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CBR and Advanced Technology in Rehabilitation

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INTRODUCTION

The President, Prof. Sek Aksaranugraha suggested the theme "CBR and advanced technology in rehabilitation" for my presentation. I'm afraid that the community-based rehabilitation program strictly corresponding to the WHO's protocol⁽¹⁾, has not been carried out in Japan. On the other hand, various community rehabilitation projects are practiced which act to complement the rehabilitation services offered in medical institutes and rehabilitation facilities. I think they are more suitably termed community-oriented rehabilitation or home rehabilitation rather than community-based rehabilitation.

In this paper, I discuss the system and practice of a home rehabilitation project which is deployed in the Yokohama area following that I present some

assistive equipment and devices which we have provided and or developed in this project for home-bound physically disabled people.

Home rehabilitation services for physically disabled people can be divided into two categories (Table 1).

One type is designed to help patients to improve their functional ability by providing medical rehabilitation for patients in their own homes, rather than in medical facilities. This kind of home rehabilitation is targeted mainly at impairment and disability levels, and services are offered by medical personnel like a physiatrist, a physical therapist, an occupational therapist and/or a clinical psychologist. The objective of this form of home rehabilitation service is mainly to improve the economic efficiency of medical treatment

	Home rehabilitation for hospital rehabilitation	Home rehabilitation for home - bound disabled
Stage	Acute and chronic stage	Chronic stage
Purpose	Functional recovery	Optimum quality of life
Target	Impairment - Disability	Disability - Handicap
Measures	Medical treatment	Comprehensive measures
Background	Bed shortening Medical expense	Welfare of the disabled

Table 1 Types of home rehabilitation

in response to the shortage of beds in hospital rehabilitation wards and the rapidly increasing expense of medical treatment in recent years. This kind of home rehabilitation has been widely reported in western countries^(2,3,4,5)

The other type of home rehabilitation service sets its goal in promoting an improved quality of life for home-bound chronically disabled people. The targets of this kind of home rehabilitation are mainly disability and handicap, and participation from various professional workers is required in this service⁽⁶⁾

Almost all home rehabilitation projects in Japan belong to the latter category, and are designed to secure an optimal living status for home-bound disabled people in the chronic stage. This is also true of the home rehabilitation service offered in our project in Yokohama. In our country, these kind of home rehabilitation projects have been established by many local hospitals or local governments in various ways.

Hereafter I would like to present our experience with home rehabilitation services in Yokohama as an example of those in Japan.

HOME REHABILITATION IN YOKOHAMA

Yokohama is one of the most intensively populated cities in Japan, with a total population of 3.3 million, of which 78,943 (or 2.39%) are registered as physically disabled. Of these, 37,965 experience severe difficulty in carrying out their daily activities.

The Yokohama Rehabilitation Center was established in 1987 by the city government as a core facility for community-oriented rehabilitation services for the disabled people. This center provides medical, social, and engineering rehabilitation services for disabled citizens, through in- and out-patient clinics, and home visit rehabilitation programs involving multiple rehabilitation professionals.

PURPOSE

The purpose of our home rehabilitation program is to offer rehabilitation services to home-bound chronically physically disabled persons in his or her actual living environment and to ensure that he or she achieves an optimum quality of life. This service was initiated in response to the needs of patients, who after finishing basic medical rehabilitation in medical facilities, were unable to cope with rebuilding their life style or adapt to their home environment as a result of their disability.

SYSTEM

The city of Yokohama is divided into 18 administrative districts. Each district office has welfare officers and public health nurses, who take care of the health and welfare needs of the disabled people in their area. When these public workers identify a need for home rehabilitation on the part of their clients, they request the rehabilitation center to dispatch a visiting rehabilitation worker. Referrals may also come from other medical facilities and from the in- and out-patient clinics within the center itself (Fig.1).

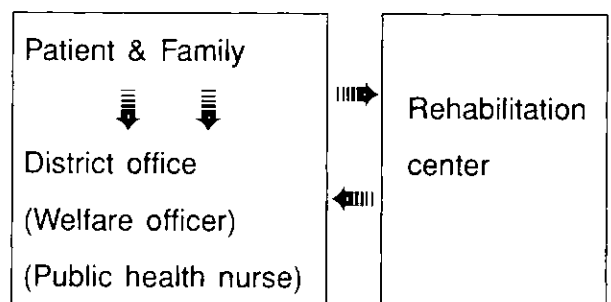


Fig. 1 System

The home-visit program begins with an initial evaluation visit. The evaluation team is composed of a rehabilitation physician, a physical therapist, an occupational therapist, a social worker, a public health nurse and a technical engineer. A district welfare officer and public health nurse also accompany the team.

The evaluation team first ascertains the patient's mental and physical status, the family's ability to provide care, the residential environment, and the patient's and family's needs. On this occasion, we have to evaluate not only the functions of the patient but also the family's ability to help the patient and also their life style preference. A rehabilitation plan is made through a team conference immediate after the evaluation visits. If rehabilitative intervention is indicated, appropriate rehabilitation workers are dispatched.

We usually discuss with the patients and family members on making rehabilitation plan. The active participation of family carers and patients is very important to succeed our home-visit rehabilitation⁽⁷⁾.

PROGRAM

In 1995, 1,082 clients were served by the program (Table 2). The mean age of these patients was 65 years, with almost the same number of men and women. The diseases causing physical disabilities, of which central nervous system diseases account for 61%. Cerebrovascular disease accounted for 42.1%. Neuromuscular diseases including amyotrophic lateral sclerosis and progressive muscular dystrophy were few in number, but there were many things to be done

for these patients as they usually maintain a high level of mental function until the end stages.

PT and OT services were offered to 709 clients, technical aids to 321, and house remodeling to 626 cases (Table 3). Physical therapists mainly focused on improving mobility function of patients, while occupational therapists aimed at optimizing self-care and related activities. A physical or an occupational therapist visits a clients' residence 4 to 5 times on average, and offers therapeutic exercise, mobility exercise, exercise in activities of daily living, re-education of transfers, and education and advise to the carer. We also provided various types of technical aids such as wheelchairs, seating appliances, transfer aids, communication aids and others. House remodeling is also often carried out.

	N=1,082
PT,OT	709
Physical exercise	
Daily skill exercise	
Care skill exercise	
Prosthetics and orthotics	185
Technical aids	321
House remodeling	626

Table 3 Service

	N=1,082
Age:	mean 65.31 years (SD 17.2)
Sex:	male 546, female 536
Diseases:	
Central nervous system disease	600(61.0%)
Cerebrovascular disease	456(42.1%)
Cerebral palsy	33(3.1%)
Spinal cord injury	88(8.1%)
Musculoskeletal disease	152(14.0%)
Neuromuscular disease	27(2.5%)
Others	155(14.3%)

Table 2 Characteristics of patients

In Japan, especially in urban areas, people's life styles are becoming increasingly westernized. However, most people still love and value the sense of the traditional Japanese way of life in their residences. People usually enjoy both the convenience of a western life style and the traditional Japanese feeling. As a result, people's life styles are very diverse, and we must carefully account for their individual preferences when making a rehabilitation plan. I think you may have similar experiences here in Thailand.

Fig. 2 shows a physical therapist instructing a patient's wife on how to improve her transfer technique. In this case, the patient spent most of his time in bed despite the fact that he could maintain a sitting posture and propel his wheelchair by himself, because his wife could not help him transfer from his bed to his wheelchair. After his wife had learnt a transfer - assist technique, he escaped from the bed-bound life, and acquired chair-bound living.



Fig.2 *Instruction on wheelchair transfer technique by a physical therapist*

Fig. 3 shows an occupational therapist giving instructions on techniques of transferring to and from the bathtub. Most Japanese consider bathing as not only a means of cleaning the body, but also as a form of recreation and relaxation. Therefore, many clients seek help in learning how to enter and exit the bath as easily and safely as possible.

OUTCOME EVALUATION

It is very difficult to evaluate the effectiveness of a project like this, because its outcomes are depending on multiple factors, not only the disability level of the client but also their social and financial conditions, the client's expectations and the welfare of the family members.

The evaluation scales usually employed in medical research do not adequately express the outcomes of this kind of composite project. Hereafter, I describe some trials which investigate the effectiveness of this project.



Fig.3 *Instruction on bathroom transfer technique by an occupational therapist*

	N=475
Improved	67(14.1%)
No change	341(71.8%)
Deteriorated	63(13.3%)
No answer	4(0.8%)
	(Matsuba 1993)

Table 4 Change in impairment

Table 4 shows the changes in physical impairment during the home rehabilitation program in 1993⁽⁶⁾. Of those receiving physical therapy with the aim of reducing physical impairment, recovery was gained in only 14.1% of the patients, while 71.8% maintained their impairment level. Several authors in western countries have compared the effectiveness of intensive domiciliary therapy with medical facility-based therapy in chronic stroke patients, and reported similar results⁽⁵⁾. Our findings suggest that we cannot expect a high degree of motor recovery of a neurophysiological level following a short period of intervention provided by this service, though it may be effective in maintaining physical status in chronic patients. I believe this is because most patients have completed their rehabilitative treatment in medical and rehabilitation facilities before returning home, and have reached a plateau in their motor recovery.

On the other hand, therapy consisting of functional training along with the provision of suitable aids and/or appliances has resulted in an improved level of functional independence (Table 5). For example, activities of daily living such as bathing

	N=141
Bathing	72(51.1%)
Toilet	40(28.4%)
Going out	44(31.2%)
Others	39(22.0%)
	(Matsuba 1993)

Table 5 Improvement of self care skill

showed a 51.1% improvement, thus indicating the benefit of intervention. Similarly, 31.2% of cases acquired new means of going out, thereby freeing them from the isolation of their homes and increasing opportunities for social interaction⁽⁶⁾.

The family carer's burden is an important issue for both the disabled persons and the caregivers. Over time a heavy care burden can depress the caregiver's ability to provide care, and as a result diminish the patients's quality of life. The study revealed that following implementation of our services, the load of the caregivers decreased in 40% of clients (Table 6)⁽⁶⁾. However, in a minority of cases, the caregivers' burden increased as a result of enhancing the daily life of the disabled persons. For example, when bathroom remodeling enables a patient to bathe in the bathtub, the care burden may increase as a result assistance required in performing this activity.

Fig.4 summarizes a study on the cost efficiency of house remodeling⁽⁸⁾.

When the bathroom is remodeled, it becomes

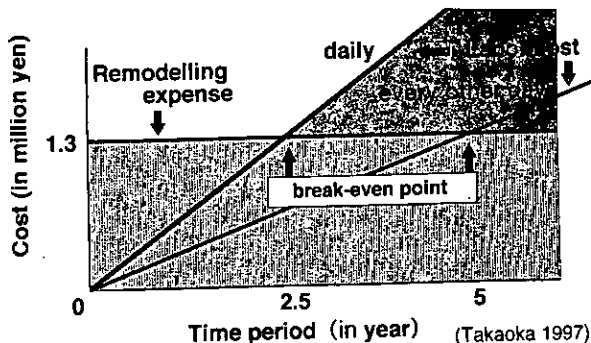


Fig.4 Cost - Benefit analysis (bathroom remodeling)

	N=475
Decreased	194(40.8%)
No change	232(48.8%)
Increased	41(8.6%)
No answer	8(1.7%)
	(Matsuba 1993)

Table 6 Change in carer's burden

easier for the disabled person to bathe, and at the same time, the caregiver's burden decreases. Average expense for bathroom remodeling is estimated at about 1.3 million yen (400,000 Bahts), and home help service costs 1,500 yen (500 Bahts) per hour.

When the caregiver's workload is converted into labor costs, the savings in labor costs equals the remodeling costs in two and a half years if the patient bathes daily, and in five years if the patient bathes every other day.

Another study revealed similar results for entryway remodeling to enhance going out activities and for utilization of transfer aids to decrease the care burden (Fig.5)⁽⁸⁾

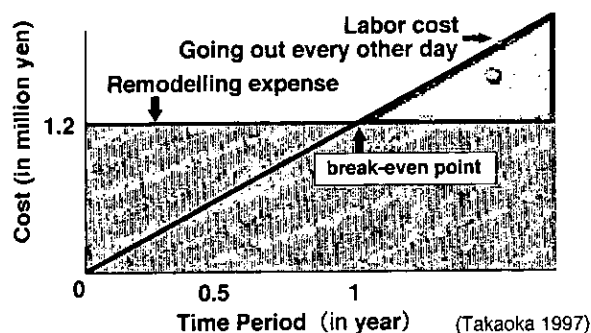


Fig. 5 Cost - Benefit analysis (entryway remodeling)

COMMENT

Here, I briefly describe some of the lessons learnt from our home rehabilitation program.

1. Methods of home-rehabilitation

The WHO Expert Committee on Disability Prevention and Rehabilitation described the following three measures of rehabilitation⁽⁹⁾.

1. To reduce the impact of the disabling condition.
2. To train the disabled persons to adapt to their environment.
3. To intervene in the immediate environment

and society.

Our experience suggests that we should not expect too much from a short period of therapeutic intervention in this kind of home rehabilitation service in achieving improvement at an impairment level. Rather, instruction to adapt to their environment and modification of the environment itself produced a remarkable improvement in the clients' quality of daily living.

2. Base facility for home rehabilitation

The quality and range of this kind of home rehabilitation service is dependent on the capability of the base facility. Accordingly, in order to offer quality home rehabilitation services, the base facility must maintain high standards, and particularly, must be prepared to offer a comprehensive rehabilitation program including a wide range of professional expertise.

3. Home and facility-based rehabilitation

In home rehabilitation programs, some patients still need facility-based rehabilitation aimed at reducing impairment and disabilities. I believe that both home rehabilitation programs and facility-based rehabilitation are necessary for the home-bound physically disabled people. These two types of programs function together like wheels propelling a vehicle and are essential in supporting our project.

4. Intermediate workers (CBR vs home rehabilitation) (Table 7)

In the community-based rehabilitation program described by the World Health Organization, rehabilitation techniques are taught to so-called trainers via intermediate supervisors⁽¹¹⁾. The intermediate supervisors are usually educated people who hold positions of responsibility in society such as teachers, nurses or local traditional medical persons. They are educated by rehabilitation professionals, following which they assess the rehabilitation needs in

CBR Project by WHO	Yokohama's Project
Rehabilitation professionals ↓ Intermediate worker (Intermediate supervisor) (Local supervisor) ↓ Trainer (Family - Volunteer) ↓ Patient	Rehabilitation professionals ↓ ↓ ← Intermediate worker (Welfare officer) ↓ (District nurse) ↓ ↓ ↓ Patient

Table 7 Persons in charge of home rehabilitation

their designated area and transfer their rehabilitation knowledge and techniques to trainers. The trainers are nonprofessionals consisting of family members or volunteers. This strategy of the WHO's CBR program is an attempt to extend the scarce rehabilitation resources to the disabled people in rural areas.

In contrast to this, in our project, rehabilitation professionals such as physical or occupational therapists directly offer the services to the client. However, it is not always possible for rehabilitation professionals alone to understand the many facets of the patient's life and their preferences, though it is very important in our project as I described before. On the other hand, district public health nurses, district welfare officers, and care workers who have jurisdiction over a district are not only knowledgeable about the health and welfare issues of the client, but also they are often familiar with the patients and their families. Therefore, they can work as an intermediary between the rehabilitation workers and the client and as a spokesperson for the disabled person and the family. These intermediate workers play an important role in our home rehabilitation project like in the WHO's CBR program. It is recognized that specific rehabilitation personnel alone cannot achieve the purpose of

community rehabilitation without society's support. Community rehabilitation depends on related health care and welfare resources in the community and on society's attitude towards the disabled people.

ASSISTIVE TECHNOLOGY IN HOME REHABILITATION

INTRODUCTION

As I mentioned before, there are three measures to improve the living status of home-bound disabled people. The third one, the improvement of the immediate environment with technical aids and house remodeling, is regarded as a very effective way to achieve a better living status for the disabled persons.

Assistive equipment and environmental adaptation can be divided into the following four categories.

1. Mobility aids, including transfer-assist equipment and seating devices.
2. Communication and environmental control aids, most of which are driven by electronic systems.
3. House remodeling.
4. Devices for recreation and sports.

Hereafter, I show some assistive equipment we provided in our project. Some of which were custom-

made in the rehabilitation engineering division, in response to the specific conditions and needs of patients and their family.

DEVICES FOR MOBILITY AND TRANSFER ASSISTANCE

A bed is one of the most fundamental assistive aids for the disabled people.

In the traditional Japanese way of life, people spend much of the time on the floor. We sit on the floor on mats named TATAMI which is a floor matting made of straw mats covered with woven rush sheets. We sleep in FUTON mattresses which are laid out on the TATAMI floor. Although the Japanese life style is becoming more westernized, many Japanese still love this style of living at a floor level. As a result of this life style, one must get up from the floor each time one transfers, which for disabled people may require a lot of assistance. Daily assistance in self-care activities is also hard to do in this situation, and wheelchair users often have difficulty in transferring.

Therefore, we often recommend the use of a bed, a chair and a wheelchair to improve transfer and mobility function. We have many kinds of commercially available beds for the disabled people. Motor-driven beds are usually employed in our project. It is convenient to help raise up patients on the bed, and for transferring from a bed to wheelchair, as the height and grade of tilt can be changed. An attached handrail is useful to help standing and transferring.

A seating device is also an important aid in helping to maintain a good sitting posture for the severely disabled people. It is easy to say "you should sit rather than lie down, as a means to prevent bed-bound states". But, it is often not possible for severely disabled people to maintain sitting and standing positions without offering appropriate assistance.

The patients with poor righting function need a

suitable chair with side and back supports to stabilize their sitting posture in order to sit comfortably. Some patients can sit stably in their chairs, but they requires someone's assistance to stand up. In these cases, the patients have to call someone every time he wishes to get up -for example go to the bathroom, even though they can walk independently with a cane or handrails.

We are requested to prepare seating devices for both comfortable sitting and to ease standing up.

For this purpose, we have seating devices with a standing assist mechanism for use at floor level living. The seat descends to the floor level when a patient wishes to sit at the floor height, and it can be elevated when he wishes to stand up.

Custom-made seating devices to maintain a comfortable seating position are widely provided for severely disabled people such as severe cerebral palsied. To design and manufacture the appropriate seating devices, multiple professionals from medical, social and engineering fields work together for each patients.

Before I move to the topics of wheelchair, I like once again to comment on Japanese houses and the Japanese way of life. As I previously stated, Japanese life styles have become increasingly westernized, while respecting the traditional Japanese feeling. Therefore, the preferred life styles amongst the Japanese people are very diversified today. Actually, many Japanese people in urban areas live in houses in which the functional conveniences of the western life style coexists with their favorite aspects of the Japanese way of living. Furthermore, almost all Japanese maintain the custom of not wearing footwear inside the house, and the floor is clean enough to sit on and lie down on.

Thus floor level mobility methods, like bottom shuffling or crawling are often practical ways of mobility for physically disabled Japanese such as cerebral



Fig.6 A paraplegic patient moves on hands and buttocks in his house.



Fig.7 A quadriplegic patient practically moves in his house by crawling.

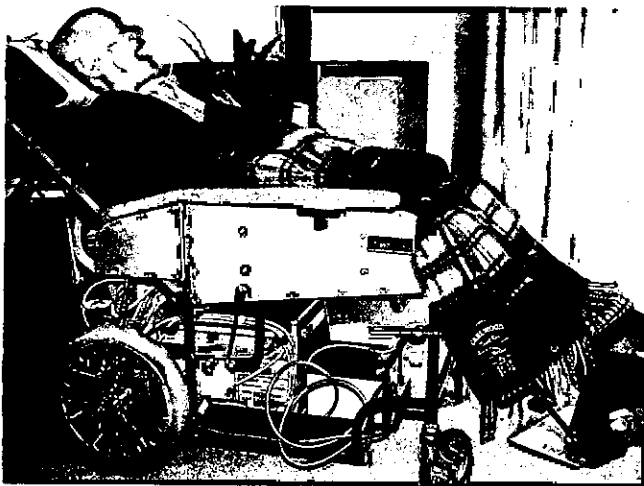


Fig.8 A wheelchair for an ALS patient contains a respirator under the seat.



Fig.9 A motor - drive wheelchair with molded seat.

palsy or muscular dystrophy clients. Fig.6 shows a paraplegic patient due to traumatic lumbar spinal cord injury. He is independent in outside mobility with a wheelchair and a car. But he moves on hands and buttocks in his house, because he doesn't like using a wheelchair on the TATAMI floor. A severe quadriplegic in Fig.7 crawls around in his house, while he uses a motor-driven wheelchair outside of his house.

With this in mind it is very important to carefully consider the preference of both patients and families to draw out their true needs, especially regarding wheelchair employment in their residences.

Hereafter, I show some specifically manufactured wheel chairs. Fig.8 shows a wheelchair made for a patient with severe quadriplegia due to amyotrophic lateral sclerosis. It contains a respirator in a compartment under the seat. He is completely dependent in all aspects of ADL, but he enjoys mobility in his house and his garden by carer's assistance.

Fig.9 is a motor-driven wheelchair with a molded seat for a patient with cerebral palsy. He can not maintain a seated posture on a usual wheelchair. and he doesn't have enough muscle strength to propel a manual-driven wheelchair. Now he can move around

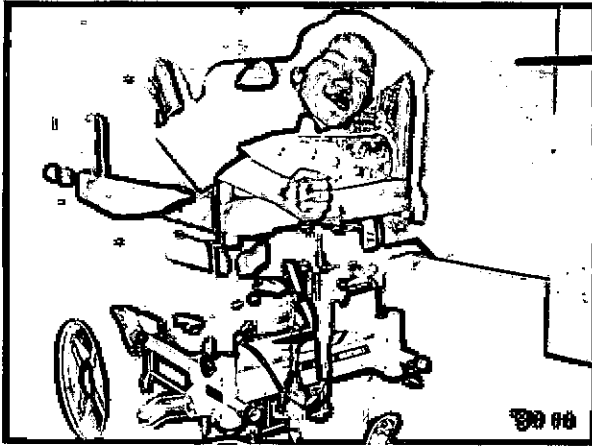


Fig.10 A motor - drive wheelchair for a patient with severe cerebral palsy

with this motor-driven wheelchair as he so wishes.

A lady with severe cerebral palsy cannot maintain a sitting position due to abnormal reflex activity such as the symmetric and asymmetric tonic neck reflex and the tonic labyrinthine reflex. She doesn't show any voluntary movement at her extremities in the upright position, but she can eat and operate a word processor with her right hand in the prone position. As she was found to be able to operate a driving lever of a motor-driven wheelchair in the prone position, we prepared the wheelchair showing in Fig.10. She moves around in and outside of the residence with this mobility device.

Wheelchairs with seat elevation mechanism are useful for floor height living in Japan. Employing a wheelchair with seat elevation system, the lady in Fig.11 plays her role of a house wife.

I have shown some specific wheelchairs. However, most of the wheelchairs we provide are, of course, ordinary standard wheelchairs. Fig.12 shows a simple and small wheelchair designed for use in small bathrooms.

It is convenient for taking shower and toileting on a commode, as most private Japanese houses have small bathrooms in which we cannot use ordinary wheelchairs.

Fig.13 shows one type of transfer equipment consisting of a body support pad and a connecting prop with a swivel, called "Komawarisan", which means "small turn" in English. This equipment is useful to help patients and caregivers in pivot transfer from a bed to wheelchair.

A ceiling hoist is becoming a common piece of equipment for home-bound patients who suffer severe difficulty in transferring and mobility. Fig.14 shows a quadriplegic patient caused by traumatic brain injury. His mother became capable of transferring the patient with this ceiling hoist.

In most Japanese houses, there are usually many floor level differences which must be cleared for wheelchair use. We often use small slope boards for little step difference clearing, and the bigger boards for a big level difference at the entrance.

Fig.15 shows a motor-driven lift at the entrance, which eases going in and out of the house. This is often utilized because the floor level of a usual Japanese house is often several tens of centimeters above the ground.

A stairlift is useful in home rehabilitation for physically disabled people both in and outdoor mobility (Fig.16). A patient with severe ataxia due to spinal cerebellar degeneration can operate a wheelchair independently. But his sphere of activity was limited within his residence on the hill, because he was unable to clear this stairway to get out to the street. The provision of a stairlift gave him independent access to the outside world.

DEVICES FOR COMMUNICATION AID AND ENVIRONMENTAL CONTROL ⁽¹⁰⁾.

People with severe disabilities often suffer from difficulties in interacting with other people and also with their immediate environment due to limitation in verbal expression and inability to manipulate



Fig.11 A wheelchair with seat elevation mechanism

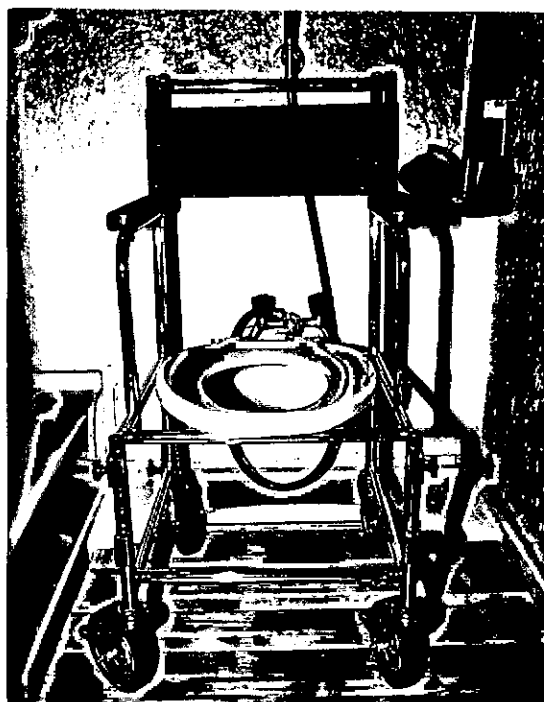


Fig.12 A wheelchair for taking shower and toileting

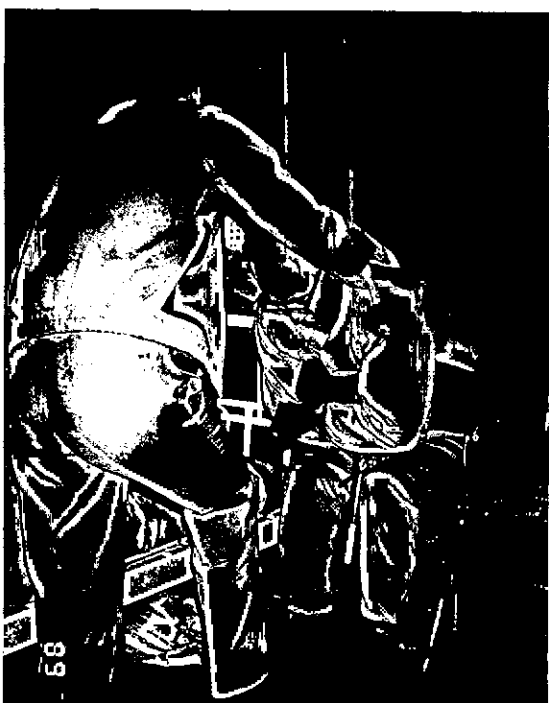


Fig.13 A device for transfer assistance "Komawarisan"



Fig.14 A ceiling hoist

devices. We can enable disabled people to minimize these difficulties with the assistive devices.

One of the most important points in the selection of technical aids for a patient is to find the most appropriate control device. It is crucial that we

find the most consistent and effortless voluntary movement that a patient operates the assistive devices. We have to choose or make control devices just fit to patients.

We use several kinds of touch switches which

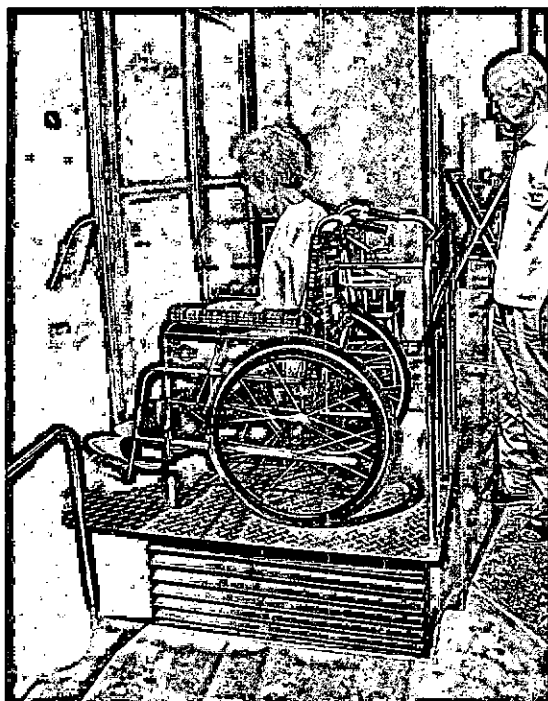


Fig.15 A wheelchair lift



Fig.16 A stairway lift

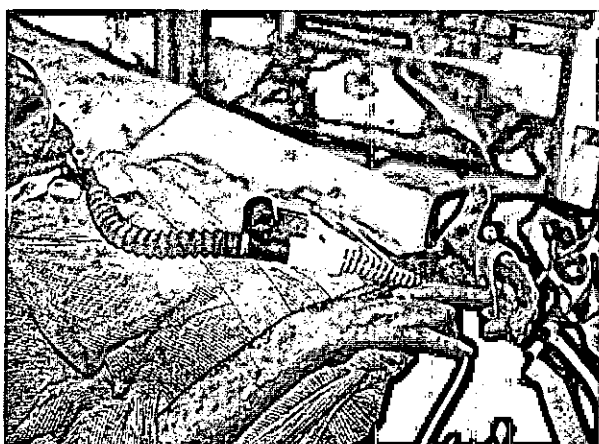


Fig.17 A fingertip switch for an ALS patient

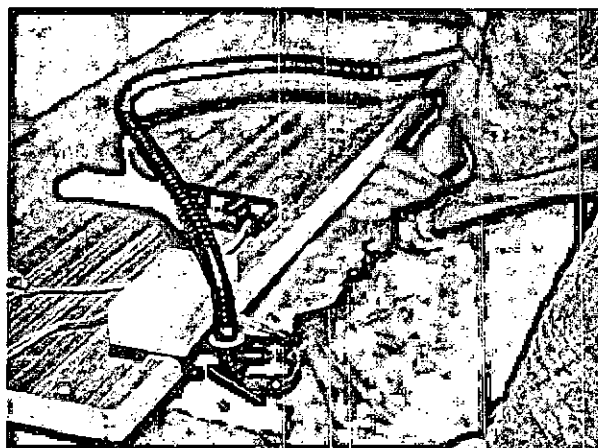


Fig.18 A puff & sip switch



Fig.19 Environmental control system

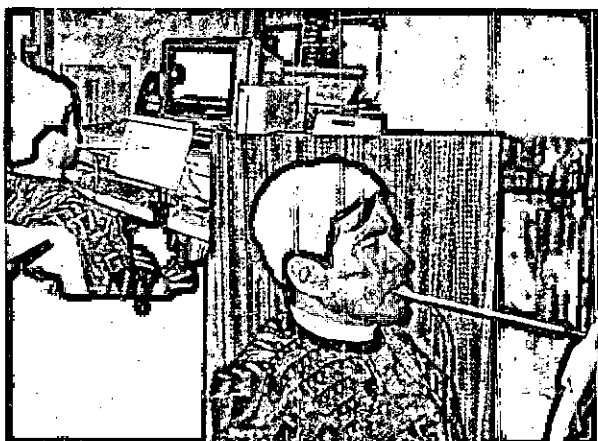


Fig.20 KB Mouse

are controlled by movement of finger, tongue and other parts of the body, and a balloon switch controlled by slight push of a part of patients (Fig.17) Sip and puff switches controlled by breathing through a tube often employed for quadriplegic patients (Fig.18).

As you may have noticed, these control devices do not necessarily require the application of highly sophisticated technology. The prerequisites for the use of the control devices are the certainty of input and the appropriate utilization of the users's residual functions.

Communication aids are usually provided for those clients with cervical spinal cord injury, cerebral palsy, progressive muscular dystrophy and amyotrophic lateral sclerosis which is known as ALS. In particular, ALS patients often have serious communication problems at the final stage of the disease since their mental function is sustained at a high level while their physical function is very limited and is declining progressively.

An environmental control system consists of an input device, a display, a controller and terminal equipment which can be connected to the system.

Fig. 19 shows a patient with quadriplegia due to cervical spinal cord injury, operating an environmental control system through a puff & sip input device. Through this system he controls many electric appliances such as an electric light, an electric bed, a television, an air conditioner, a telephone, and a magnetic control door lock. While he is alone in his home, he can talk to a visitor through the intercommunication system, and if necessary, let a visitor come in by releasing the door lock.

Access to a telephone is vital for severely physically disabled people to keep in touch with acquaintances and the community. A telephone set with the dial buttons installed in a depressed position is easy to be used by people with ataxic movement or those who use toes for dialing

We provided the telephone sets can be operated by a single switch control for the upper arm function impaired patients. When the phone rings, one can answer the phone by one push of the switch

button. He is able to make a phone call using an auto-scanning system which works by several touches of the switch.

One of the advantages of computer - based devices is its multifunctional capability. Fig. 20 shows a patient with high level quadriplegia operating a personal computer by using a key board and mouse emulator named a "KB mouse". A digitizing pad is operated by a mouth stick and a puff & sip switch in this input device. The device functions in the same manner as a standard mouse operation. The KB mouse allows him to enjoy drawing just like he used to do before he suffered from cervical spinal cord injury. His skills in computer graphics have gradually improved and his drawings have been used on the covers of a journal.

The same input device enables a young man with progressive muscular dystrophy to communicate with a number of people through a computer network system. Although he is bed-bound, he can communicate with his friends and get any information through internet access.

A display of the computer - based filing system was modified so that a user in a lying position could easily look at it. This device allows a person with muscular dystrophy to enjoy reading without any assistance.

Interaction with the surroundings and/or immediate environment is also important in enriching the lives of disabled people, just as interacting people to people. The patient who draws computer-graphics as a semi-professional artist needed to take photographs for sketching his subjects such as wild flowers and birds. Fig.21 shows a single - lens reflex camera with a puff & sip control device developed in collaboration with a camera manufacturer. Besides focus and shutter control, this alternative device allows him to change the direction of the camera in



Fig.21 A camera with a puff & sip control device



Fig.22 An electric -drive easel for a patient with progressive muscular dystrophy

the vertical and horizontal planes while mounted on a tripod.

An electric easel was produced for a professional painter with progressive muscular dystrophy. He can move his canvas both vertically and horizontally, controlling the easel with a joystick (Fig. 22). After using this easel, he became capable of drawing bigger pictures, and could once again hold a private exhibition, through which he regained an enriched life.

Here I present the case of a severe ALS patient who uses an environmental control system to improve his quality of life.

A patient with severe quadriplegia due to ALS aged 54 has been on a respirator for 5 years.

He has maintained slight voluntary movement in his right index finger which he uses to operate a touch switch for the environmental control system.

He wakes up at 6:30 every morning, while his wife is still asleep due to the rather heavy routine of taking care of him. He turns on the environmental control system with his finger tip switch, switches on the TV and chooses the channel for the morning news show by touching the switch several times. After the news show, he switches off the TV, and turns on the switch of his personal computer to write a story using a software application for a word processor. He stores his story in the machine and turns off the personal computer then turns on the TV again to watch a morning show. Until his wife comes into his room around 7:30 a.m., he carries out his morning schedule by himself.

Some of you may think it is much easier to ask an attendant to control these appliances. What I want to emphasize here is that through direct manipulation of these appliances he can be reassured that he still controls part of his life independently. This is essential for him to sustain his quality of life because it makes him feel alive and this feeling provides him with a source of energy to keep him alive. After having operated the word processor for several months, he completed his story about his battle with ALS.

Unfortunately, several months later his physical function had declined to the extent where he could no longer move his index finger. So, we provided another input device utilizing his eyeblow movement. As a result, he still controls aspects of his life style by managing some of his daily activities independently.

COMMENT

Now, I like to comment on what I think is important in developing and providing technical aids for people with severe disabilities (Table 8).

1. Accurate evaluation
2. Precise identification of the needs
3. Self-determination
4. Appropriate equipment
5. Further development

Table 8 *The essentials of appropriate technical aids*

1. An accurate evaluation of the mental and physical status of the patient and the carer's ability to assist the patients, is the first step towards applying suitable assistive equipment to each patient. Medical rehabilitation professionals play an important role at this stage. We have to investigate physical function to operate the equipment, mental function to understand how to operate the devices and determine what they want to do, and also the carer's ability to assist the patients. Environmental evaluation is also important to deem whether the devices can be installed.

2. The patients' needs must be carefully identified prior to technical aids application. It is common that clients cannot specify their own needs precisely, and they often imagine unrealistic goals. The success of home-visit services depends on the precise identification of the client's and caregiver's need⁽¹⁰⁾. In these cases, rehabilitation workers must work closely with the patient and his/her family to help them formulate their needs from a realistic point of view. We have to draw out why they wish to use a device, where they use it, when and for what reason, and how to use it. One must then clarify the clients' needs and available services. If they don't understand well the equipment we propose, it is better to let them have an opportunity to use it on trial.

3. In the process of development and provision of technical aids, any final decision should be made by the clients. To facilitate their self-determination, we have to provide the client with as many options as possible. Encouraging self determination usually improves the patients' independence. We should not

force them to make decisions to employ the equipments we recommend, even when it seems reasonable to rehabilitation workers.

4. Highly advanced technology is not necessarily the best choice on technical aids provision. High-functioning but complicated devices are often difficult to operate by clients, and left as useless possessions. We have to select and/or design equipment appropriate to each patient, though careful assessment of the clients' physical, perceptual and cognitive functions and family's function in using the equipment. Assistive devices should be applied or developed for the individual needs of the patient. If necessary, devices should be custom made according to the clients' individualized needs and disabilities.

5. To cope with various disabilities and the extensively diversifying needs of the disabled people, we have to prepare many kinds of assistive equipment.

I believe that further participation of engineers in the rehabilitation field will strongly promote an improvement in the quality and variety of assistive devices for the disabled people. Furthermore, extensive collaboration with researchers not only in the clinical rehabilitation fields but also in other fields, such as engineering department of universities, private companies and foreign institutes, should taken place in this field.

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