

Review on Early Detection and Early Intervention in Developmental Motor Disorders: From Neuroscience to Participation edited by Prof. Mijna Hadders Algra.

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This wonderful new volume from Mac Keith Press under Clinics in Developmental medicine series is a very timely and welcome publication. Under the sustainable development goals launched by United Nations for this decade of Action, goal no 3 & 10 cover provision of health care for all & reduction of inequalities. This book does the excellent job of knowledge translation to achieve the all important first step towards the detection and care of the vulnerable new born infants

While this topic has a global appeal, it is significant for MICs like India who are striving hard to bring down the preterm births as well as improve the care of NICU graduates from early days.

The other remarkable perspective mirrored in this volume is referring to the ICF frame work all through the chapters which is particularly informative to early interventionists reading these chapters. The title from neuroscience to participation is amply justified in the subsequent sections

This multi authored volume has 6 parts beginning with a nice foreword by Dr.Anna Basu. Many of her comments continue to stay with the reader as you read through with attention. There is a very poignant preface by the editor which sets the serious tone for the rest of the reading. This is not a book you can leaf through in between breaks but needs devoted weekends to absorb the highly informative as well as reflective tenor you feel through each section. Each chapter apart from vast references, has a short section on recommended reading which will be a pleasure for entrant neonatologists & early interventionists.

Part 1 has chapters 1 &2 which cover introduction By Prof..Mijna Hadders Algra & early diagnosis & early intervention in clinics by Prof.Leena Hataaza. Introduction begins with putting early diagnosis succinctly in the ICFCY frame work. It also clearly delineates the challenges of early diagnosis and the developmental reasons for the same. The repeated note on the cohesive nature of multiple domains & their tight interlinking and the reasons for it is amply stressed. Interpretation of the new definition of cerebral palsy with inclusion of all functional classification systems & developmental motor coordination disorder with the DSM V criteria differentiates the two clearly.

The high light of this section is a personal reflective note by the editor through the sentence "My wheelchair became my brain" I will not be surprised if this quote will be oft repeated by all of us when we need to convince parents on accepting the right assistive aid for children and youngsters. The cultural difference between Asian, African & western thinking leaves a deep impact on the readers. The gender neutral

intensions in the chapters referring to professional as she and the child as he is praise worthy.

The early diagnosis section deals with in detail, the early clinical signs of cerebral palsy. Beginning with the difficulty in early diagnosis using specific tests like General movement assessment & Hammersmith infant neurological examination & need for long term follow up is illustrated with a High-risk case. Subsequently relevance of GMFCS & MRI testing is covered along with the decision tree for differentiating clinical types by SCPE. A small discussion on early intervention in HR infants is commented upon & role of family & sensitive parenting is stressed, A clear summary of the chapter at the beginning is helpful for subsequent revision

Part 2 has chapter3 & covers in detail Developmental neurology [the best chapter in the book as per my interest.] describing the early neuro developmental mechanisms. This section has 4 sub sections. First section details the neurobiology in the first 2yrs. Second section is devoted to the vulnerabilities as well as windows of neuroplasticity in the developing brain including atypical development. Third section describes the basis of clinical manifestations with the underlying developmental mechanisms & the last, on the theories of motor development & the basis for early intervention

The first section details the neural embryology with picturesque details. Highlight of this section is explaining the role of subcortical plate, the seat of programmed cell death during which half of the neurons are eliminated by apoptosis as the basis of foetal behaviours which dissolves by 3rd postnatal months in primary motor, vision & sensory areas & by 1yr in PFC. Later half of gestation is the period for 20fold increase in cortical volume. Parallel development of oligodendrocytes & subsequent myelination which lasts up to the age of 40 years is described along with the development of excitatory & inhibitory neurotransmitters which ultimately decides the change from foetal periodic breathing to the postnatal continuous breathing pattern essential for survival later. Axon elimination from the last trimester to the first 2 years of postnatal life is also responsible for the contralateral control of the pyramidal tract at the spinal cord level, The elimination of synapses which starts in mid foetal period becomes most pronounced between the onset of puberty & adulthood. Lastly, the development of Cerebellum which contains 80% of neurons in the brain happens from the last phase of pregnancy till the first 3months. Summarising, the development of two circuitries, one in the sub cortical plate & then the permanent circuitry in association areas are the highlights of this phase

The second section deals with the concept of window of vulnerability as well as neuroplasticity. The multiple factors for developmental motor disorders including effects of poverty and the positive effects of sensitive parenting on dendritic spines and synaptogenesis are enumerated. Windows of opportunity for neuroplasticity

being greater in the first year than at any other time is clearly brought out. Ipsilateral axonal plasticity as the basis for baby CIMT is a valuable information

The third section deals with theories of motor development & its change in the late 20th century from the neural maturational theory to the dynamic systems theory.

This is based on nonequilibrium dynamics theory which focusses on finding equilibrium among host of multiple influencing systems influenced by spontaneous intrinsic activity responding to the new demands. Such a system results in self organisation of neural processes dynamically to higher & more functional outcomes

Second is Gerald Edelman's neuronal group selection theory [NGST] which postulates a child's exploratory drive as influenced by sensory processing & selection of best strategy from multiple options available. The neural substrate formed by a set of neuronal groups selected by genetic information & primary variability moves to secondary variability depending upon the experience and sensory & perceptual processing offered by the internal models. The transition from primary variation to secondary variation also occurs at specific ages with transitions

This is enhanced when a child plays with others due to the increased variations depicted in the neural substrate by mirror mechanism. This is a beautiful explanation again for the ICF thinking of activities as the fulcrum of function in child development. It also highlights the role of environment in mastering repertoires & developing adaptability

The damaged brain has decreased variations, decreased sensory processing & decreased selection of efficient strategies & these are the learning points from the above discussion

The last section deals with the application of the neuromaturation theory & the present thinking based on NGST & dynamic system theory. *It is* an eye opener to all developmental paediatricians. There is no outright denouncement of the Neuro Maturational theory which has initiated this whole analytical perspective to child development & I consider this as a very healthy lesson to younger generations on science & its development over the years. Both theories are given credence by stating that they bring out the essence of early motor development as multifactorial & nonlinear with lot of individual variations. Any delay in development of early milestones particularly in multiple milestones is a risk marker for future developmental motor disorders

In a book with more prose than pictures, the two videos on development of variation in typical & atypical development are excellent as also the schematic representation of the three theories highlighting the nature- nurture concepts being bridged by the very genetic basis of NGST which is delightfully demonstrative of the concepts.

The concluding remarks on the contribution of both Dynamics system theory & NGST to early detection and present theories on early intervention are stressed sufficiently for strong registration on the reader's learning. My own feeling after rereading this section multiple times is admiration for a beautiful section which has

filtered the fascinating neural mechanisms of early development explicitly & excellently. This undeniable truth is reflected in the statement “The young brain offers opportunities but no certainties”

Part 3 has chapters 4,5 &6 which deal with typical motor development from foetal life to 2yrs by Hayley C Leonard. The topic begins with an introduction to the recent concept of **Embodiment Hypothesis**

This is a concept that explains the tight interlinking of Motor system with other domains of sensory, language, cognition & socio-emotional development & how this coupled interactions from moment- to-moment result in long term learning. **Motor actions are Embodied, Embedded, encultured & enabled-4E’S [Adolf&Hock-2019]**

This concept is clarified using the example of reaching. The development of subsystems with multiple constraints leads to adaptability & behaviour emerges as a product of sensory motor experience as proposed in both NGST & Dynamic systems theory. A key principle of these frameworks is that of **nested time scales**: while behavioural change occurs over different periods, each change affects the system and its constraints in the future (Smith & Thelen 2003) & it is important to remember this in putting both theories into context.

This thought process percolates down to the rest of the developmental features of vision, cognition, speech & remarkably to socioemotional development. Some of the information like infants beginning to recognise their name as early as 5months & language as an enculturated phenomenon as much as embodied, embedded & enabling appraises Paediatricians of the new development in psychology. Multisensory development & language development as per age & sequence are well covered

Under cognitive development, development of attention from exogenous control to endogenous control as foundation for development of executive functions is amply explained. The fact that new-borns spend only 20% of their time in alert states is particularly important to NICU therapists to deliver NICU interventions. The development of attention over the first year is nicely illustrated along timescale of events that happen.

Types of memory in infancy considered as Habituation, Operant conditioning & deferred imitation are explained with examples of task & age of appearance.

The development of attachment & emotions within first 2yrs are covered. In the domain of social cognition, it is interesting to learn that the development of theory of mind construct happens as early as 2 yrs & onwards or a little early depending on the context This is a section full of lot of new learnings and I strongly recommend it to all the readers as a must section

The Next 2 chapters deal with typical motor development in foetal & early life including neonatal motor behaviour & up to 2yrs of age & the neurological basis of general movements with excellent videos with subsequent sequential development of other motor activities after GMs disappear to goal directed movements

There is an interesting section on play in infants which is seen in only primates & in infants & is associated with extended juvenile period when exploration of the physical, social & cognitive world is done by a high number of arm movements about 4500 to 12,000 per day, 31,100 leg movements & about 100 falls in a day while learning walking!! A typical child produces about 14,000 steps per day almost [double that of most adults] & this high -level mobility & play is controlled by cortico-cerebellar systems. Not surprisingly, play has such a significant role in early learning of the brain

Gross motor development, Postural control, motor behaviour, fine motor & manipulation control, Oro motor control involved in feeding & communication are also covered.

Part 4 has chapters 7& 8 dealing with atypical motor development of the foetus & young infant & from 3 months to 2 years with beautiful videos demonstrating the abnormal general movements & fidgety movements across both the age bands. Atypical head movements, sucking & swallowing in preterm children, atypical muscle tone & head preference along with deformational plagiocephaly before 3-4 months are poor predictors of later developmental outcome A Dutch study, however has linked persistent low tone between 2-5mths with later internalising behaviours in preschool & school age. On the contrary, atypical GMs with combination of reduced complexity & variation considered as primary repertoire & the absence of age specific fidgety movements by 3-5 months is a major predictor of cerebral palsy.

There is also a brief account of reflexes and reactions in young children which have been the corner stones of developmental diagnosis in the 20th century, but in the 21st century, we have moved on to better methods. Sufficient stress is given to the undeniable fact that a delay in a single mile stone has no diagnostic significance as GM development shows wide variation but multiple delays in different domains is definitely a marker for impending neurodevelopmental impairments. Topping the list is the comment **that term Developmental delay is no diagnosis but an invitation to make one**. I can only agree with this 100% more as I teach Global developmental delay as a waste basket diagnosis offering no help for intervention programmes

Moving on, importance of drawing a functional profile using all the available fcs excepting VFCS are covered. Understandably so as VFCS came up in the later part of 2020. Concludingly, the chapter draws ample attention to refer children with atypical motor development along with other comorbidities after 3-5 months for detailed work up & early intervention

Part 5 has 3 chapters dealing with over view of available tests for diagnosis & covers Psychometric Properties of Standardized Tests, assessments in the Neonatal Period and Infancy & assessment of Infants and Toddlers. Even sensory assessment & functional assessments & behavioural scales are included

Psychometric properties of tests are considered on three criteria, discriminative, evaluative & predictive tests. Their description under different age groups is of practical help. It also includes a short detail on GMFM as a predictive tool & should be of great value to therapists. All the popular diagnostic tests & some recent ones

like Standardized Infant Neuro Developmental Assessment (SINDA) are covered including training costs. But, summarising them is a **cautionary message that there are no tests which cover all needs of a diagnostician but are of use for what purpose & what age the expert is planning. Importantly, their relevance to initiate family centred services is covered.**

The last 6th part has 6 chapters dealing with the cumulative purpose of all the earlier discussions & that which matters most to families which is Early intervention. It has the opening, multi authored excellent chapter led by Prof Rosenbaum & rightly so on the importance of family in early intervention.

It begins with helping parents to make the medical decisions needed for child's development as also family wellbeing. **Importance of understanding child development as a trans actional, interactive process between the child's emerging skills & the opportunity for experimentation & learning offered by the environment & avoid deprivation from life experiences is stressed.** EI therefore includes environmental modification as an essential component based on the neuroplasticity & compensation offered by context,

The beautiful statement that **Parenting is a dance led by the child** but this dance goes awry when a child is impaired should be etched in the minds of readers. Multiple challenges begin to appear for parents as well as the child in this developmental journey. Early intervention includes sharing knowledge with the parents about their child, involve them in shared decisions & goal setting & implement them in their daily routines as life's circumstances permit should be the singularly meaningful practice. This is the new perspective of FCS in looking at EI practices from care giver's practices. **Considering needs, desires, visions and goals of parents is most important component of EI.** Being on the same page about the child's development as parents is a skill that is not adequately stressed in our medical & therapy training & is highlighted

Some of the important points that emerge in the subsequent discussion is **knowing the diagnosis is not essential for beginning early intervention.** Rather, what we are offering with EI is based on principles such as family support, child development and neuroplasticity and not on the diagnostic label. This should be a warning for all medical model followers The importance of communication skills is adequately stressed.

Respecting family autonomy, family responsibility & family specific parenting should be the corner stone of early intervention practices & **the need to let parents be parents & not therapists** must be practised. The authors suggest the role of coach to therapists. The advice to interweave what we consider as therapy into what is parenting for them is amply stressed

COPing with and CARing for infants with special needs' (COPCA) & ENabling VISion and Growing Expectations (ENVISAGE) are detailed as two family- centred approaches. **Parenting a CwSN is a marathon & not a sprint** should be remembered by all concerned professionals

The next chapter¹³ deals with Early intervention in the neonatal period. Beginning with the stress increasing factors for the families due to fragile medical condition & NICU environments are explained. Methods like Developmental care & its components are detailed. To alleviate parental stress by increasing family involvement by 3 alternatives, **family centred care, family supportive care & family integrated care** are explained in detail with special emphasis on kangaroo care [skin to skin contact] & the evidence of benefits in the infancy & long -term developmental outcome is presented. Infant massage, developmental physiotherapy & multisensory stimulation are described & the controversies in long term outcomes are presented There is significant improvement when families are more involved as in family integrated care. Pros & cons are also presented

Chapter 14 discusses the early intervention methods in the first two years. It begins with introduction to the newer perspectives of **development as a continuous interaction between brain, genetics, body & environment**, importance of family and newer perspective on disability through ICF lens

Early intervention for seriously ill children without significant neural lesions, early intervention for low to moderate risk infants & severe risk group children are described. All the existing interventions are covered along with the evidence base for them but with a lower tone of assertiveness than that of Iona Novak's systemic review. The reason for waiting up to 2 years for confirmatory diagnosis is explained by the nature of developmental processes in the brain taking time to express the typical features of Cerebral palsy. Epidemiological studies have revealed that only half of children with suspicion received a confirmed diagnosis by 1 year, 2/3rds by 2yrs & 5% by 4 years. As stated in the chapter on Families, absence of a diagnosis does not mean nothing can be done! This again goes back to ICF frame work & optimal functioning.

Parental reactions & involvement of family as a unit are again stressed. A new concept of relation-based approach to parents & families as **COACHING** is introduced as opposed to parent training & the **myth of more is better** is also demystified. Summarising the methods evolved in the early part of 20th Century is well done.

Discussion of evidence for each of them makes an interesting reading. Two new methods of family centred interventions are described in detail. Infant Behavioural Assessment and Intervention Program (IBAIP) & COPCA have shown more promising outcomes than just cognitive improvement

For high-risk infants, **Care Toy**, an individualised telerehabilitation programme has been found to be promising. Baby CIMT & its Benefits are reported

The Goals – Activity – Motor Enrichment (GAME) intervention developed by Cathy Morgan and colleagues is a home -based program again & has promising results

Small step Program [SSP] by Ann-Christin Eliasson and colleagues has been mentioned in some detail. All these 4 programmes and the extent to which they support FCS is shown in a table

The problem of dosing is again discussed as also the other comorbidities like spasticity, drooling, epilepsy & Pain. Concludingly, challenges of early intervention methods to show consistent results in different settings is discussed. A realistic admission of the goal of knowing “what intervention is best for which infant and which family has not been reached “invites some research options.

Summing up, the highlight of this chapter is the detailed chronological documentation of EI methods from 1950 onwards to the present times & is almost a brief account of history of early intervention service evolution

The chapter 15 presents a new dimension of perspectives from Environmental modifications which is now the most important component of ICF framework. This is a due recognised dimension with lot of positive opinions but not enough research studies with defined outcome measures or at the best low level of evidence

The assistive devices are described mainly under postural alignment devices. Sitting, standing and walking frames & devices with different levels of technology application & the upcoming innovations are described & detailed account of Augmented & alternative communication systems are given. Recommendations are to use them from as early as 12 months depending upon the severity level of GMFCS is well justified but probably hard to implement in resource poor settings with different cultural underpinnings. Another recommendation is multidisciplinary assessment of need & type of devices again is another constraint but should be a motivation factor to develop teams.

The last chapter 16 succinctly summarises all the earlier statements with a slightly increased accent on effect of communication on PWD with a sample vignette but this only stresses on sensitive handling by professionals, I presume.

Futuristic mention of Telerehabilitation & automated General movement assessment ends with a positive note for parents to look forward with hope & develop better coping skills to support optimal quality of life for Children as they grow up in conducive environments make this book indispensable. I strongly recommend it to neonatologists, developmental paediatricians & therapists as well as AT experts.

The extensive references & short list of recommended readings make it a delightful book for both academicians and practitioners to have this as a must read & possess title in their personal library.