Re habilitácia

ČASOPIS PRE OTÁZKY LIEČEBNEJ A PRACOVNEJ REHABILITÁCIE

K. OBRDA — J. PFEIFFER

V. MEZINÁRODNÍ SYMPOSIUM O REHABILITACI V NEUROLOGII

V. International Symposium on Rehabilitation in Neurology

PRAHA, SEPTEMBER 1976

SUPLEMENTUM 14-15 1977

ROČNÍK X/1977 CENA Kčs 24,—

Rehabilitácia

Časopis pre otázky liečebnej a pracovnej rehabilitácie Ústavu pre ďalšie vzdelávanie stredných zdravotníckych pracovníkov v Bratislave

■

Vydáva Vydavateľstvo OBZOR, n. p., ul. Československej armády 35, 893 36 Bratislava

■

Vedúci redaktor: MUDr. Miroslav Palát
Zástupca vedúceho redaktora: MUDr. Štefan Litomerický

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Redakčná rada:
Marta Bartovicová, Bohumil Chrást, Vladimír Lánik, Štefan Litomerický, Miroslav Palát (predseda), Květa Pochopová, Jiřina Štefanová, Marie Večeřová

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■

Vychádza štvrťročne, cena jednotlivého čísla Kčs 6,—

■

Rozširuje: Vydavateľstvo OBZOR, n. p., administrácia časopisov, ul. Čs. armády 35, 893 36 Bratislava

■

Toto číslo vyšlo v decembri 1978 — imprimované 22. XI. 1978.

■

Indexné číslo: 46 190
Registračné číslo: SÚTI 10/9

Rehabilitácia

ROČNÍK X/1977 SUPLEMENTUM 14 — 15

V. MEZINÁRODNÍ SYMPOSIUM O REHABILITACI V NEUROLOGII

SOUBOR PŘEDNÁŠEK

PROCEEDINGS OF THE V. INTERNATIONAL SYMPOSIUM ON REHABILITATION IN NEUROLOGY

Praha, September 1976

Editors

KAREL OBRDA — JAN PFEIFFER

Recensovali:

M. PALÁT,
E. MIKULOVÁ.

Pod patronátem Research Group in Neurological Rehabilitation při Světové neurologické federaci.

Organisované

Československou lékařskou společností
J. E. Purkyně
Československou neurologickou společností
Komisí pro rehabilitaci

Hlavní thema:

Rehabilitace po postižení centrálního nervového systemu (tzv. spasticita)
Volná sdělení

Vth International Symposium
on Rehabilitation in Neurology

Under the Auspices of the Research Group in Neurological Rehabilitation of the World Federation of Neurology

Organised by

Czechoslovak Medical Society J. E. Purkyně
Czechoslovak Neurological Society
Commission for Rehabilitation

Main topics.

Rehabilitation after Lesion of the Central Nervous System (so called spasticity)
Free Communications

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Uvítací projev
Welcoming Speeche

Paní a pánové, vážení hosté.

Dovolte abych Vás uvítal jménem Československé Neurologické společnosti J. E. Purkyně na V. Symposiu o neurologické rehabilitaci. Zvláště vítám proděkana Fakulty všeobecného lékařství a přednostu Neurologické kliniky profesora Dr. Josefa Vymazala, Akademika Jozefa Černáčka, místopředsedu Světové neurologické federace a přednostu Neurologické kliniky v Bratislavě.

První Symposium se konalo v Praze právě před 10 lety. Mnozí z Vás byli přítomni. Od té doby hodně se změnilo ve vývoji rehabilitace. Je větší zájem lékařů kliniků o tuto problematiku. Došlo se na základě podrobných expertis k závěrům, které jsou obsaženy v pamfletech Světové zdravotnické organisace. Je to odrazem změn, které nastaly v celosvětovém zdravotnictví. Narůstá problematika úrazovosti, problematika starší generace. Dětských mozkových obrn neubývá. Je stále větší výskyt kardiovaskulárních onemocnění a s prodloužením lidského věku přibývá též cerebrovaskulárních onemocnění.

Zdravotní péče, díky též technickému vývoji, se stává stále dražší. Je to otázka sociálně ekonomická, kterou se dnes také zabývají političtí činitelé na celém světě.

Jestliže na jedné straně zachraňujeme a prodlužujeme — nákladně život, musíme se také snažit, aby pacient se vracel do života pokud možno aktivního a nezávislého . Tady nastupuje v medicině rehabilitace jako prevence nemohoucnosti.

Thematika našeho Symposia se týká právě některých těchto aktuálních otázek.

Přeju Vám jménem pořádající organisace příjemný pobyt u nás a další dobré zážitky vědecké, kulturní i osobní.

Karel Obrda

Ladies and Gentlemen, dear Guests.

Let me welcome you in the name of the Czechoslovak Neurological Society J. E. Purkyně to the V. Symposium on Neurological Rehabilitation. I especially welcome Akademician Josef Černáček, Vice president of the World Federation of Neurology and head of the Neurological University Clinic in

Bratislava, and Vice Dean of the Medical Faculty of Charles University in Prague and head of the Neurological Clinic Prof. Dr. Josef Vymazal.

The first Symposium was held in Prague exactly 10 years ago. Many of you were present. Since that time a great deal has changed in the development of rehabilitation. There is greater interest on the part of physicians in the problematics. On the basis of expert opinion conclusions have been arrived at which are included in the Reports of the World Health Organisation. It is a reflexion of the changes that have occurred in the world's health service.

The problem of accidents is growing, the problems of the older generation. The numbre cases of Cerebral Palsy is not decreasing and there is a constant rise in the occurance of cardiovascular illness and with the prolongation of the life span there is also a rise in cerebrovascular illnesses.

The health care, thanks also to the technical development, is growing more expensive. It is a socially economic question which is also of interest to politicians. If on the one hand we save and prolong the life span with additional expense-we must also try to return the patient to active life and independence. That is when Medical Rehabilitation appears as prevention of disability. The topics of our Symposium pertain to some of these problems.

I wish you in the name of the Organising Committee a pleasant stay with us and further good experience, scientific, cultural and personal.

Karel Obrda

G. TARDIEU AND C. TARDIEU

DISORDERS OF TONUS AND SPASTICITY: NECESSITY FOR FACTORIAL ANALYSIS

The expressions „tonus", „hypertonia" and „spasticity" are used constantly, but unfortunately everybody gives them a different and often contradictory meaning, which produces regrettable confusion, particularly making it impossible to evaluate the results of treatment correctly.

The present article is in two parts: first the summarized bibliography of 450 references. This shows the contradictory character of the definitions given, making universal definitions of „tonus", „hypertonia" and „spasticity" purely illusory.

The second part shows well defined factors can be isolated and judged in an ever-complex reality by renouncing the use of these expressions. Each factor has different physiopathology and treatment that precise research is progressively bringing to light.

A — DEFINITIONS OF „TONUS" AND „SPASTICITY"

Tables 1 and 2 show the contradictory definitions of „tonus" and „spasticity" that are given by various authors, some of shom are very clear, others much more obscure. The latter may feel that their ideas have been oversimplified in the present article, but for the sake of clarity it was necessary to indicate the principal authors using each definition either exclusively or principally.

Two points should be emphasized: 1) Normal tonus has often been considered to be muscular activity at rest and spasticity an exaggeration of this activity. These definitions have become unacceptable, particulary since the work of Ralston and Libet (1953), who by simultaneous use of surface electrodes, needles and thread showed that there is no electric activity at rest either in the normal state or in subjects that Hoefer (1940) and many others call spastics. 2) Many authors characterize spasticity by an abnormal pattern due to insufficient inhibition in the lower levels of the nervous system by the upper structures, and characterized by the presence of so-called archaic reflexes or automatism. This conception led to numerous „methods" of re-education whose very principle is highly open to critism. As Mollaret and Bertrand emphasized, „d' une analogie de forme on a conclu trop facilement à une analogie de substratum neurophysiogique".

The following is suggested in conclusion: 1) hypertonia or spasticity should no longer be diagnosed, but simply motor disorders due to cerebral lesion; 2) the different factors should be isolated as clearly as possible, their physiopathology investigated and their treatment eventually adapted.

Table 1:

THE VARIOUS AND INCONSISTENT DEFINITIONS OF TONUS

1st Definition

NORMAL TONUS = SLIGHT CONTRACTILE TENSION AT REST

Mueller	1838	Bennett	1888	Foix	1924
Vulpian	1861	Brissaud	1895	A. Thomas	1949
Charcot	1874	Pieron	1920	Levine	1961

CRITICSM = NO EMG ACTIVITY AT REST

Lewy	1923	Lindsley	1935	Weddel	1944
Wacholder	1927	Ingebritsen	1938	Ralston	1953
Adrian	1929	Gilson	1941	Tardieu	1967
Smith	1934	Hoefer	1941	Truscelli	1968

2nd Definition

TONUS = ANY RESISTANCE to passive mobilization

To be distinguished:
— Three tonus properties ("extensivité", "passivité", "consistance", A. Thomas 1949)
— Elastic resistance and reflex resistance

Mc Kinley	1933	Broman	1949	Foley	1961
Weddel	1944	Tardieu	1958	Stolov	1966

3rd Definition

TONUS = REFLEX RESPONSE TO STRETCH

Brondgeest	1860	Magladery	1955
Gowers	1881	Rushworth	1962
Sherrington	1894	Stolov	1966

4th Definition

TONUS = NON CONTRACTING MUSCLE PROPERTIES
(ELASTICITY and other RHEOLOGICAL PROPERTIES)

Cooper	1917	Ralston et Libet	1953
Hoefer	1941	Foley	1961
Clemmesen	1951	Long, Thomas et Crochetière	1964

5th Definition

TONUS = ANY FORCE supporting a POSTURE

Galien II. ième sciècle
CRITISM = NATURE of the FORCE NOT DEFINED

— Permanent muscular contraction, in particular stretch reflex (Sherrington)
— Properties of non contracting muscle (elasticity, viscosity)

CONCLUSION

Obscurity due to iconsistent definitions

The term TONUS must be *given up*
Unanimous Physiological Bern Congress
1931 (Sherrington)

				1976
Cobb et Wolff	1932	Broman	1949	TONUS HYPERTONUS
Hoefer	1941	Clemmesen	1951	HYPOTONUS
Weddel	1944	Rushworth	1962	Unfortunately widely used

Table 2:

THE VARIOUS AND INCONSISTENT DEFINITIONS OF SPASTICITY

1st Definition

SPASTICITY = INCREASED RESISTANCE TO PASSIVE MOBILIZATION

— ELASTIC RESISTANCE
widely accepted in France from Charcot 1874

— PLASTIC RESISTANCE
widely accepted in Great Britain (lengthening reaction)
from: Sherrington 1897
Walshe 1919

1st sub-definition

SPASTICITY = INCREASE of "NORMAL TONUS AT REST"

Charcot — Pierre Marie
Strauss — Van Gechuchten
Vulpian — Dejerine
Brissaud — André Thomas

CRITISM = NO EMG ACTIVITY AT REST
Hoefer et Putnam 1940

2nd sub-definition

SPASTICITY = INCREASED STRETCH REFLEX

Sherrington	1897	Perlstein	1949	Jansen	1962
Foerster	1908	A. Thomas	1949	Webster	1964
Walshe	1919	Tardieu	1954	Herman	1970
Hoefer	1940	Rondot	1958—1968	Dietrichson	1971

3rd sub-definition

SPASTICITY = PROMINENT PART OF ELASTICITY
and other RHEOLOGICAL MUSCLE PROPERTIES

Hoefer	1952	Herman	1970
Foley	1961	Barraquer-Bordas	1972

2nd Definition

SPASTICITY = INCREASE OF ALL REFLEXES "AUTOMATISME MEDULLAIRE"

Foerster	1908	Hoefer	1941—1952
P. Marie et Foix	1912, 1920	Dimitrijevic et Nathaan	
		Dimitrijevic et Nathan	

and many others

BABINSKI'S CRITICSM (1922)
Phenomenon compatible with a very mild handicap

3rd Definition

SPASTICITY = MOVEMENTS AND POSTURE DISORDERS COCONTRACTIONS. SYNKINESIS

Foix et Chavany	1924	Basmajian	1955
A. Thomas	1949	Pendersen	1972
Broman	1949	Bauer	1972

4th Definition

TOPOGRAPHIC DEFINITION
("muscles volitionnels", distal extremities)
Foix et Chavany 1921

DEFINITION by "ARCHAIC PATTERNS"

H. Jackson — K et B. Bobath
Sherrington — A. Milani Comparetti
P. Marie et Foix — Vojta
Temple Fay

CRITICISMS

Babinski	1922
Mollaret et Bertrand	1945
Rondot	1968

ENGLARED DEFINITIONS

ETYMOLOGY: SPASTICITY = CONTRACTION, SPASTICITY = INTRICATE CONDITION

Haughlings-Jackson	1888	Sigwald	1954	Morošini	1972
Denny Brown	1947—1965	Vazuka	1958	Norton	1972
Phelps	1945	Levine	1961	Bauer	1972
Lindsley	1949	Campbell	1965	Mc Lellan	1973

CONCLUSION

OBSCURITY DUE TO INCONSISTENT DEFINITIONS

Broman	1962	Pedersen	1972

B — FACTORIAL ANALYSIS

1] Irrepresible contractions at rest (Factor B]

An essential point in this factor is the *notion of instructions*. Lying down in a calm room, the subject is asked to make no movement or contraction. We have already seen that to make a normal subject always reaches this relaxation. Some subjects with cerebral lesion can relax just as well as normal subjects.

Others, on the contrary, have irrepressible contractions — that is, they cannot help making contractions. Electromyography is the best technique for recognizing the existence of and attempting to evaluate Factor B. Figure 1 shows that is activity before stretching. It decreases during stretching, but is a contingent phenomenon that changes from one stretching to another. That is not the essential point, but the existence of contractions before any stretching. Simple clinical examination provides sufficient appreciation. The muscles, or still better the tendons, may be merely palpated. However, it i better to use „sower's" manoeuvre described later.

These irrepressible contractions may affect antagonist groups equally, in which case there is stiffening instead of movement. Many people call this spasticity, pyramidal contracture or extrapyramidal stiffness. Orthers refuse to use these expressions.

However, in other cases or at other times, contractions affect antagonist groups unequally, producing movement often referred to as athetosis or choreoathetosis according to whether it is slow or rapid. However, it is unsatisfactory to use different terms to designate one and the same factor. It is also frequent for a subject to have stiffening at one time, athetoid movements at another time, and sometimes choreic interesting, or reference to patterns that themselves often change from one moment to the next.

It is much more important to distinguish two subfactors in Factor B: factors in Factor B:

Sub-factor B_1: the subject suffers from anxiety. Irrepressible contractions are small or even absent when he feels secure in his family circle. They become exaggerated and sometimes tremendous when he finds himself in an unusual situation, for example in the presence of a doctor. Anxiolytic medicaments often have very favourable action on irrepressible contractions in these cases.

Sub-factor B_2: this is the opposite picture. The subject is calm. The intensity

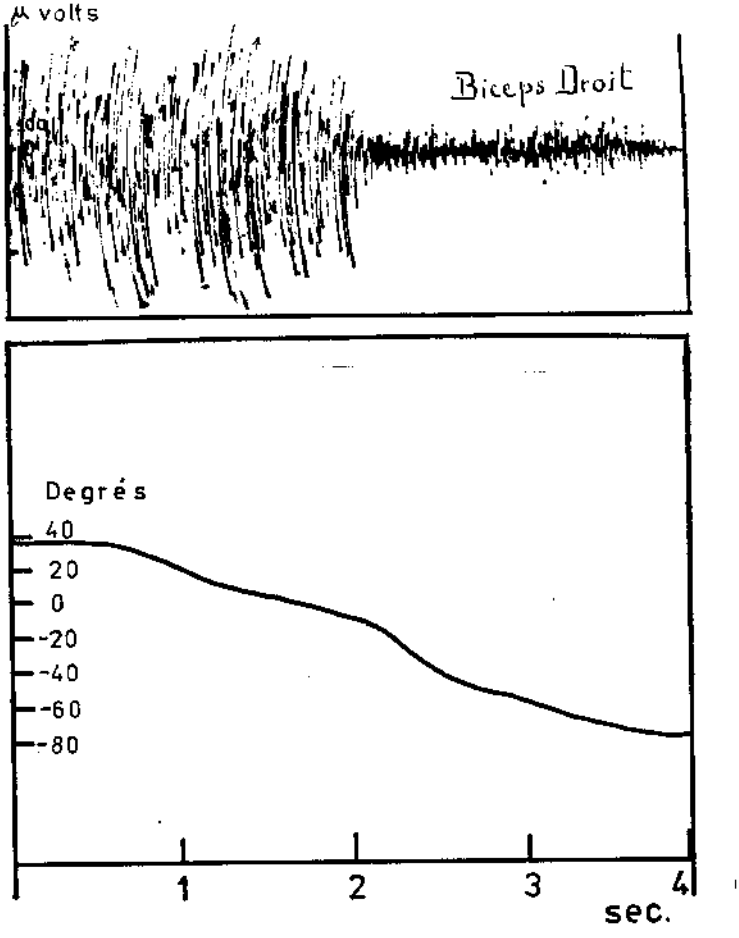

Figure 1. — Irrepressible contractions at rest.
Ordinate, above: EMG of biceps brachii recorded by surface electrodes.
Below: angle of elbow.
Abscissa: time: strong EMG activity before any stretching. This irregular character of the latter is due to variations in force.

of irrepressible contractions varies very little according to the circumstances. Anxiolytic medicaments have no beneficial effect. Various methods of re-education do not have a durable effect. Surgical tendinous elongation is contra-indicated.

II) Disordes of elasticity of the muscle, myostatic contracture

Condition of evaluation. In order to appreciate the elasticity of the muscle, no muscular contraction must exist either before or during stretching. If contraction exists, it must be supressed by blocking the nerve with procaine

or by means of ischemia. The aim is to obtain momentary paralysis and especially abolish the tendon reflex.

Appreciation of elasticity of the muscle can be made precisely in the laboratory by drawing up a tension-extension or a coupleange curve. Hoeewever, simple clinical examination gives sufficient apreciation. The angle at which minimum resistance exists and the angle at which considerable resistance is encountered must be measured. For example, to study the triceps surae, the knee must be kept straight and passive mobilization made in the direction of dorsi-flexion of the foot. In normal conditions there is a slight resistance at 15 — 20° of plantar flexion or extension and considerable resistance at 15 — 20° of dorsi-flexion, in other words a total course of approximately 35°.

When elasticity, is impaired, i. e. when myostatic contracture is present, the curve is displaced and more abrupt. For example, there is slight resistance at 35° instead of 15 — 20° of extension, and strong resistance at 30° of plantar flexion instead of 15 — 20° of dorsi-flexion, that is a course of 5° instead of 35°.

Standard histological examinations of the muscle show no impairment especially no fibrous tissue invasion. However, we have noted that there is considerable decrease in the number of sarcomeres in all muscles in state of myostatic contracture (J. C. Tabary et al 1971).

We have shown by experimentation in the cat (J. C. Tamary et all 1972) that the number of sarcomeres is regulated in the normal state. If the paw is imobilized in extension (soleus shortened) for three weeks, the tension-extension curve is that of myostatic contracture and the number of sarcomeres greatly decreased (60 %). On the contrary, if the solues is immobilized in extended position in a plaster cast, the number of sarcomeres increases (120 %). If the paw is immobilized in extension for three weeks and a right angle for a further three weeks, the number of sarcomeres is normal.

This regulation explains how myostatic contracture in a child with cerebral lesion may be due to two opposing mechanisms that require two opposing types of treatment.

a) *Myostatic contracture due to regulation disordes*

In some children it may be suggested that this regulation were insufficient or absent. Whereas the bone grows, as in all children, the muscle does not grow, or does not grow sufficiently. It therefore becomes relatively shorter and shorter compared with the bone. We may consider this to be the case 1) when there was no prolonged immobilization of the muscle in shortened position because of too frequent or permanent contractions; 2. when despite treatment myostatic contracture progressively increases from year to year. In such case, apparatus worn day and night, successive plastercasts and re-education have no effect. Only surgical tendinous elongation is indicated as its inconveniences (G. Tardieu et al 1973).

b) *Myostatic contracture due to faulty position and regulation preserved*

An opposite mechanism appears to be responsible in other children. Contractions that are too permanent immobilize the muscle in shortened position too long during the day. As regulation of the number of sarcomeres is normal, the muscle adapts its length, that is, the number of its sarcomeres. Surgical tendinous elongation must definitely not be used in this type of myostatic contracture. In animal experimentation as in clinical

work, we have noted that the muscle readapts intself to rapid recurrence is observed. On the contrary, unlike the preceeding case, succesive plaster-casts cause the myostatic contracture to disappear in three weeks.

III) Myostatic reflex in its kinetic period

Examination conditions: as in decerebrated preparation, there must be no contraction before stretching. If there is, examination must be deferred until it has ceased. It is impossible to make valid appreciation of the myotatic reflex while basal contractions exist.

Stretch reflex threshold: the myotatic reflex only appears when sufficient speed is attained. Very high speed is necessary for constantly producing the stretch reflex of a normal biceps brachii. This reflex threshold, which is very high in the normal state, is lowered in case of exaggerated myotatic reflex. Force increases exponentially with speed beyond this threshold.

Relation between stretch reflex and amplitude of muscle stretch. In most muscles, when the stretch reflex is exaggerated, it attains a maximum at the end of stretching. As Burke et al (1970) definitively showed, the quadriceps is not bound by this rule. The stretch reflex of this muscle certainly increases with speed, like the one of all muscles, but decreases with the length — in other words, with the degree of stretching. This explains the longthening reaction of Sherrington, also referred to as the „clasp knife" phenomenon.

IV) The myotatic reflex in its static period

Various cases may occur:

a) *Normal state.* We have just seen that the myotatic reflex has a very high threshold. There is no myotatic reflex in the static period.

b) *Myotatic reflex with low threshold, but not persisting in static period.* This is the case with Parkinson's disease. Resistance becomes zero as soon as the stretching is finished. There is indeed persistent EMG activity, but it is equal in the stretched and antagonist muscles, which has no further relation with the stretch reflex.

c) *Myotatic reflex with low threshold. Regular and progressive diminution in static period.* The essential characteristic is the extreme regularity of myotatic reflex diminution. This may be very easily appreciated in clinical examination if a strict technique is observed. As soon as important resistance is encountered during passive mobilization, the angle at which it occurs must be maintained patiently, and resistance will decrease very progressively in the course of time (Figure 2).

This characteristic of progressive diminution is what is observed in the Sherrington preparation. Now it has been demonstrated that there ie exaggeration of gamma fusimotor discharges in this preparation. The application of procain to the nerve spresses the myotatic reflex in this preparation without causing paralysis. This selective action is due, as Matthews and Rushworth showed, to selective paralysis of the gamma fusimotor fibres.

As this action is transistory, we replaced procain with 45 % alcohol. Three weeks after application of 45 % alcohol, we observed the same selective action in the decerebrated cat, that is, suppression of the myotatic reflex in its static period despite absence of paralysis (Figure 3).

Applying this experimentation to human clinical work, we inject alcohol either at the motor points of the muscle or by epidural route. Here again, suppression of the myotatic reflex in static period and absence of paralysis

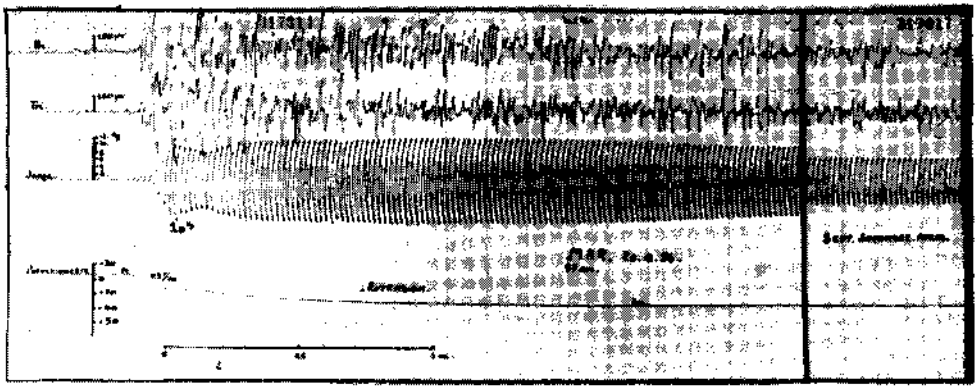

Figure 2. — Stretch reflex exaggerated in static period.
Ordinate top to the bottom: 1. EMG of biceps brachi/ 2. EMG of triceps brachi; 3. force recorded by strain gauge placed at the lower and of forearm. The force is expressed by the amplitude of oscillations; 4. angle of the elbow. Abscissa, time.
It will be observed that, as in normal state and unlike figure 1, there is no activity rest before stretching. Strong EMG activity and strong resistance appear during stretching. The essential point is that resistance decreases very progressively in course of time. This resistance implies that the muscular activity of flexor muscles is more important than that of the triceps.

are observed. We have made approximately 2000 injections and never had an accident. Suppresion of myotatic resistance lasts for months and often several years.

Exaggeration of the myotatic reflex may be the only cause of equinus. In this case it disappears after infiltration.

However, it should be remarked that this technique disappoints those who forget that it is useful only in one case: when abnormal resistance to passive mobilization is due to myotatic reflex progressively decreasing in its static period. That is, this method fails when resistance is due to basal contractions or myostatic contracture. It also fails in cases in which progressive diminution of resistance is not connected with myotatic reflex but, as Foley and also Herman showed, with phenomena of muscle visco-elasticity. It also fails in cases of myotatic reflex that we shall go on to describe.

d) *Myotatic reflex with irregular decrease.* In this case, also, passive mobilization at a sufficient speed encounters important resistance at a certain angle. The examiner holds this angle firmly and then observes that, unlike the preceding case, diminution is irregular, suddenly giving way, then becoming stronger than ever, pushing his hand back. Infiltration of 45 % alcohol can be attempted of the myotatic reflex is no longer connected with excessive gamma discharges, but with another mechanism (alpha hyperexcitability, insufficient presynaptic inhibition, insufficient activity of Renshaw cells, for example). Up till now all treatment attempted was unsuccessful, as in the case of factor B_2. This is why after histologically and physiologically satisfactory animal experiments, we began to make injections of 96 % alcohol at the motor points (G. Tardieu et al 1976) often with very successful results without incident (about fifty cases).

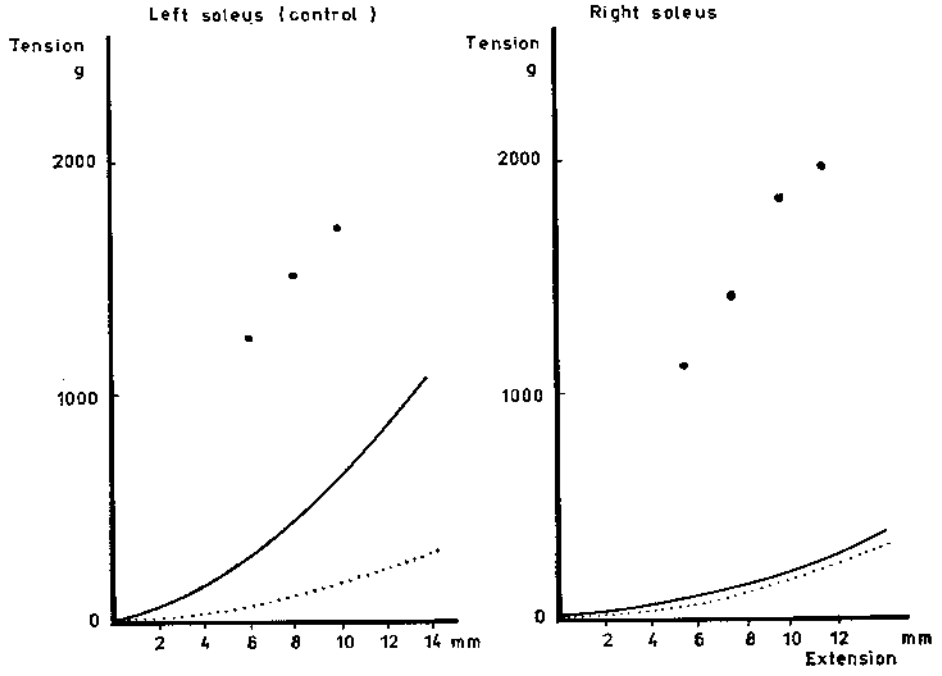

Figure 3. — Decerebrated cat. Ordinate, tension. Abscissa, extension. Comparison of left (control and right soleus (application of 45 % alcohol on nerve 20 days previously). The forces obtained by direct stimulation (.) of the sciatic nerve are similar on both sides. Tre curves shown by continuous lines indicate the force exerted by the muscle at different lengths when the nerve is intact. Dotted lines indicate this same force when the nerve is severed. The myotatic reflex is represented by the differences between the two curves; it is very strong on the control side and almost zero on the alcoholized side.

e) *Clonus.* If stretch is maintained after rapid stretching, a series of discharges ise recorded 6 per second in principle. Although we do not know why, infiltration with 45 % alkohol succeeds or fails, according to cases.

„Sower's" manoeuvre. Before concluding this section concresing the myotatic reflex, it might be interesting to indicate a personal test of real practical advantage. The subject lying in supine position and a sudden and very rapid movement of passive extension is applied to the forearm, for instance, the limb is immediately let off and allowed to continue its movement. In the normal state there is a slight check preventing the hand from striking the table, unlike what occurs in case of the paleocerebellum syndrome, for example. If the stretch reflex is exaggerated only in kinetic period, the check is much stronger, the limb soon stops its motion, but remains at the point where it stopped. If the stretch reflex is not only exaggerated during the static period, the limb not only soon stops, but travels backwads. Lastly, if there are basal contractions before the test, the limb *immediately* comes backwards. This lack of latency shows that it is not a question of stretch reflex, but basal contractions. This is the best method of displaying them and making clinical appreciation of their intensity.

V) Ipsilateral flexion reflex

Pinching the skin of the foot or forced flexion of the toe provokes flexion of the hip, knee and foot which the normal subject can prevent if he is not taken by surprise. Lack of control of this reflex and the associated one, crosed extension reflex, can by extremely troublesome. No non-mutilating treatment has proved definitively effective, which is why Guttman made injections of absolute alcohol in the subarachnoid in certain patients having paraplegia due to lesions of the spinal cord.

Mere friction of the external part of the sole of the foot can limit this reflex to dorsal flexion of the foot; Babinski showed that this had the same value as slow extension of the big toe. The value of these sings for demonstrating pyramidal injury needs no further argument, but they have no relation with the severity of the handicap, as Babinski himself showed. They cannot, therefore, be used for factorial analysis.

VI) Contraction of triceps by planter contact

Contact with the sole of the foot may not provoke flexion of the foot, but extension by contraction of the triceps, that can be very troublesome during walking. The use of anesthetic ointment may be useful in these cases.

VII) Contraction of triceps by plantar pressure

It may happen that plantar contact does not provoke contraction of the triceps, but that pressure, particularly that of the heel, causes abnormal contraction of this kind may be troublesome during; it may even be likened to the „extensor thrust" referred to by Sherrington and the „Stützreaktion" (positive supporting reaction) of Rademaker. As fibres sensitive to pressure are the same diameter as the gamma fusimotor fibres, we had the idea of injecting 45 % alcohol, not in the muscle, which has no effect in this case, but rather round the posterior tibial nerve behind the international malleolus. The result is often excellent for months or even years.

VIII) Insufficient control of afferences

Any sudden change in afferences provokes intense prolonged contractions in certain subjects. These prolonged reactions distinguish this factor from the simple startle reaction that can be intense, but always very brief. We use three tests to appreciate this factor in routine examinations — sudden intense noise, menace of a pin, pricking the external ear. When reactions are too intense, and especially when they are prolonged after these tests, we refer to this as Factor E. Pathology and treatment of factor E are totally different from Factor B described above. Unlike Factor B, Factor E is very sensitive to re-education and is in no way improved by anxiolytics. On the contrary, amphetamine produces an improvement.

IX) Hyperexcitability

Excessive contractions appear in other subjects not only during the preceding tests, but also during mental calculations and Jendrassik manoeuvre. Alpha hyperexcitability was plausible. Derivates of Gaba, especially Lioresal, would then be indicated. Results of this treatment were not decisive.

One way of resolving this problems was to turn to the Hoffman reflex, first using the $\frac{H\ Mx}{M\ Mx}$ method, secondly studying the H reflex recovery cycle.

Many works have been devoted to this subject, but they are somewhat contradictory. This is hardly surprising, since while reflexological studies were very precise, an equally precise clinical study was not made. They covered „spasticityü in general, which as this paper has shown comprises very diversified factors with different physiopathology. It is therefore hardly surprising that reflexological results are somewhat hardly confused. We have resumed these studies in an attempt to correlate reflexological results with various factors. It would be premature to announce our results.

Studies by Dimitrijevic and Nathan throw interesting light on the question; they not only noted basal contraction and excessive responses to exteroceptive and proprioceptive stimulation in patients having paraplegia due to lesions of the spinal cord, but also found that these response affected both agonists and antagonists, contrary to Sherrington's law of reciprocal innervation. Then they paralyzed a lower limb, either by blocking the nerve with procain or by temporary ischemia, and found not only suppression of spontaneous activity and decreased reactions to exteroceptive and proprioceptive stimulations in the other limb, but also the appearance of reciprocal innervation. They deduced from this that suppression of one part of the afferences arriving to the spinal cord which they called decreased „input", caused decrease in pre-existing spinal excitability.

This seems on a par with Förster's idea: he obtained amelioration by sectioning a few posterior roots in cases that were probably comarable. Unfortunately his idea, which may still be quite valid in this case, was not only etended to all cases confusedly qualified as spastic, but even led to performing wide spread radicotomies that should, in fact, be avoided, as they suppress all afferences of the lower limbs and thus make re-education impossible.

X) CO-Contractions in posture and movement

Sometimes none of the above factors is present, yet in postural maintenance, postural support or movement there are excessive contractions of antagonists or muscles entering into pathological synkinesis.

In that case the organization of posture and movement is disordered. In the normal state the orders given to the various muscles by the central nervous system contain exact instructions as to intensity and duration. The more the normal subject is gifted and experienced, the better will be the organization. This is what sportsemen call style. Organization progressively improves throught development from birth to adult status, but is defective in many subjects with cerbral lessions, According to Janda's apt expression, orders are distributed to the various muscles in confusion. None of the treatments proposed for the preceding factors is of the slightest use in cases of this kind. This is the major field for re-education; re-education implies a learning, and any learning must be performed in full consciousness. Attentive participation of the subject is indispensable. This does not mean trying to inhibit so-called archaic reflexes or automatisms that Pfeiffer et al (1969) showed to be present only exceptionally. Any method claiming to inhibit such reflexes or automatism therefore seems to us to be suprious from the start. Any method claiming re-educate the brain stem seems to us to run counter to neurophysiological knowledge. This does not in any way signify that the techniques used by protomers of these methods are to be rejected. However, their actions speak louder than their words. Let us use the technique we prefer, but let us always ask the subject for attentive participation. Let us also use the apparatus of Phelps and Pelstein that outside re-education sessions reminds the

subject throughout the day excessive contraction of certain muscles. We also use the electromyophone for giving the subject further information concerning the existance of such excessive contractions.

AN EXAMPLE OF FACTORIAL ANALYSIS

The study of all these factors might appear complicated and over-theoretical. It therefore seems useful to give a concrete example, chosen among many others. This is the case of a child with equinus in standing and walking posisick persons.

The first examination showed no basal contractions in this child, although pressure of the heel was seen to cause strong contractions of the triceps surae. These contractions prevented valid study of the effects of muscle stretching. An injection of 45 % alcohol was made around the posterior tibial nerve: all contractions due to pressure disappeared. If this factor had been the only cause of the equinus, the latter would have disappeared, in the case of thi child, suppression of this factor did not suppress the equinus.

The examination was therefore continued. It was now possible to study the myotatic reflex correctly. In fact, we found strong resistance at 25° of ex tension, which demonstrate a very progressive decrease. This is a clear indication for injection of 45 % alcohol at the motor points. Suppression of the myoatic reflex in its static period was then obseved. In this reflex had been the only cause of equinus, the latter would have been suppressed. But in this case, although the static stretch reflex was suppressed, equinus persisted in standing position.

Henceforward conditions were correct for evaluating the elasticitv of the muscle. It was found that apart from any muscular contraction, there was strong resistance at 10° of extension. There was myostatic contracture, but in a child whose foot was almost always in shortened position because of contractions connected both with afferences during pressure and with the myotatic reflex. Was this myotatic contracture not related to the shortened positionf? Was there not good regulation of the number of sarcomeres? Succesive plaster casts had to be tried for three weeks. This treatment in successful: henceforth an important resistance is no longer found, before 15° of dorsiflexion. The child nevertheless still has equinus in standing position and walking. This does not signify that the preceding treatments were unavailing. Before these treatments, re-education was incapable of improving the equinus. At present, using Perlstein apparatus if necessary, the child can progressively be taught not to contract his triceps excessively in standing position or walking.

It seems appropriate to conclude with this concrete example in order to show that „spasticity" is not sufficiently precise a term. It is just as vague to ask what treatment should be given for spasticity as to ask what treatment should be given to sick persons.

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FRANJO GRAČANIN

MOTOR OUTPUT AND MOVEMENTS CONTROL BY MEANS OF FUNCTIONAL ELECTRICAL STIMULATION (FES) IN PATIENTS WITH UPPER MOTOR NEURONE LESION

Introduction

Attemps at exploiting electrical phenomena in the restauration of motor functions go far back: as early as 1749 Deshais wrote a thesis entiled „De Hemiplegia per Electricitatem Curanda". In 1952 appear in the literature the names of Levin et al. 1952 describing the effect to electrical stimulation on the relaxation of spasticity in antagonistic muscles, and those of Liberson et al. in 1961 and Moe J. M. and. M. W. Post in 1962 applying electrical stimulation (ES) in control of the gait of the hempligics: after a prolonged gap these were first contributions of importance towards the rehabilitation of patients with upper motor neurone lesion using ES. Our experiences with patients in whom after a longer period, following the onset of CVD all other therapeutic methods led to no amelioration, showed that the application of FES induced improvement of voluntary control of motor output and a more normal activation of single muscles when walking. (Gračanin et al. 1967; Gračanin, M. Dimitrijevič, 1969).

This was the basis for further studies with a view to prevent the development of uncontrolled motor output and new organisation of motor activity, characteristic for the clinical picture of spastic paresis or paralysis, this being achieved through activation of nonresponsive muscles and restauring normal, though reinforced feedback, and through both inhibition of adequate muscles, and creating patterns of „normal" motor output whioh is no more difuse and uncontrolled. Apart from this, we have developed systems utilized by the patient simultaneously as an orthotic aid i. e. the Ljubljana Functional Electronic Peroneal Brace (FEPB) type PO 8, Functional Electronic Peroneal Apparatus (FEPA) 10, FEPA 12 etc. designed for the stimulation of n. peroneus by means of skin electrodes which are commercially available (Gračanin 1971; Gračanin and Vrabič, 1974). The Ljubljana Functional Electronic Radial Brace (FERB) (Gračanin and Dimitrijevič, 1968) and a system specially developed for children for the so termed contralateraly controlled alternated functional electrical stimulation i. e. CCA FES (Gračanin et al. 1975) whill be soon available.

Results

The data gathered by the end of 1974 show that the application of FES was performed in 611 adult hemiplegics and carried out in the framework

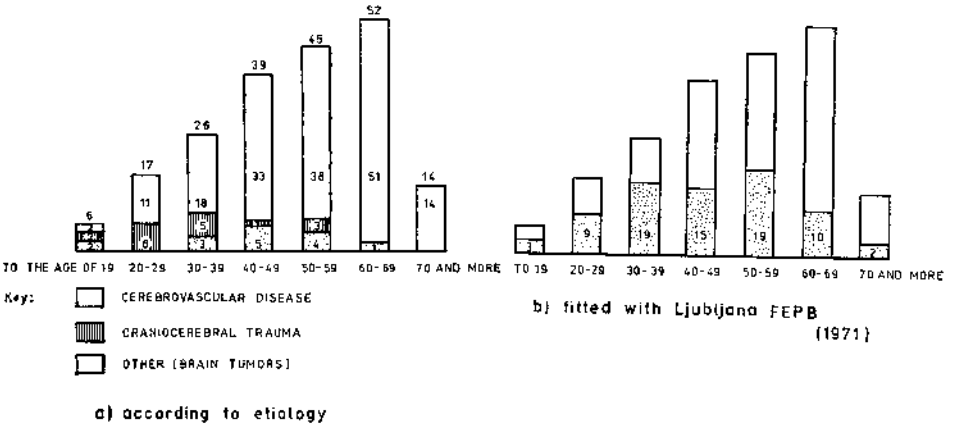


Table 1: distribution of patients according to age and etiology and according to the application of FERB.

of the programme as functional electrotherapy 234 out them use the system as an orthotic walking aid. The studies carried out in 199 patients (Gračanin, 1971) bring about distribution of the patients according to both, age and etiology and according to the number of the applied systems for FES (Table 1). Up till the present moment the proportions have not been subject to any essential modifications and we may say that our population of hemiplegics comprises cca 30 % of those in whom exists indication for applying FES. When stimulating n. radialis or finger extensors we found improvement of voluntary control muscular contraction also in remaining muscles which had not been stimulated, as can been from Table 2.

Apart from the changes in the kinematics of the gait, control of the movements of single joints, finger and wrist extensor, we succeeded in inhibiting voluntary controlled, unvoluntary and reflex motor activity an hypertonus in antagonistic muscleis i. e. finger and wrist flexors along with restauring cyclic activation of the muscles and reciprocal inhibition when walking. (Gračanin, 1970) Fig. 1.

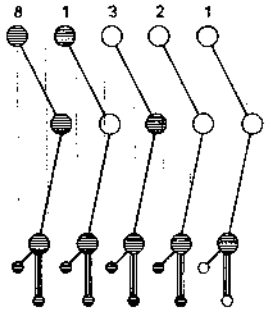
The use of FES in children proved even more satisfactory though it required some modifications of the already introduced method in relation primarly to the position of the electroded, mode of stimulation, changes in the way adapting to the gait etc.

In these children obtained, apart from gait improvement also improvement of the posture. When walking some of them presented the absence of circumduction (if it had been present), reduction of internal rotation in the hip joint and correction of equivarus of the foot: after a prolonged period of utilizing FES, we found also correction of unstable knee joint or recurvatum, as well as the reduction of other anomalies.

When developing the system for FES, we were laying special emphasis on the development of the biological — hardware interface which can been seen from the functionaly of FEPA 10, FEPA 11, FERB.

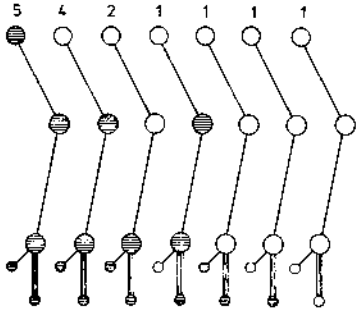
Fig. 2, 3, 4, and 5.

NUMBER OF PATIENTS TOTAL
15



	MUSCLE	BOTH	SEPARATED	TOTAL
SHOULDER	ABDUCTORS (m. deltoideus)			9
ELBOW	FLEXORS EXTENSORS	6	1 2	9
	SUPINATORS PRONATORS	9	1 1	11
WRIST	FLEXORS EXTENSORS	10	1 4	15
THUMB	FL., ADD., OP. EXT., ABD.,	11	1 2	14
FINGERS	FLEXORS EXTENSORS	8	0 6	14

NUMBER OF PATIENTS TOTAL
15



	MUSCLE	BOTH	SEPARATED	TOTAL
SHOULDER	ABDUCTORS (m. deltoideus)			5
ELBOW	FLEXORS EXTENSORS	2	0 4	6
	SUPINATORS PRONATORS	9	0 1	10
WRIST	FLEXORS EXTENSORS	6	1 3	12
THUMB	FL., ADD., OP. EXT., ABD.,	8	0 4	12
FINGERS	FLEXORS EXTENSORS	2	0 13	14

Table 2: FES effect on the restauration of voluntary controlled motor activity of the hand muscles in afferent stimulation of n. radialis.

Neurophysiological considerations

In patients presenting upper motor neurone lesion exist changes in the functional state of the spinal motor neurones though there do not appear essential changes in electrical exitability (Gračanin and Štefančič, 1972 which enabled chronical use of electrical stimulation (from a couple of months to several years). The difference existing in the excitability treshold of peripheral nerve fibres for the electrical stimulus made possible aplying of, the so termed a afferent and efferent FES, which enabled us to modify the motor output, (facilitation and inhibitation) or induced direct activation of motor units: in this way, we activated propioceptive feedback mechanisms and achieved sensory reinforcement, which is highly significant in coordination training with a pattern of performance repeated several thousand times a day. This renders possible restauring motor engram and inhibition of reflex sinergies.

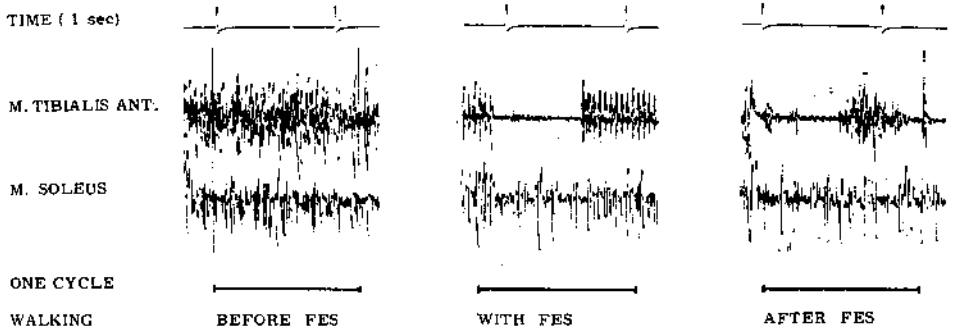


Fig. 1: EMG activity in m. tibialis ant. and m. soleus in single gait phases in a normal subject (left) after a prolonged FES in a hemiplegic (right). In present pronounced reciprocal inhibition which before stimulation existed in the form of diffuse EMG activity or was independent of single gait phases.

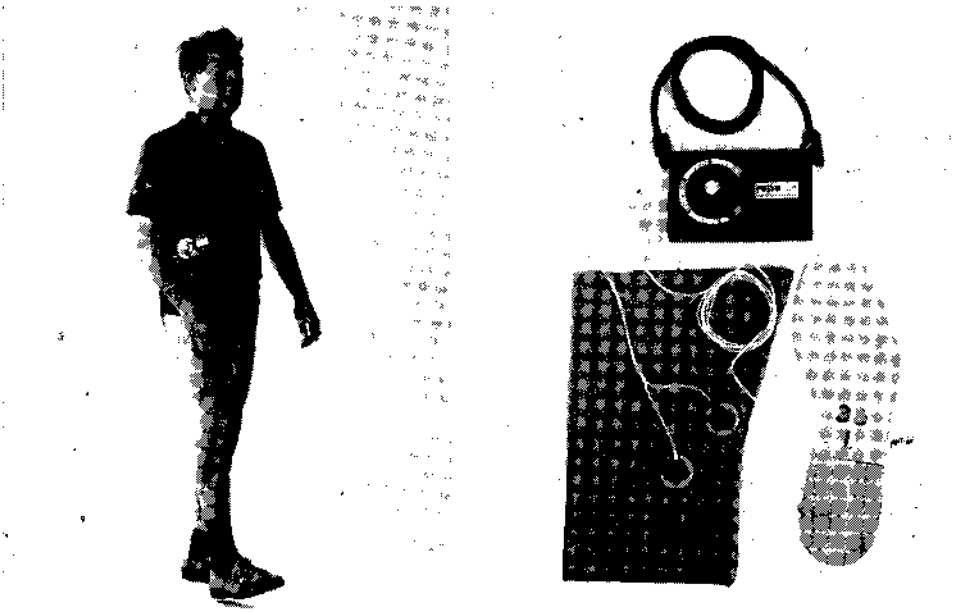


Fig. 2: Functional Electronic Peroneal Apparatus type PO 10 (FEPA 10)
1. Stimulator
2. Elastic knee support with electrodes
3. Innersole with switch
The stimulator is controlled by the hed of the affected limb (the same as in FEPA 10) while connection with the stimulator is carried out by the radio — link. The transmitter is placed within medial longitudinal arch of the foot.

The stimulator is controlled by the heel of the affected limb (the same as in FEPA 10) while connection with the stimulator is carried out by the radio — link. The transmitter is placed withen medial longitudinal arch of the foot.

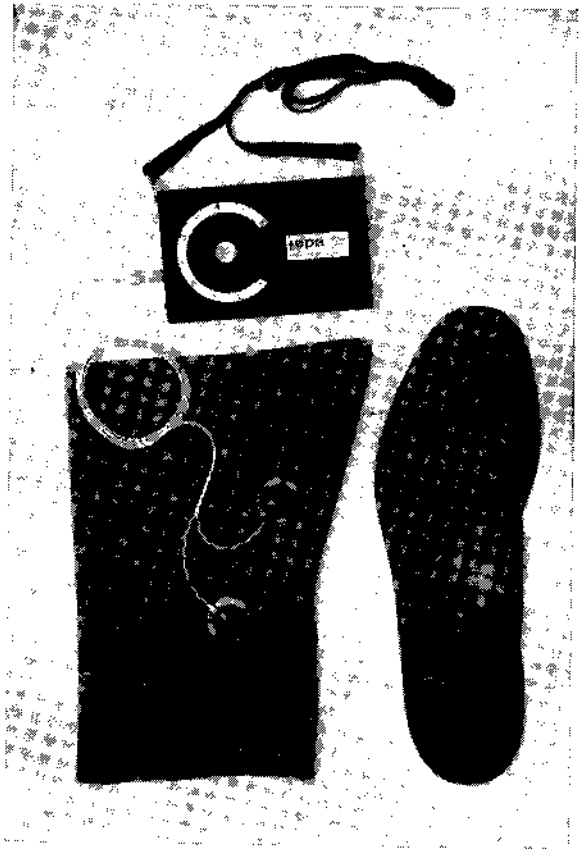


Fig. 3: Functional Electronic Peroneal Apparatus type PO 11 (FEPA 11)

Observations in hemiplegics have shown that in some patients can been recorded greater improvement of voluntary muscular contraction control (greater value for the muscular test) than it is the case with movements of dorsal flexion and eversion of the foot when walking, which shows that much more time is necessary to develop a reliable engram which inhibits ankle inversion as a part of the extensor pattern. I have already attempted in my previous studies to explain some of the inhibitory FES effect with presenaptic inhibition of mechanisms built in sensory motor organization, integrated at level of spinal cord along with the important role described FES effect on the stimulated muscles and their antagonists together with remaining of the effected limbs and the posture, we may assert that FES has not only segmental effect but also suprasegmental and supraspinal related primarly to the organization mostly dependent on the extrapyramidal system responsible for inducing patterns or engrams of motor functions. (Kotke 1975).

Conclusion

1. FES enables selectively repeated control of the contraction of nonresponsive single muscles or muscular groups, and in this way repeatively and pre-

Fig. 5: Gait of a CP child with bilateral FES. Pay attention to the shoes rubbed at the level of foot fingers as the result of a very pronounced dropfoot before applying FES.

Fig. 4: Ljubljana Functional Electronic Radial Brace.

Table 3: Distribution of children according to age groups.

Age	Number of children
to 12 months	0
from 19 to 24	2
from 13 to 18	16
from 25 to 36	31
from 37 to 60	48
over 60 months	124
Total	221

cisely produces the proper pattern, which is in patients with upper motor-neurone lesion, absent or modified.

2. FES enables facilitation of cutano-fusimotor reflexes and reinforced feedback of the affected limbs, which may be repeated several thousand times a day.

Table 4:

Distribution of children according clinical diagnosis, results of test FES, the modeof application and effect of FES on impro vement of the gait and posture

Diagnosis	test FES ±	—	FES performed with wiew to therapy at home	Ortot. Aid Reh. Ins.		Gait and Posture Improved	Mark improved	Long term effect	Note
Hemiplegia	93	15	38	15	16	47	14	41	19 bil
Diplegia and bil. hemi	45	6	25	13	3	29	42	24	57 bil
Monoplegia	9	0	4	1	4	5	4	5	
Quardruplegia		23	9	12	9	0	12		8 bil
Diagnosis not exactly def.	4	3	0	0	0	0	0	0	
Total	174	36	76	49	23	93	33	77	

3. Differences existing in the treshold of peripheral nerve fibres enable us to directly control muscular contraction and movemnts, this being achieved through activating mechanisms existing in normally innervated muscles or modifications of motor outputs through spinal segmental, suprasegmental and supraspinal mechanisms with a view to the facilitation both in voluntary controlled, involuntary and or reflex motor activity.

4. Owing to the development of the clinical method of application and the systems with improved biological-hardware intercace, has been enabled practical use of systems as for instance FEPA 10, being an active orthotic aid, whose function is integrated into sensory motor organization; with minimal energy it controls the releasing of considerable amount of biological energy, adequate muscular contraction and single joint's movements.

5. Our experiences in FES in several hundreds of hemiplegics and patients presenting upper motor neurone lesion caused by CVD or other etiologies and children suffering from cerbral palsy showed that the FES effect is the better the earlier it is applied following the onset of the disease and occuring of the first symptoms. The FES is utilized for a limited period of time as a part of the therapeutic programme, and we continue applying it as orthotic aid with therapeutic effect when it is necessary. Like other methods, FES is limited programme with all advantages and disavantages. It may be completed by methods for biofeedback therapy, through using additional entering chanels for information as it is the case with audio-visuel EMG feedback (Gračanin et al. 1975), especialy when restauring and activating motor functions of the hand.

6. One should avoid undefined indications, attempts at application for practicle use of complex systems with uncertain control sites and signals or signal sources. When doing so, the method will preserve its value and will be of wider practicale use. We may, on the other hand, expect this approach to be of practical effect also in a population of patients with different clinical picture, where the existing changes and deformations are the result of the impaired organization of motor activity and postural reflex mechanisms. (Gračanin et al. 1975 a).

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Summary

Motor output and movements control by means of functional electrical stimulation (FES) in patients with upper motor neurone lesion

In more than 800 patients, adult hemiplegies and children with cerebral palsy has been applied FES method in stimulation of n. peroneus, n. radialis, finger and wrist extensors. The result have been analysed clinically, neurophysiologicall and kinesiologicall. Apart from excitation, have been achieved facilitation in agonistic muscles and inhibition in antagonistic muscles. Further on, have been re-established mechanisms if reciprocal innervation with carry-over effect. Gait and posture improvement as well as that voluntary movements has been achieved. The author discusses also underlying neurophysiological mechanisms responsible for these changes and brings forward of CP children and that of adult hemiplegics.

SATOSHI UEDA, YASUKO FUKUYA, AKIRA SAKUMA, TOKUYUKI HAZAWA, TSUNEO HASEGAWA

STANDARTIZATION OF AN OBJECTIVE TEST OF MOTOR RECOVERY IN HEMIPLEGIA

In the practise of medical rehabilitation of stroke patients, there is an increassing need for an objective evaluation of motor recovery in hemiplegia, in order to record the progress and to assess the effect of the treatments.

Manual muscle testing, which is very useful for the evaluation of muscle strength in peripheral nerve involment or muscle disease, has been revealed uselessor even misleading for the evaluation of motor disturbance in central nervous system involvements, such as stroke.

Central paralysis, or the paralysis of central origin, is essetially different from peripheral paralysis, and its evaluation must be made on entirely different principle.

Signe Brunnstrom (1958, 1970) was the first one who recognized this point and developed an evaluation method of hemiplegia based on the evaluation and dissolution of abnormal synergy patterns. She divided the entire course of recovery of hemiplegia into six STAGES, the first three stages corresponding to the development of abnormal synergies and the latter three ones to the increasing independence of the synergies.

Basic synergies in the upper and lower extremities are shown on Table I.

Although Brunnstrom Test is very useful and actually is widely used by many doctors and therapists, there has been some vagueness in the definitions or criteria in individual subtests as well as in the determination of the stage

Table 1. Basic Synergies in Hemiplegia

— Upper Extremity —

	Flexor Synergy	Extensor Synergy
Shoulder Girdle	Retraction and/or Elevation	Protraction
Shoulder Joint	Flexion, Abduction and External Rotation	Extension, Adduction and Internal Rotation (Pectoralis major)
Elbow Joint	Flexion	Extension
Forearm	Supination	Pronation

B. Basic Synergies in Hemiplegia

— Lower Extremity —

	Flexor Synergy	Extensor Synergy
Hip Joint	Flexion, Abduction and External Rotation	Extension, Adduction and Internal Rotation
Knee Joint	Flexion	Extension
Ankle Joint	Dorsiflexion and Inversion	Plantar Flexion and Inversion

from the results of the subtests/ and more importantly, the six stages is inadequate for the assessment of short-term, minute changes.

This is the reason why we started the multi-clinical cooperative study on the standardization of Brunnstrom Test. The subjects of the study were 314 cases of post-stroke hemiplegia in various stages of motor recovery. There 207 males and 107 females; most of them were between age 40 to 69 years; and about two thirds were within 6 months after the stroke.

Each subtest of the Brunnstrom Test was redefined as objectively as possible and the Test Fonm was constructed. The Test for the upper extremity

Table 2.

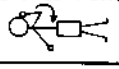
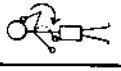
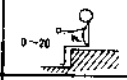
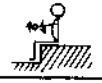
Subtest	
1a	Extensor Pattern—Associated Reaction.  Supine—Affected limb in flexor position shoulder abducted and externally rotated, elbow flexed Unaffected limb is extended against maximal resistance—Positive, if associated contraction of extensors of affected limb is elicited
1b	Extensor Pattern—Voluntary Contraction without Movement.  Supine—Affected limb in flexor position Patient is asked to move affected limb toward opposite hip—Positive, if pectoralis major 1 or triceps 2 shows contraction
1c	Extensor Pattern—Voluntary Movement as Synergy.  Supine—Affected limb in flexor position Patient moves affected limb toward opposite hip—Positive but incomplete, if hand stays short of navel Complete, if hand goes beyond navel
2a	Flexor Pattern—Associated Reaction.  Sitting—Affected limb in extensor position, hand on opposite lap Unaffected limb is flexed against maximal resistance—Positive, if associated contraction of flexors of affected limb is elicited
2b	Flexor Pattern—Voluntary Contraction without Movement.  Sitting—Affected limb in extensor position Patient is asked to move affected limb toward ipsilateral ear—Positive, if upper trapezius 1 biceps 2 or deltoid 3 shows contraction.
2c	Flexor Pattern—Voluntary Movement as Synergy.  Sitting—Affected limb in extensor position. Patient moves affected limb toward ipsilateral ear—Positive, but incomplete, if hand stays short of mamilla Complete, if hand goes beyond mamilla
3	Placing Hand behind Body.  Sitting. Positive, if hand reaches within 5cm of middle line.

Table 2.

4	**Elevation of Arm to Forward—Horizontal Position.**  Sitting. Positive if shoulder flexion exceeds 60°, while elbow does not flex more than 20°
5	**Pronation - Supination, Elbows at 90 Degrees.**  Sitting. Movement is performed bilaterally. Positive, if both pronation 2 and supination 3 are performed beyond 50°, while elbow is kept along the side 1.
6	**Arm - Raising Forward and Overhead.**  Sitting. Positive, if shoulder flexion exceeds 130°, while shoulder abduction is less than 30° and elbow does not flex more than 20°.
7	**Pronation - Supination, Elbow Extended.**  Sitting. Positive, if both pronation 1 and supination 2 are performed beyond 50°, while shoulder flexion is more than 60° and elbow does not flex more than 20°.
8	**Arm - Raising to Side-Horizontal Position.**  Sitting. Positive, if shoulder abduction exceeds 60°, while horizontal adduction is less than 20° and elbow does not flex more than 20°.
9	**Speed Test 1: Arm-Raising to Side.**  Sitting. Time necessary to raise arm 10 times to side-horizontal position is counted. Positive, if time is less than 1.5 times that of unaffected side. Shoulder abduction must be more than 60° and elbow flexion less than 20°.
10	**Speed Test 2: Arm-Raising Overhead.**  Sitting. Seconds necessary to move hand 10 times from shoulder to upright position is counted. Positive, if time is less than 1.5 times that of unaffected side. Shoulder must flex more than 130° and elbow flexion be less than 20°.

consists of 14 subtests (Table 2). As for the lower extremity, we added seven new subtests and eliminated one, thus making total of 18 subtests (Table 3), because Brunstrom's own test for the lower extremity seemed less well de fined than that for the upper.

Instead of the original six STAGES of Brunnstrom, we defined 12 GRADES as shown on Table 4.

The reliability of this newly difined, modified Brunnstrom Test was tested for inter-rater and intra-rater agreement ratio in 142 cases for the upper extremity, and in 105 cases for the lower. Although the agreement ratio of individual subtests varied from about 60 to 100 %, it was above 80 % in most of the subtests. Agreement ratio for the grade was 62,0 % for the upper extremity and 66,7 % for the lower, but the coefficient of determination for the grade was as high as 0,983 for the upper extremity and 0,974 for the lower (Fig. 1).

This result shows that this test has enough reliability for clinical utilization. The validity of this Test was tested by various statistical analyses including those of the item-score matrix and the ogive, or characteristic curve of each subtest.

Fig. 2 shows the ogives or characteristic curves of the subtests for the upper extremities. Each curve shows the percentage of achievement of the corresponding subtest against the total score of all the subtests. The analysis

Table 3.

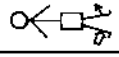
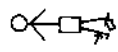
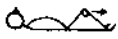
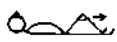
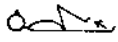
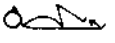
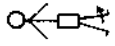
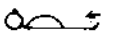
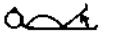
Subtest	
1-1	**Raimiste Reaction—Abduction.**  Supine. Unaffected leg is abducted against maximal resistance—Positive. if associated abduction of affected leg is elicited
1-2	**Raimiste Reaction—Adduction**  Supine. Unaffected leg is abducted against maximal resistance—Positive. if associated adduction of affected leg is elicited.
2a	**Extensor Pattern—Voluntary Contraction without Movement.**  Supine—Affected limb in flexed position. Hip abducted and externally rotated Patient is asked to extend affected limb—Positive. if hip adductors 1 quadriceps 2 or triceps surae shows contraction.
2b	**Extensor Pattern—Voluntary Movement as Synergy.**  Supine—Affected, limb in flexed position. Patient extends affected limb—Positive but incomplete. if knee does not extend beyond 20° flexion Complete. if knee extends more
3a	**Flexor Pattern—Voluntary Contraction without Movement.**  Supine—affected limb in extended position. Patient is asked to flex affected limb—Positive. if hip abductor 1 hip flexor 2 or hamstrings 3 shows contraction
3b	**Flexor Pattern—Voluntary Movement as Synergy**  Supine—Affected limb in extended position Patient flexes affected limb—Positive but incomplete. if hip flexion is less than 80° Complete. if hip flexion exceeds 90°
4	**Hip Abduction. Knee Extended.**  Supine Positive. if hip is abducted more than 20° while knee is not flexed more than 20°
5	**Ankle Dorsiflexion. Supine.**  Supine Positive. if ankle is dorsiflexed more than 5°, while hip and knee do not flex more than 20°
6	**Elevation of Leg. Knee Extended.**  Supine Positive. if leg is raised more than 50°, while knee is not flexed more than 20°.
7	**Knee Extension, Sitting.**  Sitting Positive. if knee is extended less than 30° flexion, while hip is kept in flexion of more than 60°
8	**Knee Flexion, Sitting.**  Sitting Positive if knee is flexed beyond 90° with foot sliding backward on the floor
9	**Ankle Dorsiflexion, Sitting.**  Sitting. Positive. if ankle dorsiflexes more than 5° without lifting foot off the floor.
10	**Ankle Dorsiflexion, Sitting, Knee Extended.**  Sitting Positive. if ankle dorsiflexes more than 5°, while hip is in flexion of more than 60° and knee does not flex more than 20°
11	**Hip Internal Rotation.**  Sitting Positive. if hip internally rotates more than 20°, while hip flexion is more than 60° and thigh is kept horizontal.
12	**Speed Test I—Hip Internal Rotation.**  Sitting Positive. if hip rotation 10 times by affected limb does not exceed 1.5 times of that of unaffected limb.

Table 3.

13	Ankle Dorsiflexion, Standing.  Standing Positive, if ankle dorsiflexes more than 5° while hip and knee do not flex more than 20°
14	Speed Test 2 — Tapping with Foot.  Standing Positive if tapping 10 times with foot with more than 5° dorsiflexion does not require more time than 1.5 times that of unaffected limb
15	Knee Flexion, Standing.  Standing Positive if knee is flexed more than 45° while hip does not flex more than 20°
16	Hip Abduction, Standing.  Standing Positive, if hip is abducted more than 20°, while hip and knee does not flex more than 20° (Angle between pelvis and thigh is measured

Table 4. 12 grades

Grade	Definition		Subtests used		Stage
			U—E	L—E	
0	No contraction				I
1	Associated Reaction only		1a, 2a	1-1, 1-2	II
2	Voluntary Contraction without Movement		1b-1, 2 2b-1, 2, 3	2a-1, 2, 3 3a-1, 2, 3	II
3	SYNERGIES	Incomplete & Zero	1c, 2c	2b, 3b	III
4	SYNERGIES	Complete & Zero, or Both Incomplete	1c, 2c	2b, 3b	III
5	SYNERGIES	Complete & Incomplete	1c, 2c	2b, 3b	III
6	SYNERGIES	Both Complete	1c, 2c	2b, 3b	III
7	Stage IV Tests	One positive	3, 4, 5	4, 6, 7	IV
8	Stage IV Tests	Two Positive	3, 4, 5	4, 6, 7	IV
9	Stage V Tests	One positive	6, 7, 8	10, 11, 13	V
10	Stage V Tests	Two Positive	6, 7, 8	10, 11, 13	V
11	Stage V Tests	Three Positive	6, 7, 8	10, 11, 13	V
12	Both Speed Tests Positive		9, 10	12, 14	VI

Fig. 1.

Reliability of the Test

(Upper Extremity)

Sub-test No	No of Cases	Agreement Ratio(%) 60 80 100
1a	108	
2a	108	
1b-2	26	
2b-1	5	
2b-2	5	
2b-3	5	
1c	63	
2c	63	
3	75	
4	33	
5-1	55	
5-2	38	
5-3	33	
6	49	
7-1	12	
7-2	29	
8	20	
9	40	
10	28	
Grade	142	

(Lower Extremity)

Sub-test No	No of Cases	Agreement Ratio(%) 60 80 100
1-1	23	
1-2	14	
2a-1	4	
2a-2	3	
2a-3	3	
3a-1	23	
2b	4	
3b	45	
4	75	
5	24	
6	73	
7	54	
8	35	
9	46	
10	13	
11	13	
12	26	
13	8	
14	25	
15	49	
16	38	
Grade	105	

Coefficient of Determination
Upper Extremity : 0.983
Lower Extremity : 0.974

of the data of the lower extremity gave the similar curves (Fig. 3).

The results of this analysis were used, together with the test of reliability for the selection and redefinition of the subtest for the further refinement of the Test.

The validity was also tested by principal component analysis of the correlation matrix of the subtests. Fig. 4 shows the results of the analysis after Varimax rotation, for the upper extremity. The subtests seen to form four distinct groups; Ia and 2a corresponding to the contralateral associated reaction, which appears in the earliest phase of the recovery; the group of 1b and 2b corresponding to the voluntary muscle contraction without apparent movement; 1c and 2c corresponding to voluntary movement in synergy patterns;

Fig. 2.

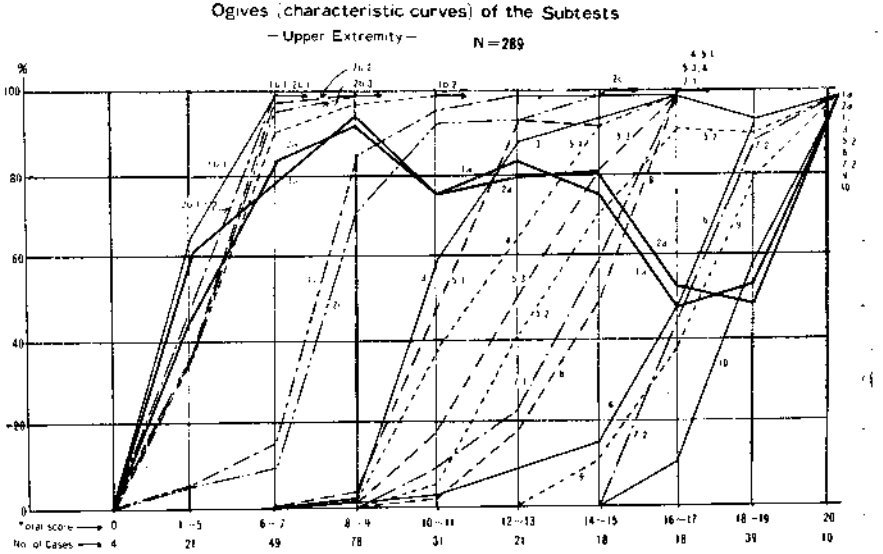
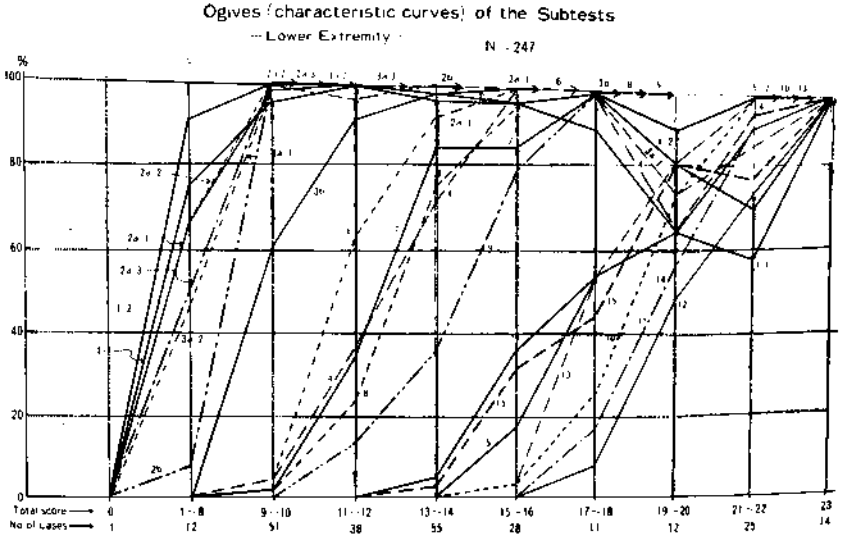


Fig. 3.



and the subtests 3 to 10 corresponding to the increasing degree of independence of the synergies. The data for the lower extremity gave the similar results (Fig. 5).

As the result of these analyses, a further refinement of the Test was made with final selection of II subtests for each of the upper and lower extremities. Fig 6 shows the selected subtests, the definition of the grades from 0 to 12, and the ogives of the subtests for the upper extremity.

Fig. 4.

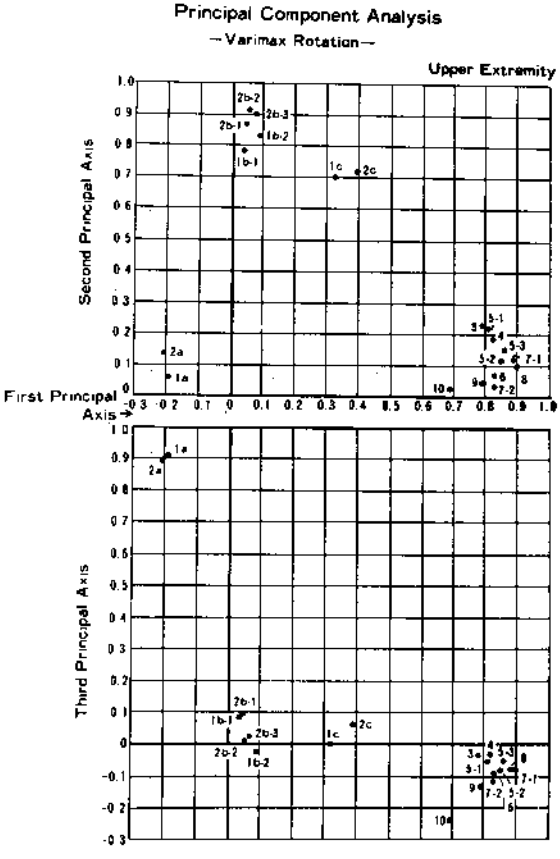


Fig. 5.

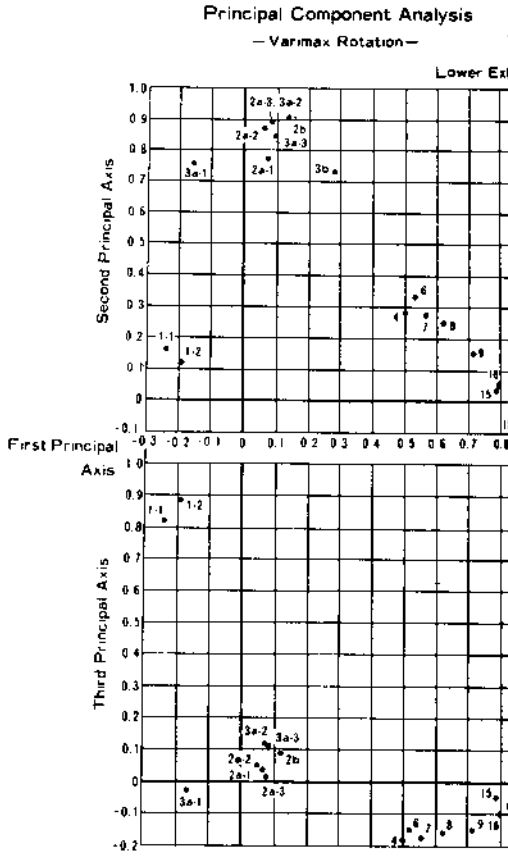


Fig 7 shows the final test for the lower extremity. One subtest, No 16, shown here with an asterisk, was redefined according to the results of the analyses. In addition, Spearman's coefficient of correlation between the grades of the lower extremity and the levels of stance and locomotion activities was 0,770.

In conclusion, we would like to stress that, through the analysis of the data of 314 hemiplegic patients, an reliable, objective test of motor recovery in hemiplegia was standardized and it could become a useful tool in the hand of the professional people engaged in the rehabilitation of the stroke patients.

Fig. 6.

Refinement of the Test—Upper Extremity

Selected Subtests			Grade	Stage
			0	I
1a	Associated Reaction—Extensor		1	II - 1
1b	Voluntary Contraction—Pectoralis		2	II - 2
1c	Extensor Synergy	Incomplete & Zero	3	III - 1
		Both Incomplete or Complete & Zero	4	III - 2
2c	Flexor Synergy	Complete & Incomplete	5	III - 3
		Both Complete	6	III - 4
3	Hand behind Body	One Positive	7	IV - 1
4	Arm Forward-Horizontal	Two Positive	8	IV - 2
5-2	Pronation-Elbow Flexed			
8	Arm Side-Horizontal	One Positive	9	V - 1
6	Arm Overhead	Two Positive	10	V - 2
7-2	Supination-Elbow Extended	Three Positive	11	V - 3
10	Speed Test 2		12	VI

Ogives of the Subtests after Refinement N=289

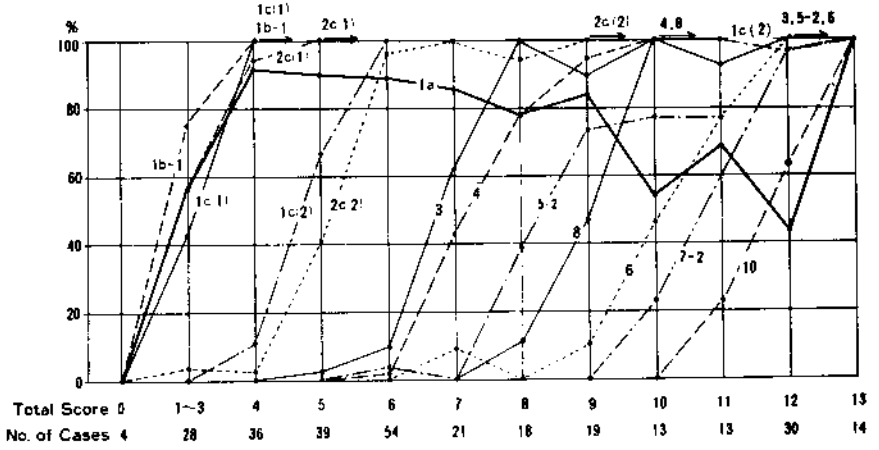
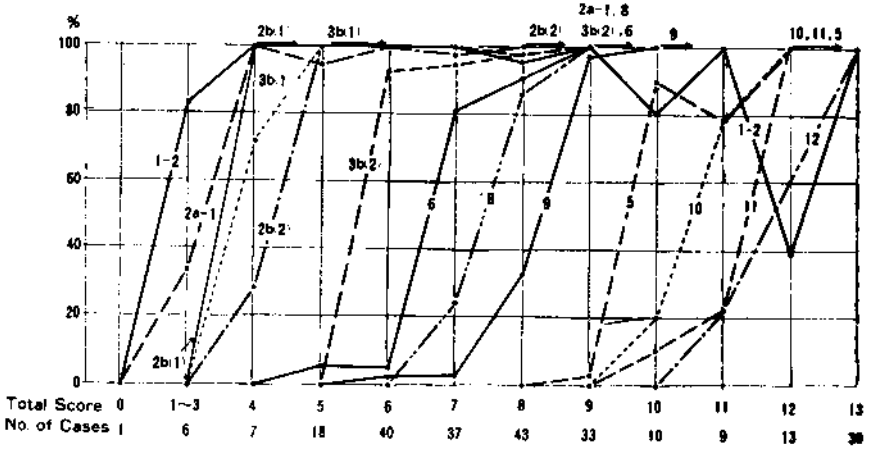


Fig. 7.

Refinement of the Test—Lower Extremity

Selected Subtests			Grade	Stage
			0	I
1·2	Raimiste—Adduction		1	II - 1
2a-1	Voluntary Contraction—Hip Adductor		2	II - 2
2b	Extensor Synergy	Incomplete & Zero	3	III - 1
2b	Extensor Synergy	Both Incomplete, or Complete & Zero	4	III - 2
3b	Flexor Synergy	Complete & Incomplete	5	III - 3
3b	Flexor Synergy	Both Complete	6	III - 4
6 *	Elevation of Leg(>30°), Knee Extended	One Positive	7	IV - 1
8	Knee Flexion, Sitting	Two Positive	8	IV - 2
9	Ankle Dorsiflexion, Sitting			
5	Ankle Dorsiflexion, Supine	One Positive	9	V - 1
10	Ankle Dorsiflexion, Sitting, Knee Extended	Two Positive	10	V - 2
11	Hip Internal Rotation, Sitting	Three Positive	11	V - 3
12	Speed Test I		12	VI

Ogives of the Subtests after Refinement. N=247



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JORDANKA GATCHEVA

A TRIAL TO APPLY THE PRINCIPLE OF FEEDBACK CONTROL IN THE REHABILITATION OF PATIENTS WITH HEMIPARESIS AFTER CEREBRAL HAEMORRHAGE

Feedback in autoregulation is a typical mechanism of the functioning of the nervous system on all its levels, the brain remaining the most perfect, programming, regulating and controling system [A. Granit, P. Anokhin, A. Monster et al., C. Marsden, G. Gottlieb et al., J. Buchwald et al.]

Modern bioengineering achieved effective audio-visual electronic devices for reeducation in motor and sensitive disturbances [J. Henry, K. Smith, W. Bierman and H. Halston etc.]. Basmajian et al. proposed a new principle for active re-education of patients with flaccid paralyses with the aid of kinesiological electromyography by activating and training separate motor units under-direct visual [oscilloscope] and auditory [loudspeaker] information. By this way the least symptoms of restoration may be stimulated and developed.

The present wonks was aidment at the evaluation of the expodiency of the principle of visual and auditory feedback control and its efficiency in the treatment of patients with spastic paralysis. Twenty-five patients with hemiparesis after cerebral haemorahage during the stage of restoration were the object of our investigation. A two-channel electromyograph Disa with superficial electrodes was used for the recording of the bioelectrical activity of the flexors and extensors of the wrist and the fingers of the paralytic hand. The recordings were made: a) at rest/ b) during movements, accomplished in a broader kinematic chain [abduction in the shoulder, extension in the elbow]. The patients were actively engaged in the trial, being instructed to follow the light patterns in the oscilloscope and listen to the loudspeaker. In a preliminary briefing the meaning of the initial electromyogram and the main tasks that had to be achieved with the aid of audiovisual control were explained to them: 1. to relax at most the spastic muscles which is to be followed by the total disappearance of light and sound signals; 2. to carry out a simple movement, thus activating electrogenesis in the main agonists and inhibiting the bioelectric activity in the antagonists; 3. to make use of the principle of „irradiation of excitation", which was achieved by stimulating the inhibited bioelectric activity of certain muscles and carrying out the relatively more preserved or already restored movement of the shoulder and the elbow. With every individual patient the preliminary training included at least 2 — 3 exercises with the aid of the electromyograph and after the method waa well mastered it was included in the general scheme of rehabilitation.

Favourable results were achieved in 21 of 25 patients as well in the muscu-

lar tone as in the active movements of the paralytic upper extremity. In spite of the pronounced individuality in the response of the different patients, some general regularities have been revealed:

1. Under electromyographic control the patients achieved to relax voluntarily the spastic muscles. This came to expression in a reduced bioelectric activity at rest and in slight cases — up to a total bioelectric silence. These effects were generally observed after a phase of initial increase of muscular tone (accompanied by enriched EMG patterns) as a result of the psychic tension at the begining of the exercise. Our observations are pointing at the following moments which play a considerable rôle for the suppression of muscular tone:

With the aid of the oscilloscope and the loudspeaker of the electromyograph the patients gets a concrete impression of the great importance of posture, of the pose of the upper extremity and the pose of the head. A better rela xation of the flexors of the wrist and the fingers may be obtained for instance in a sitting position, compared to the staying position which can be related to the elimination of supplementary impulses (supplementary transmittance of activity) from the altered muscular tone in the lower extremities at standing position. A more complete suppression of the tone of the flexors initial of the wrist and the fingers is being observed in the initial position of supination and to a much lesser extent during pronation, the typical initial position in the pose of Wernicke-Mann. The appropiate inclusion of the cervical tonic asymetric reflexes in 8 patients led to a decrease of the tone of the flexors. Characteristic for the training under audio-visual EMG-control is the active attempt by the patient to find out the most appropriate pose of the upper extremity and the wrist, which is ensuring the suppression of the abnormal bioelectric activity at rest. The elimination of gravity plays a substantial rôle during the attempts for an actively controled relaxation. In the cases, in which antigravitional bioelectric actvity is being superponed over the bioelectric activity at rest, due to an increased muscular tone, the active relaxation proved to be especially difficult. On the contrary, by eliminating gravity, the antigravitional bioelectric activity is being inhibited. Thus the voluntary suppression of electrogenesis, conditioned by the tone, may be achieved to a different extent.

2. A control and correction of proprioception which is „exteriorized" by means of audio-visual control is being achieved to a certain extent also in relation to the motor deficit and disturbances in reciprocal inervation. With initial electromyograms pointing at a weak bioelectric activity of the main agonists and a pathological increased activity of the antagonists, resulting from the stretch reflex, 16 from a total of 25 patients were able to achieve a partial correction of these disturbances. The attempt for movemnt is to be carried out after the elucidation of the initial pose by the patient himself. This proved to be a principal condition. Thus maximal relaxation is being achieved (ensured). The distant audio-visual extent and reduced force. In this case the effect is most pronounced in the enriched EMG of the protagonists. The bioelectric activity of the antagonists remains unchanged or is being inhibited. A short but intensive terminal activity is remaining, which is coinciding with the action of the protagonists being present. In the case of greater efforts by the patient, the most frequent reaction in case he is invited to move, the pathological patterns in the EMG are increasing. With the aid of audiovisual feedback control the trainee is better able to master the rate and force of muscular contraction than in routine kinesitherapy.

With the aid of audio-visual control the patient is being trained also to stimulate the inhibited bioelectric activity and weak motor efficiensy of the distal muscles (the extensors of the wrist and the fingers), which disclose a more difficult restoration. This is being achieved with the aid of appropriate movements against resistance in the more approximal articulations (abduction in the shoulder, extension in the elbow) as the movements in these are being restored earlier and to a greater and more complete extent.

The comprative analysis of the results in both groups, i. e. patients actively participating in kinesitherapy with the aid of simultaneous audio-visual information and the control group of patients submitted to rehabillitation according to the classical methods, revealed to great advantage of the proposed kinesitherapeutic method of patients with spastic paralyses.

Conclusions

1. The kinesitherapeutic method of audio-visual feedback control submitted and endorsed by Basmajian for the rehabilitation of peripheral nerve injuries may be adapted for patients with spastic paralyses after cerebral haemorrhage.
2. Favourable results were observed in relation as wele to spasticity as to existing motor deficit; including the more differentiated movements of ohe fingers.
3. With the aid of electromygraphic control the patient is enabled to find alone the most appropriate initial positions of the body, the head and the paralysed upper extremity. Thus he is creating the optimal conditions for the relaxation of the spastic muscles and fascilitating the performance of an adequate movement. Under audio-visual control the optimal volume and force of muscular contraction are being defined.
4. Wherever possible kinesitherapy of patients with spastic paralysis after cerebral haemorrhage should be preceded of several training exercises under audio-visual control. Thus the active participation of the patients under rehabilitation is being increased and the efficiency of kinesitherapy is considerably improved.

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S. VIOLA, R. MERLETTI, S. ANGELI, D. D' EMANUELE

SHORT AND MID-TERM VARIATIONS OF GROSS MUSCLE FORCE DUE TO FUNCTIONAL ELECTRICAL STIMULATION IN HEMIAPARETIC PATIENTS

Introduction

Changes of maximal voluntary contraction force of paretic muscles in heplegic patients following FES (Functional Electrical Stimulation) has been previously observed and reported by Vodovnik et al., 1973, and Stefancic et al., 1976.

Table 1 Patients stimulated daily

№	Initials and Sex	Age (years)	Time from lesion (months)	I_1	I_2	I_3
1	F. G., m	37	1	2,13	1,60	4,20
2	P. G., f	64	2,5	2,35	1,70	3,60
3	I. S., m	56	2,5	1,54	1,76	3,15
4	G. P. G., m	40	3	1,17	1,10	1,35
5	D. F., m	14	5	1,81	1,77	5,70
6	S. M., m	59	5	2,37	3,40	6,90
7	B. M., f	49	6,5	1,17	—	1,80
Average		45,6	3,6	1,79	1,89	3,82
Standard deviation		15,8	1,7	0,47	0,71	1,83

Table II. Non — Stimulated patients

№	Initials and Sex	Age (years)	Time from lesion (months)	I_1	I_2	I_3
8	M. L., f	63	1	—	1,03	0,30
9	L. G., m	37	1,5	2,00	1,14	2,70
10	T. V., m	68	1,5	1,35	1,43	2,40
11	P. E., f	68	1,5	1,11	2,46	0,96
12	F. S., f	45	4	2,00	1,51	2,25
13	D. S., m	65	4	0,22	0,60	—2,40
14	M. M., f	50	4	—	1,23	1,80
Average		56,5	2,5	1,33	1,34	1,14
Standard deviation		11,5	1,3	0,66	0,53	1,64

However, previous papers did not provide data about the statistical significance and repeatibility of the observed changes.

It is the purpose of this work to provide quantitative data on the short-term (range of hours) and mid-term (range of weeks) variations of maximal voluntary force of paretic-muscles in hemiplegic patients treated with FES of the peroneal nerve for the improvement of ankle dorsal flexion.

Materials and Methods

Most of the research effort concerning FES of hemiplegic patients has been aimed at the lower extremity and particularly at the improvement of the ankle joint function.

Ankle dorsal flexion was therefore chosen as the movement to study in this research.

Contraction force of the anterior group of the leg muscles was measured with an isometric brace with strain-gage transducers. The plegic foot and leg were placed and bound in the brace with the patient seated. The strain gage signal was amplified and displayed by a meter shown to the patient. The patient was asked to produce the maximal deflection of the index. The rotational moment, in Newton meters (Nm) was recorded on a chart recorder.

Each „measurement" consistend of ten maximal voluntary contractions lasting five seconds each and with a five second spacing between each other. The average and standard deviation of the ten values were the outcome of each measurement.

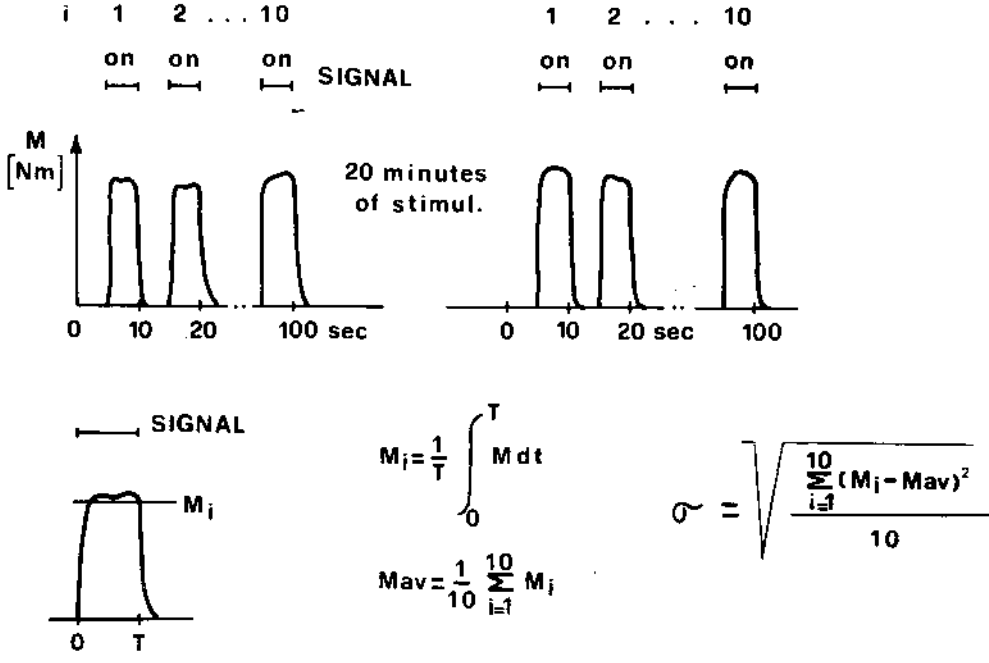

Fig. 1. Time pattern of dynamometric measurements of maximal voluntary plegic foot dorsal flexion.
The contraction signal was given by means of a light. The average moment value M_i was taken for each five second contraction.
The average value M_{av} and the standard deviation δ were computed for for each series of ten contractions.

The diagram of the experimental pattern is reported in fig. 1. A light and a programmer were used to give the patient the proper timing information. Stimulation of the peroneal nerve was applied with cutaneous electrodes with 0,3 msec pulse duration, 30 Hz frequency and cycle of 1 sec on, 3 sec off for 20 minutes. The electrodes were placed either on the fossa poplitea and on the head of the fibula or on the motor points of the tibialis anterior and peroneus muscles. A short-term and a mid-term evaluation were carried on. All the patients cosidered in the mid-term evaluation received regular prysiotherapy treatment during the observation period.

Short-Term Evaluation

A number of experiments were performed on six hemiparetic patients in order to evaluate the short-term carry-over effect of FES. No patient had previously used FES; age ranged from 14 to 64 years and time from lesion ranged from 3 to 16,5 months. Each experiment cosisted of six force measurement of the type described above over an 80 minute time interval. In the first two experiments only the six measurements were performed while in the following four a 20 minute stimulation period was placed between the first and the second measurement. The experiments were performed in different

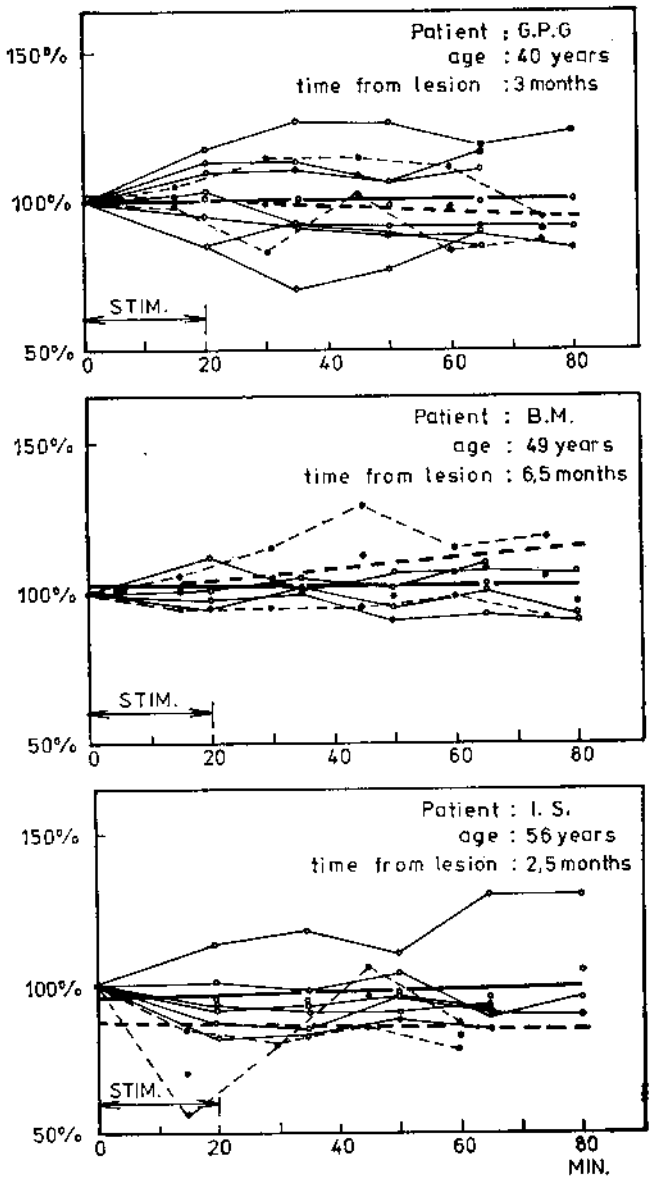

Fig. 2. Short-term time pattern of maximum voluntary moment of dorsal flexion of the paretic foot.

---o---- Measurement without stimulation

Measurements with

Minimum square line interpolating the average of the patterns obtained with stimulation.

- - - - - Minimum square line interpolating the average of the patterns obtained without stimulation.

Each pattern is normalised with respect to its initial value taken as 100 %.

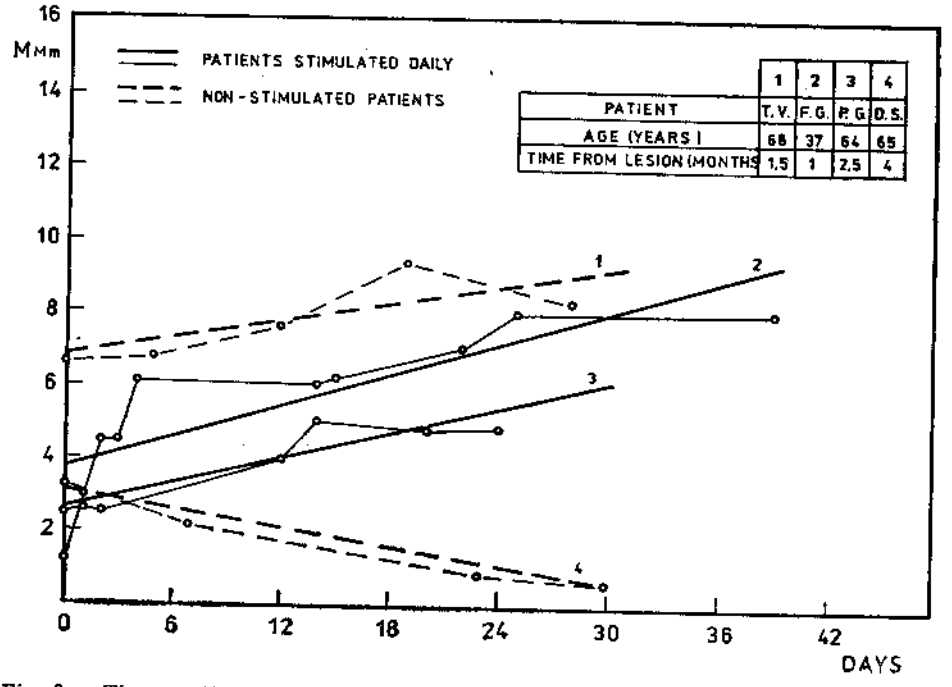

Fig. 3. Time pattern of mid-term measurements in two patients receiving stimulation for 60 minutes (day for 5 days) week (continuous lines) and in two patients receiving no stimulation (dotted lines).

days during one month. The average value of each measurement was plotted as function of time for each experiment. Since the observed pattern of time for each experiment. Since the observed pattern drifted during the month of observation (see Mid-term evaluation) a common reference value was obtained by normalisation of each pattern with respect to the first value.

Fig. 2 shows the experimental outcome from three of the six patients. As shown, increasing, decreasing and stationary patterns were recorded from the same patient in different instances and appeared to be in a random time sequence. The two plots obtained without stimulation were averaged and interpolated with the minimum square line (dotted straight lines of fig. 2). The same procedure for the plots obtained with stimulation led to the continuous straight line of fig. 2.

The slopes of the dotted lines do not appear to be significantly different from those of the continuous line, and neither line appears to have a slope significantly different from zero. While a single experiment may show a marked force increase or decrease following FES (from + 60 % to — 50 %) it appears that if the experiment is repeated at least 5—6 times on the same patient its expected time pattern does not show a significant deviation from stationarity. The variability of the single outcomes is probably due to subjective and random factors.

The initial value of each pattern ranged from 2 to 13 Nm while the normal range goes from 20to35 Nm.

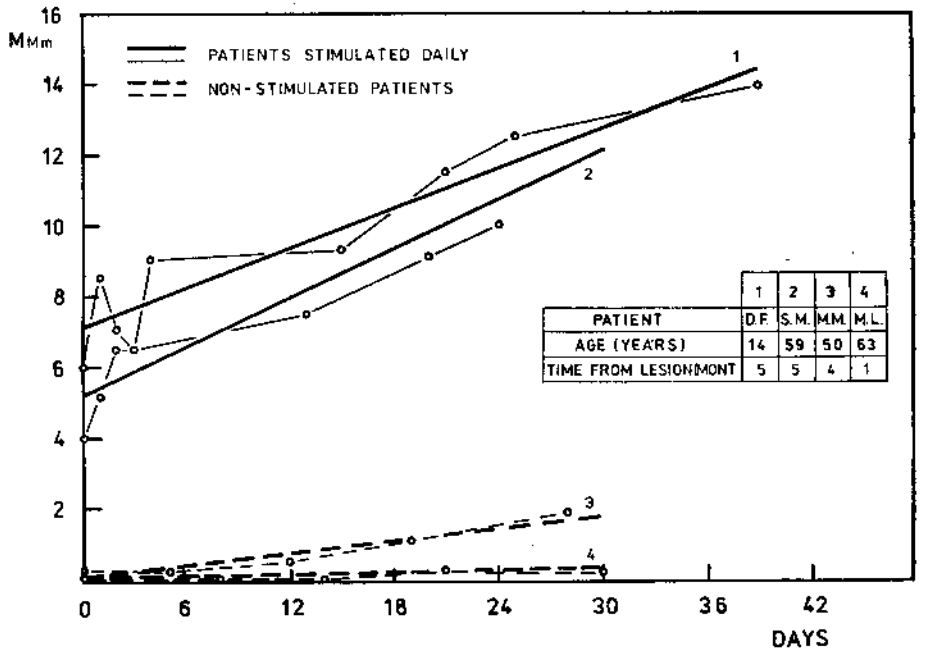

Fig. 4. Time pattern of mid-term measurements in two patients receiving stimulation for 60 minutes (day for 5 days) week (continuous lines) and in two patients receiving no stimulation (dotted lines).

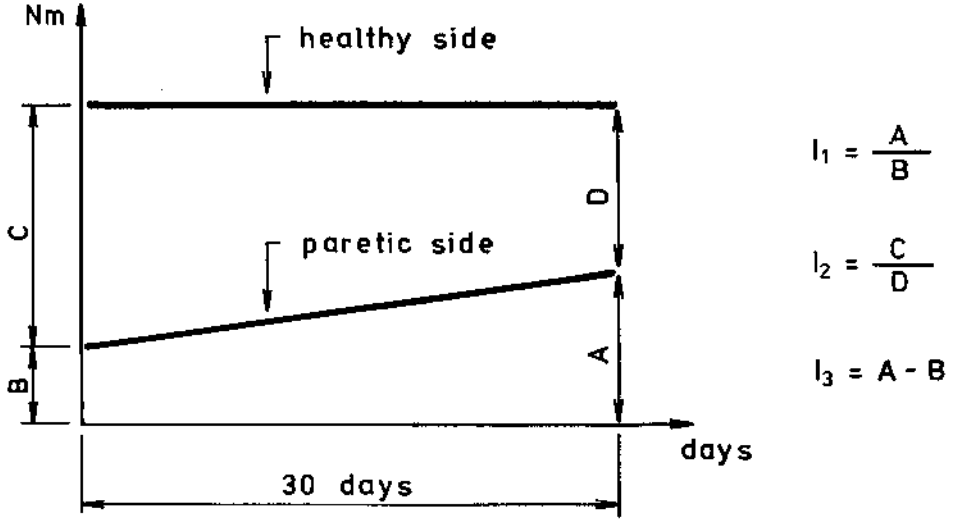

Fig. 5. Definition of parameters for the evaluation of mid-term patterns. The healthy side line is the average of the measured values, the paretic side line is the minimum square line interpolating the experimental measurements.

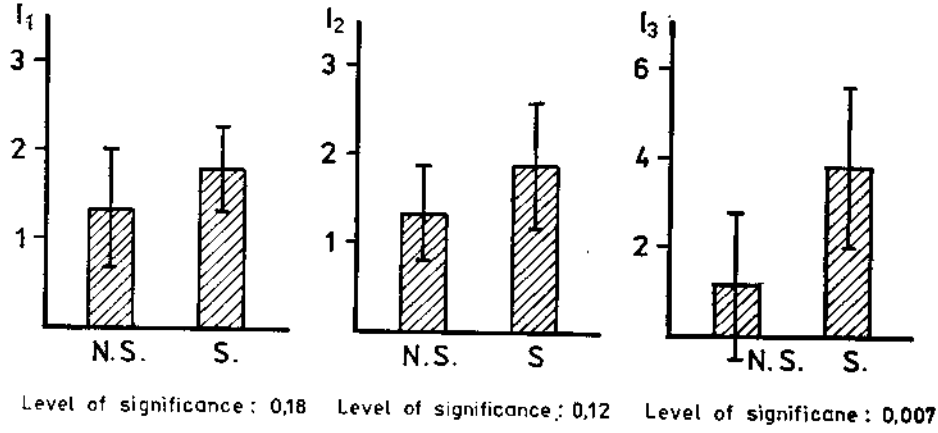

Fig. 6. Average values and standard deviations of the three indexes I_1, I_2, I_3 for the seven stimulated patients (S) and the seven non stimulated patients (NS). The level of significance indicates the probability that the differences are due to chance.

Mid-Term Evaluation

Fourteen hemiparetic patients with age from 14 to 68 years and time from lesion between 1 and 6,5 months were divided into two groups of seven patients each. One group had a 60 minute stimulation session for 5 days a week for 4 to 5 weeks, while the other group had no stimulation. No patient had previously used FES. Stimulation was applied as described in „Materials and methods". Five to nine force measurements were performed on each patient during periods ranging from 24 to 42 days. Each measurement was the average of ten maximal isometric voluntary dorsal flexions of the plegic foot as described in „Materials and Methods". The measurements were perfomend always at the same time, before the daily FES session.

Fig. 3 and 4 show the force pattern observed in four stimulated and four non stimulated patients. The measured values were interpolated with the minimum equare line in order to facitilate the identification of pattern parameters. A few measurements were also performed on the healthy side of each patient and averaged; such values did not show any particular time trend.

Quatification of the patterns was attempted by defining three „performance indexes" over a narmalized time interval of 30 days as shown in Fig. 5: Index I_1 is the ratio of the final to the initial force, index I_2 is the ratio of the initial to the final force deficit referred to the healthy side, index I_3 is the slope of the minimum square line and equals the force increase over a 30 day interval. All the initial and final values are taken on the minimum square line and do not necessarily match with any effective measured value.

Table I and II give the values of the indexes for the fourteen patients included in the study while Fig. 6 gives a graphic representation of the average values and standard deviations of the three indexes for the stimulated [S] and not-stimulated [N. S.] patients. The average values of I_1, I_2 e I_3 for the stimulated and non stimulated patients appear to be different respectively

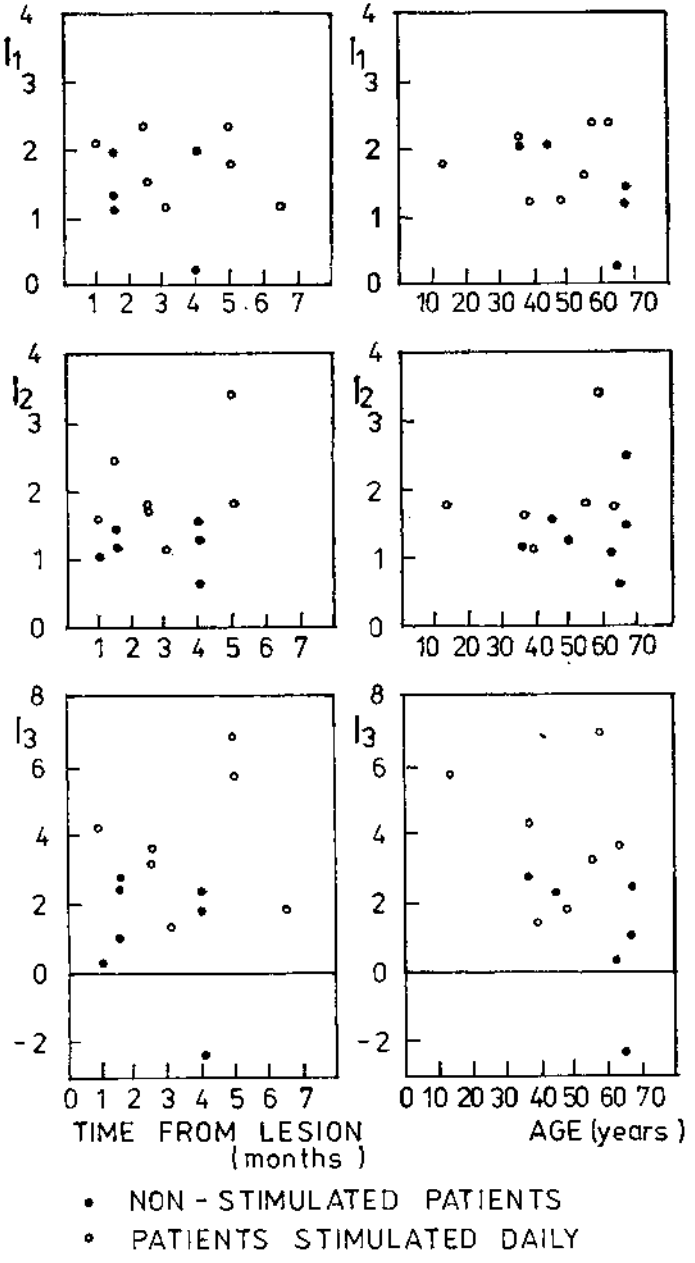

Fig. 7. Plots of the indexes as functions of patient age and time from lesion. No particular pattern can be detected from these plots as well as from the plot of I_3 as function of the initial value. Stimulation appears to be the discriminating factor.

at the 0,18, 0,12 and 0,007 level of significance. The slope of the minimum square line appears therefore to be the most representative parameter.

In order to see whether th observed differences could be due to factors other than stimulation, the indexes have been plotted as functions of patient age and time from lesion as shown in Fig. 7. Index I_3 was also plotted as function of the initial moment (first measurement).

The resulting plots show neither a particular dependence of I_1, I_2, I_3 upon age or time from lesion nor a dependence of I_3 upon the initial moment, therefore lending more support to the hypothesis of FES dependence of the indexes.

Conclusions

Our results show that there may be, in specific instances, a short-term carry-over effect of FES as reported by Vodovnik (1973) and Stefancic (1976) however such effect appears to be very poorly repeatable and not statistically significant even in the same patient.

The reasons of the variability of response are unclear but might be related to patient subjective factors. In any case quite similar patterns are obtained with and without stimulation. This evidence however, should not be taken as proof of absence of any short-term carry-over effect. An improvement of gait pattern has been clinically observed and referred by patients following walking with FES.

This aspect is presently undre investigation and the results will be reported elsewhere.

Our results are definetly more significant on a mid-term basis. Each of the three indexes chosen to quantify the results has higher values for the stimulated patients. For index I_3 the difference is highly significant showing a better and faster recovery in FES treated patients.

Clinical observation shows that the force recovery is associated with an improvement of gait pattern: the quantification of such improvement is presently the subject of further observation as well as the mechanism of the recovery itself. Our data compare well with the results of Basmajian et al. (1975) who used biofeedback training as therapy of chronic foot-drop. In our case biofeedback was used only to obtain the maximal voluntary dorsal flexion and not extensively as therapy. The biofeedback influence, if any, should have equally affected the two groups of patients.

The results presented here lend further support to the value of FES as a therapeutic technique. The association of the therapeutic and of the orthotic value with the possibility of home use of simple stimulating devices makes FES more and more important for the rehabilitation of hemiplegic patients.

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M. D. ELVIN, AND F. M. HATFIELD

SEMANTIC AND SYNTACTIC SKILLS IN RELATION INTERPRETING AND TREATING AGRAMMATISM

This paper describes an attempt to improve communicative ability in two aphasic patients with classical agrammatism (cf. Tissot et al. 1973, Luria 1966, etc). Although of different ages and differing in the aetiology of their condition, both were of somewhat above-average intelligence and their speech showed many similarities. Word-finding was relatively well preserved, but style of speaking had the characteristics loosely called 'telegraphic'. Their utterances were often ambiguous or positively misleading: sometimes because of ordering, sometimes because of omissions. (Further details about these patients are given in Table I).

Semantic Strategies: In considering the procedures that might help them, we took into account the accumulating evidence from a number of sources (Zurif et al. 1972, Zurif and Caramazza 1975, etc.) that many aphasic patients — especiellly those with lesions in the anterior regions of the cortex — rely more heavily on sematntic strategies in understanding what they hear or read, than had previously been fully realised. By 'semantic strategies' is implied not only deductions from general knowledge of the world, the immediate situation and other extralinguistic information, also more specific 'semantic--order' strategies. This term refers to the ordering of words according to their semantic function — e. g. agent, act, patient. Such a strategy implies awareness of the idea of 'complete thought' as wel as knowledge of a range of individual word meanings.

With the two patients considered here, comprehension for everyday speech was relatively wll preserved, and on tests of comprehension their scores were at or above the average for a group (207) of unselected aphasic patients — though certainly impaired in comparison with normals. From a prior study we had evidence that they retained the notion of a 'complete thought' expressed in language, and not only recognized the omission of a word demanded by the sense of the sentence, but the nature of the omission if the sentence were not too long. The probaility that they were using semantic strategies in comprehension was therefore high. If they were, we wondered whether success in understanding what they heard, could be made a basis for improving their implicit knowledge more explicit. We also wondered if a sharpened awareness of semantic functions would permit some extension of the order strategies they were using. For instance, in "the key opens the door", the key, essentially an instrument, is handled as if it were an agent in the surface structure. Could a patient in command of a sentence like "John

opens the door" (by the strategy agent, act, patient) associate an instrument with an implied but not mentioned agent for producing "the key opens the door?" Or would he need a different semantic order strategy: instrument, process, patient? If he could make the association, they something like the economy introduced by grammar could be achieved. Sucess in making the association would, of course, have to be tested by sentences like "the rock scratched the glass", where general knowledge does not determine meaning as it does with the key and the door.

If patients are using semantic order strategies to understand a sentence of a given length, one must assume a memory span of a certain length for objects, ideas, etc. conveyed by words. A priori one would expect the greater the reliance on such strategies, the more important memory span would be. We therefore needed som measure of span, and carried out simple tests: the patients were askd to point to objects just named, after reshuffle of the objects out of sight before each trial. Our two 'agrammatics' differed in their 'score' on this task: on identified two, the other four objects, in the right order. For the investigatory side of the work, we then chose two Conduction Aphasics (Boston Diagnostic Aphasia Examination classification, Goodglass and Kaplan 1972), which is equivalent roughly to Luria's classification (Luria 1966) of Afferent Motor Aphasia — one with a span of two, and one with a span of four if order is ignored — three otherwise — as near a match as we could get for comparative purposes. The two Conduction Aphasics had relatively fluent speech and used a variety of syntactic forms spontaneously. *Order of Main Constituents in a Simple Sentence:* We shall describe one of the sudies made prior to starting therapy. We prepared 40 pairs of pictures, corresponding to reversible SVO sentences. They were of five types:

1. Agent acting on another potential agent ("girl pushes boy", "boy pushes girl");
2. agent conceived of as having acted in the past ("man punched lady" — lady with black eye, "lady punched man" — man with black eye);
3. agent in position or with instruments suggesting he would act on the other in the near future ("girl will dress boy" (girl holding trousers, "boy will dress girl" — boy with dress);
4. two objects that might cause an effect on each other with effect pictured as result of past act ("blue jeans stained socks" — socks with blue streaks and vice versa);
5. two things not intrinsically agents, which might affect each other in the near future ("tree will hade house" — sun rising, tree, house and vice versa).

The patient had to point to the correct member of the picture pair on hearing the sentence. Later he was asked to say something that would identify one of the pair for the hearer. *Results:* Our main findings were two — *First,* memory span we indeed closely associated with the agrammatic's performance — not only in production, but also in comprehension. The agrammatic with the long span often succeeded, where the other failed. This was *not* true of the performance of the Conduction Aphasics at this level of difficulty, though their memory spans were similar. It is necessary to realize that — in comprehension — difficulty connected with an agrammatic's short span may be easily masked by extraulinguistic information. Given the sentence "the girl will hit the boy" for one of a presented pair of pictures, a patient need only remember the first noun and take it as the agent to make a correct choice. In these conditions the agrammatic with a short span did well. But when

the sentence referred to a past event, he began to make errors because what he could see was the result and what he *remembered* was the first two words only ... so for "mann punched lady" he chose the man with the black eye, presumably understanding it as man is was punched — past participle being equivavlent to past in English. The agrammatic with a better memory span succeeded in this task. Another important point about effect of memory span on „agrammatic's" performance is that the *type* of word to be processed and kept in mind may be crucial. For example, the patient with the short span could point to the penny, „in, under, behind, etc." a box ... so he 'understood' the preposition when other circumstances were constant; but he could not point to one "on the book", "under the box", etc. when two items in the situation changed, although — as test results showed — he could remember the names of two objects for subsequent indentification in the right order. Presumably the greater complexity and abstractness of the notion of 'on-ness' or 'in-' puts a heavier semantic load, as it were, on the patient than does an object name. Both 'agrammatics' began to have trouble with phrases including prepositions just *before* their memory span for names was reached.

The *second* main finding was that 'agrammatics', regardless of memory span, had great difficulty when instruments were used as if they were agents in the surface structure. With the patient with the longer memory span (Patient 1) the same difficulty was observed in production as with comprehension and often took the form of inversion ... OVS ... the reverse of what he wished to say.

Table II gives a summary of the findings. For *Comprehension,* the indication of relative success, a plus (+), means that a task score would be achieved by chance less than once in a hundred times ($P = < .01$), and the indication of relative failure, a minus (—), that it might occur more than once in twenty times ($P = > .05$). Similar indications for *Production* are based on percentage of successes before aid was offered. Since it was not practical or therapeutically desirable to give all patients the same number of trials or offer help at the same point, no estimate of statistical significance can be made and the indications must be considered suggestive only. However, the percentage differences were, in fact, quite large — a + indicating success on more than 80 % of the trials, a — success on less than 40 %. In addition a tick (√) indicates that there was a difference between the performance of the patient with relatively long memory span and that of the patient with relatively short span, and a zero (O) that no such difference was found. The two Conduction Aphasics succeeded on all the tasks and there was no difference in performance associated with memory span. In the case of the „agrammatics', successs was limited to the patient with relatively long span on three tasks, and on two tasks both 'agrammatics' failed.

Therapy: The general idea behind the therapeutic methods we wished to test, was explication of the semantic functions and order strategies which the patients appared to be using in comprehension, with the hope that they might be used in production. In the case of the 'agrammatic' with short nemor span, his chief strategy seemed to be 'first noun is agent', but in production he often followed the agenty patient before giving the verb (the SOV order often reported — cf. for instance von Stockert 1976). He welcomed the discussion we initiated and the idea of agent-act-patient order was rapidly grasped. On tests three to four months later, production without deviant SOV trends has risen from 14 % to 66,6 %, and improvement on other clinic tasks with other workers was noticed. The 'agrammatic' with the longer

memory span had no trouble in producing correctly ordered agent subject sentences, but did not understand or produce instrument subject sentences satisfactorily. Suggestions that an instrument ('tool' he called it) might be treated 'as-if' it were an agent seemed to confuse him. We therefore altered our approach and discussed passive forms, giving him the word 'by' to mark the agent or instrument. The result was interesting. He produced, fairly easily, correct passive formulations for pictures showing no 'intrinsic' agents--e.g. 'the candle will be lighted by the match'. But passive formulations for pictures with agents were generally incorrect. It looked as if the notion of instrument was a fixed one, for which he already had an order strategy, viz. instrument comes at the end (where in fact it most commonly occurs). Giving him a word to implement *this* strategy much improved his production. However, since agent and instrument order strategies were separate and different, confusion arose with passive forms including intrinsic agents and with active forms including only intrinsic instruments.

Since the two Conduction Aphasics, with equivalent memory spans, had no trouble with any of the tasks (other than those arising from word-finding and word-formulating difficulties which could be severe) it looks as if their retained syntactic skills, though imperfect at a more complex level, aired oral language in--at least--two ways: *first,* be chunking information for comprehension and prearranging it for production so freeing them from a close dependence on memory span; and *second;* by providing a grammatical function for elements of a pre-existing semantic structure so permitting flexibility in the use of language.

Conclusions: First, memory span as we tested it (a pointing span, often but by no means always the same as a repetition span) is certainly a limiting factor for 'agrammatics' --and much more so for them than for more fluent aphasics.

Second, memory limitations do not mean that they cannot be helped to improve speech production somewhat beyond their immediate memory span. Explication of semantic order strategies used in comprehension assists them in serial processing, and such processing may be supported by retained perceptual abilities (for instance, a reasonably good appreciation of what 'sounds right' when spoken aloud) and/or by specifically learned devices (for instance, use of the word 'is' or 'by').

Third, the limitation imposed by basic semantic functions of words seems more severe. For instance, an SVO sentence in which the subject is an instrument is a grammatical device and does not alter the instrinsic semantic function of the subject. Moreover, it is understandable that reliance on semantic order strategies might make them rigid and make patients resistant to 'as-if' procedurs--even when there is some basis for metaphor in ordinary behaviour and spech as there is some basis for metaphor in ordinary behaviour and speech as there would seem to be in this case (e. g. the person who is angry with the 'table that hit him'). Introduction of really new strategies--that is of ones not already in use for comprehension—may be possible, but so far as our experience goes to date would seem to require very considerable discussion of the semantics of individual words which may be both intrinsically complex and variable (e. g. 'by') and of the communicative situations in which one order is more appropriate than another.

Practically, we feel that the explication of strategies used in comprehension is to be recommended for 'agrammatics' in circumstances (like ours) when intensive therapy is not possible. It can certainly bring speech production

Table 2. Performance dependent on memory span v; not dependent 0
Success on task (+); Failure (—)

Task	SVO		Prepositions & Prepositive Phrases	
	Comp.	Prod.	Comp.	Prod.
Cond.	(1) 0 (+)	0 (+)	0 (+)	0 (+)
Aphasics	(2) 0 (+)	0 (+)		

„Agrammatics"
(1) 0 (+) v (±)
v (±) v (±)
(2) 0 (—) 0 (—)
(1) Agentive subject (2) Iustrument subject

more into line with comprehension and therefore improve communicative ability within these limits. Whether it can do more is still a question under investigation.

Table I

Patient 1. [D. E.] 22-year old assistant storekeeper [pre-traumatically a steel plate layer]. Above average intelligenc on psychometric testing post brain damage. Left internal carotid artery occlusion following a neck injury 5 years prior to this study. This led to left-sided cortical damage, manifesting in severe right-sided hemiplegia, persistent right facial weakness, mild right sensory loss, and a severe language loss-for the first 12 months-both expressively and receptively.

Patient 2. [S. B.] 64-year old former laboratory technician, considered to be, and to have been, of average intelligence. Cerebrovascular accident, with pulmonary embolus and deep venous thrombosis 3 years prior to study. The CVA resulted in a right hemiplegia, equivocal right facial palsy, and some loss of pinprick sensation on the right. There was no hemianopia.

Patient 8. [P. W.] 67-year old ex-local government officer, probably of above average intelligence. Cerebrovascular accident 10 years previously, which left him with a dense right hemiplegia and some sensory loss. Earlier some right facial weakness and some articulatory apraxia had been reported, but both conditions had improved greatly.

Patient 9. [R. B.] 52-year old manager of jeweller's shop, considered to be of rather above average intelligence. Cerbrovascular accident 1 year previously. Initially right hemiparesis, but this rapidly improved after admission to hospital. Hypertensive. These was diminished sensation on the right side. No field defect.

All four patients were formerly right-handed. All had had basic education to the age of 14 or 15 only, although this did not necessairly represent their potentiality.

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J. VOTAVA, J. PFEIFFER

THE ANKLE CLONUS: ITS MECHANISM AND POSSIBLE INFLUENCING

It is generally accepted, that clonus or pseudoclonus is a manifestation of myotatic hyperreflexion and occurs only concurrently with spasticity. Each rhythmic contraction is induced by a new stretching of the muscle spindles. Clonus is important diagnostically and in some cases it disturbs walking.

Electromyographic recording of clonus was done by many authors: Jung, Isch, Brune & Schenck, Baykuschev, Miglietta. They determined the basic clonus parameters and their changes under the influence of Jendrassik's manouvre, R reflex, cooling etc.

However, many questions remain unsolved, e. g. why clonus can be induced only in some spastic muscles, which muscles participate in clonus, and the like.

We recorded clonus first as a means of evaluating spastic muscle blockade. Later we focused our attention on ankle clonus alone — its parameters, the conditions of its origin, the participation of individual muscles.

We generated clonus in the usual way, i. e. by sudden passive dorsiflexion in the ankle, which causes stretching of the soleus muscle as well as stretching of other shin muscles — the group of deep plantar flexors: m. flexor digitorum longus [the most accessible for EMG recording], m. flexor hallucis longus and tibialis posterior; also mm. peronei. The stretching of m. gastrocnemius lateralis and medialis depends on the knee position: it is maximal during extension. M. flexor digitorum brevis is also stretched when clonus is induced in the usual way. It can also be stretched separately by pressure on the toes, whereas soleus can be streched alone by pulling the heel.

Material and Method:

We recorded clonus 27 times in 22 patients with central paresis of different origin. Clonus of the upper extremity was studied in 2 cases, ankle clonus in all the other cases. We recorded EMG activity in m. soleus, gastrocnemius

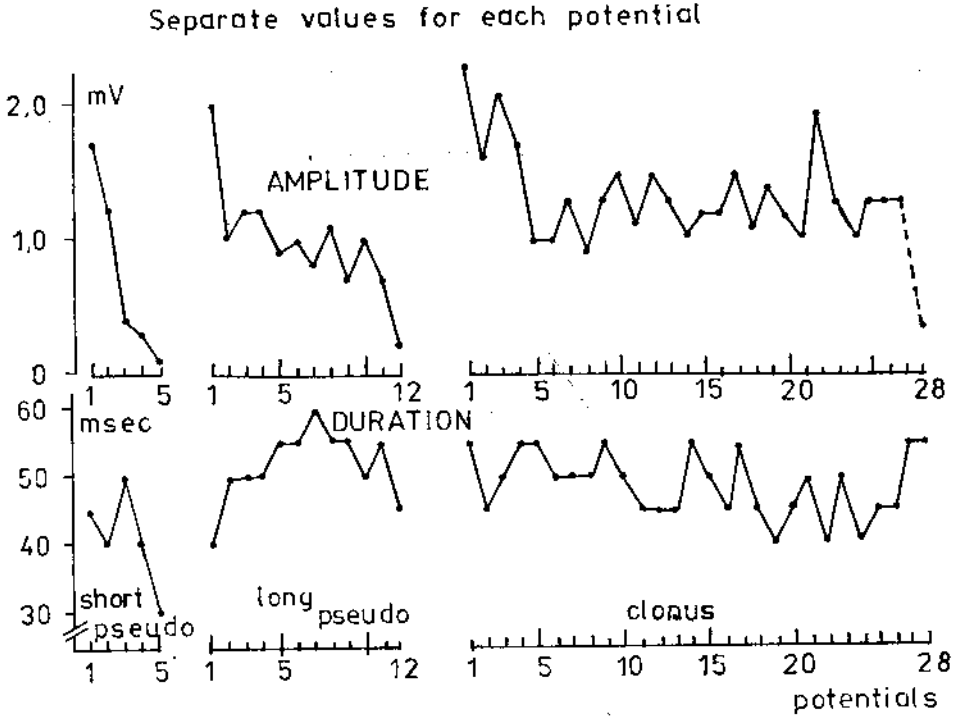


Fig. 1.

lateralis, gastrocnemius medialis by surface electrodes as a rule, in m. flexor digitorum longus and brevis by needle electrodes. After being amplified, bioelectric potentials were recorded on film from the screen of Medicor device.

In 11 cases blockade of nervus tibialis or its branches was performed with 2 % Procain or 40 % ethyl alcohol.

In 17 cases clonus was induced and recorded in different knee positions. In 11 of these cases, the correlation was thoroughly followed: the knee angle was changed from maximal extension to maximal flexion by steps of 30 degrees. The maximal ankle dorsiflexion was measured in dependence on the knee position before each check. Clonus was induced at different ankle angles in 4 cases.

The EMG records of clonus were evaluated. We measured the amplitude and duration of each potential and also the interval between the start of two subsequent potentials. The interval equals the reciprocal value of the frequency. In pseudoclonus we evaluated the number of induced potentials after one stretch, which corresponds to number of mechanical jerks.

In further evaluation we counted the average of separate values for the first potentials after each stretch, for the second potentials and in cases of long pseudoclonus or clonus also for mean stabilised potentials. To decrease the oscilations in lengthy recordings we counted the average of 5 subsequent potentials.

Results:

We found regular rhythmic EMG activity in all 25 cases of soleus muscle. Polyphasic potentials differed in size according to the change of motor unit

Fig. 2.

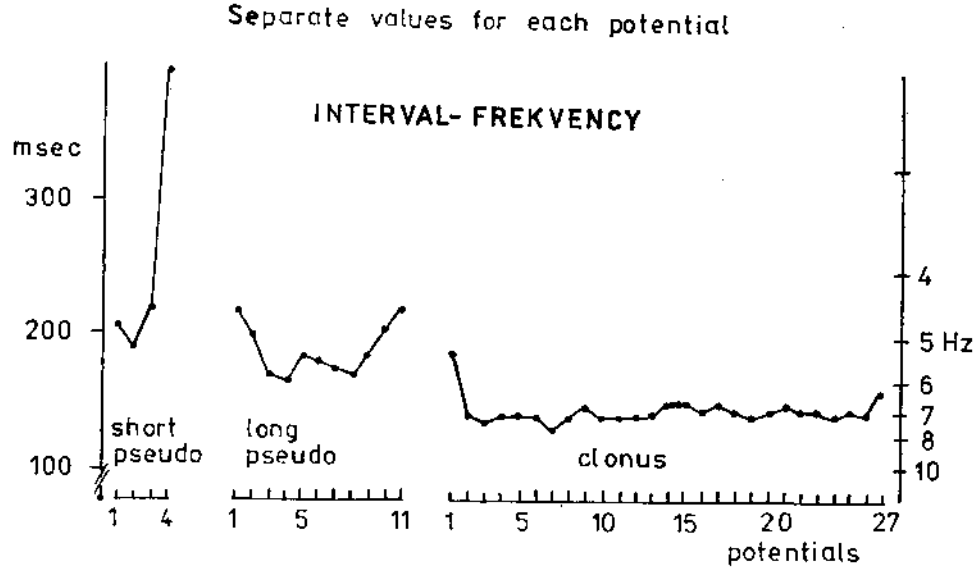
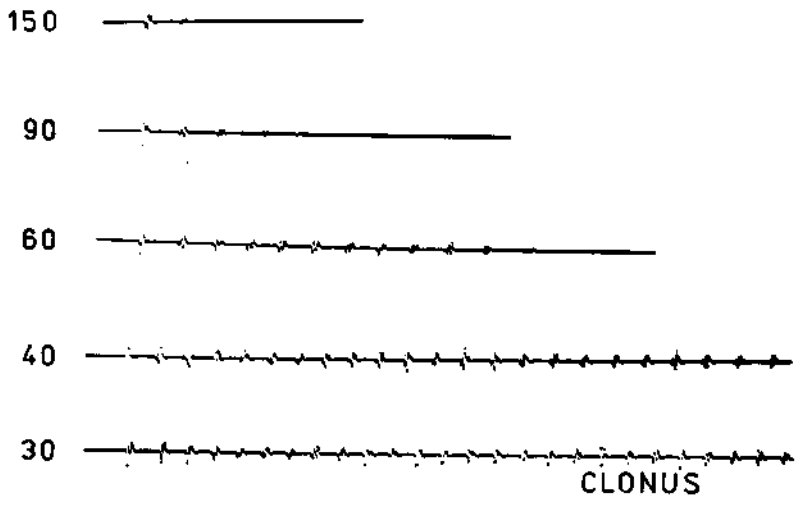


Fig. 3.



recruitment. Between potentials there is an absolute silent period, with the exception of the end of some psudocloni. The parameters correspond with the results of other authors.

The amplitude of a stable clonus is 0,5 — 2,0 mV, rarely, 4,0 mV with standard placement of surface electrodes. The first potential is regularly higher than the others. The amplitude falls fast during a short pseudoclonus, during longer pseudoclonus and clonus it oscillates at the mean value. (Fig. 1).

The duration of potentials oscillates between 30 and 60 msec. It is stable within this limit, with the exception of the end of pseudoclonus. (Fig. 1).

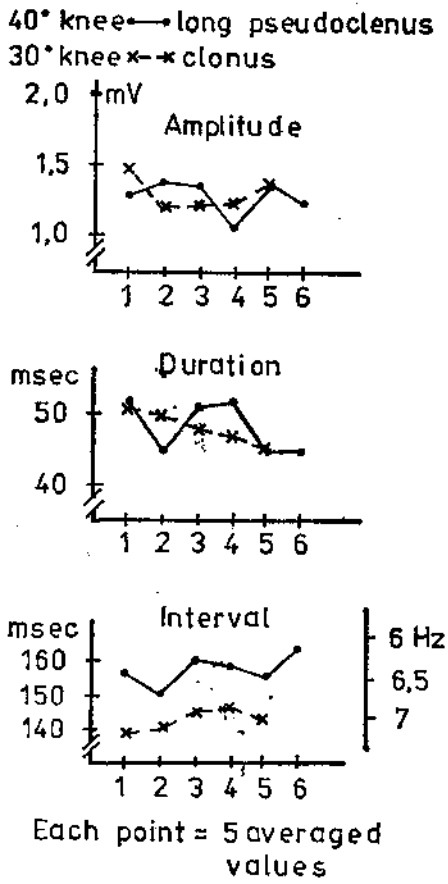


Fig. 4.

The longest interval is after the first potential. After this it stabilizes and is very stable in clonus: 120 — 180 msec, which corresponds with the frequency of 5,5 — 8,5 contractions in one second. In agreement with Isch we found higher frequency (over 10 per second) in small children. The interval becomes longer at the end of pseudoclonus. The silent period between two potentials is always more than twice as long as the duration. (Fig. 2)

An important aim of work was to follow the dependence between the knee position and induced clonus. The excitability of the soleus muscle changed considerably in all examined cases. The lowest excitability was at maximal flexion and increased with extension. It is expressed by an increased number of potentials in the pseudoclonus and by change of the pseudoclonus into clonus. (Fig. 3). The amplitude of the first, second and mean potentials increases with extension of the knee and intervals become shorter. The potential duratians do not change considerably.

It is interesting to compare the clonus and the very long pseudoclonus — over 30 potentials. (Fig. 4) The difference is caused by the change of the kne angle by 10 degrees. The amplitud and the duration do not change, but the interval is distictly longer in pseudoclonus and causes instability.

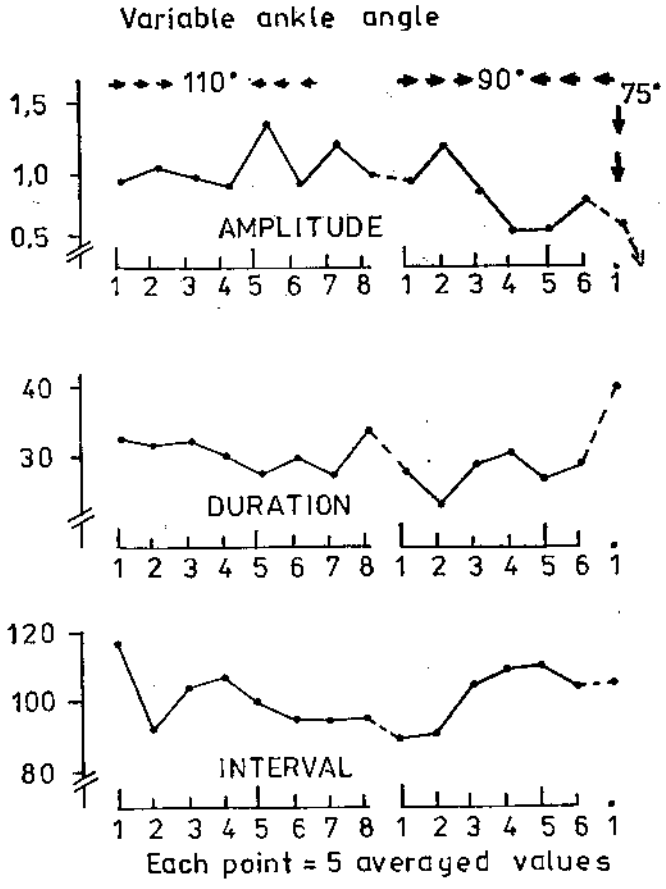


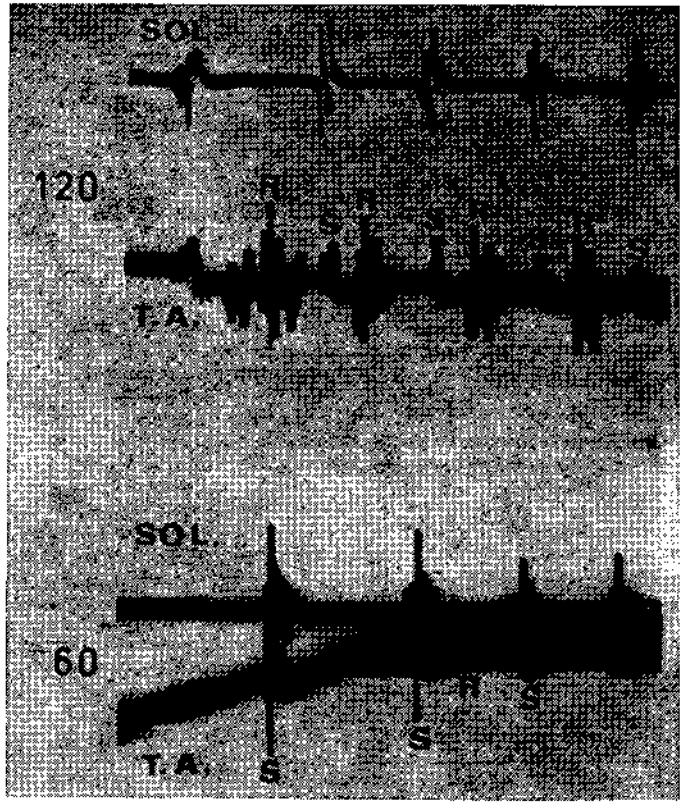
Fig. 5.

In some patients another change appears at maximal knee extension. We noted a marked decrease of excitability in 5 patients out of 11 and a slight decrease in 3 more. It is shown by the change of clonus to pseudoclonus or by the total absence of stretch response. In the 3 remaining patients it was at the maximal extension that excitability was the highest.

Clonus parameters can be influenced also by a change of the ankle angle. The amplitude decreased, the interval increased with dorsiflexion. (Fig. 5) When maximal dorsiflexion is reachd, the clonus is interrupted.

A record of gastrocnemius lateralis was made in 13 cases. In all the cases the rhythmic EMG activity was markedly lower than the activity of the soleus muscle. There is no activity at all at maximal knee flexion and in some cases also during extension. The amplitude of recorded potentials was always lower than half the soleus amplitude. M. gastrocnemius medialis was recorded 10 times with simular parameters as the former. Separate stretching of these muscles, achieved by sudden passive knee extension, does not induce any rhythmic EMG activity.

We recorded m. tibialis anterior in only 6 patients. The EMG activity is not regular. Where activity is present, it is often reciprocal with a delay



of 60 msec at the onset compared with the soleus muscle. Less often it is synchronous. In one patient we observed mainly reciprocal activity when the knee is flexed and synchronous when it is extended. (Fig. 6). When the knee is flexed, the reciprocal activity of m. tibialis anterior changes into contraction that holds, though soleus activity disappears.

M. flexor digitorum longus was recorded in 9 cases. There was usually no response or only a single potential in the record. In one case did we record irregularly interrupted activity during soleus clonus.

We recorded m. flexor digitorum brevis 4 times and were able to induce regular clonus in one case. It can be induced together with soleus clonus by pressure on the foot. A separate clonus can be induced by abrupt toe dorsiflexion.

Discussion:

We can conclude from our results, that only soleus contraction occurs regularly during clonus. The activity of other muscles, including m. gastrocnemii, is much smaller, irregular and insuficient to keep the clonus going. In the exceptional instance it is possible to induce a clonus in m. flexor digitorum brevis. That is independent of the soleus clonus.

The changes in clonus observed during change in knee position can be explained by the alteration of both mechanical and reflex conditions for

clonus induction. The maximal ankle dorsiflexion decreased during maximal knee extension in all our patients. This change is caused by stretching of the mm. gastrocnemii. The clonus inhibition found in some patients at maximal knee extension can be explained simply mechanically, becauses soleus stretching is impossible. Furthemore excitation of the secondary endings in the gastrocnemius spindles causes inhibitation in the soleus.

The highest excitability is usually at middle knee position (30 — 60 degrees), because both the gastrocnemius and soleus primary endings are stimulated by sudden stretching, but the secondary endings are not under pernament stimulation. Afferentation along the I a fibres from the gastrocnemius facilitates soleus motoneurons, as proved by Bonaziz in his H reflex study.

When the knee is in maximal flexion, m. gastrocnemius remains loose during soleus stretching and does not facilitate the latter. In some cases there is increase of tibialis anterior activity with reciprocal soleus inhibition. Similarly, there is clonus inhibition when the nociceptve plantar reflex is induced. Clonus depression during maximal ankle dorsiflexion can be explained by the excitation of the secondary spindle endings in the soleus along with mechanical influence.

The important role played by the soleus in ankle clonus induction is the reason for a separate alcohol blockade on soleus branches of nervus tibialis when the clonus disturbs the patient's gait.

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J. C. J. VAN HEMERT

A DOUBLE-BLIND COMPARISON OF BACLOFEN AND PLACEBO IN PATIENTS SUFFERING FROM SPASTICITY OF CEREBRAL ORIGIN

Introduction

In the past the treatment of patients suffering from spasticity due to cerebral lesions was mainly restricted to passive and active physiotherapy. Bobath and Bobath developed a method for the facilitation of normal postural reactions and movements in spastic patients; this facilitation technique obtained active automatic motor responses with a progression towards more voluntary and purposive movements once the automatic patterns were established. Unfortunately, with such exercise therapy results were not fully encouraging. Attempts have also been made to reduce spasticity by local nerve-blocking with phenol injections or by neurosurgery.

Later, many muscle relaxants were introduced with little success. except for diazepam and some of its derivatives, which are still widely used, but here too the possibilities are limited because of unwanted effects due to the high dosage often needed to acheive the desired muscle relaxation.

The first rational approach on a neurophysiological basis was made possible by the discovery of a group of substituted γ — aminobutyric acid (GABA), to which baclofen belongs.

Baclofen exhibits a completely new type of action; it inhibits both monosynaptic and polysynaptic reflexes and also reduces the activity of the efferent gamma neurones. It has been suggested by Bencke that baclofen increases the excitability of the Renshaw negative feed-back loop and thus reduces excitability of the α—neurones.

Its site of attion is mainly spinal and it does not influence neuro-muscular transmission. One of the novel features is its ability to inhibit the monosynaptic extensor reflex just as strongly as the polysynaptic flexor reflex; no other substance behaves in this manner.

These unique pharmalogical properties and extensive evidence from clinical trials in many countries demonstrating its efficacy and superiority in the treatment of spasticity due to spinal lesions and multiple sclerosis, encouraged us to test its efficacy and tolerability in patients suffering from spasticity of cerebral origin.

Patients and Methods

Thirtyfive patients (34 females and 1 male) with ages ranging from 3 — 61 years (mean 25,5) were included in the trial, and radomly distributed to

Table 1: Incremental Dosage Scheme (tablet number)

Day	morning	afternoon	evening
1	½	½	½
2 and 3	—	½	½
4	1	½	½
5	1	½	1
6 and 7	1	1	1
8 and 9	1	1	1 ½
10 and 11	1 ½	1	1 ½
12 and 28	1 ½	1 ½	1 ½

two treatment groups. No patient was considered eligible for admission if there was an established history or EEG findings suggestive of epilepsy. Patients in whom spasticity did not constitute a significant hindrance to motor function and patients suffering from muscle atonia or hypotonia (e. g. cerebral atonic diplegia) were excluded together with those suffering from severe renal or hepatic insufficiency. Patients under therapy with tricyclic or phenothiazine psychotropic drugs were also excluded from the trial.

Medication was given over a period of 28 days with an incremental dosage scheme as shown in Table 1.

Each tablet of baclofen contained 10 mg of active substance. Eeach patient was assessed with appropriate rating scales by the same physician at approximately the same time of day at weekly intervals for severity of spasticity, cerebral and extrapyramidal symptoms, type and severity of clonus, deep tendon reflexes, walking ability and degree of scissoring and the degree of impairment of active and passive physiotherapeutic response, self-help, and manual dexterity.

At the end of the trial period an evaluation of each patient was made, not only by the physician, but also by the physiotherapists and nurses as to whether baclofen treatment should be continued.

Results

Details of the thirty-five patients admitted to this double-blind trial are given in Table 2. As might be expected some of the patients had associated disabilities and the distribution and severity of these is shown in Table 3.

The results of the pre-treatment assessment of the patients is given in Table 4.

Three patients (all in the baclofen subgroup) had concomitant disordes, one a hip luxation, one was blind and the third suffered myositis ossificans. Three patients in the placebo group had previously been receiving diazepam (as a tranquilizer rather than as a muscle relaxant) and this medication was

discontinued one week prior to the start of the trial with an apparent deterioration in mood of the patients.

Significant improvement was observed in favour of the baclofen group (after 28 days) in spasticity, impediment of active and passive physiotherapy and manual disability (2×2 table, $p \leq 0{,}01$).

The remaining symptoms considered in the assessments were not influenced by either drug or placebo therapy.

Figure 1 represents graphically the percentage of patients that improved during the trial period.

Also, significant improvement in abduction of the lower extremities and in the average total score (variance-analysis, $p \leq 0{,}05$) was seen in favour of baclofen.

The final evaluation by the physician on the therapeutic effect is as follows:

Therapeutic effect	Baclofen	Placebo	Total
Deteriorated	—	1	1
No change	2	15	17
Slight improvement	7	1	8
Moderate improvement	8	—	8
Good improvement	1	—	1
Total	18	17	35

The degree of improvement is significantly higher for the baclofen group (2×2 table, $p < 0{,}01$)

When the trial period was over, continuation of the drug therapy appeared to the medical staff to be desirable in 11 of the 18 patients from the baclofen group. This did not apply to any of the placebo group of patients. This difference is statistically significant (2×2 table, $p \leq 0{,}01$).

The final evaluation by the physician on the therapeutic effect is as follows:

The degree of improvement is significantly higher for the baclofen group (2×2 table, $p \leq 0{,}01$).

The final evaluation of the physiotherapist was: improvement in 11 patient from the baclofen group and 1 patients in the placebo group.

It was observed by the prysiotherapist that, during the therapy with baclofen, the reflex-inhibiting positions could be reached sooner which entails faster progress in the Bobath-therapy. Moreover it was striking that without direct physiotherapeutic interference the spastic flexion of the hands disappeared, the hands opened and in particular the pyramidal fusomotor regulation developed.

The evaluation given by the nursing staff was: improvement in 9 patients from the baclofen group, and 2 from the placebo group. Both evaluations are

Fig. 1.

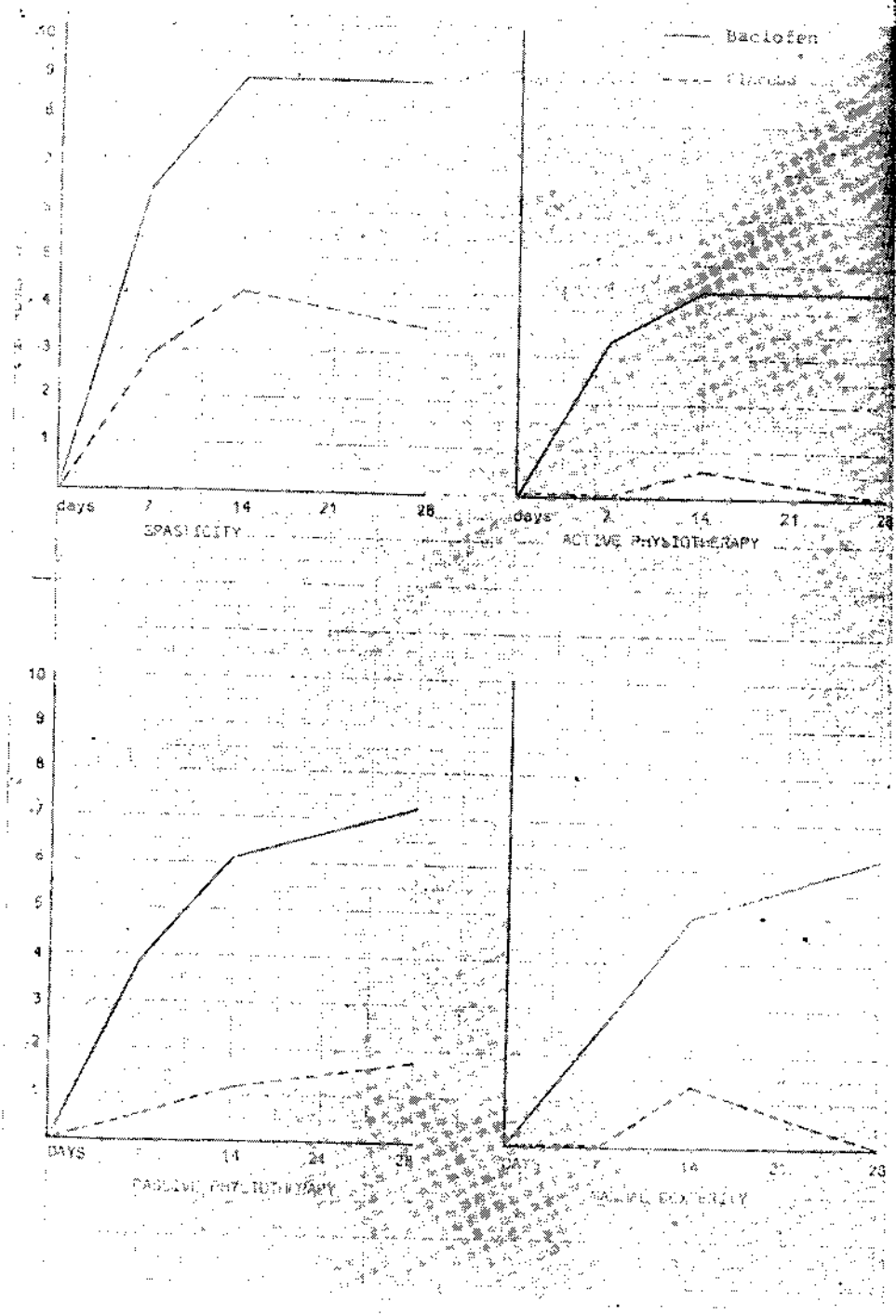
Baclofen
days
14
21
28
SPASTICITY
ACTIVE PHYSIOTHERAPY
DAYS
PASSIVE PHYSIOTHERAPY

Table 2: Description of Sample

Absolute (f) and relative (%) frequencies

Characteristic	Baclofen N = 18 f	%	Placebo N = 17 f	%	Total N = 35 f	%
Age: (Median: 25,5 y.) Below median	9	50,0	9	52,9	18	51,4
Sex: Females	17	94,4	17	100,0	34	97,1
Weight: (Median 45,7 kg) Below median	9	50,0	9	52,9	18	51,4
Type of Cerebral Palsy: Spastic	17	94,4	15	88,2	32	91,4
Distribution of Spasticity: Diplegic	16	88,9	11	64,7	27	77,1
Associated Disabilities						
Mental deficiency	16	88,9	16	94,1	32	91,4
Contract. upper limb	—	0,0	1	5,9	1	2,9
Contract lower limb	4	22,2	3	17,6	7	20,0
Fixed posturing	10	55,6	6	35,3	16	45,7
Rectal incotin.	11	61,1	7	41,2	18	51,4
Urinary incont.	14	77,8	9	52,9	23	65,7
Concom. disease: Present	3	16,7	—	0,0	3	8,6
Previous Muscle Relaxant Treatment:	—	0,0	3	17,6	3	8,6

The two subsamples were homogeneous with respect to the above variables.

statistically significant in favour of the baclofen group (2×2 table, $p < 0,05$).

In none of the patients were any side effects observed.

Discusion

It is remarkable that previously published results with baclofen in patients suffering from cerebral spasticity were dissappointing. Perhaps expectations were mis-directed or set too high.

The aim of our therapeutic measures and nursing arrangements is to improve and maintain our patients in the best possible condition. The purpose

Table 3: Distribution of Severity of associated Disabilities in each subsample.

Disability	SEVERITY						Total	
	Mild		Moderate		Severe			
	B	P	B	P	B	P	B	P
Mental deficiency	2	4	6	4	8	8	16	16
Contractures upper limb	—	1	—	—	—	—	—	1
Contractures lower limb	1	—	1	1	2	2	4	3
Fixed posturing	6	5	2	—	2	1	10	6
Rectal incontin.	—	—	3	3	8	4	11	7
Urinary incontin.	2	2	3	3	9	4	14	9

B = Baclofen P = Placebo

The distribution of the above variables was not significantly different in the two treatment subsamples.

of this trial was to find out whether and to what extent baclofen could improve the results of such measures. This was found to be the case for most of our patients. In the first place, it appeared that the Bobath-technique used by the physiotherapist became more effective, because more voluntary movements with better coordination were possible during baclofen medication.

In addition, a greater manual control in eating, drinking and playing was noticed by the nursing staff. Here, too, it became clear that a greater number of more complex movements were possible without the occurrence of spasms. Further study of these aspects is under way.

A second point of interst is the absence of unwanted effects. This may be ascribed to the very gradual increase in dosage. The dosage scheme used here was established on the basis of a pilot study preceding this trial which showed that most patients responded favourably on a dosage of 45 mg daily.

Nevertheless it remains essential, when initiating therapy, to take into account the variation in individual tolerance for baclofen. Patients suffering from epilepsy were excluded from this study, since epilepsy is regarded as a contra-indication for baclofen, but there are clear indications from our own experience that this drug may suppress rather than provoke epilepsy. This is being further investigated.

Conclusion

This trial has shown that it is possible to ameliorate spasticity of cerebral origin. This, in turn, extends the possibilities of physiotherapy, expressed amongst other things in improved abduction of legs and increased manual ability. Improvement in the application of the Bobath method was achieved, while the limits set by spasticity were obviously diminished by baclofen. The

Table 4:
Presence of Individual Signs/Symptoms (considered as criteria for assessing efficacy of treatment) before Treatment.
Absolute (f) and relative (%) frequencies of patients who had relevant symptoms before treatment.

CRITERIA	Baclofen f	Baclofen %	Placebo f	Placebo %	Total f	Total %
Spasticity	17	94,4	14	82,3	31	88,6
Extrapyramidal symptoms	7	38,9	6	35,3	13	37,1
Cerebellar symptoms	—	0,0	1	5,9	1	2,9
Clonus	6	33,3	10	58,8	16	45,7
Dep tendon reflexes:						
a) Biceps reflexes present	18	100,0	17	100,0	35	100,0
	17	94,4	16	94,1	33	94,3
Walking ability impaired to some degree	16	88,9	11	84,7	27	77,1
Scissoring:						
a) Patient able to walk	11/11	100,0	11/11	100,0	22/22	100,0
b) Patient unable to walk	2/7	28,6	1/6	16,7	3/13	23,1
Impairment of active physioterapy	18	100,0	17	100,0	35	100,0
Impairment of passive physiotherapy	18	100,0	17	100,0	35	100,0
Impairment of self help	17	94,4	15	88,2	32	91,4
Impairment of manual dexterity	16	88,9	15	88,2	31	88,6

The distribution of the above variables was not significantly different in the two subsamples.

nursing staff repeatedly noticed that some patients receiving the drug clearly had a better grasp and maintained a better grip.

Some patients, who previously had not been able to coordinate action with both hands, could do so while under drug therapy. Baclofen had no effect on extrapyramidal symptomatology, clonic and monosynaptic reflexes of biceps and quadriceps. The scissorgait existing in some patients was caused by contractures. The drug had no effect here. The patients in this trial were handicapped to such a degree that there was hardly any question of self-help. Baclofen brought no improvement there.

It is remarkable that no single unwanted effect was found. This may be ascribed to the very gradual increase in dosage which does imply, however, that one must wait 2 — 3 weeks until the therapeutic action becomes fully evident.

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M. C. DOMS—LISSENS

THE ROLE OF THE MINOR HEMISPHERE IN RECOVERY FROM APHASIA

Introduction

The literature on the neurological mechanism which underlie the recovery process in aphasia is very sparse. We can note the progress an aphasic made in language, but we do not know what happened in his brain. What are the possibilities of the human brain in recovery from aphasia?

The purpose of this paper is to assemble arguments which may elicit some aspects of a possible substitution mechanism basic to recovery from aphasia.

Role of the minor hemisphere in langugage

One hemisphere plays a leading role in language functions. We may wonder then what is the role of the subordinate hemisphere for those functions. A study of the *pathology of the minor hemisphere* shows that this half-brain:

1. has some language capacity mostly a receptive one;
2. plays an important role in reading and writing;
3. is concerded in metalinguistic tasks requiring a greater language ability than daily conversations;
4. is very important for singing.

(Lebrun Y., 1974)

Left hemispherectomy allows us to study the remaining capacities of the opposite half-brain. Dominant hemispherectomy in young children with infantile hemiplegia does not seem to influence the normal development of language. Some left hemispherectomy cases in adults were described by Zollinger R. (1935), Lereboullet J. (1936), Smith A. (1966), Smith. A. and Burklund C. (1966), Gott P. (1973), French L. and coll. (1955). Hilier W. (1954).

Summarizing the results of those studies we note that the minor hemisphere has the following capacities:

1. an auditory comprehension varying from „fair good" to „very good";
2. a minimal expressive speech mostly limited to single words, sometimes short sentences and curses;
3. repetition of words, sometimes of sentences/
4. a good arithmetic reasoning;
5. the printing of some words;
6. expression by singing.

Capacities which seem difficult to recover are

1. spontaneous (propositional) speech;
2. reading written words;
3. writting.

Split-brain-studies by Sperry R., Gazzaniga M. and others (1967, 1972, 1973) have shown that the minor hemisphere:

1. is almost speechless and agraphic, but able to spell simple words with great cut-out carboard letters;
2. has a limited capacity for calculation;
3. is capable of auditory comprehension of language/
4. is capable of some comprehension of written language, but unable to respond to printed commands;
5. has little or no syntactic capability, the only possible ability being, to make distinction between affirmative and negative sentences.

The minor hemisphere and recovery from aphasia

In the previous chapter we tried to show the verbal capacities of the minor hemisphere. One may wonder now whether those capacities are exploited in recovery from aphasia.

Aphasia occurs after damage to the dominant hemisphere. Recovery might be due to other neighbouring areas in the same hemisphere which take over the function of the damaged area. What would follow is, that the dominant hemisphere remains in control of language and speech functions. One would then further foresee that another lesion in the dominant hemisphere should produce further language disturbances, whereas damage to the minor hemisphere should not impair the language and spech of those patients.

Nevertheless, Kuttner, H. described in 1930 the case of a 53-year-old woman. She showed a motor aphasia and a right hemiplegia after a left-sided cerebral vascular accident. She recovered completely. She was right-handed and there were no sinistral antecedents in the family. One year later another vascular accident, but this time in the right hemisphere, was followed by a left hemiplegia and a global aphasia. This time she did not recover the aphasia at all.

Similar cases were described by Sollberg G. in 1970. Those cases suggest that after the left C. V. A. the minor hemisphere had supplied for langugage functions. After a right C. V. A. none of the hemispheres was capable of taking over language functions.

The previous cases suggest the possibility of exploiting the language capacities of the minor hemisphere in recovery from aphasia.

We shall try now to support this hypothesis.

Case description

Medical follow-up

G. is a 17-year-old right-handed bilingual (French — Dutch) student. On May 7th, 1975, he was victim of a motor-cycle accident. There was an important cranial fracturein the left parietal region with cerebral contusion and loss of cerbral substance. He was operated upon for the first time that same day: a real „trench" in the left parietal lobe had to be „cleaned" and a lot of brain tissue had to be aspired. Twenty days later he developed a Klebsiella-meningitis. A second surgical intervention was necessary: a cortical fungus had to be cleaned. After four months there were circulatory problems of the cerebrospinal fluid. A third surgiical intervention consisted in the placing of a low-pressure-valve (Holter-type). In October 1975 a cranioplasty was performed, because of the hollowing of the parietal region after the third intervention. He developed a second post-operative meningitis

which could be stopped by chemiotherapy. Two months later in December 1975 a fifth and last surgical intervention was necessary. The cerebrospinal fluid had to be derivated once again, this time on the right side. E. E. G. — records have always shown pathological signs in the left temporal, parietal and occipital, sometimes even in the frontal regions.

Neurolinguistic follow-up

After the first two surgical interventions the patients was awake, but akinetic and mute and showed a massive right hemiplegia. In the following weeks his vigilance improved and he showed a global aphasia. Approximatively 3 months after the trauma the comprehension of oral language started improving gradually. The patient uttered two words: „NON" and „PEDRO", the name of his horse. He remained totally agraphic and alexic. We shall not give a detailed description of the patient's therapy, nor of all the progresses he made. We just want to stress some of his performances which reminded us of left hemispherectomy cases and split-brain patients whose minor hemisphere capacities could be controlled.

The marked improvement of G.'s comprehension in the first instance cooresponds with the results obtained in split-brain's and in left hemispherectomies in adults where the minor hemisphere was active. As in the expressive language of Smith and Burklund's patient (hemispherectomy) expletives and curses (in French and in Dutch) appeared as the first words in G.'s vocabulary. Besides „NON", „PEDRO" and some curses G. could — in that same period — sing the familiar song „Frère Jacques". The melody of the song was correct (the minor hemisphere works) and the words followed.

When the patient was requested to recite the words without melody, this seemed impossible. This also suggests an active participation of the minor hemisphere in his recoveery process. In his recovery process G. started talking with isolated words, in the begining only nouns. Werbs were much more difficult to recover.

Gazzaniga M. (1974) observed the same progress in global aphasia and in split-brain's. „The difficulty we experienced in training symbols referent to actions is also reminiscent of the finding that the right hemisphere of the split-brain patient was unable to process natural languages verbs. It may well be that the left hemisphere is specialized for predication."

Eight months after the trauma G. did not yet understand written orders. Split-brain patients are also unable to understand written commands when they are presented to the minor hemisphere.

About six months after the trauma the patient started spelling words with three-dimensional plastic letters. The words he makes are correct but he is unable to read them aloud. Levy J., Nebes R. and Sperry R. (1971) observed the same in their split-brain-subjects. They also arranged the letters correctly and formed short words with their left hand, hidden from their view by a screen. They were also unable to say which words they had spelled. In those subjects it was undoubtedly the minor hemisphere that could effect language expression manually (left hand) through letter arrangement, whereas the answer could not be expressed vocally, by either hemisphere.

When our patient had mastered some writing capacity with his left hand, about ten months after the trauma, it happened frequently that he could not name an object or a picture we presented him, but he then asked a pencil and wrote the word or the first letters of the word down. He was unable

to read it. Split-brain subjects have the same dificulties when their minor hemisphere is working. (Levy J. and coll., 1971).

In the left hand-minor hemisphere-combination a split-brain patient may be capable to select the correct object the examinor asked for. If asked what he holds in his left hand, he may answer „cigarette lighter" instead of „nail clip" for example. He will recognize it as an error, wince and make another try, which may be as bad as the first one. Probably the dominant hemisphere guesses. The minor hemisphere recognizes the error, but is incapable to correct it. The same way of approach was used by our patient: several trials and errors accompanied by winces.

In observing their split-brain patients identifying numbers Gazzaniga M. and Hillyard S. (1971) noted the patients made rhytmical mouth movements. There was a linear increase in reaction time as a function of the size of the number, suggesting that some kind of rhytmical couting strategy was being employed. This was verified by the subject's report afterwards: „What I do is to count up until I hit the number that sticks out. Then I stop and tell you what it is."

It is possible that those patients refer to an automatic series. Anyway, the minor hemisphere was active at that moment. Strange enough our patient always used and still uses the same strategy in identifying numbers, letters or in couting.

The comparison of the lingustic capacities of our patient with hemispherectomies and split-brain's suggests an active participation of the minor hemisphere in the linguistic recovery of G. The arguments to support this hypothesis are theoretical of course.

The clinical aspects are extremely important in this case to support our view point. The description we have given of all the surgical interventions on this patient already suggests that the left hempisphere is much damaged. The slides presented at the Symposium show the enormously dilated ventricles and a great encephalic cyst in the left parietal lobe. In short the hydrocephalus and all the brain matter that has been aspirated allow us to say that there is practically no brain tissue left in the left hemisphere. In spite of this the patient recovered quite well and has now — one year after the trauma — an almost perfect comprehension of oral language. He is able to express everything orally, but with a persiting agramatism. Since April. 1976 he starts making complete sentences. His agrammatism is regressing well by now. He is able to read short sentences and to write some isolated words with his left hand. As he is in good physical condition now, we wanted to control the activity of his minor hemisphere with a Xenon-experiment.

At the international DAUSSE Symposium (Paris) Ingvar prsented in 1973 his experiments with Xe-133. He noted that in a verbal test the cerebral blood flow (C. B. F.) increased more in the frontal and rolandic region than in the temporal region of the dominant hemisphere. When the patient talks there is an increasing of the C. B. F. in the pre-motor, rolandic and temporal zones of the dominant hemispheres. While reading the C. B. F. increases in the same regions and in the occipital cortex.

We wanted to do this experiment with our patient, but by injecting the minor hemisphere. Unfortunately the experiment was impossible for ethical and practical reasons:

1. because of the two valves a carotid punction could be dangerous in this patient;
2. the experimental conditions are already difficult to tholerate for normal, healthy persons. As a matter of fact, the subject must lie in the same

position for at least on hour, with the camera at 1 cm from his head, without anaesthesia, with ijection needles in and a lot of instruments around his body;

3. as the radioactive gaz is eliminated trough expiration he has to talk in a mask. The mask should then be equipped with a mini-microphone to make the subject audible and to make a tape-recording of his speech. Moreover he would need headphones to understand the instructions because of the noise all the machines make.

Anyway, this experiment will be done in the future, but with patients for whom the procedure would be less dangerous.

Conclusion

The arguments we assembled here prove that the minor hemisphere has some language and speech capacity.

Our case description favours the acceptance of the theory that the minor hemisphere can function as a replacement tissue for speech and language functions, when those are impaired by damage to the dominant hemisphere.

We also wish to stress the importance of such a theory for revalidation work in the field of aphasia. The capaties of the minor hemisphere can be a starting-point for the therapy. There exists already the MIT [Melodic Intonation Therapy] [Sparks R. and coll. 1973, 1974], a therapeutic program that makes use of an assumed residual melody through a series of graduated steps. This therapy postulates that the minor hemisphere trough its musical function, might play a role in verbal output.

We realise that this report is only a starting-point for further study of the language and speech capacities of the minor hemisphere and study of its role in recovery from aphasia. Only other clinical and experimental findings can confirm the theory.

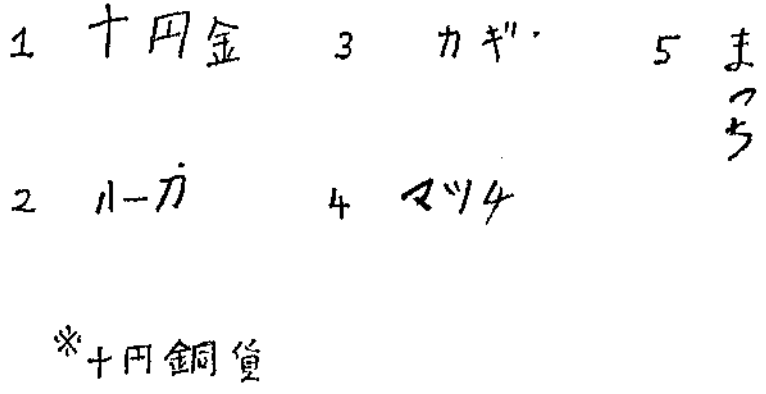
YUKIO OTA AND SHU-ICHI KOYABU

ON THE TREATMENT OF AMNESTIC-APRACTIC AGRAPHIA IN THE JAPANESE LANGUAGE

The Japanese written language is composed of two entirely different kinds of characters: Chinese and Japanese syllabic ones. The latter has two types: Hiragana (cursive form) and Katakana (square form). As well known pictographical and ideographical elements are found in many Chinese characters. Such elements are favorably utilized in treating a case of agraphia.

A case report

K. O., male, born in 1933, a right-handed truck driver. He completed only the compulsory education course of eight years. He was able to read and write rather well. On 30 Sep. 1963 a car hit his truck violently from behind. He got a hard blow on the left occipital region, being followed by a clouding



1: A ten yen copper coin in Chinese character, unfinished.
* indicates correct one.
2: A knife in Chinese character, correct.
3: Matches 4
3: A key in Katakana, correct.
4: Matches in Katakana, correct.
5: Matches in Hiragana, correct.
(The Japanese language may be written either vertically or laterally.)

K. O. could write only 4 words correctly out of 17 words which he was told to write.

Fig. 1: K. O. 's handwriting of names of 6 commot objects indicated on Head's serial tests. He was told to write the names in Chinese characters (excluding matches), Hiragana and Katakana.

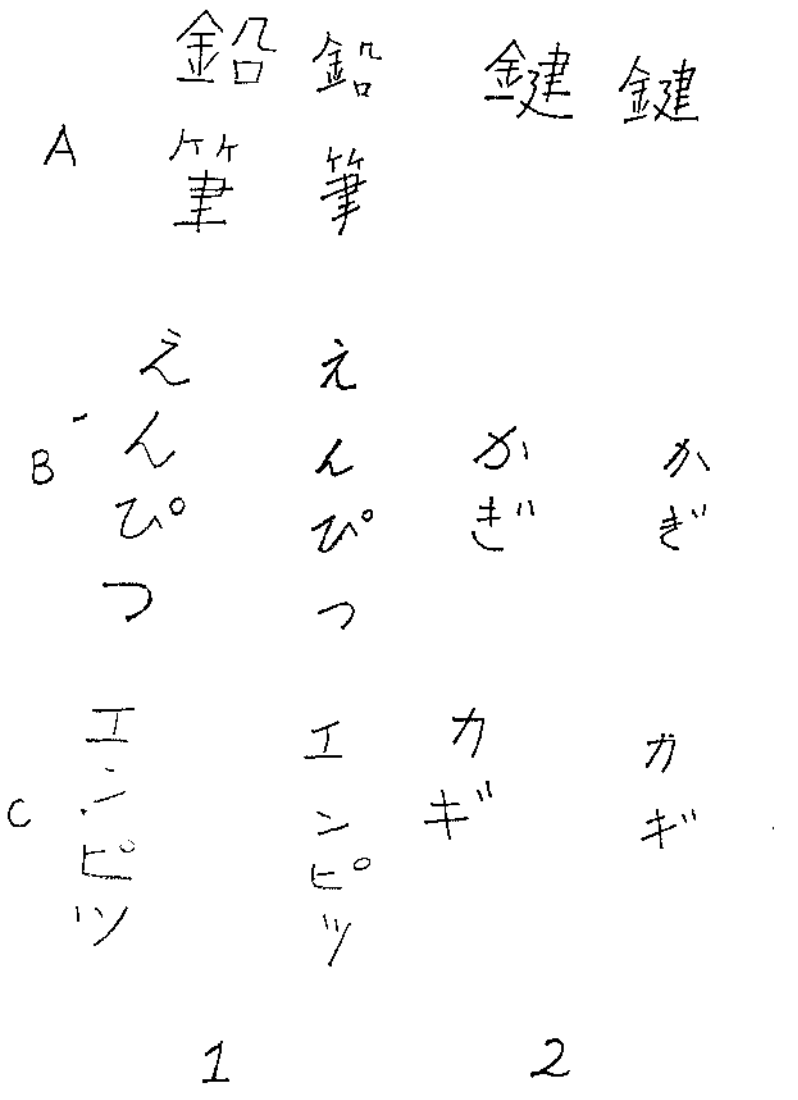


Fig. 2: Copy
left: examiner's handwriting
right: the patient's handwriting
1: A pencil
2: A key
A: Chinese character
B: Hiragana (cursive form)
C: Katakana (square form)

of consciousness of three days' duration. Immediately after he recovered his consciouness he had difficulties in spontaneous speech, writing and calculation and a serious right hemiparesis. Then he had shown a gradual improvemnt.

The first medical examination made at our department on 13 Aug. 1965 revealed the following findings: homonymous lower quadrantanopsia and

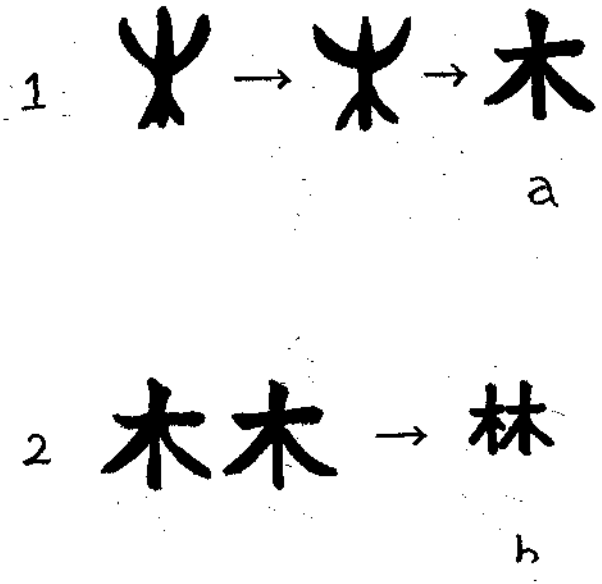


Fig. 3.
1: An example of pictographs.
a) is Chinese charater for tree.
2: An example of ideographs.
b) is Chinese character for woods: combination of two trees stands for woods.

a marked diffuse enlargement of left ventricle in PEG. He was euphoric and abulic to some extent. Neuropsychologically he had a very slight disturbance in a long spontaneous talk and reading long sentences aloud and serious difficulties in writing and calculation. Slight disorders in right-left orientation and finger localization. Otherwise, no aphasic, alexic, agnostic and apractic disorders including a constructional apraxia were observed.

On agraphia and rehabilitation

Although he could write a very few words or characters spontaneously and on dictation, the written ones were correct. He was able to find his errors spontaneously, if he made mistakes in writing. Fig. 1 shows his handwriting of names of common objects indicated on Head's serial tests. In this test he was told to write the names of objects both in Chinese and two kinds of Japanese syllabic characters (Hiragana and Katakana). As shown in the figure his ability of writing was very poor — orally he could name the common objects easily and correctly. On dictation the same difficulties were observed. A copy was perfect as shown in Fig. 2. It is justified that the above — mentioned agraphia is classified into amnestic-apractic agraphia (Goldstein). A hard training lasting for four months by copying written characters, words and sentences brought an improvement to some extent but the results were not satisfactory.

In Jan. 1966 the author began to make use of a new method of training. The patient was taught how to write Chinese characters by pointing out

VÁCLAV SMITKA — EVA ŠÁDKOVÁ

PSYCHOLOGICAL ASPECTS OF REEDUCATION IN APHASIC OLD PATIENTS

The Hospital for Long Term Patients of Prague 8 concentrates in 80 — 90 % (160 beds) chronic old patients with the following internal diseases: above all conditions after ictus, diseases of the locomotor apparatus, ischemic heart disease etc. Therefore it is necessary to consider the patients' psychological state with regard to the clinical picture of multimorbidity which concerns mainly psychic changes taking place on the basis of general sclerosis.

Psychic states in the neuropsychological picture of the chronic old patients manifest themselves in a number of non-specific changes: general decrease of cortex activity, decrease of content and speed of pereception, increase of the time interval needed for treating the information and a number of further factors. We observed the above given symptoms to a greater or leaser extent in our patients who had been physically and psychically rehabilitated, namely in old patients with chronic aphasia in the process of reeducation.

For two years (from April 1974 to May 1976) we observed a group of 40 patients out of 72 patients treated in group and individual applied psychotherapy. This. group was devided into two subgroups: 20 patients treated in group meetings, 20 patients in individual psychotherapy. The average age of all 40 patients was 70 years, the average length of hospitalization being from half to one year. The placing into group meetings was preconditioned by full or partial mobility and the following psychic states: pasivity — apathy, interpersonal troubles and repeated behavioural disorders (conflicts). The average participation time of the patients in the groups was from 3 — 6 months, adaptation time to the group 1 — 3 weeks, by conflict inciting individuals as many as 6 months. The group and individual meetings took place once or twice a week. The following changes in the psychic state of all 40 patients were stated: the passivity-apathy state remained without change in 8 patients, interpersonal troubles decreased in 20 patients, behavioural disorders in 12 patients.

In the applied group psychotherapy (the term „applied psychotherapy") being used in the sense of treatment and transfer of information from psychiatry, neurology etc. into gerontology, the program consits of playing social games, reading, discussions, listening to recorded music, singing, drawing. In the individual therapy it consists mainly of giving facts and putting down memories of one own's life. As the arrangement of the group meeting program itself is difficult, it is necessary to pay the greatest attention to variety in seeking further possibilities according to long term observation of the

patients' individual state. Problems with introducing into situation for creating inner need of the pacient's participation in the group arose in our group meetings aspecially in apathetic and problematic patients. During the adaptation period basic motivation as intentional action was constitued.

We found out in the individual applied psychotherapy 1. improvement of ten patients' psychic state, above all in the existential frustrational states of life evaluation hidden by interpersonal troubles and tension and 2. in a higher degree the possibilities of confindetial contect between the therapeutist and the patient. It was found out that in 32 patients out of 40 observed ones improvement in socialization, retardation of psychic maladaptation and hospitalization syndroms appeared.

During an equal 2 year term we observed a group of 20 aphasic old patients who all had ictus with right-sided hemiparesis, mixed aphasia, prevaillance of motor aphasia. The average age of the patients was 67 years, the average time of hospitalization 1 — 3 years. The group was devided into two subgroups of light and serious aphasic, patients, each group having 10 members. The results of reeducation in speech, writing, reading and counting were observed. Altogether 11 patients succeeded in writing with the left hand. In the subgroup of 10 light aphasic patients 5 patients improved in the observed communicative activities, 3 patients improved moderately, 2 patients remained without change. In the subgroup of 10 serious aphasic patients 1 patient improved notably, 2 patient moderately, 7 patients remained without change. In the improved aphasic patients improvement of movement was to be noticed.

Group meetings of aphasic with non-aphasic patients alternate. They are advant ageous for the competiveness of the patients who can see their own achievments and this is that helps to improve their interpersonal relations, resocialization. Twice we put into the mixed group of aphasic and non-aphasic patients individually selected non-aphasic patients who acted as opinion leaders and fellow therapeutists. Mixed groups induce many problems, such as imitation, taking ower of paraphasic forms. On another occassion we noticed incerase of inner tension passing from the aphasic patient to the non-aphasic patient and vice versa. This form of mixed groups with the program modified and specialized for reeducation appeared to be remarkably productive in nonverbal items (social games, music, singing). The patient's emotional bonding on the therapeutist may play a negative role here and according to our experience it seems to be suitable to alternate two therapeutists in certain individually stated time-intrvals or to place the aphasic patient into the group acocrding to his present state. There are two personalites in action here: the therapeutist and the aphasic patient. In addition to his professional abilitis the therapeutist should dispose of empathy which helps to anticipate critical moments, for instance when the aphasic patient develops emotional bonds which may originate in unexpectedly good results in reeducation. The personalities of the therapeutist and patient must be equal partners, particularly in old patients. We consider the most important part of rehabilitation and reeducation the reconstruction of the premorbid personality of the aphasic patient sometimes carried out hypothetically, especially in lonely patients. Eisenson stressed the influence of psychological features of the personality on the results in reeducation which, according to our experience, deepen with the age and chronicity, namely in the emotional sphere.

The significance of the influence of the aphasic patient's premorbid personality, his/her present state and specificity of applied reeducation is documentated by the following case: patient F. S., 67 years old, double ictus in

1968 with right-sided hemiparesis, total motor aphasia, treated in our hospital since 1972. First examination of aphasia in 1973 showed maintained vowels u, e, a, acalculalia, severe agraphia, alexia. Perception was essentially maintained, during the examination monotone tune the patient produced the above metioned vowels; in reducation of the other vowels he achieved little success. He succeeded in writing with his left hand. He proved to be an egocentric, rigid, dominant, mostly passive, often negativistic personality. In the course of 8 years of total motor aphasia physiognomic communication (e. g. gesticulative and mimc) got fixed. Being asked the patient pronounced the word „sakra" (swear) in January 1976. Reeducation in speech was started from this word. In February when training a new word, a fragment of a folk song with the very word was used. The patient joined the therapeutist, sang without mistake with little literalies only. In further reeducation music- singing method described by Várgha and Gereb was used. In the course of 5 — 6 weeks of successful reeducation we observed notable changes in the patient's psychic state: he smiled, showed interest in his environment. Passive and negativistic attitudes appeared less frequently. Some features of his personality, such as rigidity etc. proved to be frequent strong obstacle in reeducation. We managed to get over it by using the above mentioned method, by means of audiovisual techniques and hypothetical reconstruction of the premorbid personality. The present state of phasic activities: the active stock of words comprising about 60 words, with the hint of the first syllable — several hundreds of words; improvement in counting, reading, writing.

We give a brief description of the modified method whose following part were exposed apart or together: tune of a known song with original text, a text of a song in monotony freshly trained words put into, tune, rhytmical speech, solmization syllables for training of new words. The procedure went from articulem to graphem.

According to Sheldon's typology the patient of the given case proved to be a cerebrotonic type in which certain personality features manifested themselves as a retardation factor in comparison with the patient H. B., 65 years old. Being a viscerotonic type this patient was vital, assiduous and achieved remarkably better results in reeducation.

In the last years psychophysiological neurophysiological relations between verbal and non-verbal communication, especially music, singing, physiognomy and speech were pointed at for example by Sedláček, Sychra, Charvát, in the sphere of reeducation by Beyn, Taylor-Sarn, Cvetkova and others.

In conclusion we may say that according to our experience it's probable that for certain chronic organic old patients the aplication of non-verbal archetypal phenomena (music game) is specific and productive, since these evoke and release through emotional aesthetic effect parts and needs of the personality stored in the long term memory both subconscious und unconscious. These factors construct the compensative abilities of the central nervous system, reconstruct blocked needs and motivations damped by multimorbidity of the old age. Thus they become part of the rehabilitation and applied psychotherapy. It is possible to apply these phenomena in a modified way reeducation of chronic aphasic old patients with stress on dispositions of the whole patient's premorbid personality.

VLADIMÍR JANDA

COMPARISON OF SPASTIC SYNDROMES OF CEREBRAL ORIGIN WITH THE DISTRIBUTION OF MUSCULAR TIGHTNESS IN POSTURAL DEFECTS

In this brief paper we would like to point out one similarity between several clinical pictures. This similarity is not mentioned very often but we consider it as an important one.

It is well known that in a spastic syndrome usually spasticity does not develop in all muscles to the same extent and that the difference between the degree of spasticity may be great. In one subject we can find muscles which show only a very slight increase of the tonus or are even hypotonic whereas other muscle groups may be very spastic and develop evident contractures. A certain localisation of a lesion causes, of course, a more or less similar picture, as for instance capsular hemiplegis of Wernicke Mann type or spastic diplegia in cerebral palsy.

Roughly spaking a cerebral localisation of a leasion causing a spastic syndrome provokes a striking by similar pattern in distribution of spasticity in various muscle groups.

F. i. in capsular hemiplegia or spastic diplegia muscles which show the greatest spasticity and spastic contractures are usually responsible for the typical clinical syndrome. The following muscles are in these syndromes usually „really" spastic: triceps surae, tibialis posterior, rectus femoris, iliopsoas and tensor fasciae latae, hamstrings, piriformis, trunk erectors, pectorialis major, upper trapezius and levator scapulae and in general flexors in the upper extremity. Other muscles, as typically the tibialis anticus, the vasti, the glutei, the abdominal muscles, the lower stabilisers of the scapula and in principal the extensors of the upper extremity are those in which the increase of the muscle tone is much less evident or which may be hypotonic and signs of hypotrophy.

Let us switch now to a completely other clinical pictures. It is again fairly well known, that in postural defects and degenerative joint diseases which may be considered as a postural defect in a broader sense, regularly not only muscles with a decreased muscle streght but tight and short muscles are found as well. As we have shown in our previous papers, the development of muscle weakness and/or tightness in diferent postural defects, as in faulty posture, in vertebrogenic (disc) disease, like in painful back, is not occassional one but follows certain rules. These rules are so evident that it is even difficult to find an exception. Therefore, we are convinced and we are right to speak about a typical pattern of developing a typical dysbalance between muscles with a tendency to get weak and muscles with a tendency

to get tight and shortned and contracture. Thus these clinical pictures to some extent can be considered as a systemic disease.

Strikingly enough, muscles which show a tendency to develop tightness and shortening are exactly the same as those which in spastic syndromes of capsular origin show the greatest spasticity. And muscles which show usually only slight signs of spasticity or even hypotonia are those which have a tendency to get weak and inhibited in postural and other defects.

In our further studies concerning the degree of muscle activation in various movements we could demonstrate that muscles with a tendency to get short and tight are activated during various movements far more compared to the muscles which respond more or less by inhibition.

A similar situation can be observed in various other pathological conditions of the motor system. Thus f. i. even in peripheral nervous lesions, in traumatic cases of the osteoarticular system and many others, muscles which show a tendency to develop hyperspasticity or spastic contractures in cerebral types of spasticity show a much greater tendency to get tight.

From the clinical point of view muscles which respond more by tightness shortening and contractures have more pronounced antigravity function, whererar muscles which respond more or less by inhibition and weakness have predominantly a phasic function.

Summarizing, the purpose of this paper was to mention that in some pathological conditions — and these conditions may be very diferent — from capsular hemiplegia or spastic diplegia to injuries of the osteoarticular system or postural defects like foulty posture or painful back, the behavior and response of certain muscle groups is to a great extent similar — one chain of muscles develops contractures, tightness, spasticity, the other on the other hand inhibition, weakness and lesser spasticity. This different reactibility between these two muscle systems follows actually the same rules. In other words, between some types of spasticity and some other pathological conditions of the motor system — as far as the muscles is concerned — the difference of symptomatology is more of a quantitative than of a qualitative character. It is gradual and not oposite, black and white, as we are used to think about.

In other words, by carefull examination of a normal subject, of a subject with non nervous motor lesion and of a spastic of cerebral origin the symptomatology of changes of muscular function is gradual. A spastic syndrom from this point of view may be concerned as an extreme expression of a physiological relaionship between different muscle groups. These pronounced differences in spasticity of cerebral origin may be explained as some kind of desinhibition in a similar way as in the explanation of many other symptoms of a spastic syndrome.

In addition, this similarity of muscle changes in different pathological conditions may be one of the explanations why one method of therapeutical exercise is well effective and may be used with benefit in completely different syndromes.

GERHARD GÖLLNITZ

SOME FUNDAMENTAL ASPECTS OF THE REHABILITATION OF CHILDREN SUFFERING FROM CONSEQUENCES OF CEREBRAL DAMAGE

At birth, a healthy child possesses functioning systems which are controlled by the nervous system and permit the child to adapt to its environment. This adaptaation is a specific biological property which permits long term adaptation to nature and the interpersonal social environment to a far greater degree in man than in other, less highly developed biological species. In other words biological cybernetic systems can and must, in contrast to technical cybernetic systems which are usually of a closed nature, maintain their stability in the face of a constantly changing environment if their very existence is to be ensured.

Our particular problem is that there are children who possess this outstanding adaptability to only a reduced degree, who, even in the face of normal environmental requirements, fail to adapt step by step, for example which regard to their metabolisms, the maintenance of chemical and physical cell constants or the regulation and control of the endocrine gland system under the influence of the hypothalmus. Adaption also includes the biologically controlled ontogenetical maturation of the child in its interaction with internal and external environmental conditions, so that the gradual development of the motor functions, the assumption of an upright posture, the tool functions, the sensory references, speech, body scheme and the basis for both intellectual and social relations, also represent adaptation processes.

Forms of desadaptation occur if eithter environmental conditions are extremely non-conducive to human life or — and this is of major interest within this framework — if, as a result of pre-, peri- or post-natal damage to the brain or part of the brain, the expected adaptation performance fails to materialise. Thus, the non-manifestation of the motor development or the formation of modified motor patterns in the case of hypnotic, spastic, extrapyramidal forms of paresis or cerebellar dyskinesia are the consequences of such a desadaptation. The purpose of rehabilitation is therefore to create special therapeutic and sociodynamic conditions in order to help avoid misadaptation and to raise the performance and development of the personality of the child to the normal, or as near normal as possible, state of development, even if it takes longer than normal to attain this state.

If, after adaptation or readaptation has taken place, some organic disturbance occurs [menigitis, encephalitis, brain trauma], the organism will endeavour to compensate for the consequent deficiency. This phenomenon is well known in medical circles, examples being the hypertrophy of the ventricle musculature in the case of cardiac valve defects or the intesified activity of one kidney if

the other fails. If, for certain somatic reasons, the necessary degree of compensation is not achievable, or if compensation is disturbed by additional internal or external loads, this may lead to impairment of the organism to such a degree that the further life of the organism may be endangered. This state is known as decompensation and may be defined as the situation in which the compensatory regulators of a chemical, physiological or morphological character which are otherwise available to the human organism fail temporarily or permanently, or are not present. Well known are the deterioration in motor coordination in the case of cerebral paretic patients who are forced to stay in bed or are treated with plaster of Paris for long periods and the reoccurrence of aphasic disturbances in consequence of tiredness, physic loads or oxygen deficiency of the brain.

In the case of a child, adaptation-performance rises for ontogenetical reasons from birth to its first peak during the third year of life, whereupon it continues to rise and reaches its climax when the organism achieves maturity. Thereafter, it initially remains at a constant level before it steadily declines in the course of adulthood. The slighter the impairment of the adaptation performance, the better will be the compensation ability and vice versa.

With regard to the problems associated with neurological rehabilitation during childhood, the fact that, depending on their severity, organic noxa impair the developing brain is of importance. The etiology, time, severity and location, however, will differ from case to case. The neurological symptoms will depend on the system involved and its ontogentic-funotional manifestation. Specific brain-localised syndromes, however, cannot be expected until the particular functions such as sitting, grasping, standing, walking, speech, writing, reading or the acceptance of social orders have become manifest in the child as a consequence of his or her stage of development. We are all acquainted with the transition from hypotonia in infants to spasticism in early childhood, the persistance of pathological reflex mechanisms in the case of circumscribed cerebral development retardation and the brain-organic psychic axis syndrome which appears simultaneously with all cerebral damage and neurological syndromes. Apart from deficiencies in the integration of the sensory functions and the difficulties encountered in adopting conditioned stereotypes, the step by step development of the child is slower or, at least, partly delayed and this may lead to disharmonic, asynchronous phenomena. The maturation of the intellect will usually also be impaired, particularly as a consequence of the restricted breadth of physic performance (attentiveness, concentration, endurance and sensitivity to stimuli). The affectivity will remain undisturbed temporarily or over a protracted period.

The advancement and motor rehabilitation of these children should not, therefore, concentrate only on the primary, conspicuous paralysis, dyskinesia, speech impediment or apraxia. It is absolutely necessary that these activities should be based on the state of development of all of the child's performance potentials. The state of the child's drives can also be influenced by medicamentous and pedagogic methods. Of major importance, however, is the fact the development of the sensory functions „seeing" and „hearing" will always slightly precede the motor coordination: the actions „see and comprehend" and „listen and want to see" are necessary conditions for the activation, coordination and development of the body motor functions to perform purposeful, premeditated actions.

The expression of the „brain-organic psychic axis syndrome" (Göllnitz) in the case of a developing child is not dependent on the severity of the brain

damage alone: the compensatory processes and decompensation properties may be diluted or accentuated by interpersonal and sociodynamic phenomena, so that neurological rehabilitation will be merely a matter of „patching up" unles the doctor and his team simultaneously take the development of the child's personality, his resonance and ability to compensate into account and, ifnecessary, to fully integrate these facets into the rehabilitative therapeutic treatment.

We may thus draw the following conclusions:

1. A necessary condition for the rehabilitation of patients suffering from neurological deficiences following cerebral damage is not only the specific neurological diagnosis, but the thorough assessment of all motor, rhytmic, sensory-physiological, lingual and psychic performances.
2. In infants and small children, promotion of the readaptation of the system involved is more important than therapy based on the symptoms alone.
3. Good compesantory performance can only be obtained if the breadth of psychic performance of the child within the framework of the brain-organic psychosyndrome and the harmonic development of the personality is taken into consideration.
4. The rehabilitation of each child must be oriented on the long term, and the possibility of new symptoms appearing during the manifestation of the child's ontogenetical-functional development must be taken into consideration. Knowledge and understanding for this must be aroused in the physiotherapists, parents and pedagogues involved.

SIGRID POSER AND GERHARD RITTER

MULTIPLE SCLEROSIS AND DRIVING LICENCE

Introduction

In order to get knowledge of the traffic performance of patients with Multiple Sclerosis (MS) a statistical traffic study was performed. During an epidemiological survey 294 MS-patients were interviewed and examined. Information was gained from the patients on the possession of a driving licence, on the date of its ecquisition, on the actual use of it, on the holding of a motor car and a possible special fitting in the car.

In Germany traffic violations are recorded in a central registration buro in Flensburg (Kraftfahrtbundesamt). For research purposes the records of individual patients can be obtained provided the professional discretion is guaranteed. The data of the MS-patients possessing a driving licence could be gained in this way and correlated to the physical findings relevant for traffic performance. The clinical data were recorded during the examination in a standardized manner on 2 optical mark reader sheets.

The purpose of the investigation was

1. to get information on the frequency and kind of violations recorded for the MS-patients,
2. to compare the results with the data of the general population,
3. to search for amy particular features shown by the patients who became offenders in comparison to the patients without registration.

Results

153 out of the 294 MS-patients (52 %) had a driving licence, mostly class 3 for driving motor cars; 4 patients had a licence to drive trucks and 2 had the permission for professional trasportation of passengers. For reasons of health 32 (21 %) gave up driving spontaneously, twice the licence was withdrawn by the authority.

The central registration in Flensburg recorded 11 out of the 153 (7 %) as traffic offenders. Of the 9 men and 2 women 7 were registered once, 2 twice and another 2 three times. The following 11 violations of traffic rules occurred:

disregard of red lights	(6 times)
defect of tire	(2 times)
dangerous turn	(1 time).
illegal alteration to the car	(1 time)
insufficient marking of a broken car	(1 time).

6 delicts were recorded:

drunken driving (5 times), 2 times connected with accidents, hit and run accident (1 time).
Withdrawal of driving licence (4 times), prison sentence (1 time) and fines between 50 and 1500 Deutsche Mark were imposed on the offenders.

Neurological disturbances relevant for traffic performance in MS-patients wih (N = 11) and without (N = 142) registered offences of traffic rules.

kind of disturbance		control group N = 142 N	%	offenders N = 11 N	%	level of significance
psyche	euphoria	25	18	1	9	
	depression	10	7	1	9	
	others	14	10	1	9	
	total	49	35	3	27	
visus	1 eye ↓	25	18	3	27	
	2 eyes ↓	13	9	1	9	
	total	38	27	4	36	
diplopia		12	8	1	9	
paresis arm	slight	26	18	1	9	
	moderate	4	3	—	—	
	severe	1	1	—	—	
	total	31	22	1	9	
paresis leg	slight	36	25	1	9	
	moderate	17	12	—	—	
	severe	19	13	3	27	
	total	72	51	4	36	$p < 0,1$
spasicity arm	slight	24	17	3	27	
	moderate	2	1	—	—	
	severe	1	1	—	—	
	total	27	19	3	27	
spasicity leg	slight	26	18	1	9	
	moderate	15	11	2	18	
	severe	16	11	1	9	
	total	57	40	4	36	
clonus/spasms		51	36	4	36	
coordination	arm	59	42	2	18	
	leg	51	36	7	64	
sensation of depth	leg	63	44	6	55	

A comparison of the clinical symptomatology of the patients without registration with the offenders showed a trend for the offenders to be slinghtly less disabled (see table); this difference was not statistically significant, however.

Discusion

The literature on the traffic performance of physically handicapped is scarce; figures for MS-patients do not exist. The epidemiological setting of our study presented two major advantages:

1. the bias of selection was small; nearly all known MS-patients from the area could be traced. Patients not able to come to the clinic were examined and interviewed in their homes;
2. most patients were cooperative to answer the questions because they were in close contact to the clinic for years. They were informed on the scientific purpose of this study; but they knew that they can always get medical and social help by the same persons involved in the research program.

Compared to the general population MS-patients had a lower rate of registered traffic violations (16 % versus 7 %). The following explanations are possible for this fact:

1. frequently MS-patients make no use of their licence
2. the kilometres covered per year are less for the MS-group
3. MS-patients are particularly safe drivers.

21 % of the MS-patients studied gave up driving spontaneously, the corresponding figure for the general population being 11 %. As data on the other 2 items could not be gained, the contribution of the 3 mentioned factors to the low percentage of traffic offenders among the MS-patients cannot be evaluated.

As to the kind of offences the MS-group is remarkable. Whereas exceeding speed limit and violation of the right of way are the most common irregularities in the general population these items were not recorded at all in the MS-group. 6 out of 11 MS-patients did not pay attention to traffic lights, however. This frequent disregard of red lights could be due to

1. visual impairment and/or scotomas for colours
2. paresis, spasticity or coordination disturbance of limbs
3. psychic disturbance with or without altered reaction time.

The traffic offenders did not present any of these symptoms more often than the MS-patients without registration. On the contrary, they seemed to be slightly less disabled than the control group. Together with the sex ratio of 9 men to 2 women for the offenders which is complety atypical for MS it makes it likely that other factors are more important for traffic offences than the disease itself.

A general retention of a driving licence for MS-patients or heavy restrictions seem not to be justified. In cases of disability severe enough to prevent driving special fittings in the car may be helpful. If they are planned and tested carefully, the regained ability to drive can mean an essential contribution to rehabilitation in certain cases.

V. VLACH

SOME MOVEMENTS PATTERNS SUITABLE TO THE REHABILITATION OF INFANTS EVOKED BY EXTEROCEPTIVE STIMULATION

In rehabilitation of laesions of the central nervous system we usually intend to evoke complex motor patterns that form basic components of the normal motility in infants and/or adults. These complex movement stereotypes are genetically based and coded. They appear according to the development of the central nervous system at definite evolutive periods dating from the embryonal stage untill the end of the 1st year, may be even later. They change during the evolution, they develop, and consequently differ according to the age. In adults they exist in definite and practically identical forms. Many of them are inhibited during the evolution of course, but do not disappear totally.

The human brain possesses a considerable number of these motor patterns which emerge and manifest themselves during the evolution spontaneously. Many of them are able to be evoked in arteficial way. Sometimes nearly the total functional motor whole can be evoked, sometimes only its definite component.

One and the same motor pattern or its fragment very often can be arteficially elicited by several different stimulations. Thus it is possible by using special technique to evoke a special motor pattern and at the presence of a laesion of the central nervous system to substitute arteficially a missing or

Fig. 1.

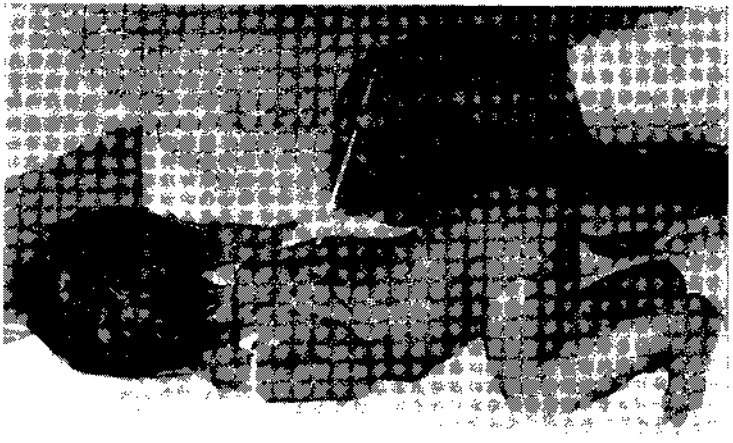


Fig. 2.

Fig. 3.

pathological motor link by a nearly normal stereotype. In this way an improvement of the damaged motility can be achieved.

Verticalization and locomotion are the main goals in rehabilitation and reeducation of retarded and/or injured infants. These two goals are able to be achieved by using not only proprioceptive but also exteroceptive stimuli for to evoke suitable motor stereotypes. In our practice we make use of many different exteroceptive reflexes — sensitive and sensoric — for to elicite simple and/or complicated motor responses suitable to the rehabilitation of not only central but also peripheral nervous laesions.

In activating verticalization of the cephalic end of the trunc we use in prone position the cutaneous neck reflex and in activating verticalization of the pelvic end we use the cutaneous vertebral reflex, the most sensitive area of which lies in the thoracal region. Locomotion in prone position can be achieved according to Bauer by cutaneous stimulation of the soles or activated by the interscapular reflex which provokes complex swimminglike motor activity.

The neck reflex: tactile stimulation of the skin in the neck region provokes contraction of the underlying paravertebral neck muscles producing extension of the neck and elevation of the head in prone position. This movement is accompanied by a slight flexion and adduction of upper limbs. The reflex is suitable to the activation of the verticalization of the head and upper part of the trunk in retarted and cerebrally injured infants as well as in some myopathies.

The vertebral reflex: tactile skin stimulation over processus spinosi from the sacral region up to the vertebra prominens evokes synchronous bilateral contraction of the long paravertebral muscles, the most sensitive reflexogenous zone being between the scapulae. The contraction produces an arching of the spine leading to the elevation of the pelvis, accompanied by a flexion on and adduction of the thighs and/or lower limbs that are localized under the trunk. In such a way the lower part of the trunk is verticalized. Both these reflexes represent an antigravity motor tendency — exteroceptively evoked coordinated verticalization patterns — of the upper and/or lower trunk respectively. They can be used to the activation of the elevation of the head and to the activation of the verticalization to the all 4 position in retarded and neurologically affected infants as well as in some myopathies.

As for lomocotion in this developmental period creeping can be activated in retarded and cerebrally injured infants by exteroceptive stimulation as well.

Besides the very well known techniques described by Bauer and by Vojta (reflex creeping), we make use of the s. c. interscapular reflex: tactile skin stimulation between the spine and the margo vertebralis scapulae on one side evokes a homolateral rotation and a slight elevation of the head, an incurvation of the trunk accompanied by the flexion of the homolateral and semiextension of the contralateral extremities. This complex motor pattern resembles swimminglike movements of the newborns. In our practise it is used to the facilitation and/or activation of the creeping in retarded and cerebrally affected infants as well as in some myopathies. Skin stimulation once to the righr, once to the left side of the thoracal spine evokes alternative creeping serpentine activity of the head, trunk and all 4 extremities.

ERZSÉBET BALOGH, SZABOLCS HORVÁTH

THE PHARMACOLOGICAL INFLUENCE ON PARALYSES MAINLY SPASTIC PARAPARESIS IN INFANCY AND CHILDHOOD

1. The diseases show age-specificity with reference to pediatrics, as well as in pediatric neurology. Certain forms are almost entirely absent below the age of one year, others are more frequent, and their appearence dfiffers also from that in adults.
2. Motor development and maturation of the nervous system involves a continuous changing pattern. Although apraizal of the efficiency of the antispastic drugs by objective methods is considered important by most authors, the methods will be insufficient if newborns and infants of various gestational age and birthweight are not given continuous control.
3. The difference in drug tolerance is the third essential factor. Therefore a number of drugs may not be given below three years of age, while others are tolerated relatively well. Also it belongs to an other age-specificity of drug tolerance that the primary action in adults of certain drugs will be negligible in infants and the drug's secondary action i. e. the spasmolytic effect prevail: for instance Nitrazepam and Meprobamat.
   Only a few muscle-relaxants can be given to prematures with a very low birth weight.

Table 1: Data of infants treated with Lioresal

Patients in groups	Number	Birth injury	Neurological symptoms	
			tetra-	parapareisis
Prematures (birth weight: 900 — 2400 g)	10	6	4	6
Small-for-date infants (birth weight: 1050 — 2600 g)	14	12	6	8
Matures (birth weight: 3200 — 3800 g)	4	4	3	1
Total	28	22	13	15

Table 2: The effect of the Lioresal treatment

Patients in groups	Number	Treatment in month		Good effect	Like other drugs	Side effect
		Begining	Duration			
Prematures (900 — 2400 g)	10	1—24 daily	2—18 dose: 10 mg	8	2	—
Small-for-dates (1050 — 2600 g)	14	4—16 daily	1—16 dose: 8 mg	10	3	1
Matures (3200 — 3800 g)	4	4—16 daily	4—10 dose: 10 mg	3	1	—
Total	28			21	6	1

Table 3: Lioresal in different neurological disordses in early chidlhood.

Neurological disorders	Number of cases	Improved	Not improved
Paralysis spinalis spastica	5	3	2
Morbus Friedreich	2		2
Disseminated sclerosis	2		2
Neck injury	1	1	

In Hungary only Mydeton (1-piperidino-2-methil-3-/ptonil/propanon-3-chlorhydrate) was available. (Figur 1). Naturally in addition to the various special conductive and rehabilitation methods (Bobath, Fay, Kabat, Pethó, Vojta) pharmacotherapy has to be applied.

Lioresal having been synthetized nearly ten years ago revolutionized the rehabilitation of paraspastic diseases of spinal origin. Its effects in small babies and its action in adults with cerebral palsy have not been mentioned however in literature. Therefore we examined the antispastic effect of two drugs: Lioresal and Diazepam.

The Lioresal is a gamma-aminoacid derivative (Fig. 2) which inhibits both the monosynaptic and the polysynaptic reflexes. It reduces the activity of the efferent gamma neurons and larger doses decrease the activity of the alpha neurons, too.

Twenty-eight patients with central lesion manifest already on the neonatal period have been treated with Lioresal. (Table 1). Paraspasticity was present mainly or exklusively within the symptoms of cerebral palsy (thirteen and fifteen cases respectively). Ten of the twenty-eight patients have been prematures; fourteen small — for — date babies and four mature born infants. Most of them, altogether twenty-two patients had been subject to perinatal injury, too.

On the table 2 the beginning of drug therapy and the duration of its appli-

cation in months is to be seen. We considered as good effect, when improvement was better than by the other antispastic drugs. We compared the effect of the different drugs in one and the same patients. After ten days of Lioresal therapy they received during same period the other mentioned drugs: Mydeton, Diazepam and in some cases Nitrazepam. The subsequent therapy depended on the neurological findings and the repors of the parents. The daily doses are disployed according to the three groups. In twothirds of cases Lioresal was given alone. The other one third received Lioresal additionally because the other drugs were ineficient. In two infants with neonatal cerebral seizures and spikes in the EEG, the severe spasticity had forced us to give Lioresal in spite of the seizureprovoking effect of the drug (Pinto at al.). The seizures did not reappeare and spasticity of the infants diminished considerably. We have never observed severe side effects, in one case only hat to be discontinued the treatment because of vomiting. After all good effect was observed in twenty one cases, while in sist the Lioresal effect was not superior to that of the other drugs.

We gave Lioresal in other pathologic condition, too. (Table 3) Three of five patients with spastic spinal paralyses reported on the subjectiv relieve of complaints. Two patients with Friedereich's disease and two with disseminated sclerosis did not improve. We observed however a very good result in an eighteen months old child with neck injury, who developed first tetraplegia and later showed a spastic tetraparesis.

In another group of sixteen patients with light spasticity, hyperexcitability and persistant archaic reflexes, as well as with some motor -retardation, were given Diazepam for a period of one — nine months with very good effects.

The rahabilitation of spastic cerbral palsy which occures frequently in prematures and infants with perinatal injury is a serious and important problem.

Physiotherapy and conductiv treatment are a precondition of the psychomotor development. But pharmacotherapy is an essential component of such treatment. According to our experiences Lioresal been efficacious in older children and adults can be used with very good results in neonates, as well as in premature infants, too.

M. LEHOVSKÝ, V. TOŠNAROVÁ

THE USE OF MONOSYNAPTIC (H) REFLEXES IN THE EVALUATION OF SPASTICITY IN CHILDREN

In 1918 Hoffmann stimulating popliteal nerve in man avoked both direct motor response in calf muscle and late well synchronized response with latency of some 30 msec.

This feature was later confirmed by many investigators (Lloyd 1943, Rushworth 1964). It was also found, that the amplitude of late response (H) is higher in patients with central paresis when compared with normal individuals. Further clinical use, however, was not possible because of great variability (Paillard 1953). Only the technique of Matthews (1966), in which the amplitude of direct (M) and late (H) waves are measured gives the possibility of clincal use.

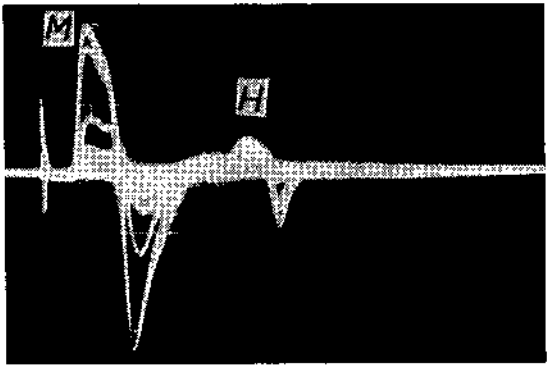
We have been working in our laboratory on this problem for several years and I take the liberty to show some of our results.

Material and methods:

Part I M : H ratio

We have investigated 31 normal children and 55 children with spasticity.

Fig. 1.
Brings the summarized records of all responses to increasing stimuli from subthreshold to supramaximal. M — direct response H — late response.



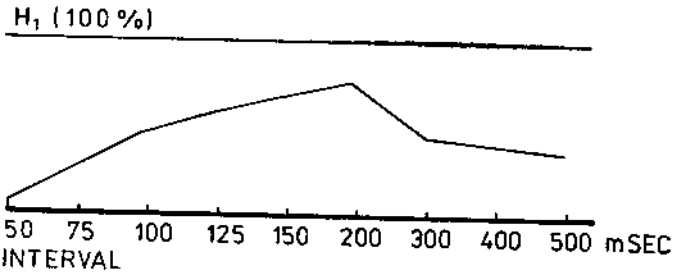


Fig. II.
Shows the ratio of H 1 response and H 2 response. The H 1 amplitude is taken as 100 %, the H 2 is proportional. In normal group the H 2 amplitude is lower than the H 1.

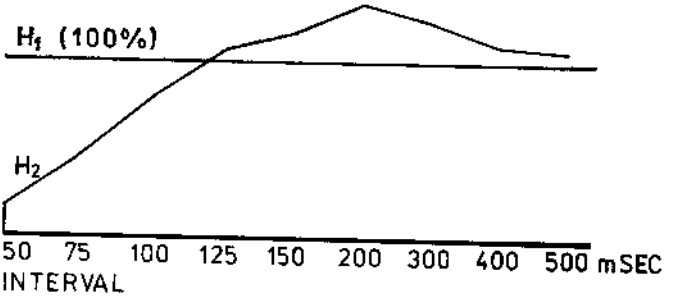


Fig. III.
Shows the H 1 : H 2 ratio in spastics. The H 2 is higher than H 1.

The children with spasticity were further divided in 3 steps according to the intensity of spasticity. All children were investigated on Disa 2 channel EMG apparatus with memory screen and stimulator. The duration of stimuli was 0,2 msec, the intensity gradually increasing from subthreshold to supramaximal. The electrodes were surface Disa, the distance between electrodes of some 20 mm. All resposes were summarised on one picture and pick to pick amplitude of both responses were measured. The example see fig. I. The average M: H ratio in normal children was 25,1 ±, whereas in spastics the ratio was 39,3. The difference is significant on 1 % level. In children with mild spasticity the ratio was 21,3 in intermediate 32,1 and in marked spasticity 42,5.

Conclusion part I:

Our results show, that the M : H ratio gives enough information about intermediate and marked spasticity. The method fails in mild spasticity. It is though (Spiro 1974) that the amplitude of H wave gives the information about the excitability of alpha monotoneutrones in medulla. Our results are in agreement. We have shown that the M : H ratio is higher also in spasticity in childhood. This might be caused by deliberation of monosympatic segmental reflexes from suprasegmental depressive influence.
Part II H1 : H2 ratio

The method of double stimuli (Bergamini 1972) gives another possibility in studies of reflex excitability. In this method double stimuli are applied using the same technique of registration. The interval of stimuli started for 50 msec, the longest was 500 msec. In all intervals pick to pick amplitude H1 and H2 were measured, the first being taken as 100 % and the second was proportional. The group of 24 normal children and 45 children with spasticity was investigated.
Fig. II showes H1 : H2 ratio curve in normal children.
Fig. III the same in spastics.

Conclusion part II:

We can see that the H1 : H2 ratio is different in normal and in spastic children.

In control group the amplitude H2 was lower in all intervals between stimuli compared with H1. In spastics the H2 amplitude reached the H1 when the interval between stimuli was 125 — 150 msec. In longer intervals the H2 amplitude was higher then H1. The amplitude in spastics was higher even when the interval between stimuli was 0,5 sec. The method can distinguish spastics from normal controls, however, the explanation is somewhat different. This seems to be some kind of facilitation on the segmental level. The long duration of facilitation shows the long loop reflex activity from suprasegmental structures.

Conclusion

Summarising both methods presented we can say, that they confirm clinically detectable spasticity and to some extend — especially the M : H method, give some information about the intensity of spasticity. This has also the main significance to its further clinical use in the evaluation of results of various methods of the treatment.

J. SÜSSOVÁ

CONTRIBUTION TO THE STUDY OF HEMIPARETIC FORM OF CEREBRAL PALSY

In studies of children suffering from cerebral palsy, our attention was attracted by the fact that among children with hemiparetic form of this disease those affected on the left side showed a lesser mental retardation. We sought the explanation in the fact that a great percentage of these children suffered from epilepsy, however even here a satisfactory reply to this question was not found.

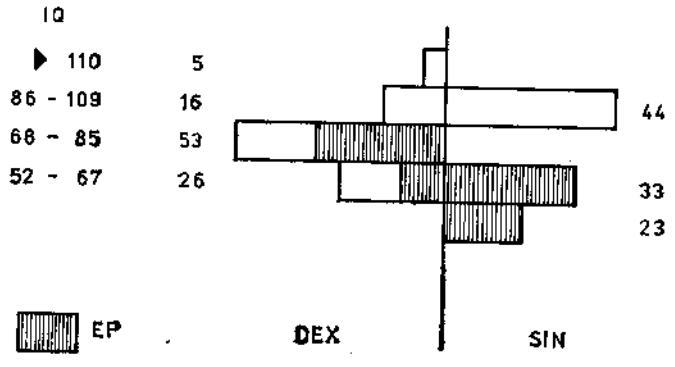
As neither the literature was giving satisfactory attention to the side affected (Kirman, Lesný), we decided to study this question more deeply in our group of children.

Method and Material

Our study comparised all children suffering from hemiparetic from of cerebral palsy that were treated in the Prague Institute for Physically Affected Youth in the years 1971 — 1976. The age of children was 7 to 15 years. In our study, however, could be taken only 28 children as the others did not satisfy criteria stipulated by us. In particular, however, it was not possible to obtain all data from children that had already been released from the Institute.

In all children was studied: Which side was affected, at what age the disease appeared, presence of epilepsy, its form, and at what age of child the first attack of epilepsy appeared. We also studied intelligence quotient by tests suitable for the particular age.

Fig. 1.



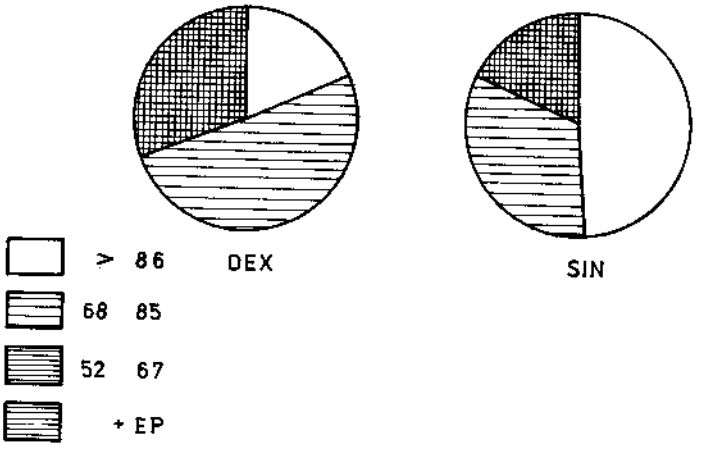


Fig. 2.

The group studied comprised 28 children, of which 16 boys and 12 girls. Epilepsy was present in 13 children, 7 boys and 6 girls; in 8 children was the right side hemiparetic form in 5 left side form.

In 6 children suffering from epilepsy, the first attack of epilepsy was before they reached the first year of their lives. Most frequent were the attacks generalized with focal beginning — in 9 cases.

Only motoric Jackson attakcs were not found in one single case. In 3 cases was found a combination of grand mal and petit mal attacks. In 1 case were present only petit mal attacks.

Mental level of children studied ranked from a standard to imbecility. In 1 case the IQ was over 110, in 7 cases the IQ was average, 10 cases showed feeble mindedness, 8 cases debility, and 2 cases imbecility.

Obtained findings were compared and mutual relationships searched.

Of the righ side hemiparetics, totaling 19, only one quarter had a normal intelect. One of these patients had a very light motoric affect, and he used the affected hand as his main hand for writing. In these children with normal intellect, no epileptic fits were present. Three quarters of patients manifested a reduced intellect — 10 feeble minded and 5 debils; 8 of these suffered of epilepsy.

Of left side hemiparesis suffered 9 children. Half of these had a normal intellect and suffered of no epileptic fits, as is also the case in right side hemipareses. No child showed a feeble mindedness, debility and imbecility was present in one half of these children. Contrary to the group of right side hemiparetics, all of them suffered of epilepsy.

As already introduced, epilepsy was present in 13 children, however, this was not even once in children with normal intellect. In left side hemiparetics with lowered intellect, epileptic paroxysms were present in all cases, in right side hemiparetics only in half of the cases. Of 6 children up to one year of age, showing epileptic paroxysms, 5 were debils and imbecils, and only in 1 child where the epilepsy was of the type petit mal, at that time compensated, the affect was manifested as feeble mindedness.

Graph Nbr. 1. Percentage of left, and right side hemipareses, classified by degree of metal level, showing the presence of epilepsy in individual groups.

From Graph Nbr. 1 results a greater percentage of children with normal intellect in left side hemiparetics, and appearance of mental defects in children without epilepsy in right side hemipareses. Right side hemiparetics show mainly feeble mindedness, with a drop both to normal, and debility. Left side hemipartics are mainly in sphere of normal intellect, with a drop to mental defects. There is, however, present an error of the group as children with serious mental defects were not represented in our group, and even the 2 imbecile children were shortly removed from the Institute.

For this reason, we also cannot take a definite view to the statistical importance of predominating right side affect. It is probable that children with left side affect remain more frequently with their families and are capable to complete the school education and obtain a specialized qualification in normal facilities together with healthy children. This opinion can be negated, or confirmed only by a detailed study in terrain.

Discussion

From our study results that, in left side hemipareses, normal mental level is more frequent as against the right side hemipareses. In left side hemipareses a mental defect is found only with the presence of epilepsy, whereas in right side hemipareses a mental defect is frequent even without any presence of epilepsy. Whether the reason could be that with right side hemipareses the dominant sphere is affected, we do not know as yet, but this supposition cannot be excluded. See Graph Nbr. 2.

Graph Nbr. 2. Instructive demonstration of degree of mental affect in both types of hemipareses.

The majority of our findings fully correspond with those of other authors, as long as they studied the same features [Pětová, Vojta, Lesný]. Contrary to Pětová and Vojta, in our group was not found a patient with epilepsy and normal intellect. This could be explained by older age of our patients; in several epileptics, that could be compensated with difficulty, we observed an increasing mental defect. Lesný describes a side classification of hemipareses, and also has a majority of right side hemipareses. The group described by him is, however, also not from a terrain, but comprises children from a sanatorium. In the majority of literature, the appearance of epileptic paroxysms and mental defect are described only generally.

Conclusion

We do not consider our studies as terminated. The work suffers from small amount of findings and small number in group studied. Only further studies will help to disclose whether the cases of left side hemiparetic forms of cerebral palsy are really less frequent and whether mental defect is present more frequently in right side hemiparetics.

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OLLE HÖÖK

MOTIVATIONAL PROBLEMS — SOME NEUROPSYCHOLOGICAL ASPECTS

The individual with long-lasting symptoms after disease of traumatic injury is confronted with the necessity of making adjustments. The way in which his problems are experienced and solved depends upon the nature and extent of the injury — and or disease — but perhaps even more so upon his pre-morbid personality. In this,a number of complex motivational problems are intertwined. The social environment in the sidest sense involving not only the situation, but the residential surroundings and the community as a whole are also of importance. A description is given of psychic defence mechanisms as denial reactions, regression, aggression, rationalization, diversion of the anxiety, compensation, identification, sublimation. The adjustment towards work in regard to motivation and attitude are especially discussed.

H. HABERFELLNER, B. ROSSIWALL

FUNCTIONAL THERAPY OF ORAL SENSORI-MOTOR DISTURBANCES

After successful early treatment of cerebral palsy we often find residuals in the three most refined areas of motor-co-ordination: disturbances of the oculo-motor system, clumsiness of manipulation, and oral sensori-motor incompetence.

The oral symptoms usually are the most debilitating ones. An open mouth and a protruded tongue signal mental retardation. Drooling and inadequate speech-articulation impair social acceptability and so do defective mastication and swalloging habits. All these symptoms are aggravated by emotional and physical stress.

To combat oral dysfunctions our team, consisting of a paediatrician and rehabilitation expert, an orthodontist, and speech therapists, applies apparative methods. Such devcices can — with a minimum of stress — inhibit pathologic stimulus responses such as the so called tongue thrust and facilitate physiologich movements in the pharyngo-oro-facial-region.

Pat. age (years)	Duration of treatment (months)	Diagnosis	Oral Muscular Tone	Oral Sensibility	Normalization of Sensibilty	Lip-Seal	Transport of Saliva	Nasal Breathing	Improvement of Speech Articulation
E.W. 7+½	12 18 24	Ataxia Hemiplegia Ment. Ret.	Hypotonia	mild Hypo-sensibility	+ +/— +	++ ++ ++	++ ++ +++	+/— +/— +	+/— +/— +
K.M. 9+½	14 20 26	Athetosis mild Ataxia	Hypotonia	Hypo-sensibilty	+/— + +	+ + ++	+ + ++	+ + +	+ + +++
K.K. 8	6 12 18	Diplegia (minimal)	Hypertonia	Hyper-sensibility	+ ++	++ +++ +++	++ +++ +++	++ + +	+ ++ ++
S.A. 8+½	6 12 18	Ataxia Mental Retardation	Hypertonia	Hyper-sensibility	+/— +/— +	+/— +/— +	+/— +/— +/—	+/— +/— +	+/— +/— +
E.K. 9	6 12 18	Tetraplegia (minimal) Ataxia	Hypotonia	mild Hypo-sensibility	+/— + +	+/— ++ ++	+ +/— ++	+/— +/— +/—	++ ++ ++
K.W. 8+½	6 12 18	Psychomotor Retardation	Hypertonia	Hyper-sensibility	++ ++ ++	+ ++ +++	++ ++ +++	+ + +	+ + +++
S.R. 12	12 18 24	Athetosis (minimal)	Hypotonia	Hypo-sensibility	+ + +	++ +++ +++	+++ +++ ++	++ ++ ++	++ ++ ++
V.U. 11	9 15 21	Diplegia (minimal) Ment. Ret.	Hypertonia	Hyper-sensibilty	+ + ++	+ ++ ++	+ post- + traumatic	++ *+ +	+ +/— +
L.R. 6+½	13 19 25	Tetraplegia	Hypertonia	Hyper-sensibility	++ +++ +++	++	+ + ++	++ +++ +++	++ +++ +++

RATING: +/— questionable, or no change at all + improvement * loss of anterior teeth during epileptic seizure.
++ marked improvement +++ excellent improvement

Initial treatment with a prefabricated vestibular shield can alter the pathologic sensori-motor milieu sufficiently to allow the fitting of the functional appliance.

This appliance consits of four vestibular pads and a retrodental shield. These parts are connected by stainless steel wires and meet the following therapeutic principles: muscle-born-stimuli from the predental region are transferred to the retrodental oral cavum and the other way around. The appliance fits quite loosely and is held in position by tongue, teeth and lips. The oral shield inhibits tongue protrusion and provides a more physiologic posterior resting position of the tongue.

Device tissue contact works towards normalization of hyper- and hyposensibility. The simultaneous normalization of muscular tonus could be explained by the fact that mild skin stimulation will alter the tonus of the underlying muscles by alteration of gamma motor neuron activity, whereas a stronger stimulation acts via alpha activity.

An acrylic shelf betwen the maxillary and mandibular teeth provides a usefull stabilization which can be compared to the auxiliary mandibular support („jaw control") as normally provided by the therapist in oral treatment according to Müller.

Small resin forms which can be either manipulated enorally by the therapist by steel bars inserted through openings in the shield provide possibilities for sterognostic training. This is especially helpful for speech therapy. Fixation of the resin forms in a mobile way to the palatinal lingual surface of the oral shield has been a progressive step in further reduction of stress. These fixed bodies are exchanged in six weeks intervals to allow for experience with different shapes and sizes. The resin forms encourage explorative tongue movements of great variety contrasting the paucity and monotony of movements which are characteristic for oral stimulus response in cerebral palsy. These seemingly subconscious movements can be observed trough the sufficiently transparent shields. The use of larger resin forms of identical shapes for tactile manual exploration extends the efficiency of these standard functional appliances (modified orthodontic monoblocs) to oral-manual interactions.

So far we have treated 25 patients, nine of which for at least 1 1/2 years. This group is presented in table I. Coordination and synchronization of interdependent oral functional chains can be altered most favourably in cases of oral hyeprsensibility and muscular hypertonie. Improvement of mastication and function of the velum palatini are not listed but show similar improvements. To clear nasal air passage to allow for lip closure, adenoidectomy was necessary in several cases. Velum function proved to have become sufficient to prevent rhinolalia aperta — a formerly considered contraindication for adenoidectomy.

This apparative treatment approach leads to night auto-therapy, thus also sparing time of therapists.

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J. MACH

OUR EXPERIENCES IN OPERATIVE TREATMENT OF SPASTICAL PARALYSIS OF LOWER EXTREMITIES

The complex nature of cerebral paralysis demands also a complex therapy, where the operative arrangements represent an important part of treatment. A surgical operation is only sensible by strict indication, reasonable aim, dose according to situation and exact remedial gymnastics. An absolute indication consists in strong, passiv no correctable contractures with dislocations of joints on the understanding of clear will to going and a normal or only a little reduced intelligence. The surgical successes decrease by extension of spasms to the whole muscular system of the body and by additional existing extrapyramidical disturbances of movement. The ability of using the arms plays an important role in operations on the lower extremities. A normal ability of supporting in the postoperative process of learning to go will increase the chances to improve the ability of going. The kind of operation is determined by the existence of pure musculare spasms or genuine contratcures. Operations on the nerve system are indicated in the case of pure spasms and involve in our experience uncertain successes in the long run, whereas operations on muscles, sinews or possibly on bones are necessary, if genuine secondary contractures exist. The following orthopaedic principle is valid in all operations: if several operations are necessary, you always have to begin on the proximal joints, that means to correct possible defective positions of the hip joint, afterwards that of the knee joint and at last to produce a normal function of the foot. In that way will be reached and improvement of static and a dynamic productivity drive by use of systematic application of remedial gymnastics.

We performed 155 operations on lower extremities of 71 spastic people in the Orthopaedic Hospital of the Wilhelm-Pieck-University of Rostock from 1971 to 1975. These were only operations on sinews, muscles and bones to correct concractures respectivly dislocation of joints. In this period we did not operate on the nerve system, because we learned in the past, that in this way we succeeded only for a short time. Among the 71 patients there were 42 male and 29 female. The average age was 8,7 years. 19 patients suffered from diplegia, 24 from hemiplegia and 28 from tetraplegia. On an average each patient was operated on 2 times, maximum 6 times. The operations divide in the following way:

achillotenotomia 81 < 27 one-sided / 27 on both sindes

tenotomia of adductors	54	2 one-sided 26 on both sides
Eggers-operation	13	3 one-sided 5 on both sides
subtalare arthrodesis		6 one-sided
arthrodesis of the knee		1 one-sided

This showes that the operations of the soft parts are predominant, with the prolongation of the Achilles tendon in the first place. To carry out an exact prolongation we used the open z-shaped tenotomia with the aim of producing relations as physiological as possible and we absolutly prevented over-corrections. In 95 % of ours patients, which were operated in such way, we reached good operating-results, i. e. in going the heel touched the floor. The suboutaneous tenotomia of addutors was mostly carried out on children with strong spasm of the adductors and tendency for scissor-gait. Only 3 children need a recidiv-operation.

The spastic concrature of the knee joint could be influenced positivly by the displacement of the ischiocrural muscles to the femur condyles according to Eggers-operation. Bone operations are relativly seldom indicated by spastic people. They are carried out only in exceptional cases after the end of growth, if an extreme dislocation of the foot exist. Then we perform a subtalar arthrodesis with wedgeshaped resection from the middle foot.

To sum up can be said, that an improvement of static and dynamic relations can be reached by surgical operations on the lower extremities of spastic people, but the operations only represent a small but important part of the whole complex therapeutic programme.

G. HUFFMANN

CATAMNESTIC INVESTIGATIONS OF THE VALUE OF OCCUPATIONAL PROGNOSIS IN PERSONS WITH CEREBRAL PALSY

The fate of people handicapped mentally and physically since early childhood can be strongly influenced by testing the occupational aptitude before beginning training.

A test of this type begins with a *differentiated assessment of the physical and mental defect.* The neurological examination must be augmented by tests of speech ability, recognition of perception and of manual skill. The psychiatric assessment is in need of support by psychological tests. Detailed statements on attention, impulse, the verbal production, the reactive emotional lability, on correctness and effort, memory for recent and old events and especially on the differentiated intelligence profile are of great necessity. The effect of the single handicap on the impairment of various activities becomes evident only during *work tests.* These often surpisingly show the marked disability by minor cerebellar or extrapyramidal impairment of movement but also the surpassment of marked motor defects by impulse and willpower.

Our current considerations are based on previous examinations of loo people between 12 and 26 years of age, the majority of whom showed marked neurological and psychic handicaps because of cerebral palsy. In order to assess the problems of the handicapped in the process of integration into jobs it is important to find *individual grades.* It must be composed of as many factors as possible that are related to the needs of the job. We chose four tests to grade the physical handicap. The degree of locomotor handicap and the need for help have high importance for all occupations. The manual

Tab. 1 Degree of physical handicap

Numeric scale	Handicap	Degree
0	no handicap	0
1—5	light handicap	1
6—9	medium handicap	2
10—13	marked handicap	3
14—16	severe handicap	4

Tab. 2 Prognoses and achieved occupation in 49 patients with cerebral palsy

	Prognoses	8 years later
without occupation at home	∅	6
industrial occupation	23	24
business	15	9
artisan	11	10

Tab. 3. Occupational prognoses and occupation 8 years later in 49 persons with cerebral palsy.

		(Nr. of persons)
Occupational prognoses	→ workshops for handicapped or low productivity:	30
	→ job with apperenticeship or on-the-job training with full productivity:	19
Achieved occupation	→ workshops for handicapped or low productivity: (including 6 persons at home without occupation)	25(+5*)
	→ job with apprenticeship or on-the-job training with full productivity:	14(+5*)
	*prognoses were not corect	

ability test and the work tests show the manual qualities. Five grades were introduced in each separate test method. The sum of these grades amounts to the degree of disability which also has five grades (*Table 1*).

The *ocupational prognosis* utilizing the quite useful statement on the individual physical handicap is incomplete without careful attention to *psychic factors*. In 89 examined persons, a more or less marked lack of intelligence was found, 76 showed inherited, organic or reactive psychic abnormalities which strongly influence the occupational outlook. If isolated gifts, deficits, or special abilities, career desires and even the stress of the individual job are to be considered in the occupational prognosis it will then only occasionally be possible to find a correlation to a single job. Therefore, we previously confined ourselves to grade only into *groups of various productivity* in our prognosis.

In the case of the 32 male and 17 female persons we reexamined we had predicted an industrial job group in 23 cases, a business field job in 15 cases and an artisan's job in 11 cases (*Table 2*). The industrial job group allows for the lowest requirements in regard to versatility and facility of change.

Tab. 4. „Indome" of 49 persons with cerebral palsy aged 20 to 34 years

	Nr. of persons
none :	6
„allowance" up to 100 DM per month:	16
pay up to 500 DM per month :	16
income up to 1000 DM per month :	9
income exceeding 1000 DM per month:	2

Tab. 5. Living quarters of 49 persons with cerebral palsy between 20 and 34 years of age

	Nr. of persons
„at home" (parents, grandparents, aunt):	31
in special homes for the handicapped:	12
in dormitories	2
independent in own living-quarters:	4

At the time of the *re-examination 8 years later* the occupations could be alloted to an industrial job in 24 cases, to business in 9 cases and to artisan's jobs in 10 cases. Of the six cases who were at home and without an occupation three were severely physically handicapped, two already showed marked psychic abnormalities during the first examination and one seemed to be heartless and resigned.

With regard to the various *degrees of productivity* the result of our tests allowed only for an occupation in a workshop for handicapped or a job with very low productivity in 30 of 49 persons with cerebral palsy. In 19 cases a trained job or a job with on — the — job training with full productivity could be expected (*Table 3*). Eight years later 30 of these patients were in workshops for handicapped or on jobs with low productivity. The six living at home were added to this group, however because their prognosis had only allowed for such attention and they could have been employed by such workshops if they had been available. 19 patients had trained and untrained jobs with apparently sufficient productivity. In these groups five persons each were included whose prognosis was not correlated to the achieved occupation. Whereas the occupational prognosis prevailed in 39 cases (i. e. about 80 %), only 5 patients (i. e. about 10 %) did not achieve full productivity for various reasons. On the other hand, 5 patients were unexpectedly fully integrated into occupational life.

The usually low productivity is demonstrated by the low *incomes* of the

working persons between 20 and 34 years of age who were occupied in th manner (*Table 4*). 22 patients earned nothing or only received an allowanc 16 handicapped people earned up to a more DM 50,— per month. Only 11 of the reexamined earned up to DM 1000,— per month or only slightl more. In this context, it was remarkable that apparently only four person were in possession of a *special workplace for handicapped,* three others claime to have a special indentity card for the handicapped. Two persons owned their own tax-free. car. Only 2 female persons were married, one had 3 small children, but was living away from her husband. Beside these cases, only 2 other men lived in their own rented rooms (*Table 5*), two others preferred a room in a dormitory. 12 people lived in special homes for the handicapped and even 31 were still living with their parents, grandparents or next of kin or had returned there.

Our investigations throw a light on the social situation and the fate of persons with marked defect syndroms rising from cerebral palsy. They prove that our cited test methods are able to provide an occupational prognosis with an accuracy of almost 80 %. The consideration of a prognosis of this type before entering occupational training helps to avoid many detours as well as many disappointments and to alleviate the fate of this group of people with multiple handicaps.

CLAYES, J.

ATAXIA HYPOTONIA AMONG CEREBRAL PALSY CHILDREN

On occasion of the 20th anniversary of our Rehabilitation centre joint at a special education school for disabled children we made a study on Ataxia and Hypotonia.

This because we found an increasing frequency of these types. On a population of 185 cerebral palsy children with exclusion of all mixed types, there were 40 ataxio-hypotonic children. These cases were thordughly analyzed clinically by the whole team under the direction of the rehabilitation doctor.

The multifactoral analysis showed that: — it can cover discrete athetosis, which we found in 3 on 40 cases or 7,5 %,

— a lot of synkinesia of Janda was found or 14 on the 40 cases or 35 %,

— that it is very difficult to distinguish between the cerebral and the cortical type of ataxia.

Detailed handdexterity tests, writing and perception tests are indispensable even as psychomotor and psychopedagogics tests.

The classification of Guy Tardieu concerning the troubles of the postural tonus are useful as item for the diagnosis of rehabilitation.

The evolution of ataxia proceeds in the direction of progressive disappearance of the moteo disabilitaties. So that these children disappear in the rehabilitation centre about the age of 14 to 15 years, and join mostly the special education school for mentally retarted children.

The evolution of the dyskinesia is one of more tightening, less athetoid and choreaathetoid synkinesia with activation, through temporo spatial organisation disordess with cocontraction and at last evoluating to pure temporo spatial organisation disability in the slighter cases.

This seems to indicate that Dyskinesia is more familiar with ataxia. The treatment should be adapted in a multifactoral way.

V. STARÁ, Š. RUSŇÁK, J. ROMÁNEK, M. KOVÁŘOVÁ

POSSIBILITIES OF SOCIAL ADAPTABILITY OF CEREBRAL PALSIED CHILDREN

At present time they are being discussed and delimited the principles of a complex care of cerebral palsied children which shall influence the deficiency of the neuropsychic evolution in all components.

Tab. 1.

Groups of children according to age			
	age		
I.	3 + 4	19	63 % ♂ 37 % ♀
II.	5 — 9	56	52 % ♂ 48 % ♀
III.	9 — 15	56	58 % ♂ 42 % ♀
Total		131	58 % ♂ 42 % ♀

Tab. 2.

Intelligence — a statistic survey					
Group	Age	IQ	Normál School ZDŠ	Speciál School ZŠ	Non School O
I.	3	85 (60 — 96)			
	4	93 (81 — 113)			
II.	5 — 9	69 (47 — 99)	44 %	40 %	16 %
III.	9 — 15		48 %	45 %	7 %

We know about the broadness of the problems. There have not yet been elaborated the methods of a qualitative complex evaluation of the patient in the particular stages of the evolution which should be the starting point of a more about the possibility and the methods of evaluation of social prognosis of the patient in the early age in order to lay down in the respective programme exactly which of the dysfunctions are determinating for the future of the patient in the respective age and which are to be re-educated especialy. Since the method of a motoric reeducation has been already maste-

Tab. 3.

Intelligence — a qualitative analysis				
Group	Age	Nonverbal subtests	Verbal subtests	Social understanding
I.	3	71 %	21 %	
	4	65 %	45 %	20 %
II.	5 — 9	Dispersion + assymetry of results		

red, the psychic condition, sensual defects and the defects of speech and of other forms of the interpersonal communication are of decisive importance for the majority of children.

The situation cannot be solved in the way of giving the most possible care to the patient. Since the capacity of the patient is limited and often he is overburdened more than a healthy child. That way we can bring him as far as the superlimit inhibition. It is therefore a question of a suitable individual daily regime for the child, so that the granted services should be in the optimal quality and quantity without overburdening of the patient, and that we could make a full and suitable use of the exacting and expensive work of the team of nurses. All our effort has one goal: the most possible social adaptability and integration of the patient.

As basis for the solving of these problems we have carried out a complex analysis of a part of patients who have been given medical treatment in our clinic in Luže-Košumberk in the last year. A team of specialists — neurologist, psychologist, speechhearing therapist, pedagogue and physical therapist — have examined a group of 131 children in the age of 3 to 15 years. This group is not a representative one for the cerebral palsy, the reason for this being the structure of patients in our clinic. The patients are approximately middle hard handicapped and there are represented all forms of cerebral palsy according to the current scatter.

The quite easy cases are not taken into account since they are treated in an ambulant way. On the other hand the very hard cases are excluded for the reason of indication because only those children can be accepted in our clinic who are capable of either normal or of some special type of education and therefore they must not be psychically more handicapped than up to the middle oligofreny. This group of children is however the reatest problem of rehabilitation.

Already from the beginning the group of children has logically divided into 3 subgroups, according to the periode which play the most important part in the evolution of cerebral palsied children and which appear to us to be critical in a certain way.

Table 1

Group I. Children of preschool age 3 + 4 years old where there is often possible to catch up with the particular fall-outs of sensual and

psychic functions through a special education and where it is possible to influence substantionally the motoric function.

Group II. Children from 5 to 9 years old — this is the period when the state of intellect and the psychic characteristics are definitely formed which will be decisive for the form and possibilities of the school education.

Group III. Children from 9 to 15 years old — a later school period in which the question of a future profession should be decided and the patient accordingly directed.

Table 2 — global intelligence

The psychologist was occupied mostly with the group I (children from 3 to 4 years old) where we have chosen children closest to the norm so that some qualitative differences could be analysed as it is shown at the next table.

In the group II there are included all children so that the IQ is lower, the table shows even the division according to shool attendance.

The group III covers the division only according to school attendance.

Table 3 — qualitative analysis of the intelligence

In the group I — children 3-4 years old — we see a substantial difference in the decline of components which are dependent on social conditions. This is caused by lack of informations, by influence of handicap, and it means a relatively higher delay of speech in respect to the content then perhaps the delay of the fine motoric. This must be the first direction and goal of our educational care.

The group II (children 5-9 years old) has disperced disproportionated results in intelligence-tests because of influence of various grades of social adaptability and education and of handicaps.

Table 4 — aspect to speech concerning contents

The first group is divided in children from 3 to 4 years old. Here we can see very well the progress on evolution (I emphasise again that — as IQ is concerned — we have chosen the children in the limits of norm or under average). The first grade signifies the level of normal children, the second and the third grade signify gradually a worse one, the zero signifies a total afunction. The children of 3 years are disperced in about thirds to the described subgroups. The children of 4 years reach already 80 to 90 % of normal value.

Here we see the critical period of the child in which the speech is formed. To this table for this group it is joined an orientation in respect to the understanding of the somatic scheme which is also rapidly improving within one year with the reeducated children.

The group II is broader, it has a higher scatter and lower IQ as shown above. The defects of speech in relation to the age are relatively worse, the norms are attaint only by 81 %, 69 % and 50 % of children in the particular points.

Table 5 — speech in formal aspect

The results are similar, a rapid evolution from 3 to 4 years, worse results of organs of speech, of dynamics of speech and graphomotrics which depend on the motoric defect.

Tab. 4.

Speech — aspect of contents in %															
Group		Sounds				Vocabulary			Sentence				Orientation in somatic scheme		
	age	1	2	3	0	1	2	3	1	2	3	0	1	2	3
I.	3	33	23	33	11	33	45	22	11	56	—	33	78	11	11
	4	80	20	—	—	90	10	—	80	20	—	—	90	10	—
II.	5—9	81	11	4	4	69	31	—	50	27	23	—	—	—	—

Tab. 5.

Speech (formal aspect of speech in %)																			
Group	Age	Social acceptance			Articulation			Mobility of organ of speec			Dynamic factors			Grapho/motoric abilities				Reading			
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	0	1	2	3	0
I.	3	22	45	33	11	44	45	33	45	22	22	56	22	22	56	22	—	—	—	—	—
	4	90	10	—	70	30	—	80	20	—	50	50	—	—	20	50	30	—	—	—	—
II.	5—9	31	35	33	35	42	23	66	30	4	29	56	15	25	25	29	24	30	20	33	17

The motoric deficiency remains a restricting factor even at a good educational care.

In the group II (5 — 9 years) all formal aspects of speech remain behind already in two thirds of children.

Table 6 — self-care

The evaluation concerns only the groups II and III (5 — 15 years).

Evaluation: the grade I carries out the function, grade II only with help, grade III does not carry out. Here we attain a distinct improvement in the group III of older children. This reeducation is therefore of a great importance.

Table 7 — Ability of using of means of transport

Here there is a dependence of gross motorics-locomotion.

There is no big difference between the groups II and III. One cannot

Tab. 6.

Self / care						
Group	Toilet			Meals		
	1	2	3	1	2	3
II.	60,5 %	34,5 %	5 %	83 %	9 %	8 %
III.	77 %	16 %	7 %	91 %	7 %	2 %

Tab. 7.

Use of means of transport						
Group	Car			Omnibus + train		
	1	2	3	1	2	3
II.	55 %	26 %	19 %	46 %	22 %	32 %
III.	59 %	30 %	11 %	41 %	28 %	31 %

attain any great change more through evolution, perhaps a special intensive training could be successful. A car is for the patient more suitable than a public means of transport.

Table 8 — evaluation of two interesting functions

Imagination of space + graphic expression.

In both cases the function improves trough evolution and reeducation. With older children there is joined the ability of a simple typewriting which has been also reeducated.

Table 9 — shows the development of various skills in the group II and III (age 5 — 15 years).

We have examined always abilities in proportion to the respective age. After a complex rehabilitation the fundamental skills incerase. (Construction of brikes, play with ball, sewing, spreading on bread, cooking of a simple dring, sense of rhythm, dence, various skills mentioned allways in % with children who are closed to the norm).

Conclusion

Our modest analysis has brought forth some important factors in the development of cerebral palsied children.

1. A rapid development of speech and intelligence at the turn of the 3rd and

Tab. 8.

Group	Imagination of space	Graphic expression	
		writing or draving	typewriting
II.	48 %	61 %	4 %
III.	95 %	88 %	21 %

Tab. 9.

Fundamental skills								
Group	Bricks	Play with ball	Sewing	Spreadin on braed	Cooking of drink	Rhythm	Dance	Various
72540	90 %	79 %	2 %	2 %		59 %	2 %	2 %
17			48 %	70 %	72 %	81 %	5 %	72 %

4th year when it is possible to settle some of the deficiencies of the psychic functions in qualitative respect through a specialy directed psychic reeducation, and especially the strenghening of the socialy conditioned components of intelligence is of decisive importance.

2. A fundamental development of intellectual quality is finished at 8 to 9 years (which is also confirmed by Mrs. Robaye of Brussel). In this age the fundamental placing of the child in the school instruction is decided and hte regulation with respect to the possible profession.
3. In the further period from 9 to 15 years a training of the individual skills with an exactly directed energy is possible, but it must not overburden the powers of the patient and it must lead to the goal of a strictly designated programme.
4. In the development of speech the aspect of contents is first decisive, later on a limiting factor is a formal function of the organs of speech. After we have attained certain limits of development it is neccessary to take use of other forms of communication, for instance graphic expression.

If we would not take into account these limiting factors of our possibilities of rehabilitation, the determined programme would not be real for the patient.

N. LAITER, L. GAGNARD, F. DOYON

STATISTICAL APPROACH OF CEREBRAL MOTOR DISABILITY RESULTING FROM THE RELATION AETIOLOGY — HANDICAP

The use of fuller statistical methods has allowed us to state precisely the incidence of aetiology upon the distribution of neurology troubles in the spastic child.

By Cerebral Motor Disability we mean, as we have been taught by Profesor G. Tarrdieu, the whole constitued by the motorial sequellae of a brain lesion from early childhood with total or partial preservation of intelligence.

Material and Method

The present study concerns 846 health documents of spastic children first recorded in the medical departments of Pr. Tardieu at Garches and Bicetre. It has been made up with the help of the Statistical Research Unity of the National Health and Medical Research Institute.

Knowing how dificult it is to state the I. Q. of a young and very handicapped child, we have chosen to widen Prof. Tardieu's definition on intellectual grounds: the inferior limit of I. Q.'s here is 55 and we have 12 % of children with an I.Q. between 55 and 70 in our population.

Within the former numerous pieces of information of this inquiry, we have kept but a certain number of variables in our today's study.

Two methods have been used successively:

1. The first, through an analysis of the correspondences between aetiology and the handicap, aims to state, not assuming any a priori hypothesis, the relations existing between these characteristics.

It appeals to 12 variables of aetiology and 19 variables that seemed to us to sum up the handicap at its best.

2. The second method, more classical, the X2 study, has aimed to corroborate and deepen this analysis with a much more important number of characteristics defining the handicap (86).

Results

— The first two slides show the frequency of various aetiological factors and the „identificator" that will be used on the pannel analysing the correspondences.

— The three following slides show the frequency of the characteristics of the handicap that are held up, and the „idetificator" that will be used on the pannel analysing the correspondences.

— The pannel analysing the correspondences has 36 colums from the 12 variables of aetiology re-coded in the binary system and 47 lines from the 19 variables summarizing the handicap and also re-coded in the binary system.

For technical reasons, the analysis of the corresondences finally refers to 642 health documents only.

— The number 6 slide shows the main results of the analysis of the correspondences.

Three axes only have been kept for they are enough to sum up 76 % of inertia or total „variancy", understanding 43 % for the first axis, 22 % for the second one, and 11 % for the third.

The first factorial axis is the vertical axis. The elements are circled in green on this slide.

At the bottom of the pannel, we can see:
— the birth-weights over 2 kg 500,
— the very difficult deliveries, the forceps, the circulars of the umbilical cord,
— the reanimations lasting more than a quarter of an hour,
— less than a quarter of an hour,
— the isolated attackes of the upper limbs,
— the important attacks of the upper limbs,
— the important attacks of the language.

Opposing this, at the top of the pannel we can see
— the birth-weights under 2 kg 500,
— the normal deliveries, the Caesarian operations and the seats,
— the lack of reanimation,
— the isolated attacks of the lower limbs (paraplegia),
— no attacks of the upper limbs,
— no attack of the language.

The second factorial axis is the horizontal axis. The elements are circled in orange.

It clearly opposes the left hand-side of the pannel:
— the post-natal accidents,
— the hemiplegiae,

to the right hand-side of the pannel, where are listed:
— the small birth-weights under 2 kg 500,
— the pathology of pregnancy: traumatism, riks of abortion or metrorrhagiese, incoercible vomitings,
— the pathology of delivery: seats, reanimations however long it lasts,
— the seat of the atack: paraplegia, quadruplegia, isolated attack of the upper limbs.

The hemiplegia variable is a characteristic practically exclusive of the second factor.

The third factorial axis artifically individualized here by circling the elements in blue, isolates three elements: foeto-maternal incompatibilities, functional deafness and ocular palsies. Here again, the foeto-maternal incompatibilities is a characteristic practically exclusive of this third factor.

The study of the proximities between the horizontal and vertical axes allows to make clear some associations according to the seat of the attack.

The paraplegic attacks are essentially due to prematurity: as a matter of fact, in our population, birth weight and conceptional age are tightly correlated. In this group one also finds again:

— the pathological obstetrical antecedents of previous pregnancies,

— traumatisms, metrorrhagiae, and risks of abortion during the pregnancy,

— neither pathology of the delivery nor reanimation,

— the language and the dressing are not perturbed,

— on the contrary, one can find again the spasticity and the retraction on the lower limbs with an attack of the hip fexors and a weakness of the postural balance,

— lastly the strabism so common to our former prematured children.

The isolated attacks of the upper limbs are due to be birth-weights over 2 kg 500 with a pathology of the delivery, forceps, the circular of the cord, the difficult deliveries and reanimation lasting more than a quarter of an hour.

Besides an important attack of the upper limbs and language, one can find again unequal tensions in the lower limbs.

The quadruplegia attacks with the major handicap of the dressing are to be linked with incoercible vomitings during the pregnancy and the reanimations of uncertain duration or lasting less than a quarter of an hour.

The hemiplegia attacks are to be linked with post-natal accidents, aetiologies that can't be determined and unknown birth-weights.

Lastly, close to the attacks with dissociated topography triplegia and monoplegia, one can find again the Caesarian operations and all the pathology of birth that have not required any immediate reanimation.

Thus, this method of the analysis of corresondences has allowed us to make it clear the existence of a close link between aetiology and the distribution of troubles.

The second method, after elliminating the foeto-maternal incompatibility on account of unsufficient number (4 %, that is 31 cases) and grouping for the same reasons, the various kinds of reanimation, has allowed to go further forward in the description of these syndromes.

As you can see on the following slides, 78 variables out of 86 defining the handicap, show significant differences between the two groups — birth — weights under 2 kg 500 — and birthweights above 2 kg 500.

The syndrome of the former prematured child is definitely an entity.

One can also notice that among the 370 children whose birth-weights were over 2 kg 500, the group of the reanimated children appears to be the most handicapped one with important troubles at rest and in the gesture control. The post-natal accidents include a large number of hemiplegiae and they are spastic and retracted chiefly in the upper limbs.

Here again, the differences are significant between the three groups in 63 cases out of 86 and this, in spite of the associations to which we have been compelled.

It was hard, within ten minutes, to say the main point of this study, but it has appeared interesting to us to draw these facts out with a view to a better knowledge of cerebral Motor Disability.

K. LEWIT

PAIN ARISING IN THE POSTERIOR ARCH OF THE ATLAS

When we first distinguished headache of cervical origin we were astounded by the high incidence of this condition. The encouraging results of treatment given to the cervical spine even increased our interest. Yet it was mainly the failures which propted us to improve diagnosis and try better to understand the underlying mechanisms. In order to illustrate this we shall give some examples of important disorders of spinal function.

The muscle being the effector of the motor system is the most labile structure and therefore is most frequently involved in the pathogenessis, mostly showing incerased tension. It is therefore no coincidence that acute wry neck is also called „acute myalgia" and that it is fashionable to speak about „tension headache" which is usually considered to be of psychological origin. The physiology of the motor system, however, teaches us that in addition to psychological stress there are quite a few more causes of increased muscle tension:

1. Faulty muscular pattern (habit), the patient overstraining the upper neck musculature because the inter — and subscapular muscles are week; 2. faulty breathing with overstrain of the auxiliary respiratory muscles (of cervical origin); 3. a forward drawn head position causing static oversrain; 4. head anteflexion of long duration causing overstrain of ligaments and muscles; 5. blockage of intervertebral joints, being the most frequent cause of muscular spasm. It is obvious that each of these causes or mechanisms requires different treatment, a combination of these mechanisms being frequent.

In some of these types of headache anteflexion of the head plays a role causing a forward shift of the centre of gravity of the head producing overstrain of the neck musculature. There are, however, patients in whom retroflexion increases pain. This is particularly notorious in vertebral artery involvement with its characteristic combination of headache and dizziness. However, there is yet anoather type of headache which *may* get worse during retroflexion and this is ***pain arising in the posterior arch of the atlas.***

As a rule patients are suffering from severe headache of long duration. It may be localised in the occiput, but typical migraine is frequent. Retroflexion of the head may be painful. The most important sign is tenderness of the posterior arch of the atlas on palpation. Therefore the technique of palpation with the overlying muscles relaxed is of crucial importance. It is possible only with the patient supine, his head propped up in anteflexion (figure 1). On palpation there is *invariably* increased tension felt (due to muscle spasm) if the patient feels pain. After palpation mobility of the atlantoocipital joints is tested which can be done either by springing the occpi-

Figure 1:
Palpation of the posterior arch of the atlas.

Figure 2:
Springing of the occiput against the atlas (model).

Figure 3:
Retroflexion between the occiput and atlas with the head rotated.

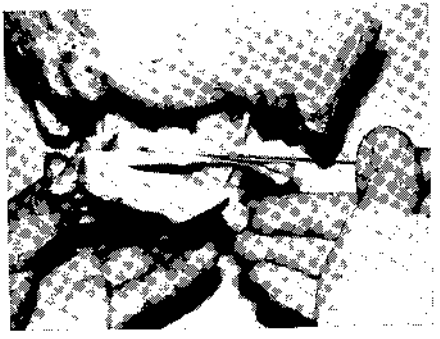

Figure 4:
Insertion of the needle on the posterior arch of the atlas (model).

put againts the atlas fixing its posterior arch between the operator's thumb and forefinger and producing a dorsal shift of the head (figure 2), or by retroflexion of the rotated head againts the atlas, i. e. with the atlanto-axial joint locked (figure 3). Thanks to these techniques we have learned that isolated movement restriction of retroflexion between the occiput and the atlas is frequent but remained undiagnosed previously. The tender posterior arch of the atlas is found as a rule in all types of atlanto-occipital blockage provided there is headache. There are frequent pain spots in the occipital region considered to be painful points of emergence of the occipital nerve, but are in our

opinion merely signs of referred pain arising a) from the posterior arch of the atlas or b) from the lateral aspect of the spinous process of the axis (due to painful insertions of the neck muscles).

Treatment: If movement restriction is found, manipulation is the treatment of choice. After successful manipulation spasm promptly subsides.

If there is hypermobility or pain and tenderness even after manipulative therapy, local anesthesia or even better, needling without anesthesia is the treatment of choice. Periostal massage, too, can be useful. The needle is inserted laterally at the site where the transverse process of the atlas can be palpated between the mastoid and the maxilla. When bone is hit the needle is pushed maeially so that it glides on the dorsal surface of the posterior arch of the atlas until the most painful spot is touched (figure 4). This can be noted by the reaction of the patient. We now prefere needling *only*, to infiltration with an anesthetic, beacuse there are fewer undesirable reactions, finer needles can be used (of the type used for acupuncture) and one can correct the position of the needle if spasm does not subside. Immediately after needling spasm should be relivied which can be ascertained by palpation even with the needle still in place.

Aftertreatment consists in automobilisation and remedial exercise if required.

Incidence: in 108 patients with cervical headache or migraine examined in the course of one year a tender posterior arch of the atlas was found in 48 patients.

64 patients, 28 male, 36 female have been under observation. On clinical examination 24 were of the „usual" type of cervical headache, 21 with attacks of migraine; in 10 there was deterioration of pain during retroflexion and in 9 during anteflexion.

There was blockage of the atlas against the occiput in several directions (including retroflexion) in 29, in retroflexion *only* in 19 and no blockage in 16.

Therapy was manipulative only in 9, only by needling or infiltration in 14 (in another 2 periostal massage), and both types of treatment were given in 38.

Therapeutic results achieved in the course of 1 — 2 years were excellent in 33, good in 22 with 9 failures. 5 of these failures were cases of migraine. It was worth noting that amongst the patients of this group there are 6 who had been in our care previously without obtaining relief and who have now been successfully treated. Another important reason of the therapeutic failures is the complexity of the mechanisms involved.

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