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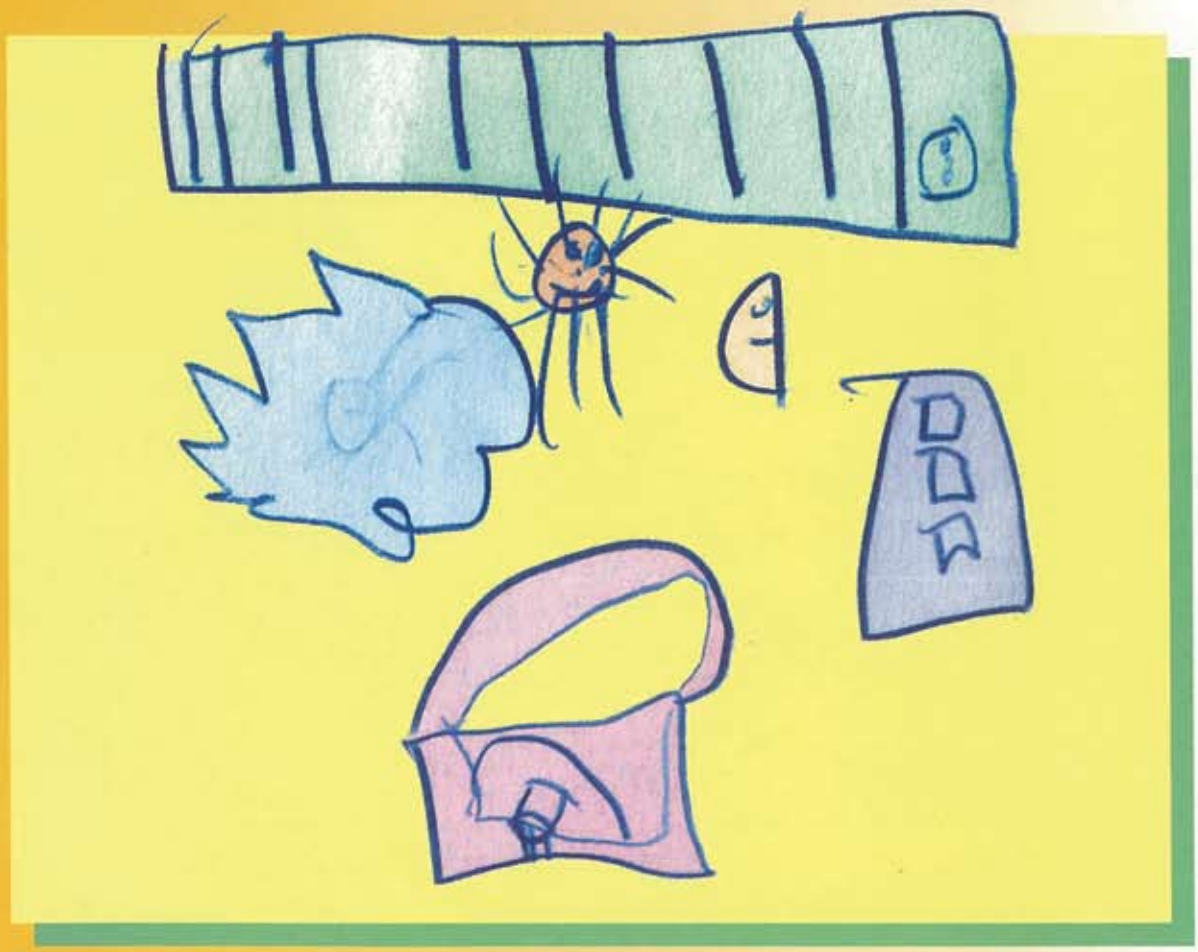
# BRAINCHILD

The Official Publication of HKCNDP
Pediatric Neurosurgery



香港兒童腦科及體智發展學會
The Hong Kong Society of Child Neurology and Developmental Paediatrics

BRAINCHILD
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# The Hong Kong Society of Child Neurology and Developmental Paediatrics

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## SPECIAL ISSUE ON PEDIATRIC NEUROSURGERY

CONTENTS



On the Cover is a drawing of
Air-conditioner, Sun, Cloud, Moon, Bag and Building
by three-year-old epileptic boy

# The Hong Kong Society of Child Neurology & Developmental Paediatrics

BRAINCHILD – AUGUST 2006 ISSUE

## Message from the President

Neuro-surgery is a major form of treatment modality within child neurology and neuro-surgeons are close comrades of child neurologists in combating disorders within our subspecialty. No wonder, the current issue of *Brainchild* is devoted to "*Paediatric Neurosurgery*". Our special thanks are due to the effort of Dr Dawson Fong, *Issue Editor*, for editing the excellent articles of this issue and for his visionary commentary on the evolution of paediatric neuro-surgery which annotates clear picture for development of this specialty in Hong Kong. I would like to take this opportunity to congratulate our paediatric neuro-surgical colleagues for their outstanding achievements over the past thirty years in developing this important specialty from the hitherto two neurosurgeons taking care of all patients within the Hong Kong territory, both for adult and children, 40 years ago to the present day proud list of competent paediatric neuro-surgeons on the Specialist Register at the Medical Council of Hong Kong. Child neurologists are especially benefited from this fruitful evolution in that, in close partnership, we are now able to offer quality services and cutting-edge hi-tech skill to the care of children of Hong Kong. The selected articles on "*Botulinum Toxin Injection in Cerebral Palsy Guided by Electrical Stimulation*" (by Dr Chak Kwong Wai), "*Severe Traumatic Brain Injury in Children: 7 Years Experience in Tuen Mun Hospital*" (by Dr KKT Leung et al), "*Selective Dorsal Rhizotomy – Experience of Tuen Mun Hospital*" (by Dr HY Law et al), and "*Epilepsy Surgery in Children – Pre-surgical Evaluation*" (by Dr Chak Kwong Wai) are all high quality scientific papers covering various aspect of the domain. Readers would surely find these local data and information very useful for their own knowledge and their daily professional practice.

HKCNDP is proud to introduce our new Council elected in May 2006 with most of the members continue to serve the Council with their ever-unfailing enthusiasms and dedicated effort. We are particularly pleased to congratulate Dr Catherine Lam being elected Vice-President and Director of Scientific Meetings, Dr Liu Kam Tim and Dr Ma Che Kwan as Honorary Secretary and Deputy Honorary Secretary of the Society. Dr Wu Shun Ping will stay on in the council to offer his much needed help. Dr Stephanie Liu and Dr Eva Fung were co-opted as additional council members. We also would like thank once again the paramount contribution of Dr Lau Wai Hung during his service as Vice President and Council Member of the Society and look forward to his continual support in the future. With such a powerful Council, I am sure our Society is going to effect powerful projects to bring our Society from success to success!

The Hong Kong Society of Child Neurology and Developmental Paediatrics (HKCNDP) is very pleased with its work in Specific Learning Disabilities (SLD)/Dyslexia in Hong Kong. Following the success in having SLD officially recognized and included into the Rehabilitation Programme Planning (RPP) by the Rehabilitation Advisory Council of Hong Kong, the Society has launched a document on "*Specific Learning Disabilities and Dyslexia in Hong Kong: 2006 Position Paper on Future Direction*" in February this year to supplement our effort and efficacy in the care of our children with SLD. A copy of this Position Paper is included in the current issue of Brainchild for readers' reference. This is the second consensus document issued by the Society on the subject. The first one was published on 2nd December 1999 on "*Specific Learning Disabilities (SLD): Position Statement and Papers*" whereby local experts unanimously agreed on the *Definition of SLD*: a feature even professionals from developed countries are unable to achieve up to this day. *It is no easy task!* We are proud to have well motivated and initiated professionals in Hong Kong dedicated to the welfare of our children and working via their selfless devotions. We are pleased to witness the Position Paper being favourably received and positively supported by Policy Bureaus and Government Departments from the Hong Kong SAR Government. We are confident that the current Paper is going to be utilized as an important document by the HKSAR Government and professionals in Hong Kong for policy making, healthcare finance planning, programmes setting, technical formatting, project implementing and outcome measuring in the future. Currently, the Society Working Group on SLD endeavours to focus on three major areas including *public health education* on the concept of equality, *promotion of intrinsic talents* of children with SLD, and *job opportunities* for SLD after school leaving (activities with the Hong Kong Vocation Training Council). We continue to stress more on the positive assets of SLD and their potential achievements if proper training opportunities are optimally and judiciously provided. We aim at promoting better understanding of SLD amongst public both at school and in the community. This is essential for better acceptance of these disabilities by the community.

Encouraged by the success of our work in SLD, the Society Council in October 2005 inaugurated the new *HKCNDP Working Group on ADHD* to coordinate local work on ADHD for children in Hong Kong. We started with meetings to share local expertise, knowledge and information on the subject and achieved these via four professional meetings by *Professor Patrick Leung (CUHK)* on Epidemiology, *Dr Lee Chi Chiu (HA Psychiatry Service)* on Genetics, *Professor Tatia Lee (HKU)* on Psychological Model, *Professor Shiu Ling Po (CUHK)* and *Professor Cheng Pui Wan (CUHK)* on School Management, *Mr Joseph Lau* and *Dr Stephanie Liu* (Child Assessment Service of Department of Health) on Clinical Features. All sessions were attended by overwhelming number of professionals from transdisciplinary and transectoral sources all dedicated to the welfare and care of our children with ADHD. The enlightening presentations and inspiring discussions will be gathered collectively by the Society to form a "*Position Paper on ADHD: Where do we go from here in Hong Kong*" for our future work in Hong Kong.

In order to keep up with the momentum, the Society Council also resolves to bring in cutting-edge information from abroad via our 2006 ASM in November 2006 on ADHD. The Course Director this year is *Professor Drake Duane MD* of the Institute for Developmental Behaviour Neurology, Arizona State University, Scottsdale, Arizona, USA. Dr Duane is an experienced child neurologist cum developmental paediatrician currently ranked as top world expert in the area of childhood ADHD in private practice which is appropriate and relevant to upgrade local service standard for ADHD in the private sectors and at primary care levels in Hong Kong. Also during the same period, we shall host our *Joint Meeting on Developmental Paediatrics on ADHD* with invited experts from the Mainland of China (Beijing, Shanghai, Guangzhou, Chengdu, Chongjing), Hong Kong, Macau, Singapore and Taiwan to share experiences for our children with ADHD within the Chinese ethnic group. The goal is to study the incidence, morphology, genetics and management of children within our region and to identify any special features in ADHD which might be different from our Caucasian counterparts. It is obvious that with all these effort, we should be able to provide optimal management to our children with ADHD in Hong Kong and within our Region which all child health professionals should strive to achieve!

I thank you once again for your ever-unfailing patronage to our Society and I wish you all reading pleasure!

Dr Chok-wan CHAN
Editor-in-Chief, *Brainchild*, Official Publication of HKCNDP
President, The Hong Kong Society of Child Neurology & Developmental Paediatrics (HKCNDP)

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# The Hong Kong Society of Child Neurology & Developmental Paediatrics

BRAINCHILD – AUGUST 2006 ISSUE

## Message from the Guest Editor

### Pediatric Neurosurgery

Illnesses in children have always captured the attention of physicians. It is no surprise that hydrocephalus, probably one of the most common entities in neurosurgery, has intrigued people like Hippocrates, Vasalius and Galen. Yet it takes the medical profession more than 2 millennia to build up the knowledge base and technology to establish a unique specialty that deals with diseases of the central nervous system surgically. It was another half a century in the 1950s that the first department of pediatric neurosurgery was established in Boston. Pediatric neurosurgery has since remained the most prominent and well established subspecialty in neurosurgery.





In my early years as a surgeon, my senior used to say that paediatric neurosurgery was dealing only with shunts! In the eighties when western countries noticed the problem of a dwindling birth rate, speculation came up that pediatric neurosurgery would be hard hit as it would have less and less entities to deal with and consequently less pediatric neurosurgeon would be needed. Decades passed but from someone who stays dearly in love with pediatric neurosurgery – this specialty remains as vibrant as it has ever been. Advent of technologies in different aspects allows non-invasive yet thorough investigations on frail patients of ours, followed by extensive procedures safely and a recovery both physical and functional to a degree hard to imagine before. Surgical options that once considered too risky are now ready for them.

In this field of medicine, we are dealing with a dynamic organ undergoing maturation; its plasticity allowing adaptation to trauma, physical or pathological, and a system that is still learning. A child is not a small-sized adult, whose well-being could always be maintained with treatment extrapolated from regimens for adults. A child belongs in a class of its own that requires special attention if not a different philosophy.

As surgeons, we deliver treatment with operative procedures and the success of which could be gauged from postoperative images. Yet we have to be mindful that we should aim higher and only reap our reward when these children could be reincorporated to their premorbid milieu and go on to maturation as they would in health. We are in the best position to see that possibility and to mobilize fellow colleagues and team members of

different expertise to walk our patients down the road of rehabilitation. In our practice, not only do we collaborate closely with pediatric neurologists, intensivists and other specialists in the acute phase of treatment; development pediatricians, clinical psychologists and the whole team of rehabilitation professionals are of equal importance if we want the best results.

In this special edition of Brainchild, the emphasis is not on surgery itself but rather the problems we have to tackle in our approach to these entities. I am indeed delighted to have gathered together articles on a few aspects of pediatric maladies, either in an acute phase or later on in life. My gratitude goes to all the contributing colleagues whose supports on my work in the years past have made all the difference in my life!

Dr Dawson Fong
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# Severe Traumatic Brain Injury in Childhood: 7 Years Experience in Tuen Mun Hospital

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Severe traumatic brain injury (TBI) in children remains an important public health problem yet not adequately attended to in Hong Kong. This retrospective study was undertaken to analyse the epidemiological data and factors associated with survival in this group of patients. Twenty-nine pediatric patients with severe TBI, managed by the Department of Neurosurgery of Tuen Mun Hospital between 1995 and 2001 were studied. Mortality rate was 24% and 84% of the survivors were considered as having good neurological outcome 6 months after injury. Better motor response and normal pupillary reaction on admission were favorable factors for survival, ($p = 0.024$ and 0.033 respectively). The following factors were found to be independently associated with poorer outcome: presence of early haemodynamic shock ($p = 0.007$), diabetes insipidus ($p < 0.001$), subdural haemorrhage ($p = 0.031$) and diffuse axonal injury ($p = 0.022$).



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## Introduction

Paediatric head injury first arouse interest in local medical profession in 1990s when Chan et al reported a 20 year retrospective cohort of 12072 children with head injury, 1.3% sustained severe intracranial complications[1]. Chan's study was followed by Poon's group in 1996, reporting similar finding in a newly developed eastern suburb with rapidly growing population[2]. Poon reported an overall mortality rate of 0.6% for all children with head injury.

Majority of paediatric head injury are minor problems. Those with severe intracranial complications are susceptible to permanent disabilities. Over the last few decades, there has been great advance in neurosurgical technique and intensive care which enable more children survive the once fatal injury. Just like many developed areas, Hong Kong is now in an era that medical profession strives for intact survival and concerns about long-term outcome in a wider scope of neuropsychological and psychosocial function.

In this retrospective study, we aim at collecting epidemiological data on local children with severe traumatic brain injury and the predictive factors for survival. We also report their outcome as measured by Glasgow Outcome score 6 months after injury.

## Methodology

All computer records of paediatric patients (aged 0 to 16 years) managed by the Department of Neurosurgery of Tuen Mun Hospital from Jan 1995 to Dec 2001 were retrieved and scrutinized to identify those who sustained severe brain injury due to external impact. The severity was defined as Glasgow Coma Scale (GCS) of 8 or below following non-surgical

resuscitation, or a deteriorated GCS of 8 or less after admission before any neurosurgical intervention. Those arrived dead were excluded. As a standard practice in many trauma centres, the initial assessment was performed by a team of neurosurgeon, orthopaedic surgeon, intensive specialist and emergency specialist. CT brain was performed after cardiopulmonary stabilization and interpreted by neurosurgeon.

All medical records were critically reviewed to gather information on clinical factors which might be associated with survival. These include age and sex, factors thought to reflect severity of primary injury on the brain e.g. Glasgow coma score, best motor response on GCS, pupillary response on admission (presence of any abnormal pupillary reaction versus bilateral equal and reactive pupillary response), abnormality on admission CT scan. Other factors thought to reflect secondary injury like haemoglobin level and plasma glucose on arrival, systolic blood pressure on arrival, first measurable intracranial pressure and presence of haemodynamic shock warranting fluid resuscitation and inotropic support within the first 12 hour, presence of post traumatic seizure were also studied. We defined survival as the immediate outcome, the score on Glasgow Outcome score (GOS) at six months after injury as the longer-term outcome. GOS 4 or above was considered as good outcome.

Univariate analysis by Chi-square test, was employed for statistical analysis. $P < 0.05$ is considered as statistically significant for better outcome.





## Result

Among 2758 paediatric patients hospitalized within the study interval, 29 patients (1.06%) sustained severe traumatic brain injury, 20 boys and 9 girls. They aged from 2 months up to 16 years old (mean age 81 months, SD 58 months). Six children (20%) were victims of inflicted injury, 8 children (28%) sustained the injury due to falling from height and the remaining 15 (52%) were involved in road traffic accident. Fourty-four percent had associated injuries, mostly long bone fracture or facio-maxillary bone fracture. Seven out of 29 died, giving the mortality rate of 24% for sever traumatic brain injury, and the overall mortality for all children admitted for head injury was 0.26%. Six patients were victims of inflicted injury – 5 from non-accidental injury (aged 2 to 43 months), and one 11 years old was victim of assault.

Subdural haemorrhage was the most common abnormality on admission CT scan, followed by skull fracture, cerebral edema, diffuse axonal injury and contusion. Eighteen patients were monitored with intracranial pressure (ICP), 3 patients had operation for clot evacuation, 9 had craniectomy and 4 had lobectomy to save life.

## Prognostic Factor for Survival

Among the clinical factors studied, better motor response and normal pupillary reflex on arrival were associated with survival; p was 0.024 and 0.033 respectively. Subdural hemorrhage

**Table 1:** Summary of Epidemiology Data of the Studied Group

| Description | | Percentage |
|---|---|---|
| Age | | 2 months to 16 years old (mean 81 months, SD 58 months) |
| Sex distribution | | 20 boys : 9 girls (M : F = 2.2 : 1) |
| Multiple injury | | 44% |
| Mortality for severe TBI | | 24% |
| Mortality for head injury | | 0.26% |
| Cause of injury | Inflicted injury | 20% (5 NAI, 1 Assault) |
| | Fall related | 28% |
| | RTA | 52% (12 pedestrians, 3 passengers) |
| Mortality for subgroup | NAI | 40% |
| | Fall related | 25% |
| | RTA | 20% |

**Table 2:** Intracranial Complications Documented on Admission CT Brain

| Intracranial Complications | Frequency (%) |
|---|---|
| Fracture | 45 |
| Subdural haemorrhage | 48 |
| Epidural haemorrhage | 28 |
| Subarachnoid haemorrhage | 17 |
| Intracerebral haemorrhage | 10 |
| Diffuse axonal injury | 38 |
| Contusion | 38 |
| Cerebral edema | 41 |



and diffuse axonal injury were associated with mortality, p was 0.031 and 0.022 respectively. Haemodynamic instability within the first 12 hours was very significantly associated with mortality; p was 0.007.

Five patients presented with biochemical evidence of diabetes insipidus (DI), all of them died. Among the 24 patients who did not have diabetes insipidus, 22 survived. The presence of DI seems to herald mortality, p was <0.001. The electrolyte disturbance appeared early in the clinical course, on day 2 to day 4.

Age, sex and systolic blood pressure on arrival haemoglobin level and plasma glucose borne no prognostic implication to survival, p were greater than 0.05.

Twelve survivors were followed up at 6 month post injury, 8 (67%) had good recovery (GOS 5) and 2 (17%) was moderately disabled (GOS 4). Two patients remained severely disabled (GOS 3). Four patients were lost for follow up because they were transferred to other institution after one month of injury. They were all severely impaired at the time of transferral. Others were lost for follow up because of default or early discharge.

Table 3: Significant Prognostic Factors in Association with Survival

| Variables | | n | Death (N=7) | Survival (N=22) | P* |
|---|---|---|---|---|---|
| Best motor response | Motor score 1-3 | 12 | 6 | 6 | 0.024 |
| | Motor score 4-6 | 15 | 1 | 14 | |
| | Missing data | 2 | 0 | 2 | |
| Pupillary reflex | Abnormal | 13 | 6 | 7 | 0.033 |
| | Normal | 14 | 1 | 13 | |
| | Missing data | 2 | 0 | 2 | |
| Presence of shock within first 12 hours | No | 13 | 0 | 13 | 0.007 |
| | Yes | 15 | 7 | 8 | |
| | Missing data | 1 | 0 | 1 | |
| DI feature | No features | 24 | 2 | 22 | <0.001 |
| | With features | 5 | 5 | 0 | |
| Subdural haemorrhage | | | | | 0.031 |
| Diffuse axonal injury | | | | | 0.022 |

## Long-term Neuropsychological Function

Eleven survivors returned to mainstream schools, 3 needed special remediation and we had no data for the remaining 8. Five patients had neuropsychological assessment after injury – one was severely retarded, one mild grade mentally retarded and 3 functioned with low average to average intelligence.

## Discussion

The present study has depicted the epidemiology and outcome data of 29 paediatric patients with severe brain injury in a large suburb area of Hong Kong. The mortality rate of this group, 24%, was comparable with the figures in well-established trauma centers in other developed countries[3,4]. Causes of injury in our patients fell into three distinct categories with percentage very similar to reports elsewhere regarding road traffic accidence and fall related injury. However, we had a much higher percentage of violence related injury, especially non-accidental injury[3]. Unlike other western countries, we did not see many sport related injury and even more fortunately, we did not have gun shot injury. Boys were more prone for severe brain injury, especially in road traffic accidence. This might reflect a higher risk-taking tendency in male, particularly adolescent boys. High mortality rate appears irreversible in severe brain injury and this fact should direct more resources to prevention of paediatric brain injury.

The higher percentage of inflicted injury might be explained by that more lower social class families live in the area. Deprived children are more likely to be involved in traumatic brain injury[5]. The mortality rate for non-accidental injury was 40%, much higher than that for falling (25%) and road traffic accidents (20%). This is in keeping with the clinical

impression that shaken babies fared worst, explained by a fatal match of vulnerability of the very young brain and the sheering force that results in diffuse axonal injury. For the 3 survivors, 2 were severely disabled and one had good recovery at 6 months. Longer-term sequelae remain to be seen. There has been growing evidence that children sustain early brain insults are particularly vulnerable to significant residual cognitive and neurobehavioural problems, which may only be apparent when the child is in school[6-8]. Extended follow up into adolescence or even early adulthood is deemed necessary in these patients. The prevention of child abuse is a complex issue that goes beyond the scope of our discussion. However, educating the public about the high mortality rate and long term functional sequaelae of child abuse is an urgent public health measures because of the heavy burden it causes. In the 90s, the majority of reported child abuse cases were managed within the social welfare system instead of judicial system[9]. We now witness a gradual change of attitude in our society. Hopefully this will be followed by a decrease in incidence soon.

Our study concurs with many other previous studies in concluding that better motor response and normal pupillary reaction on arrival are good prognostic factors for survival ($p = 0.024$ and $p = 0.03$ respectively). Subdural haemorrhage and diffuse axonal injury are associated with mortality[10,11]. As understood, these factors mirror the severity of primary impact to the brain. Our study echoes the finding that early hypotension predicts mortality[12-14]. The importance of preventing secondary injury to an already jeopardized brain needs no further emphasis.



Interestingly, presence of diabetes insipidus is very strongly associated with mortality ($p < 0.001$). All patients with this complication died. The biochemical disturbance appeared within the first 4 days of the clinical course. There has been case reports of cerebral salt wasting following brain injury but not diabetes insipidus[15]. It needs to be confirmed with further study whether this represents a severe diffuse axonal injury that involve the hypothalamus / pituitary or merely a consequence of irreversible brain death.

Among our survivors followed up at 6 months, majority (67%) were free of major neurological sequelae. However, memory impairment was one of the most common problems they encountered when returning to school. Other complaints included attention problem and emotional difficulties. This pattern of excellent physical recovery coupled with neuropsychological deficit was well documented in literature[16]. It has been shown that most neuropsychological impairment will gradually improve in the first one to two years after injury and level off in subsequent course. If left unattended, the neuropsychological deficit impairs one's learning, emotional and social function.

Our present study is very much limited by its small sample size. One would expect interaction between prognostic factors and outcomes and we were not able to perform meaningful logistic regression because of the sample size. Many reported prognostic factors e.g. hypoxia, hyperthermia were not studied, as data was not collected in a standardised way in this retrospective study. Thirdly, follow up data was not complete regarding longer-term neuropsychological function, school performance and family coping.

## Conclusion

The present retrospective study identifies a few clinical factors associated with survival in severe traumatic brain injury in children. Favourable factors are better motor response and normal pupillary response and unfavourable factors are the presence of haemodynamic shock, diabetes insipidus, subdural haemorrhage and diffuse axonal injury. Majority of our patients had good neurological outcome 6 months after injury. The neuropsychological outcome of this population needs longer term follow up to delineate. Future study should aim at territory wide prospective cohort with a systematic collection of data on clinical variables at acute phrase as well as neuropsychological and social functional follow up.

## Acknowledgement

We wish to thank Mr Dick Luk, our clerical staff, for his tremendous support in this project.



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# Botulinum Toxin Injection in Cerebral Palsy Guided by Electrical Stimulation

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## How Accurate is Manual Placement of Needle?

Most clinicians who perform botulinum toxin A injections for children with cerebral palsy do so using the "free hand" or manual technique without using radiological or electrophysiological guidance to aid needle placement. A study was done by a group of orthopaedic surgeons in Royal Children Hospital, Melbourne to investigate the accuracy of manual needle placement compared with needle placement guided by electrical stimulation[4]. A total of 1372 separate injections for upper and lower limb spasticity were evaluated in 226 children with cerebral palsy. When manual needle placement was checked against electrical stimulation, the accuracy of manual needle placement compared with electrical stimulation was acceptable only for gastroc-soleus (75%); it was unacceptable for the hip adductors (67%), medial hamstrings (46%), tibialis posterior (11%), biceps brachii (62%), and forearm and hand muscles (13% to 35%). The authors recommend using electrical stimulation or other guidance techniques to aid accurate needle placement in all muscles except the gastroc-soleus.



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## Methods of Needle Placement for Intramuscular Injection of Botulinum Toxin

1. Manual Placement –
   a) Surface landmarks
   b) Palpation of muscle bellies
   c) Passive movement of distal joints
2. Electrophysiology –
   a) Passive EMG detecting motor unit potentials
   b) Active electrical stimulation of muscle
3. Ultrasound
4. Fluoroscopy
5. Computer tomography

## What is the Mechanism of Electrical Stimulation?

Electrical stimulation may be used to activate an entire muscle via large nerve stimulation, or to activate small fascicles within the muscle belly. The former technique is referred to as motor nerve stimulation, the latter as motor point stimulation. The latter likely reflects stimulation of small motor nerve branches within the belly of the muscle. Motor nerve stimulation is used primarily for phenol neurolysis rather than Botulinum toxin injection, as the nerve may be somewhat remote from the belly of the muscle. Motor point stimulation is useful for Botulinum toxin administration, in that needle placement is, in theory, within a region of a high density of neuromuscular junctions (the "motor point zone"). Such placement

would presumably put the botulinum toxin as close to the binding area as feasible. Whether this affords maximal effect at reduced doses remains an intriguing but unproven hypothesis in humans. Compelling data from animal studies has been published and human studies are underway[3].

## How to Use Electrical Stimulation in Botulinum Toxin Injection?

Electrical stimulation may be more appropriate in patients unwilling or unable to voluntarily activate muscles during the examination. The basic technique for electrical stimulation is similar to that for EMG. After the initial palpation and passive ROM steps, the Teflon-coated hollow EMG needle is inserted into the target muscle. Stimulation is initiated at an intensity sufficient to produce a visible contraction or fascicle twitch. Then we check whether the contraction of muscle is what we expect. For example, in botulinum toxin injection of tibialis posterior, if the needle is correctly placed, foot inversion will be seen. If the electrode is inserted too superficially, it will be in the soleus or flexor digitorum longus causing foot and toes plantar flexion. If inserted is too deeply it will be in the tibialis anterior causing foot dorsiflexion.

Initial intensity is often in the 1-3 milliampere (mA) range. The primary objective at this point is to reposition the tip with successive reductions in stimulus intensity such that maximum twitch is produced from the minimum stimulus. The final target stimulus intensity is typically 0.25 - 0.5 mA[3].

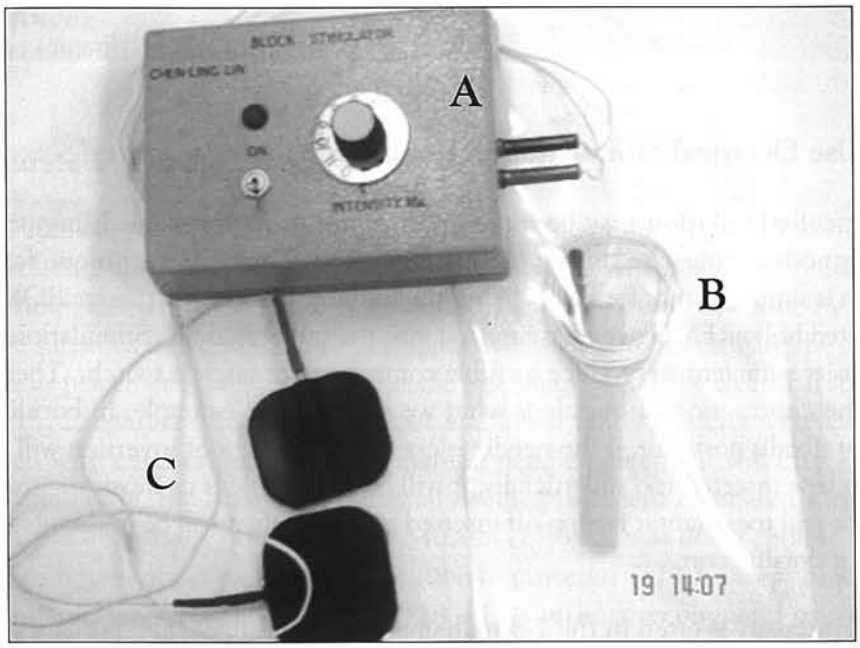
## Where? Common Muscle Targets Using Electrical Stimulation

- Forearm flexors (e.g. flexor digitorum profundus, flexor digitorum sublimes, flexor carpi radialis and ulnaris)
- Wrist and digit extensor (e.g. extensor digitorum communis, extensor carpi radialis)
- Thumb adductors, opponens, flexor pollicis longus
- Interossei and lumbricals
- Hip flexors
- Posterior tibialis
- Extensor hallucis longus[3]

## Equipment Requirement

- Teflon-coated, hollow EMG needle
- Reference lead with surface electrode
- Battery – powered electrical stimulator
- Alcohol skin cleaner
- Syringe
- Botulinum toxin
- Sedation (IV midazolam)
- Local analgesic (EMLA cream)

**Figure 1:** Showing the electrical stimulator (A), Teflon-coated hollow EMG needle (B) and reference lead (C) with surface electrode








## Sedation and Local Analgesics

Intravenous midazolam has been used for toxin injection. The recommended dosage is 0.1-0.5 mg / kg. In dosage greater than 0.5 mg / kg, this short-acting benzodiazepine depresses the CNS and must be used following conscious guidelines. Although patients might still feel the pain, they do not remember the experience. EMLA cream is applied topically to decrease skin sensitivity. Penetration of this agent is limited and the pain associated with deep muscle injection often is not blocked. Application of the cream requires an occlusive dressing, either provided with drug or assembled in the office (e.g. plastic wrap). ELMA cream should be applied at least one hour before the start of a painful procedure[1].

## How to Select Muscle for Injection in Spastic Upper Limbs Deformity?

Toxin injections in the upper extremity are used to improve active and passive range of motion, facilitate care, improve function, facilitate activities of daily living, and maximize self-esteem.

Elbow flexion deformity is generally secondary to over activity of the biceps and brachialis which often can be localized by palpation. However, the brachioradialis and pronator-flexor muscles may also contribute to elbow deformity. Injection of the biceps, often the more spastic one, weakens supination.

Abnormal pronation is secondary to pronator teres overactivity. Wrist flexion occurs primarily because spasticity of the flexor carpi ulnaris and flexor carpi radialis.

Spasticity of the finger flexors (flexor digitorum superficialis and flexor digitorum profundus) may provide secondary deforming force. Common clinical deformities observed in the hand include the following:

1) thumb and finger flexion secondary to overactivity of the flexor pollicis longus, flexor digitorum superficialis, or flexor digitorum profundus
2) thumb-in-palm deformity secondary to overactivity of the adductor pollicis or first interosseous muscles. These muscles are deep and difficult to palpate and without active EMG or electrical stimulation they are difficult to inject

The target muscle is determined by disability. The muscles most frequently injected are biceps, pronator teres, flexor carpi radialis, flexor carpi ulnaris, and adductor pollicis[1].

## Anatomical Landmark for Needle Insertion[2]

**Pronator Teres**

Needle insertion: Insert at muscle belly which located two finger breath below the point between medial epicondyle and tendon of bicep tendon in supinated forearm position

Action of muscle: Pronation of forearm

**Flexor Carpi Ulnaris**

Needle insertion: Insert the needle into the medial forearm at the midpoint between the elbow and wrist

Action of muscle: Ulnar deviation of the wrist

**Flexor Carpi Radialis**

Needle insertion: With the patient's forearm supinated, insert the needle four fingerbreaths distal to the midpoint between biceps tendon and medial epicondyle

Action of muscle: Flex the wrist radially

**Adductor Pollicis**

Needle insertion: Hand should be held in full pronation, thumb in radial abduction. Electrode inserted at the free edge of the first web space. The needle is directed toward the proximal end of the first metacarpal bone

Action of muscle: Adduction of thumb

**Flexor Pollicis Brevis**

Needle insertion: Insert the needle just medial to mid-point of the first metacarpal in the thenar eminence

Action of the muscle: Flexion of first metacarpal – phalangeal joint

**Opponens Pollicis**

Needle insertion: With needle parallel to the hand, insert needle into the patient's lateral thenar eminence, just above the first metacarpal bone

Action of the muscle: Oppose the thumb to other fingers

**Tibialis Posterior**

| | |
|---|---|
| Needle insertion: | Insert needle medial to the tibia, slightly distal to the mid-point between the ankle and knee, deep to the soleus and flexor digitorum longus |
| Action of muscle: | Foot inversion |

## Future Development

The use of electrical stimulator in botulinum toxin injection has been shown to improve accuracy of muscle localization compared with manual technique. This technique can extend the use of botulinum toxin in deep muscle injection causing better rehabilitation result especially in spastic upper limb and those patients with lower limb varus deforming due to spasticity of tibialis posterior. Further study is required to find out whether electrical stimulation localization provides the greater efficiency, i.e., the maximum effect with the lowest dose of toxin. Minimizing toxin exposure is important for patients requiring injections at multiple sites (e.g. spastic quadraparesis) for reducing the development of antibody-mediated non-responsiveness, and for cost control.



## Team Approach

We have started the botulinum toxin injection in cerebral palsy in Tuen Mun Hospital for nearly ten years. A team approach is taken for case selection and rehabilitation with occupational therapist and physiotherapist. The preliminary outcome is very encouraging.



Because of a large variety of neurological and orthropaedic problems in children with cerebral palsy, a tailor-made paediatric neuro-orthopaedic specialist with knowledge and skill in both paediatric neurology and orthopaedics may be required in future.

## Conclusion

Botulinum toxin has a vital role in the physical rehabilitation of children with spasticity. Despite the mounting evidence that needle placement guided by electrical stimulation is more accurate in muscle location than the conventional way of manual technique, it remains under-utilised. Personally I think it should play a more prominent role in our daily practice.

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# Selective Dorsal Rhizotomy – Experience of Tuen Mun Hospital

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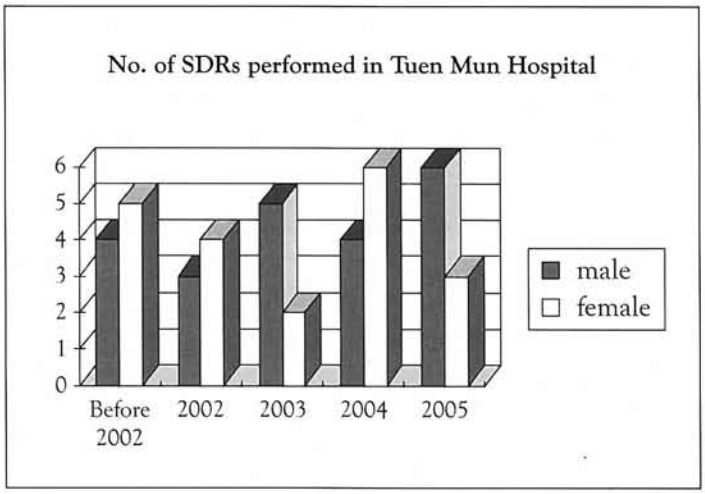
[1]Department of Neurosurgery, Tuen Mun Hospital; [2]Physiotherapy Department, Tuen Mun Hospital; [3]Child Assessment Service, Department of Health

## Introduction

Dorsal rhizotomy is the sectioning of dorsal spinal rootlets. It was first used by Foerster in 1908 to treat human spasticity[1]. The procedure was further refined in the 1960s and 1970s when Gros et al and Fasano et al[2,3] described selective dorsal rhizotomy (SDR). The use of SDR to treat the spasticity associated with cerebral palsy has become popular after Warwick J. Peacock and his colleagues' work[4].

Tuen Mun Hospital SDR clinic was established in 1996. So far more than 40 patients had SDR done in our unit. Potential surgical candidates are referred to the clinic and assessed by a multidisciplinary team that consists of physiotherapist, paediatric neurologist, developmental paediatrician, urologist, orthopaedic surgeon, and neurosurgeon. (Appendix I)




## Indication and Preparation

For spastic diplegic patients, disturbed fluidity of gait or movement is the prerequisite selection criteria. Their function should be affected by spasticity mainly and should have no fixed orthopaedic deformity. However, lower limb strength and trunk control should be fair to good. Normal to near normal intelligence and good family support are preferred.

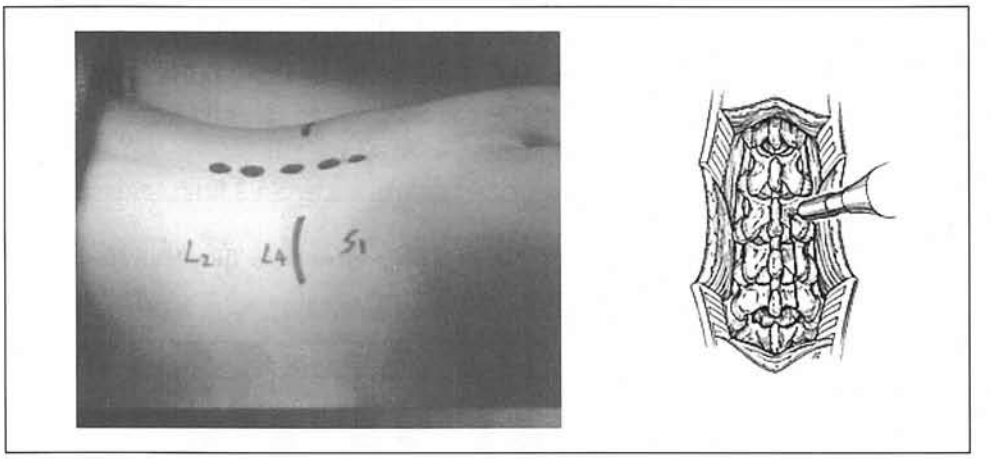
For spastic quadriplegic patients, they should have no dystonia or fixed contracture at multiple joints. Their passive movement, care and positioning are hindered by spasticity.

Pre-operatively, the patients will have 2-6 months of intensive physiotherapy for muscle strengthening. Parameters including muscle tone, range of movement of joints, functional status (GMFM), sensory and gait pattern will be recorded. Other pre-op investigations include gait analysis, oxygen consumption and urodynamic study.

All SDRs in the series at TMH were performed by the same neurosurgeon.

## Procedure

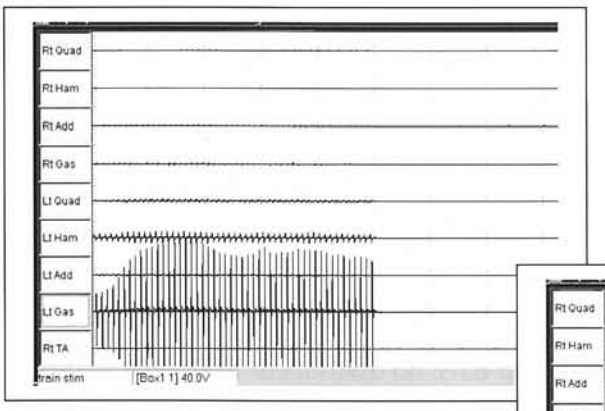
Patient is placed in prone position, Midline incision is carried out allowing exposure of L1/L2 to S1 spinous process and lamina. The thoracolumbar fascia was opened on both sides of spinous process. The paraspinal muscles were detached from lamina of L2 to L5/S1. The facets were exposed laterally. The ligamentum flavum between L4 and L5 or L5 and S1 was opened with hook and knife. Fine power dissecting tool was used to make laminotomy from L2 to L5/S1. The interspinous ligament was cut over L5/S1 allowing retraction of lamina superiorly. Epidural fat was removed. The dura and the arachnoid layer was opened and anchored with haemoclip. Nerve roots were exposed and level were identified by motor root stimulation and observing corresponding myotome movement.



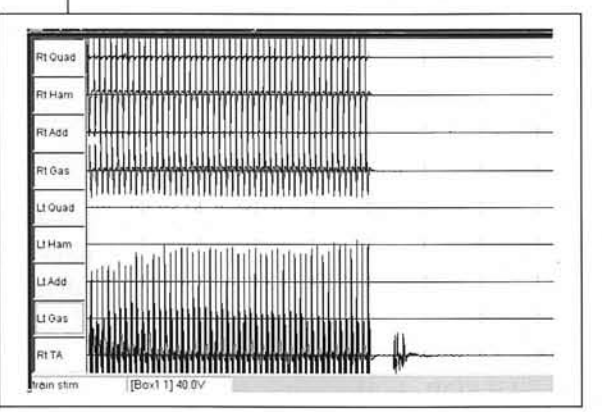





Based on intraoperative electromyography (EMG) patterns and gross motor response, about 50% of the dorsal spinal nerve rootlets from L2-S2 were sectioned. Paediatric neurologist and physiotherapist will be present in operation theatre for intra-op EMG analysis.




EMG of normal rootlet




Abnormal contralateral spread

Setting of intra operative EMG

All patients were to receive a strict extensive nursing and mobilisation protocol right after surgery followed by intensive physiotherapy for 6-12 months. (Appendix II)

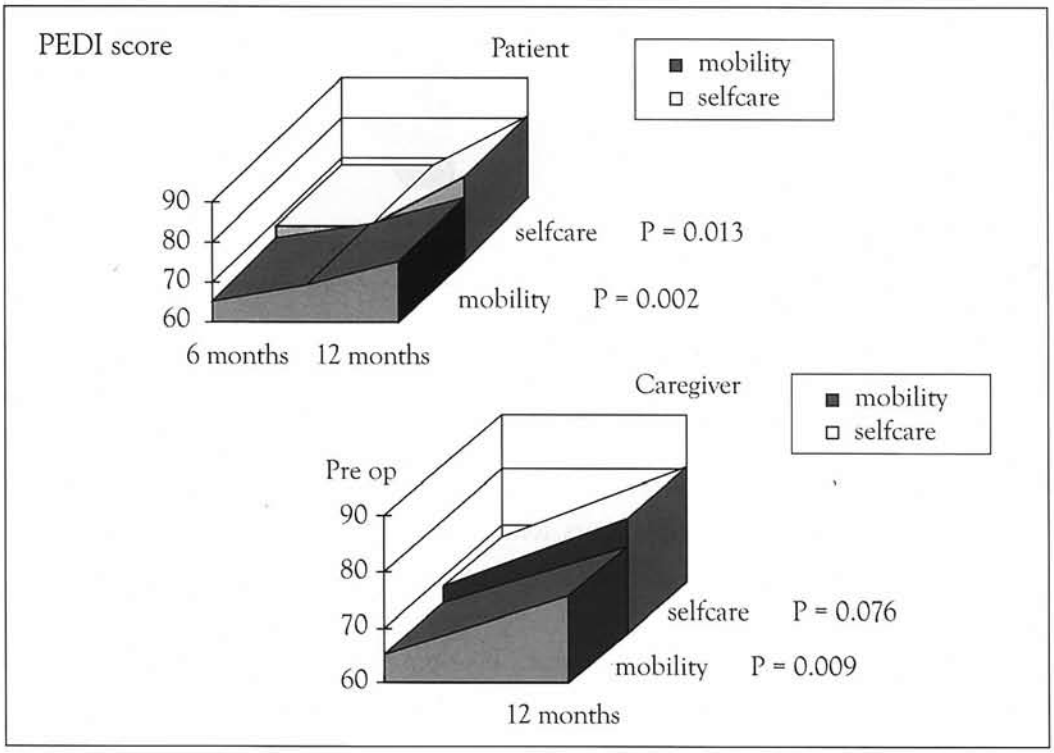
A prospective outcome study is being performed on all recruited candidates. This study uses a multidimensional approach of the International Classification of Functioning, Disability and Health (ICF) when assessing SDR efficacy. All patients are evaluated within 1 month before SDR, then at 6 months and 1 year after surgery. Main outcome measures include Gross Motor Function Measure (GMFM), Pediatric Evaluation of Disability Inventory (PEDI), Canadian Occupational Performance Measure (COPM) and 3-D gait analysis.

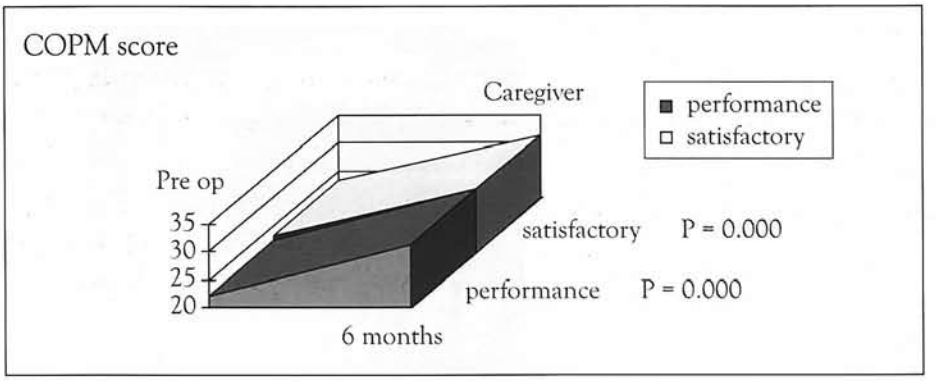


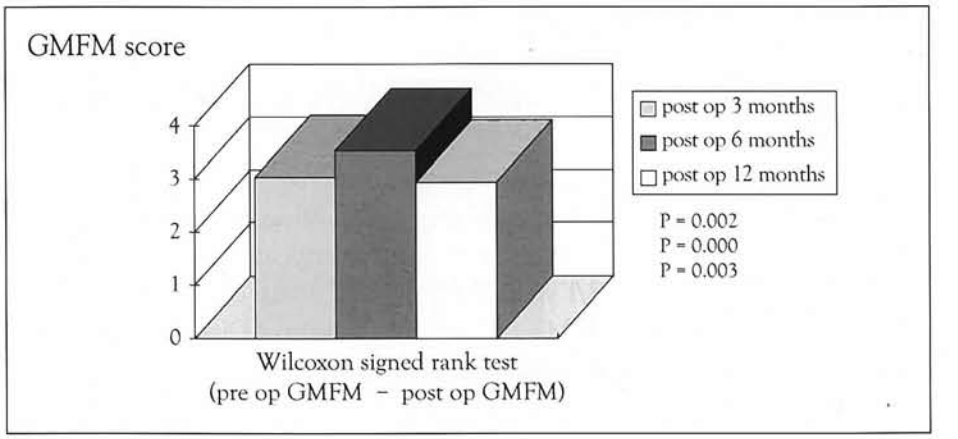


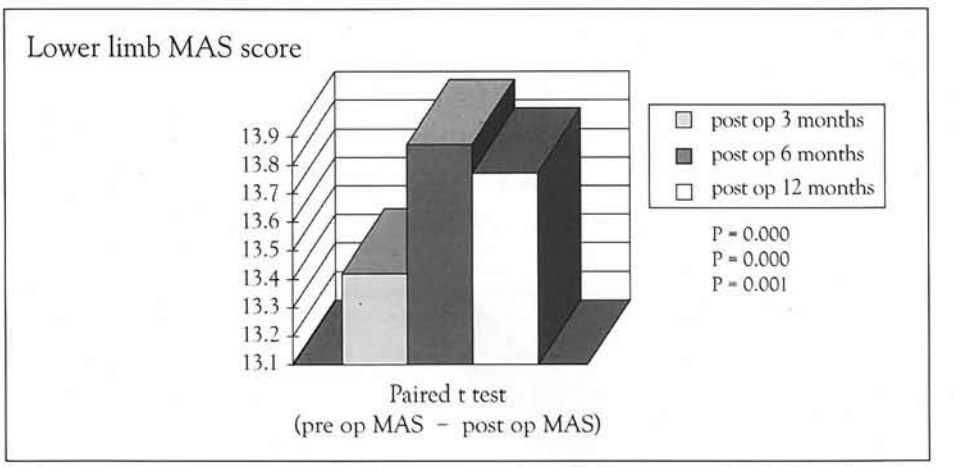
## Results

A total of 21 patients who had SDR from July 2003 to August 2005 were entered into this study. The mean age was 94 months. The male to female ratio was 9:12.








Twenty patients have spastic diplegia and 1 patient has spastic quadriplegia. Eighty-one percent of patients have normal intelligence. Most patients have GMFCS level I and II (57%). Twelve patients have completed 1-year assessment while 5 patients completed evaluation at 6 months.

With SDR, range of movement of joints, reduction in lower extremity muscle tone, GMFM score gains, PEDI self care skills, mobility functions, COPM performance score and satisfaction score were all significantly improved.

Gait analysis also showed improvement. Five patients had improvement in urinary symptoms, 2 of them had urodynamic studies confirmation. We also observed some improvement in hand writing in some patients. Complication was rare.

## Conclusion

SDR can safely improve the outcome of the carefully selected children with spastic diplegia not only in impairment domain but also in activity and participation levels under the ICF framework.

Spasticity and range of movement of joints are improved. Caregivers are satisfied because patients can be handled with greater ease. The diplegic dependent or independent walkers tolerate exercise better. Gait is initiated more easily with a more normal pattern. With a longer stride, they can walk faster.

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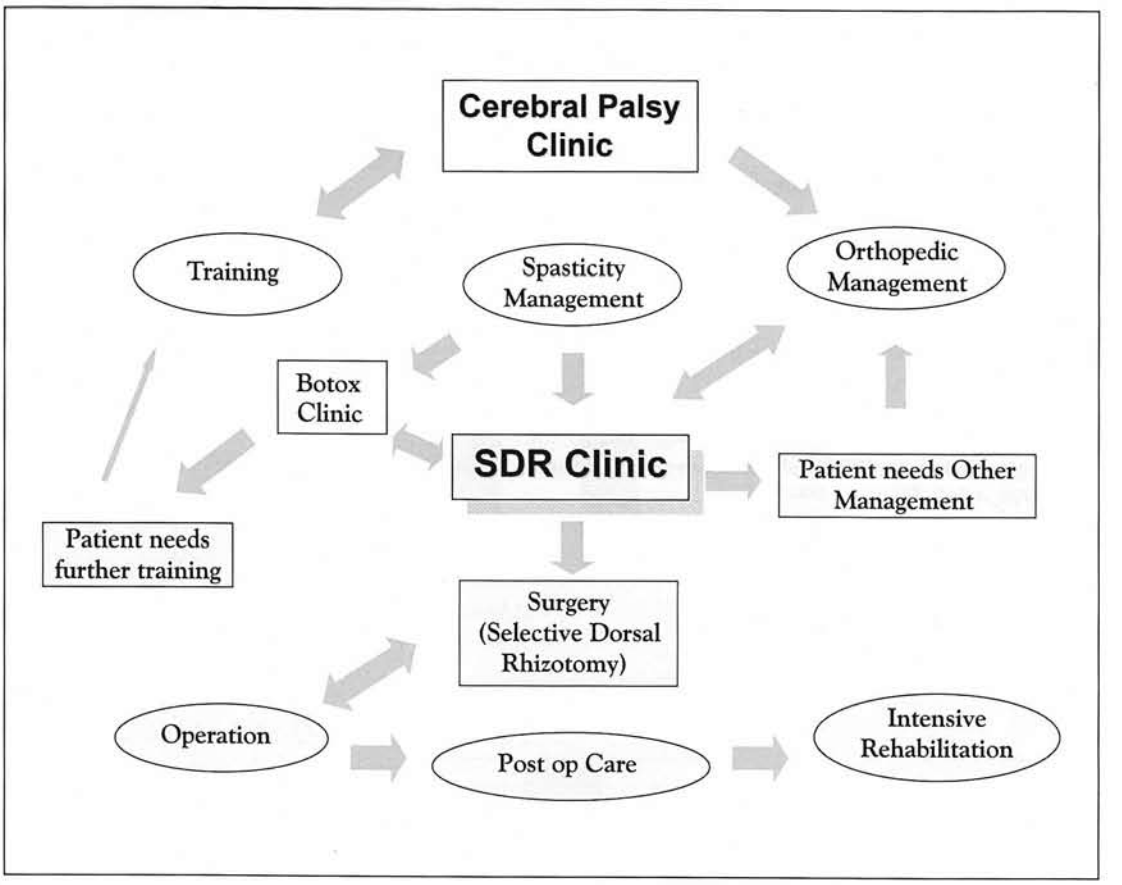
Appendix I

Selection of Candidates



## Appendix II

### Nursing Care Protocol for Paediatric Rhizotomy Patient
### Department of Neurosurgery
### Tuen Mun Hospital

**Pre Operative Nursing Management**

- **Family Education:**
  - arrange doctor / family interview
  - explain the pre & post op nursing care
  - reinforce the information provided by other health care disciplines
- **Participate in obtaining an Informed Consent**
- **Ready the urodynamic study result**
- **Arrange pre op CT brain, X ray hip & spine with marker**
- **Bowel preparation (e.g. D/S supp) on the day before surgery**
- **Foley's catheter on the operative day (on call or in O.T.)**
- **Refer Occupational therapist for wheel chair fitting**

| Post Operative Management | Day 0 | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day6> |
|---|---|---|---|---|---|---|---|
| Neurological & Vital Signs Monitoring | Hourly obs to Q4H | | Q4H to QID observation | | | | |
| Tissue Drain | Special care & obs | | | Off drain as prescribed | | | |
| Gross LL Power Charting | Hourly obs | | Q4H to QID obs | | | | |
| Position & Turning | Follow the Rhizotomy protocol by physiotherapy department<br>Reinforce and monitor family's technique | | | | | | |
| Nutrition & Hydration (1200 to 1500 ML / day) | NPO + IVF | IVF + Sips of water | Off IVF if feeding well / fluid to soft diet, DAT | | | DAT | |
| Elimination – Urination | Foley's catheter care B.D. | | | | Bladder training according to prescription | | Try urinal or bedpan |
| – Bowel | Use of diaper but avoid soiling of dressing.<br>May try commode when sit out | | | | | | |
| Wound | Close observation for infection & leakage.<br>Keep Dressing intact till off stitch on day 10 to 12 | | | | | | |
| Pain | Round the clock analgesic | | Pain assessment & PRN analgesic | | | | |
| Skin | Prevent pressure sore formation (skin care & devices) | | | | | | |
| Personal Hygiene | By ward staff | | Invite family in caring | | | | |
| Cast | | Apply Dynacast on day 1 after stretching exercise<br>P & O for sandal on day 4 | | | | | |

- Post-op X-ray spine
- Send X-ray spine and hip for reporting upon

BRAINCHILD
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# Epilepsy Surgery in Children – Pre-surgical Evaluation

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## The Goal of Pre-surgical Evaluation

The main goal of the presurgical evaluation is to define the exact location of the "epileptogenic zone" – the cortical area capable of generating seizures – the surgical removal or disconnection of which will result in seizure control.

### Definition of Abnormal Brain Area

- **Irritative zone** : areas generate interictal spikes
- **Symptomatic zone** : areas of cortex where seizures produce symptoms
- **Ictal onset zone** : area of cortex where seizures are generated
- **Epileptogenic lesion** : structural abnormal brain that causes epileptic seizures
- **Functional deficit zone** : cortical area of non-epileptic dysfunction
- **Epileptogenic zone** : area of brain necessary and sufficient for initiating seizures, and whose removal is necessary to abort seizures



2006

The concept of the "epileptogenic zone" is purely a theoretical one, and its extent and location cannot be determined until we have actually made the patient seizure free after surgery. One should keep in mind that there is so far no preoperative index to predict accurately the epileptogenic zone.

## Presurgical Evaluation

1. Phase 1 investigation
   - Video EEG – scalp EEG recording: interictal and ictal discharge, ictal semiology
   - Neuroimaging: MRI with epilepsy protocol, f-MRI
   - Ictal / interictal SPECT, PET
   - Neuropsychological test, Wada test
2. Phase 2 investigation
   - Invasive electrodes: depth electrodes, subdural electrodes (strip & grid)
   - Functional cortical mapping

### Advantages

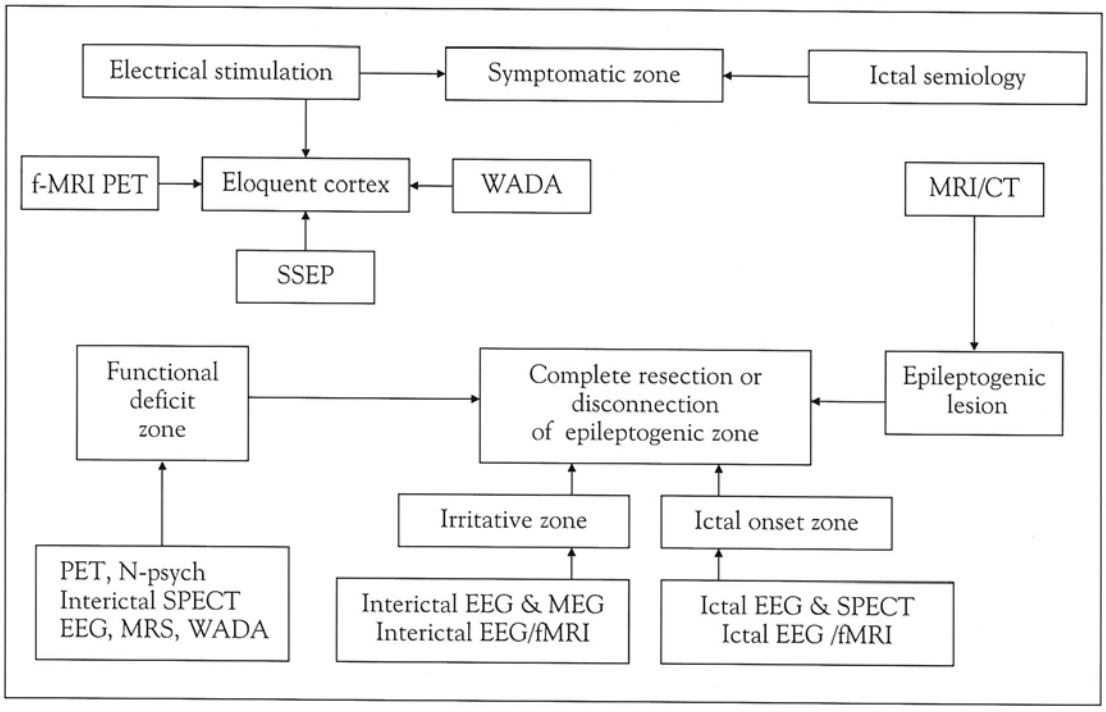
- Record signals from relatively small areas of cortex or deep seated lesion not detectable by scalp recording

### Disadvantages

- Carries small but definite risks of complication such as bleeding, infection
- Small sampling rate; risk of incomplete coverage

Intracranial electrodes should be implanted only in the context of a specific question drawn from the result of phase 1 study

**General concept of epilepsy surgery evaluation**




## Neuroimaging

### MRI

MRI is an integral part of presurgical evaluation of patients with intractable epilepsy.

### Special Techniques Enhancing Detection Rate for Brain Lesion

- Both T1 and T2 weighted with thin slices
- Three dimensional volume acquisition
- Coronal as well as axial images
- FLAIR / Fast spin-echo inversion recovery
- Multimodality co-registration with ictal / interictal SPECT, PET, f-MRI, MRS
- Volumetry, thickness analysis, surface rendering, diffuse tensor imaging for additional information

Epilepsy dedicated MRI has higher sensitivity for lesions compared with routine MRI.

MRI has the advantages of better soft tissue contrast and spatial resolution, multi-plantar capabilities, and the lack of artifact from adjacent skull base or bony calvarium. Although computed tomography is sensitive to calcification, the role of CT in epilepsy has diminished considerably over the past decade. The probability of an informative CT in the presence of a normal MRI is less than 1%. The preoperative identification of an organic lesion has a dramatic impact on the postsurgical seizures outcome. The result of surgery in nonlesional extratemporal epilepsy is still disappointing. Therefore, surgery in such patients should be carefully considered.

Hippocampal abnormalities on MRI associated with mesial temporal sclerosis include hippocampal atrophy, hyperintense signal changes in fluid-attenuated inversion recovery (FLAIR) sequence and loss of internal architecture. Extrahippocampal abnormalities with MTS are temporal horn dilatation; temporal lobe atrophy; atrophy of parahippocampal gyral white matter between the hippocampus and collateral sulcus; hyperintensity in the anterior temporal lobe white matter; indistinct gray-white matter junction, atrophy of fornix and mammillary body.



MRI plays a pivotal role in detecting cortical dysplasia. Some reports claim MRI demonstrates abnormalities in 60-90% of the patients with cortical dysplasia. Common MRI findings include abnormal gyral / sulcal pattern, increase cortical thickness, blurring of the gray / white matter junction, and high signal in subcortical white matter that sometimes tapers toward the lateral ventricle. FLAIR is very useful in making abnormal signal more evident. Several studies showed a correlation between increased signal intensity on FLAIR and the presence of balloon cells. Usually epileptogenic region is more widespread than that evident on MRI.



The common tumours are astrocytomas, gangliogliomas, oligodendrogliomas, mixed gliomas, and dysembryoplastic neuroepithelial tumours (DNETs). These lesions are usually small. They are often present in situ for a number of years. Remodeling of the inner table of the adjacent calvarium is common. These tumors have well-circumscribed margins on MRI and are rarely associated with substantial white matter edemas. Other epileptogenic substrates that can be shown on MRI include vascular abnormalities and encephalomalacia. MRI can be completely normal in patients with clear-cut partial-onset seizures.

## PET and SPECT

PET and SPECT are effective in assessing brain function or its impairment associated with epilepsy. In patients with no obvious abnormality on MRI, functional images may provide the definite information for identification of epileptogenic foci. Both PET and SPECT demonstrate the functional changes in different stages of seizures – interictal, subclinical, ictal and postictal phases. FDG PET and CBF SPECT have been used to examine metabolic

and circulatory changes in each stage. PET has higher resolution than SPECT. Interictal hypometabolic area is related to epileptogenic zone. The sensitivity for epileptogenic zone varies from 60-90%.

Various types of ligands for PET, SPECT are being developed, for example, AMT PET to detect epileptogenic tuber in tuberous sclerosis[2]. Significant advances in data acquisition and analysis for functional imaging in epilepsy have been made. Statistical analysis makes it possible to access the findings objectively and precisely, much better than visual inspection. Spatial normalization is frequently used to average the acquisition data obtained from different patients. SISCOM, a computerized ictal – interictal subtraction technique without spatial normalization, facilitates identification of areas of increased CBF during the ictus.

## Electrophysiological Studies

### EEG, Video EEG Monitoring

- Most important noninvasive diagnostic tools for revealing epileptogenic region
- Simultaneous recording of EEG and clinical behaviour for semiology
- Provide large amount of interictal abnormalities
- Reveal ictal EEG from seizure onset area
- Limitation in revealing electrographic seizure in vigorous convulsive seizure from motion artifacts or low amplitude high frequency electrographic seizures





### Characteristic Semiological Features Suggesting Partial Onset

- Focal motor seizures; motor cortex
- Clonic ocular (aversive) seizures; occipital lobe
- Versive seizures; contralateral frontal lobe, involvement of premotor cortex
- Seizure with arm elevation (fencing posture); supplementary motor area
- Aphasic and phonatory seizures; temporal, inferior frontal, or inferior parietal on dominant hemisphere
- Sudden anarthria; inferior rolandic cortex
- Interactive vocalization or countless repetition of certain words; supplementary motor area
- Somatosensory focal seizures: postcentral gyrus
- Elementary visual symptoms: occipital lobe
- Elementary auditory seizures: parietal lobe
- Seizures with olfactory sensation: anteriosuperior portion of the uncus
- Seizures with gustatory sensation: parietal operculum or superior periinsular cortex
- Seizures with vertiginous sensation: parietal lobe
- Complex gestural automatism and altered consciousness: temporal lobe
- Asymmetric spasm

### Electrophysiological Parameters Suggesting Focal Cortical Pathology

- Focal or asymmetrical hypsarrhythmia
- Focal paroxysmal fast activity
- Single spike prior to or after hypsarrhythmia
- Persistent focal abnormality in serial EEG
- Focal episodic flattening during non-REM sleep
- Persistent subclinical subtle ictal discharge
- Focal polymorphic slowing
- Depression of fast activity
- Unilateral absence of sleep spindles
- Focal amplitude attenuation
- Abolishing bilateral abnormality after amytal injection
- Loss of cortical peak on somatosensory EP

## Neuropsychological Tests



Usually brain function at the seizure focus is already deficient before surgery. It is therefore assumed that resection of the epileptogenic focus of the brain does not cause any additional deficit. However, if this portion is still functional and is included in the resection, there may be additional decline. It is well established that epilepsy patients with better performance are likely to have a greater decline in mental function after surgery. On the other hand, it is noted that decreases in seizure activity following surgery have been associated with improvement in some cognitive functions. This is partly because epileptiform discharges disturb functions of remote cortical regions.

Patients with seizures arising from the left temporal lobe tend to perform poorly on tests of verbal learning and memory, whereas patients whose seizure arise from the right temporal lobe tend to perform worse on visual / nonverbal tests[1,3-6]. On the other hand, the sensitivity of neuropsychological tests to frontal lobe dysfunction is less reliable than that for memory impairment associated with temporal lobe damage.

There are many modalities in neuropsychological evaluations:

1) General intellectual status and cognitive function
2) Language function
3) Visuospatial ability
4) Memory and learning
5) Motor ability
6) Mental control

The neuropsychological abnormalities are affected by many factors:

1) Location and extent of the epileptogenicity
2) Age at seizure onset

3) Duration of seizures
4) Seizure type
5) Seizure frequency
6) Interval from the last seizure
7) Medications

Neuropsychological assessment is mandatory in a comprehensive pre-operative evaluation of patients in many epilepsy centers for the following purposes:

1) To predict the cognitive changes that may occur after epilepsy surgery
2) To identify the epileptogenic focus
3) To plan for rehabilitation

## Wada Test

- It involves intracarotid injection of sodium amytal to paralyse the ipsilateral hemisphere. It has been used to determine the lateralisation of patient's focus.
- Interpretation: If a patient becomes aphasic or paraphasic, the injected hemisphere is presumed to have language function. If aphasia occurs in both sides, the latency to the first verbal response is compared to determine the dominant side.
- For memory function, percentage of correctly memorized items is calculated for both sides. In many epilepsy centers, patients with memory score of 67% or greater are classified as having passing score for the memory test. In comparative method of evaluating memory, 20% difference between the sides indicates the dominant side is the lower side.



## Invasive Intracranial Monitoring

Intracranial EEG may aid in the localization of the epileptogenic zone in the cases where seizure semiology, surface EEG, neuroimaging and neuropsychological tests are not consistent. Although intracranial EEG has the advantage of being able to record signals from relatively small areas of cortex, the results should be interpreted carefully not to overlook the influence of activities in brain apart from the area covered with the electrodes.

Intracranial EEG should not be used in "fishing expedition". This invasive study serves to provide an answer to a specific question. Problems such as differentiation between mesial temporal lobe epilepsy and neocortical temporal lobe epilepsy; laterality of mesial temporal lobe epilepsy; spatial relationship between the presumed epileptogenic zone and the functionally indispensable area; must be defined before the invasive study is considered. Prolonged invasive monitoring has the advantage of being able to analyse both interictal and ictal phenomena.

## Patient Selection

1) **Indication for Surgical Candidacy**

**Medical Intractability (definition)**

1. For surgical remediable syndrome, failure of seizure control by first-line combination therapy or second-line monotherapy may be good enough as surgical indication
2. For others, systemic sequential trials of 4 or 5 drugs both in monotherapy and combination therapy may be required

2) **Contraindication**

1. Underlying degenerative or metabolic neurological disorders
2. Supervening medical illness
3. Benign epilepsy syndrome, pseudoseizures
4. Relative contraindications: medical non-compliance
   a. interictal psychosis
   b. severely dysfunctional family dynamics



## Principles

1) Determine that the lesion is responsible for the patient's habitual seizure
   i. by semiology and electrophysiology
   ii. higher concordance rate among various tests predict a favorable outcome

2) Determine the safety of resection
   i. by neuropsychological test
   ii. by Wada test

3) Determine the extent of resection
   i. by ECoG and intracranial ictal recording
   ii. epileptogenic zone usually include seizure onset zone and zone of early propagation
   iii. varies according to different pathologies
   iv. for neuronal migration disorder; wider resection predicts better outcome
   v. for tumor; capsule +1 cm extent of adjacent cortex

## Child Versus Adult

There are fundamental differences between pediatric and adult patients with intractable epilepsy. For pediatric candidates – our prime target in this articles – differences include the underlying pathology as well as the organ itself.

*Pathological Substrate*

- Mostly extratemporal
- Limited proportion of MTLE
- Developmental cortical anomalies

*For a Developing Brain*

- Neural plasticity
- Cortical specification

## Surgically Remediable Epilepsy Syndromes (SRES)

These are epileptic disorders for which:

1. The natural history is relatively well known to be medically refractory or even progressive
2. Presurgical evaluation can be accomplished non-invasively
3. Surgery offers an excellent chance that disabling seizures will be completely eliminated
    - Mesial temporal lobe epilepsy with hippocampal sclerosis
    - Lesional partial epilepsies: Tumours, Cortical dysplasia, AVM, cavernous angioma
    - Diffuse hemispheric epilepsies: Rasmussen's encephalitis, Hemimegalencephaly, Porencephaly, Sturge Weber syndrome
    - Secondary generalized epilepsies in infants and small children: Tuberous sclerosis, hypothalamic hamartoma



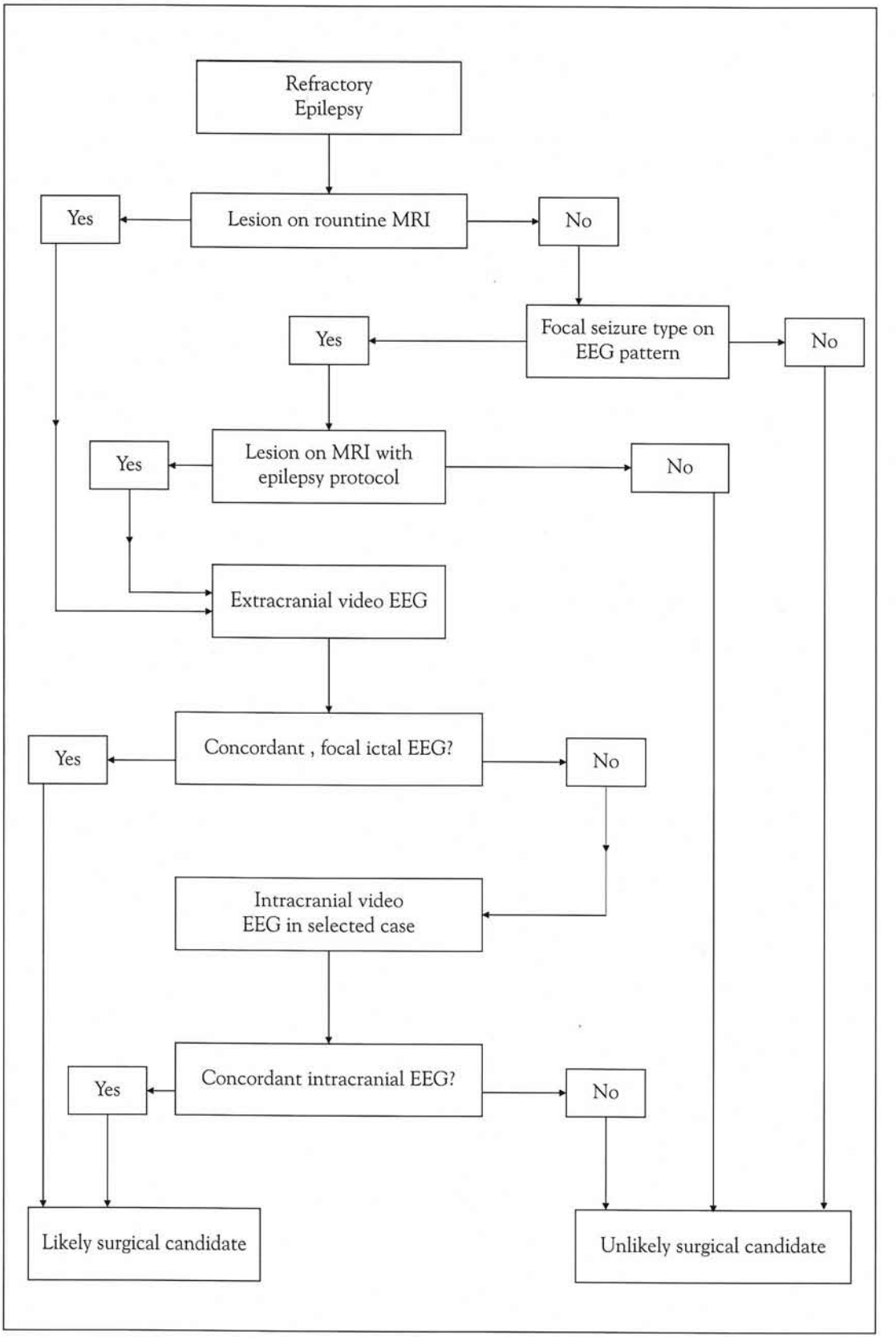
## Epilepsy Surgery

The ultimate aim of surgery for these patients is to excise the focus of seizures without causing undue disability. How close we are to achieving this depends very much on the location of the focus or at times foci. In case the target region is in close proximity with functional eloquent areas, compromise has to be made. Functional areas as defined by preoperative functional MR studies or at surgery on an awake patient are to be respected. In situation where the culprit cannot be delineated from the functional areas, a more conservative attitude has to be taken. Therefore surgeries can be divided into 2 main groups – curative or palliative.

### Curative Surgery

- Cortisectomy
- Lobectomy
- Hemispherectomy

Flow chart to show how to select patient with refractory epilepsy to have epilepsy surgery[6]



### Palliative Surgery

- Multiple subpial transaction
- Corpus callosotomy
- Vagas nerve stimulation

**Seizure outcome of epilepsy in children** (Comprehensive epilepsy program, Severance Hospital, Yonsei University in Seoul)

- Temporal lobectomy: 74% seizure free in children, 80% seizure free in adolescents
- Extra-temporal resection: 58% seizure free in children, 52% in adolescents
- Hemispherectomy: 60-70% seizure free outcome

## Conclusion

We have a large number of children with intractable epilepsy. Epilepsy Surgery is their hope. The success of surgery depends very much on correct case selection and accurate epileptogenic focus localization that require a lot of resources in term of both hardware and software.

The hardware are highly technical machine such as digital Video EEG, MRI, PET, SPECT scan and functional MRI. Software refers to medical expertise of specialists like neurosurgeon, neurologist, radiologist, neuropsychologist, EET technicians who are committing their working in epileptology. These specialists know how to select and interpret the appropriate investigations. An integrated team approach gives them the best chance in achieving the best result for their epileptic patients. In Hong Kong epilepsy surgery is still in its early development when compared with that in western countries. But as awareness grows in this community and as our experience accumulates from more we do, epilepsy surgery would surely be a viable option for these unfortunate patients.



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# Specific Learning Disabilities and Dyslexia in Hong Kong: Position Paper on Future Directions

The Hong Kong Society of Child Neurology & Developmental Paediatrics

This Position Paper was launched by the Hong Kong Society of Child Neurology and Developmental Paediatrics (HKCNDP) consequent to the successful inclusion of SLD/Dyslexia as member of category of disabilities within the Rehabilitation Programme Planning (RPP) of the Hong Kong Rehabilitation Advisory Council in 2005. It is the fruit of an Open Forum hosted in Queen Elizabeth Hospital on 28th July 2005 which was attended by more than sixty transdisciplinary and transectoral professionals from institutions, professional bodies, non-governmental organizations, educators, school teachers and principles, frontline workers, parents and many others all converged with one dedicated mission: *to set directions for future management of children with SLD/Dyslexia in Hong Kong.* The summary of opinion and comments collected from the Forum formed *nidus* with inputs from participants and experts eventfully crystallize into the First Draft of this Paper which was further amended eight times by circulation. Final Draft of the Position Paper which was officially adopted by all professionals in February 2006 and widely circulated to government bureaus and departments, policy makers, professional bodies, institutions, NGO's, Parent Groups and others for comments and endorsements. It is encouraging to witness its being favourably received and positively supported by Policy Bureaus and Government Departments from the Hong Kong SAR Government. It is envisage that the Paper is going to be utilized as an important document by the HKSAR Government and professionals in Hong Kong for policy making, healthcare finance planning, programmes setting, technical formatting, project implementing and outcome measuring in the future. The Paper sets a good prototype for all child health workers to amalgamate effort of all professionals to achieve powerful advocacy for our children with special needs. It is a worthwhile paper for all readers to scrutinize and to resonate effort for the care of our children!



*This paper is based on the Forum on Specific Learning Disabilities (SLD) organized by the Hong Kong Society of Child Neurology & Developmental Paediatrics on 28th July 2005 to arrive at a position paper on future directions for Specific Learning Disabilities and Dyslexia in Hong Kong.*

## Participants at 28 July 2005 Specific Learning Disabilities Forum Organised by Hong Kong Society of Child Neurology & Developmental Paediatrics

| | |
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## Background

Specific Learning Disabilities (SLD) (特殊學習障礙) is often referred to as the hidden handicap, with dyslexia (讀寫障礙) being present in the great majority of individuals in this group of disorders. Persons with dyslexia are characterized by severe deficits in reading, spelling and writing to dictation. The condition is disabling in that affected individuals' deficiencies in literacy, if not habilitated early and effectively, will lead directly and through secondary effects and emotional complications to severe impairments in learning, daily activities and contribution to society. It is today widely considered as a public health issue with marked educational and social dimensions, requiring multi-disciplinary and cross-sectoral attention.

SLD and dyslexia have received increasing professional and public awareness in Hong Kong over the past decade. Systematic measures to identify, assess and support affected individuals in education and the community are being continually developed. At the 2005-06 review of the Rehabilitation Programme Plan (RPP), the RPP Working Group and Rehabilitation Advisory Committee resolved that SLD is a disabling condition that should be added into RPP as a category of disability.



## Definition#

SLD is a term that refers to a group of disorders manifested as significant difficulties in the acquisition and use of listening, speaking, reading, writing or mathematical abilities, despite access to conventional teaching. These disorders are intrinsic to the individual and neurobiological in origin, with onset in childhood and extending beyond it. Language processing difficulties distinguish SLD as a group.

SLD is not the direct result of sensory impairment, mental retardation, social and emotional disturbance or environmental influences (e.g. cultural differences or insufficient / inappropriate instruction). Accompanying weaknesses may be identified in areas of speed of processing, working memory, phonological recoding, fine-grained auditory and / or visual processing, sequencing, organization, and motor coordination. Some individuals with SLD have outstanding skills. Some may have skills that are masked by their SLD, while other individuals may have strengths in aspects not affected by their SLD.

Developmental Dyslexia is one of the specific learning disabilities, characterized by difficulties with accurate and fluent word recognition, word reading and writing to dictation or spelling. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and further acquisition of

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*# This operational definition was drafted jointly at the HK Society of Child Neurology & Developmental Paediatrics Forum on SLD on 28 July 2005, with academic and practicing representatives from medicine and allied health, education, psychology, social work, parent groups and administration (Appendix A). It is based on current knowledge of these conditions.*

knowledge through print. Unexpected discrepancy exists between learning aptitude and achievement in school in one or more basic subject areas.

It is acknowledged that SLD may co-occur with other developmental disorders. Attention deficit / hyperactivity disorder (ADHD), with its own different neurological basis, diagnosis and treatment, is not a form of SLD, but may also occur in individuals with SLD.

Corresponding terminology for SLD in the *International Statistical Classification of Diseases and Related Health Problems – Tenth Revision (ICD-10)* is under the group "Specific Developmental Disorders of Scholastic Skills", as listed in Appendix A.

## Prevalence

Data reported by the Hong Kong Specific Learning Difficulties Research Team (Chan, Ho, Tsang, Lee & Chung (under review))[1] indicated that, based on a study at 27 schools in Hong Kong, Kowloon and the New Territories with the use of the *Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD)* (Ho CSH, Chan DWO, Tsang SM & Lee SH, 2000)[2], the prevalence rate of specific learning difficulties in reading and writing (dyslexia) in Hong Kong is 9.7% to 12.6% with 6.2% to 8.7% mild cases, 2.2% to 2.3% moderate cases and 1.3% to 1.6% severe cases.



Figures on SLD cases reported by the Education & Manpower Bureau (EMB) were 461 in 2000-01, 948 in 2001-02, 980 in 2002-03, 922 in 2003-04 and 1,065 in 2004-05 respectively. A total of 4,376 students with SLD in all primary and secondary schools were identified within these past five years. While these figures may reflect the workload presented to EMB, they do not reflect how serious the Hong Kong situation is. Their distribution within schools of different academic achievement also varies significantly.



## Types of Services

### Early Identification

With the aim of achieving early identification of varied needs of children so that appropriate services can be made available to them in a timely manner, an inter-sectoral community-based programme, the Comprehensive Child Development Service (0-5 years) will be launched (2005 Policy Address of the HKSAR Government)[3]. Needs of children at risk for SLD are expected to be included.

*The Hong Kong Learning Behaviour Checklist for Preschool Children (Parent Version)*, a tool for parents to identify preschool children at risk for SLD, was introduced at the end of 2005 (Hong Kong SLD Research Team 2006)[4]. A screening instrument for preschool teachers to identify at risk children for follow up still needs to be developed. A teacher's checklist for identifying SLD students in secondary schools is being considered, and should be completed as soon as possible.

In 2000, *The Hong Kong Specific Learning Difficulties Behaviour Checklist for Primary School Pupils* (Hong Kong SLD Research Team 2000)[5] was made available to schools to assist teachers in identifying students suspected to have specific learning disabilities; and from 2004 September, a new Primary One Checklist screening for Learning Abilities (EMB, 2004)[6] was launched, where Chinese, English, mathematics, social adaptation, verbal language and motor abilities of Primary One students can be checked to identify any learning problems and further educational needs. Teachers are expected to provide additional support to those identified as at risk, and to refer out those who are identified as having significant difficulties.

### Assessment

Assessment of suspected SLD cases generally takes place within the educational setting after learning problems are noticed. EMB and outsourced educational psychology services help to provide diagnosis. Assessment for diagnosis is made by educational psychologists with standardized tools. Timely response to request for assessment is needed, with parents informed of the results and plans in order to maximize school-family cooperation.



Sometimes, cases may present to the health care sector, such as those where the underlying SLD is masked by other problems, like behavioural, emotional or other developmental and health problems. These children will be assessed by relevant professional disciplines, including clinical psychologists, from child assessment centres, certain hospital teams, non-government organisations (NGOs) and private settings. Follow up management of dyslexia itself remains within the school system, while other conditions diagnosed, such as attention deficit, motor coordination, hearing, visual and emotional problems, will be referred to respective service providers for treatment.



In Hong Kong, the HKT-SpLD was developed in 2000 for assessing primary school children up to ages 10½ years[2]. Further norming of three subtests of this HKT-SpLD for Primary 5 and Primary 6 students is being done, for these data to be included in the 2nd edition of the HKT-SpLD in 2006[7]. A tool for assessing dyslexia in Secondary 1 to 3 is being developed by the Hong Kong Specific Learning Difficulties Research Team, and is expected to be published around the end of 2006[7]. Reading achievement levels for grade and age are needed in Hong Kong to document baselines and monitor progress.

## Education

### *Remediation and Accommodations*

Students with SLD are educated in mainstream schools. Both direct remediation for dyslexia and accommodations in schools and examinations should be provided for these students.

Direct evidence-based remediation for dyslexia in adequate amount and with outcome measures is important. Promoting oral language skills and phonological / orthographic

awareness skills through heightened reading and literacy programmes for at risk children is valuable. Teachers delivering these programmes should have a relevant language background, with training in dyslexia remediation for Chinese, English, and English as a Second Language (ESL). For secondary schools, the availability of special education needs coordinators (SENCO) with a strong language background is desirable. A differentiated curriculum may be required for some children. Strength discovery and development outside of the formal curriculum as well as portfolio building should be emphasized for these children.

The format for delivering the above curriculum and programmes may include pull-out teaching, co-teaching within the classroom and Individualised Education Plans (IEP). After school support programmes will also be valuable for those without adequate support at home.

### *Examination Accommodations*

Many schools and parents are still unaware of the availability of accommodations for eligible students with dyslexia (at schools' internal examinations during Primary 5 and 6 for secondary school entrance placement, at the Hong Kong Certificate of Education Examination (HKCEE) and the Hong Kong Advanced Level Examination (HKALE)). Applications by secondary schools on behalf of these students for open examination accommodations are still minimal compared with actual need. Effort is needed from EMB and the Hong Kong Examination and Assessment Authority (HKEAA) to promote awareness of such examination accommodations to school administrators, parents and students, and to ascertain compliance within schools. The range of accommodation measures that can be provided for students with SLD needs to be widened as indicated, including the use of computers or having questions read out and answers given orally.



### *School Support*

Teachers' knowledge and skills in managing SLD are necessary prerequisites. At least one teacher with a special education background should be available in each school to support students with special education needs (SEN). EMB recommends an explicit school policy for delivering and monitoring quality, timeliness and outcome of services for all SEN students. Small classes are essential if adequate frontline teachers' participation in identification and remediation is to be provided. It is also felt that the Government could encourage and reward dyslexia-friendly schools through a set of outcome indicators, where good support for students with SLD and a genuinely inclusive atmosphere are ensured.

EMB is currently providing support to children with a variety of SENs in primary schools either through its ongoing intensive remedial support programme or its New Funding Model where $10,000 to $20,000 per annum is provided to a student with SEN. Secondary

schools with high intake of bottom 10% of junior secondary students are supported by the School-based Remedial Support Programme (SBRSP), which provides remedial teaching to students in basic subjects of Chinese, English and Mathematics; while all secondary schools are supported by school social work service which aims to identify and help students with academic, social and emotional problems. For SLD, it is proposed that earmarked resources within the school to support students with SLD at different stages of education be considered. Adequate access to computer use and related SLD software in schools is necessary.

Motivational factors are important in helping students with SLD in schools. Although some of these students may not be able to achieve much concrete progress in terms of standard school achievement results at this juncture, the attention and understanding given to them by good school-parent-child teamwork are valuable in rejuvenating their interest in learning and self-esteem. Parent-school collaboration in helping these children is considered critical for success.

Studies at Hong Kong's Special Schools for Social Development (special schools set up for students with serious emotional and behavioural problems) have shown that over 50% of students universally tested upon admission to primary school have been positively diagnosed with SLD[8], demonstrating a marked over-representation of SLD within groups of young people with serious emotional and behavioural problems. Such psychological problems are believed to be significantly related to the negative experience that students with SLD go through in regular schools, where their condition is either unidentified or not appropriately supported. Intensive psychosocial remediation through collaboration of school, family and community is needed for these young persons, before it is possible to redirect them into a positive academic learning path.



A special school for some students with SLD who need intensive and specialist attention (full time, part time or temporary enrolment), should actively considered.

*Higher Education*

Due to the relatively limited flexibility of today's curriculum and open examination systems, students with SLD in Hong Kong today usually can only manage to access tertiary education through vocational training and sub-degree programmes. With the proposed New Academic Structure for Senior Secondary Education and Higher Education (EMB, 2005)[9], where whole-person development approach and liberal studies as a core subject are highlighted, the time is ripe for considering a wider curriculum selection and credit based system for secondary students, particularly those with SLD. This would allow development and maximization of these students' areas of strength and enhance opportunities for them to access tertiary education in their areas of competence and special talents.

Concessions on language requirements at university entrance should be considered for students with dyslexia who demonstrate adequate standards for the subject applied, in order to remove undue barriers for access to tertiary education.

Learning disabilities support centres in tertiary institutions need to strengthen their resources and support for students with SLD, who comprise the large majority of students with special needs within tertiary institutions of developed countries.

### *Adults with SLD*

Issues relating to adults with dyslexia, including adult literacy education, remedial training, accommodations in professional licence examinations and in the workplace, need to be addressed.

## Community Support and Development of Self-help Groups

Public education to increase understanding of SLD, reduce misconceptions, and foster an inclusive atmosphere towards SLD is important.

Public organisations and NGOs are currently providing a number of parent support programmes for families of children with SLD. However, a system to ascertain the quality of such programmes is needed. More promotion is still needed to introduce these services to families. Peer support groups such as the Hong Kong Association for Specific Learning Disabilities (HKASLD) parent group provide valuable platforms for families of children with SLD in HK to share resources, experience and aspirations.



## Professional Training

Because of the high prevalence of students with SLD within mainstream schools, all teachers and school administrators need to have a basic understanding and awareness of SLD. Modules in SLD for undergraduate teachers should be compulsory, and in-service training for all existing teachers and school administrators on SLD is recommended. It is proposed that the Advisory Committee on Teacher Education and Qualifications (ACTEQ) study the demands placed on teachers by students with SLD, and include the subject in pre-service teacher education, as well as promoting teachers' and principals' continuing professional development in this area.

In 2005, EMB commissioned a 30-hour basic course for in-service teachers on SLD in Chinese and English. The first batch of training commenced in the 2005 September school year. More advanced courses focusing on SLD are recommended in future. Specific functional posts with positive career paths are recommended for these specially trained teachers.

Because courses today mainly provide basic awareness of the condition and the whole process of teacher empowerment is expected to take a number of years, Hong Kong teachers at this time rely strongly on specialist support, especially by educational psychologists, to provide timely diagnosis and delivery of effective remediation programmes. A system to ascertain the quality of such support is needed.

## Issues of Special Concern

The following areas for research and development in Hong Kong are identified:

(a) Studies on emerging literacy milestones in Chinese for identifying at risk preschool children;
(b) Identification instruments for parents and teachers for preschool and all school levels;
(c) Diagnostic assessment instruments at different ages;
(d) Reading achievement levels for grade and age in Hong Kong to document baselines and monitor progress;
(e) Development of validated intervention methods for step-wise reading remediation in Chinese and in English as a second language;
(f) Teaching approach for language and other content subjects for students with SLD, especially in higher grades;
(g) Stock-taking of higher education opportunities for students with dyslexia in Hong Kong;
(h) Development of counselling and social remediation programmes for students with dyslexia with significant and prolonged school failure;
(i) Parents' role in supporting the child at home and as a team member within the school;
(j) Effects of dyslexia-friendly teaching on students with and without dyslexia.





The following SLD related concerns in public education should be addressed:

(a) Public awareness of the presence and nature of SLD to be promoted;
(b) Concept of equal opportunity and rights from the perspectives of both affected and unaffected individuals and families, to be made understood to the public;
(c) A supportive community for adults with SLD to be developed and enhanced.

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## Appendix A

## International Statistical Classification of Diseases and Related Health Problems Tenth Revision

F81 **Specific developmental disorders of scholastic skills**

Disorders in which the normal patterns of skill acquisition are disturbed from the early stages of development. This is not simply a consequence of a lack of opportunity to learn, it is not solely a result of mental retardation, and it is not due to any form of acquired brain trauma or disease.

F81.0 *Specific reading disorder*

The main feature is a specific and significant impairment in the development of reading skills that is not solely accounted for by mental age, visual acuity problems, or inadequate schooling. Reading comprehension skill, reading word recognition, oral reading, skill and performance of tasks requiring reading may all be affected. Spelling difficulties are frequently associated with specific reading disorder and often remain into adolescence even after some progress in reading has been made. Specific developmental disorders of reading are commonly preceded by a history of disorders in speech or language development. Associated emotional and behavioural disturbances are common during the school age period.

"Backward reading"
Developmental dyslexia
Specific reading retardation

Excludes: alexia NOS (R48.0)
- dyslexia NOS (R48.0)
- reading difficulties secondary to emotional disorders (F93.-)

F81.1 *Specific spelling disorder*

The main feature is a specific and significant impairment in the development of spelling skills in the absence of a history of specific reading disorder, which is not solely accounted for by low mental age, visual acuity problems, or inadequate schooling. The ability to spell orally and to write out words correctly are both affected.

Specific spelling retardation (without reading disorder)

Excludes: agraphia NOS (R48.8)
- spelling difficulties:
- associated with a reading disorder (F81.0)
- due to inadequate teaching (Z55.8)

F81.2 *Specific disorder of arithmetical skills*

Involves a specific impairment in arithmetical skills that is not solely explicable on the basis of general mental retardation or of inadequate schooling. The deficit concerns mastery of basic computational skills of addition, subtraction, multiplication, and division rather than of the more abstract mathematical skills involved in algebra, trigonometry, geometry, or calculus.

Developmental:
- acalculia
- arithmetical disorder
- Gerstmann's syndrome

Excludes: acalculia NOS (R48.8)
- arithmetical difficulties:
- associated with a reading or spelling disorder (F81.3)
- due to inadequate teaching (Z55.8)

Appendix B

## Circulation List

1. Secretary for Health Welfare and Food Bureau: Dr York CHOW
2. Permanent Secretary for Health Welfare and Food Bureau: Mrs Carrie YAU
3. Secretary for Education and Manpower Bureau: Professor Arthur LEE
4. Permanent Secretary for Education and Manpower Bureau: Mrs Fanny LAW
5. The Council Members of the Legislative Council of Hong Kong
6. Hong Kong Rehabilitation Advisory Council
7. Hong Kong Rehabilitation Programme Planning (RPP)
8. The Commissioner for Equal Opportunities (EOC)
9. Hong Kong Institute of Education
10. Hong Kong Paediatric Society
11. Hong Kong College of Paediatricians
12. Hong Kong Psychological Association
13. The Pathways Foundation
14. The Association for Specific Learning Disabilities (ASLD)
15. Focus on Children's Understanding at School (FOCUS)
16. The Boys and Girls Clubs Association (BGCA)
17. Hong Kong Christian Services
18. Heep Hong Club
19. The Spastic Association of Hong Kong
20. The Teacher-Parents Association of Hong Kong
21. The International Pediatric Association
22. The Asia-Pacific Pediatric Association
23. The International Child Neurology Association (ICNA)
24. The Asia-oceanian Child Neurology Association (AOCNA)
25. The Hong Kong Journal of Paediatrics (New Series)
26. The ***Brainchild*** (Official Publication of the Hong Kong Society of Child Neurology and Developmental Paediatrics
27. Others



## Meeting Announcement

### 9th Asian – Oceanian Congress of Child Neurology

January 24 to 27, 2007
Waterfront Hotel, Cebu City, Cebu, The Philippines

For Registration details and abstract submission please visit their Website:
www.aoccn2007.org

Abstract submission deadline 31 October 2006

Early Bird Registration deadline 31 August 2006

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