLEXION ie. CONTAINED MORO.
5.	NO MORO.		

ATNR

1. ABSENT.
2. PRESENT.
3. OBLIGATORY.

PROTECTIVE EXTENSION - DOWNWARDS

1. EXT, ABD AND EXT. ROTAT LEGS TO WT. BEAR & FEET FLAT.
2. EXT, ABD AND EXT, ROTAT LEGS TO WT. BEAR ON TOES.
3. EXT, ABD AND EXT, ROTAT LEGS TO WT. BEAR ON TOES, THEN FEET FLAT.

SIDEWAYS PROPPING

1. EXT. ARM TO WT. BEAR.
2. NO PROT. EXT.

SCARF

1. ELBOW BEFORE MIDLINE.
2. ELBOW AT MIDLINE.
3. ELBOW PAST MIDLINE.

APPENDIX XI/II : INA STUDY : DATAFORM

INA STUDY - DATA FORM

Appendix XI/II.1

MOTHER'S SURNAME :
FIRST NAME :
FATHER'S NAME :
BABY'S NAME :
STUDY NUMBER :
HOSPITAL FOLDER NO :
ADDRESS:

CLINIC : SISTER : PHONE :
TELEPHONE NO :

DATE OF BIRTH :
BIRTHWEIGHT (GRAMS) :
AGA OR SGA (AGA = 1, SGA = 2)
GESTATIONAL AGE (WEEKS) :
HISTORY :

NAME OF THERAPIST :
DATE OF FIRST EXAMINATION :
CHRONOLOGICAL AGE (WEEKS) :
CORRECTED AGE (WEEKS) :
WEIGHT (GRAMS) :
DATE OF SECOND EXAMINATION :
CHRONOLOGICAL AGE (WEEKS) :
CORRECTED AGE (WEEKS) :

INA 1ST ASSESSMENT

SUPINE LIE

Rt. Lt.

HEAD _____
FOLLOWS _____
HAND _____
LEG _____

TRACTION

Rt. Lt.

HEAD AND TRUNK _____
LEGS _____

EXT. TIME (SECS) _____
ARMS _____
STATE _____

SITTING _____

PRONE LIE _____

LANDAU

HEAD AND TRUNK _____
HEAD AND TRUNK ASYMMETRY _____
ARMS _____
LEGS _____

EXT. TIME (SECS) _____
STATE _____

AXILLARY HANGING

HEAD _____
LEGS _____

EXT. TIME (SECS) _____
STATE _____

INA 1ST ASSESSMENT

Appendix XI/II.3

VOJTA

HEAD AND TRUNK
ARMS
HANDS
LEGS

EXT. TIME (SECS)

STATE

COLLIS HORIZONTAL

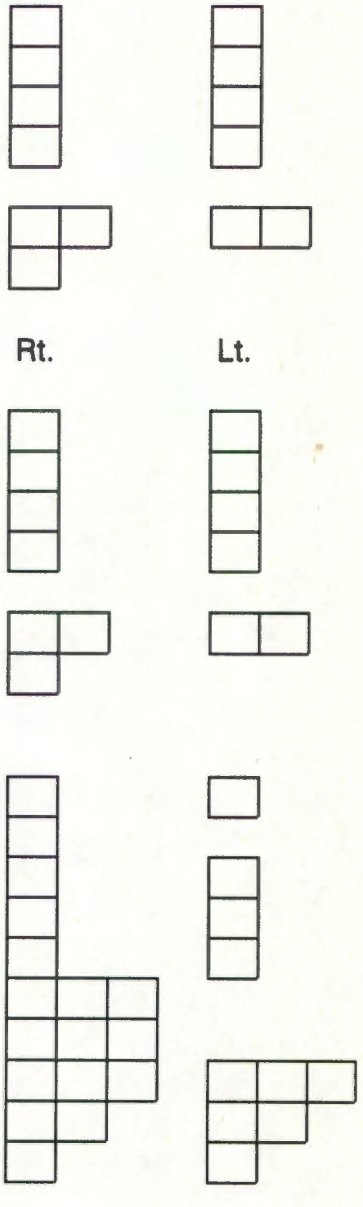
Rt. Lt.

HEAD AND TRUNK
ARMS
HANDS
LEGS

EXT. TIME (SECS)

STATE

HAND GRASP
MORO
ATNR
PROTECTIVE EXT. DOWN.
SIDEWAYS PROPPING
ADDUCTOR ANGLE
HEEL TO EAR
POPLITEAL ANGLE
DORSIFLEXION
SCARF

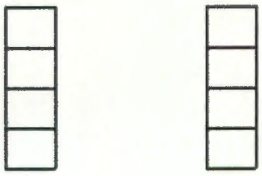


INA 2ND ASSESSMENT

SUPINE LIE

Rt. Lt.

HEAD
FOLLOWS
HAND
LEG

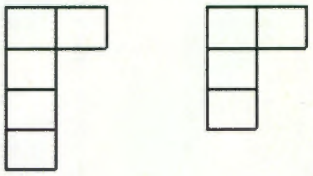


TRACTION

Rt. Lt.

HEAD AND TRUNK
LEGS

EXT. TIME (SECS)



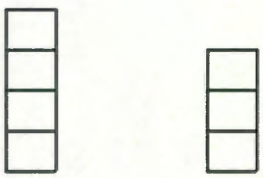
ARMS
HANDS
STATE

SITTING

PRONE LIE

LANDAU

HEAD AND TRUNK
HEAD AND TRUNK ASYMMETRY
ARMS
LEGS



EXT. TIME (SECS)

STATE

AXILLARY HANGING

HEAD
LEGS

EXT. TIME (SECS)

STATE

INA 2ND ASSESSMENT

Appendix XI/II.5

VOJTA

HEAD AND TRUNK
ARMS
HANDS
LEGS

EXT. TIME (SECS)

STATE

COLLIS HORIZONTAL

Rt. Lt.

HEAD AND TRUNK
ARMS
HANDS
LEGS

EXT.TIME (SECS)

STATE

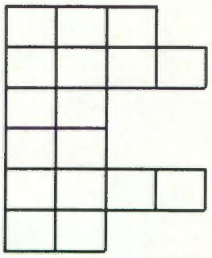
HAND GRASP
MORO
ATNR
PROTECTIVE EXT. DOWN.
SIDEWAYS PROPPING
ADDUCTOR ANGLE
HEEL TO EAR
POPLITEAL ANGLE
DORSIFLEXION
SCARF

GRIFFITHS 12 MNTHS

D.Q.
LOCOMOTION
PERSONAL & SOCIAL
LANGUAGE
EYE HAND CO-ORDINATION
PERFORMANCE

NEONATAL DATA

HC (head circumference)
APGAR 1' (apgar score at 1 minute)
APGAR 5' (apgar score at 5 minutes)
TSR (time to sustain respiration)
CORD pH
BD (base deficit)



MODE OF DELIVERY

1. = NVD (normal vertex delivery)
2. = C/S (caesarian section)
3. = Breech
4. = Instrument
5. = BBA (born before arrival)

SEX

1. = MALE
2. = FEMALE

U/S BRAIN

1. = NORMAL
2. = Grade I GMH (germinal matrix haemorrhage)
3. = Grade II (haemorrhage)
4. = Grade III (haemorrhage)
5. = Grade IV (haemorrhage)

Yes(Y)/No(N) = LEUCOMALACIA

Yes(Y)/No(N) = SHUNT

Yes(Y)/No(N) = HYDROCEPHALY

NEONATAL DATA

RDS (respiratory distress syndrome)

HMD	(hyaline membrance disease)	☐
TTN	(transient tachypnoea of the newborn)	☐
PULMONARY HAEMORRHAGE		☐
PNEUMOTHORAX		☐
PNEUMONIA		☐
APNOEA		☐

HYPOXIA

ASPHYXIA		☐

METABOLIC

HYPOGLYCAEMIA		☐
K+		☐
Na+		☐

INFECTION

SUSPECTED		☐
NEC	(necrotising enterocolitis)	☐
SYPHILLIS		☐
AFIS	(amniotic fluid infection syndrome)	☐

CARDIAC

PDA	(patent ductus arteriosus)	☐
PPH	(post partum haemorrhage)	☐
FAS	(fetal alchohol syndrome)	☐
BRUISING		☐
CONGENITAL		☐

DIED	☐
LOST	☐

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