

DRIVER RE-EDUCATION AFTER STROKE - CASE STUDY

Beata Stasiak-Cieślak, Piotr Malawko,
Tomasz Szczepański, Piotr Kosmowski

Abstract

The article presents the characteristics of a case study - stroke survivors with unilateral neglect syndrome, mechanisms used in re-education training and elements of functional rehabilitation. The focus was on an important diagnostic problem in the field of occupational medicine and the return to driving for people after stroke. The aim of the research work undertaken was to justify the experimental description of the driver after a stroke and to confirm the possibility of returning to driving, including compulsory re-education. Literature analysis, review of legal acts, characteristics of adaptation devices and conclusions from the case study were also carried out.

Keywords

stroke, disabled driver, adaptation, driver re-education

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1. Introduction

Stroke is a common disease that leads to severe disability. According to the International Classification of Diseases (ICD-10), it may include: (I) - cardiovascular diseases, including (I63) - cerebral infarction; (I64) - stroke; (I69) - consequences of cerebrovascular diseases; (G) - nervous system diseases, including (G46.3) - brainstem stroke syndrome; (G46.4) - cerebellar stroke syndrome [9]. The definition of stroke proposed by the World Health Organization (WHO) is as follows: "it is a clinical syndrome characterized by a sudden onset of focal and sometimes generalized brain dysfunction, the symptoms of which persist for more than 24 hours or lead to death and have no other cause but vascular one"[3].

Every year 15 million people worldwide experience a stroke, of which 5 million develop irreversible psychomotor changes [6], [11]. In Poland, this disease is one of the most common death factors, and also leads to secondary disability of various types. The number of strokes is estimated at 75,000. annually. This disease affects men more than women, and it is estimated that the number is 175 and 125 cases per 10,000 of residents,

respectively. The risk of stroke is directly proportional to age. It is estimated that more than half of all strokes occur in people over the age of 70 [10]. The following types of stroke are distinguished: ischemic, hemorrhagic and venous stroke, which occurs relatively rarely. Many modifiable factors contribute to the development of stroke [17].

One of the complications of stroke are neuropsychological disorders, including attention deficit disorder, which includes one-sided neglect syndrome (called half neglect, half inattention, or visual-spatial agnosia). The clinical picture reflects the inability to process or respond to stimuli appearing in a specific half of the visual field due to brain damage on the opposite side to the one affected by the stroke. Unilateral skipping syndrome is diagnosed in about 43% of patients with right hemisphere stroke and in about 20% of patients with injuries on the left side [5].

The quality of life of patients after a stroke is significantly deteriorating, therefore an important role is played by conducting a quick diagnosis and implementing specialized pharmacological, physiotherapeutic and psychological procedures characteristic for cardiovascular and neurological diseases.

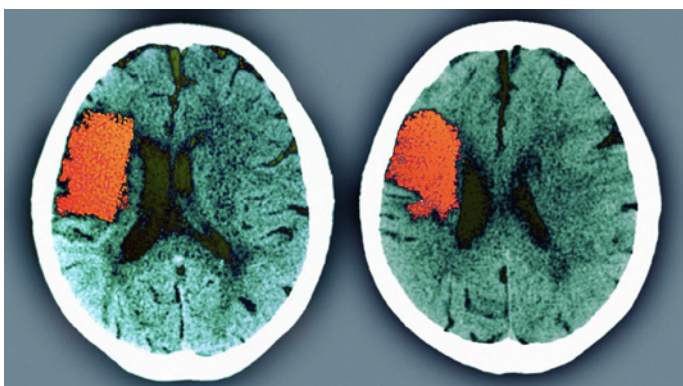
The aim of the research work undertaken was to justify the experimental description of the driver after a stroke of the right hemisphere with unilateral neglect syndrome and to confirm the possibility of returning to driving, taking into account compulsory re-education, as well as the use of adaptive equipment. The article also presents an overview of the literature and normative acts as well as the scope of vehicle adaptation.

2. Analysis of the literature

The motor symptoms of a stroke are characterized by the failure of one or more limbs. Sensory symptoms include loss of sensation in one or more limbs. There may also be visual disturbances or unilateral blindness or visual field disturbances, including double vision. The next group of symptoms are speech disorders (sensory and motor aphasia, dysarthria). Another characteristic feature of stroke is behavioural disturbance. The latter group of symptoms includes balance disorders [8].

Figure 1 shows an example of an ischemic stroke in the image (spot in red) of a computer tomograph (CT) examination, while Figure 2 shows the result of a popular clock drawing test performed with a patient in the diagnosis of this disease, indicating Unilateral Neglect Syndrome (USE). The test assesses the visual-spatial functions that are also necessary for driving.

Fig. 1. Ischemic areas in stroke



Source: Science Photo Library

Fig. 2. Clock drawing test [18]



Source: Science Photo Library

Siwek et al. [13] as part of a study conducted at the Provincial Specialist Hospital in Olsztyn, assessed 84 patients after a stroke of the right hemisphere of the brain (38 people) and the left hemisphere of the brain (46 people). The period of hospitalization of patients with features of unilateral neglect was analysed in comparison to patients who had not been diagnosed with this deficit. The features of the unilateral neglect syndrome were found in 27 patients, of which 21 were related to the stroke of the right hemisphere, and 6 - to the left hemisphere of the brain. By analysing the results of the research, it was shown that a stroke of the right hemisphere of the brain extends the patient's rehabilitation process, and the persisting symptoms interfere with functioning and rehabilitation.

Wojtan et al. [18] assessed the occurrence of symptoms of half (unilateral) neglect in 36 patients after ischemic stroke, and analysed the dynamics of these symptoms, the impact of clinical and sociological data on the occurrence of the syndrome and the impact on the functioning of patients in everyday life. The medical records of patients after ischemic stroke were analysed. In the study group, the syndrome was diagnosed in 40% of patients after a stroke located on the right side, and a negative influence of the syndrome on the performance of basic activities by patients was observed.

Akinwuntan et al. [1] described the studies of 68 patients after a stroke who underwent a mandatory assessment of their driving ability over 18 months. The evaluation included a physical examination, visual and neuropsychological evaluation, and a road test. Based on these assessments, the physician, psychologist and road safety expert decided whether the patient was "driving fit", "temporarily disabled" or "unable to drive". Logistic regression analysis revealed a combination of visual neglect, Rey's figure, and road tests as the model that best predicted ability to drive following a stroke. Using the discriminant function, the ability to make judgments of 59 (86.8%) subjects was correctly predicted. The driving ability can be predicted with great accuracy from the results of several road tests. However, some people require extended assessments and further testing.

The analysis of international studies (no data from Poland) shows that 30–66% of patients return to driving after a stroke [4]. Persons who do not return to driving are clearly more disabled than returnees. Most people who do not return to driving say they are not doing so because of a physical or mental disability, while a smaller percentage report that they are unable or unwilling to return. People who do not come back are more likely to be depressed and less likely to perform everyday activities outside the home, such as shopping or working. A study conducted on acute stroke patients who benefited from inpatient rehabilitation showed that 31% of them returned to driving six months after the stroke [2].

Shimonaga et al. [12] investigated targeted and sustained attention which is considered essential for driving. Identification of brain abnormalities caused by a post-stroke-cognitive impairment related to driving would help to determine the predisposition to drive after a stroke. MRI was performed on 57 patients who were assessed for attention loss using the CAA (Clinical Assessment for Attention) test, which included the Continuous Performance Test (CPT) - simple version (CPT-SRT), the behavioural inattention test (BIT) and the test on a driving simulator (divided attention task and simple and complex reaction times ensure constant attention). A statistical non-parametric map (SnPM) was created that showed the relationship between the location of brain damage and the cognitive function used in driving. Linear regression analysis confirmed the importance of both hemispheres, especially the right one, for cognitive functions and the ability to drive a car.

In Poland, the legislator does not provide for medical or psychological verification or re-training for people after a stroke. Usually, the person concerned, himself / herself, or at the request of the attending physician, suggests re-examination or not carrying it out at all. Persons with an unlimited driving license, in most cases, make (or not) the appropriate adaptive changes in the vehicle and do not use the advice of a doctor, driving instructor or an adapter. In addition, some people from this group are also unaware that if their psychomotor functions are preserved, they can drive a car again. The case of one-sided neglect is a controversial one, because this type of disorder may, without the driver's awareness, significantly hinder safe driving. The case study described below opens new perspectives, for the stroke survivors with partial neglect, in terms of socio-vocational activation and significant improvement in the area of rehabilitation by implementing an individual re-education training program.

3. Normative acts concerning drivers with disabilities

Drivers or candidates for drivers after a stroke should meet, like all drivers, the following requirements set out in the Act of 5 January 2011 on vehicle drivers, Art. 13 sec. 4 and 5 (Journal of Laws of 2011, No. 30, item 151, as later amended).

In Chapter 2 relating to persons authorized to drive vehicles in Art. 3 the following entries appear [19].

1. "The driver of the vehicle may be a person who has reached the required age and is physically and mentally fit and meets one of the following conditions:
 - has the ability to drive the vehicle in a manner that does not endanger safety, does not interfere with road traffic and does not harm anyone, and has an appropriate document confirming the authorization to drive the vehicle;
 - is undergoing driving lessons as part of the training;
 - passes the state examination.
2. The driver of the vehicle may also be a person who is undergoing training as part of the initial qualification, accelerated pre-qualification, supplementary preliminary qualification or accelerated supplementary pre-qualification, referred to in the provisions of chapter 7a of the Act of September 6, 2001 on road transport (Journal of Laws of 2019, item 2140) and is physically and mentally efficient - Art. 39a, section 1, points 3) and 4) [22].
3. A physically disabled person may be a driver if he / she obtained a medical certificate stating that there are no health contraindications for driving a vehicle".

In addition to the above-mentioned important driving authorisations, the driver should have current medical examinations. If the driver becomes disabled after receiving the authorization, he should notify the relevant regional authority as soon as possible.

If, after the examination, the driver does not agree with the contents of the medical certificate, he/she has the right to appeal against the doctor's decision. The appeal should be preceded by an application for medical re-examination in an authorized unit and specified in the regulations issued under Art. 81 of the Act of 5 January 2011 on vehicle drivers (Journal of Laws of 2011, item 151). Re-examination is carried out in an entity with a higher reference level than the entity that performed the previous examinations. The unit performing the tests under the appeal procedure should be entitled to do so, and the obligation to cover the costs of the tests rests with the person applying for renewal of the license. After the examination, the medical examiner issues an opinion in the form of a final decision. During the examination, the examining physician assesses, inter alia, muscle strength and grip, and limitations in joint mobility - fingers and wrists, elbows and shoulder.

If the medical certificate contains health contraindications for driving or referring to the health of the applicant driver or candidate, the competent physician shall send a copy of the certificate to [19]:

1. the entity performing the re-examination, if the person submitted an application for medical re-examination;
2. the regional authorities appropriate for the place of residence of the examined person, after 14 days from the date of the examination, if the person examined or the entity referring the examinations did not submit an application for re-examination or the medical certificate was issued after the examination was repeated.

In the case referred to in Art. 79 sec. 8 point 1, the authorized doctor attaches a copy of the documentation related to the examination, to the copy of the medical certificate. In relation to the persons referred to in Art. 10 sec. 3, in the case specified in Art. 79 sec. 8 point 2, an authorized physician sends a copy of the medical certificate to the appropriate head of the regional authorities [19].

In a situation where the test result is positive and there are no contraindications to drive vehicles, due to health condition, the driver receives back the suspended driving license. In the place designated for this on the driving license, only the restrictions imposed on the driver by the Regulation of the Minister of Infrastructure and Construction of May 20, 2016 on the model documents confirming the right to drive vehicles: Annex 1 (Journal of Laws of 2016, item 702) [23], are placed. Information resulting from codes or subcodes placed in driving licenses issued before the date of entry into force of these regulations shall remain valid for the period of the rights issued, unless the restriction in use has been issued for an indefinite period.

The places where the information related to the restrictions are included are in the fields of the column with the number 12 [23]. Information about restrictions is written in numerical form as codes and subcodes. Here are some examples of such subcodes:

- 20.03 - brake pedal adapted to be operated with the left foot,
- 20.04 - brake pedal under the entire foot,
- 20.05 - tilting brake pedal,
- 20.06 - manually controlled main brake,
- 20.07 - the possibility of effective use of the brake pedal with a specified force... N [23].

A driver who meets all of the above-mentioned guidelines can be a full participant of the road traffic. Efficient and safe driving of the vehicle by him should not cause dangerous situations with the participation of other road users.

4. Driver after stroke - case study

The case study presented a series of activities carried out by a disability driving instructor with a stroke survivor to assess the return to driving in accordance with the road traffic regulations. A series of tasks is presented, ranging from an unstructured interview conducted over the phone, and ending with medical verification by an occupational medicine doctor with authorizations to examine drivers, changing the data in the driving license (definition of restriction codes) in the relevant department of transport appropriate to with the place of residence and the appropriate adaptation of the vehicle to physical limitations of the person entered for training.

Mr. Piotr, a man aged 66, residing in Pomiechówek in the Mazowiecki Region, not working (retired), the only driver in a two-person household, with a car with an automatic transmission, after two ischemic strokes (December 2016, February 2017) with left-sided full-body paresis, with a left-sided neglect syndrome diagnosed by an instructor, enrolled in re-education training enabling people with driving license to return to driving (indefinitely). The term "unilateral neglect" is used to describe a behavioural disorder. It can be defined as a limitation of the ability to react and direct oneself towards the stimuli located in space opposite to the brain damage (stroke - right hemisphere of the brain). The importance of proper diagnosis and treatment as well as early rehabilitation should be emphasized in order to improve the neurological condition.

In November 2017, Mr. Piotr applied to participate in the proprietary program run by the substantive partner of the Motor Transport Institute, with the aim of returning to driving after a stroke. The initial interview was conducted based on the thematic questionnaire on people who became disabled as a result of random events. Mr. Piotr had a stroke in February 2017; the driving instructor confirmed the possibility of the tests because the contractual six months have passed since the last health (stroke) incident. The current health condition and dysfunctions, medications taken and concomitant diseases did not exclude the patient from the possibility of additional training courses as part of re-education training. The preliminary qualification was passed with a positive result, and the, so-called, try-on meeting was set up in order to select adaptive devices. The training was scheduled for January 2018.

The "try-on meeting" was held in November. Its aim was to broadly assess the possibilities and needs of the person enrolled in the training. At the meeting, the type and extent of limb dysfunction was assessed in terms of the needs of car control. A questionnaire consisting of 14 questions was completed - ranging from asking about the date of the last stroke to questions about motivation to return to driving and current rehabilitation.

Mr. Piotr moves about without any instruments (crutch, cane), his left leg is weaker and less agile. A slight contracture of the left hand prevents it from working freely, and the hand and fingers are in a condition that excludes operating the steering wheel. Mr. Piotr suffers from type 2 diabetes and has a pacemaker implanted. For this reason, he asked about the possibility of not wearing seat belts. A short discussion developed and after taking into account the legal considerations (the need to have a medical certificate exempting the seat belt) and the effects of activating gas bags during a possible collision, the suggestions were made. The instructor stated that the belt pressure in the normal mode was negligible and should not interfere with the pacemaker operation. He also ascertained that injuries could be serious in a collision with the deployment of an airbag with the seat belts unfastened. It was therefore agreed that Mr. Piotr would drive with the seat belts fastened.

Then, the Post-stroke Driver Function Control Program was presented and discussed.

1. **The way of using the vehicle control mechanisms.** The capabilities of a non-disabled person and the driver with limb movement restriction were compared. The reference was made to the difference in handling a car with a manual and automatic transmission. Drivers' habits, inaccessible to people with disabilities, were mentioned.
 2. **Ability to control car by means of adapted devices.** It was mentioned, how to use the control knob with the remote control and what problems may arise - e.g. frequent gripping the steering wheel instead of the knob or awkward attempt to help with the other hand.
 3. **Behaviour in relation to road signs, traffic lights, signals given by persons authorized to direct the traffic.** The assessment of the impact of stroke on the psyche and their negative effects on the psychomotor skills of the driver was characterized.
 4. **Reflex, appropriate response to potential traffic hazards.** Examples were presented of what negative consequences a stroke can have on psychomotor performance. It was proposed to check the reaction time in the natural operation mode in road traffic with maximum safety. The instructor then observes, in road conditions, how the test driver will react in the event of e.g. a change of light on a signalling device or when suddenly there is a threat in the form of a running pedestrian, cyclist, etc.
 5. **Driving in heavy urban traffic.** One should check resistance to stress, the ability to change lanes at high intensity, manoeuvres at intersections, etc. everyday phenomena on the road.
 6. **Spatial observation while approaching the intersection, behaviour towards pedestrians and other road users.** The correct operation of the driver's most important sense - a vision, and functioning in this respect, is assessed. A common phenomenon among people after stroke is lateral neglect syndrome, a condition that is difficult to assess by the patient himself. In a hospital, it is possible to diagnose, but without determining the degree of intensity and impact on driving a vehicle. While driving, the "neglect" manifests itself as a lack of reaction (the subject does not sears on the left side, e.g. a pedestrian entering a crossing, while entering a roundabout, he ignores vehicles already moving on it, etc.) in road situations, which is one of the more dangerous. The trainer noted that this could be a key part of the final assessment.
 7. **Reaction to the commands transmitted with respect to the driving direction.** It is checked whether the person confuses the left side with the right one.
 8. **Parking skills - spatial observation, reversing, observation through the exterior and interior mirrors.** Parking re-education of the use of mirrors is conducted.
 9. **Driving on the roads with increased permissible speed.** The high speed mirror observation test is performed prior to the overtaking manoeuvres and the lane change test using the knob.
 10. **Driving in conditions of reduced air transparency (in the period from dusk to dawn).** Driving is performed in suburban conditions from dusk to dawn, without the road being illuminated by street lights. It is assessed whether there are no changes in the twilight vision process after the stroke (short-distance observation with the dipped headlights on and the effect of blinding by the headlights of oncoming vehicles). It is checked whether the tested person adjusts the speed to his observation abilities and the possibilities in the area of movement.
 11. **Fatigue and its influence on the ability to assess the traffic situation and to react appropriately.** Fatigue is common among stroke survivors. The test time is assumed to be 2.5 to 3 hours behind the wheel. Fatigue behind the wheel in healthy and young people is slow and subjectively difficult to assess. It appears much earlier in stroke survivors. After the complete cycle of driving, comments and recommendations are discussed, e.g. no driving in the dark or not longer than 1.5 hours.
- After conducting a full interview with a questionnaire, the instructor agreed with Mr. Piotr the technical and organizational conditions of the training (re-education), he answered questions regarding, for example, the number of hours of training, its duration, costs, conditions in which the training will be conducted, or how long will it take to check the fatigue phenomenon.
- Following the interview, the instructor presented a vehicle for driving lessons for people with disabilities, equipped with various adaptive devices. Due to functional limitations, the car must have an automatic gearbox and a knob on the steering wheel integrated with the remote control. Mr. Piotr was acquainted with the devices, and then his own vehicle was inspected. The client accepted all conditions and undertook to undergo full training and to perform the necessary tests. The start date of the training was con-

firmed for January 2018 and the frequency of meetings was set.

Before the course, the area in which the first few hours of training will be conducted was explored. Relevant statements were signed and the regulations were read. Basic training principles were discussed, such as: "We drive in accordance with the regulations", "The instructor gives orders".

The driving instructor has conducted the instruction on the use of the multifunction remote control along with the correct gripping of the steering wheel while driving. The training did not include the use of an automatic transmission due to the fact that such a vehicle was owned by a person undergoing re-education. The training began with simple tasks, such as driving forward, driving backward, turning, turning back, driving in a curve. Then the use of turn signals was added. Mr. Piotr carried out all the instructor's instructions smoothly with great composure.

The next stage of the training was planned in real road traffic. The driver of the vehicle maintained the speed with the right intensity, perfectly keeping the lane, correctly cornering. Subsequent drives were planned in Nowy Dwór Mazowiecki, on the roads with greater traffic, in order to check the next stages of the training. The instructor's first observations were related to drawing attention to the driving too close to the axis of the two-way road (the left edge of the lane). In this situation, the driver was asked to drive in the middle of his lane for half an hour, not overrunning the lines and controlling his driving track. It was ascertained that completing this task meant that the behaviour was a habit, not a cognitive problem. The task was completed correctly.

The next stage of the re-education was driving tests at the roundabout. The first test was unsuccessful - the instructor was forced to use the brake due to a collision situation with another vehicle moving on the roundabout. The trainee signalled that he did not see the vehicle approaching from his left. After this incident, the instructor conducted a few more drives with careful observations during the entry and exit from the roundabout and during the entire roundabout driving process, taking into account Mr. Piotr's use of mirrors, especially the left one. The drive ended with an extensive summary of the problem that the instructor observed. The person enrolled in re-education was reminded that certain stroke 'disturbances' could arise as a result of complex tasks related to psychomotor skills. Driving on the roundabout made the instructor aware of the problem of one-sided neglect, previously undiagnosed.

Subsequent meetings focused on the problems of one-sided neglect that emerged from real-time road testing. Each instructor's task was accompanied by the command "look left" to draw attention and force an appropriate reaction and analysis of the situation. After several hundred commands, the driver's brain began to absorb this activity and react automatically. Repeated exercises and repetition of activities related to observing the left side of the visual field and "feeling the side" led to a breakthrough in functional rehabilitation during re-education.

While repeating subsequent tasks, the instructor noticed a tendency of the driver to approach the vehicle in front too close. The other tests of the program, including the test of severe fatigue, were positive. After many hours of re-education, the program was successfully completed. One-sided neglect was removed by the long hours of patient work of the instructor with the student.

The next step was an examination by an occupational medicine physician with a license to examine drivers. For this meeting, the consent of specialists from various fields of medicine was needed. A certificate with a note that there are no contraindications for driving a car was issued by a neurologist, diabetologist and cardiologist. The trainee also received an appropriate certificate of the course and a positive result of the final examination conducted by the instructor.

In April 2018, the trainee obtained a medical certificate stating that there are no health contraindications for driving a motor vehicle, specifying restrictions on special requirements for the person driving the vehicle in the form of the following restriction codes (10.02 / 40.11 / 35.02):

- 10 - required modifications to the gearshift system: 10.02 - without the clutch pedal (or hand lever for driving license categories AM, A1, A2 and A),
- 40 - required modifications to the steering system: 40.11 - a knob on the steering wheel,
- 35 - required modifications of control devices (light switches, windshield wiper, washer, horn, direction indicators): 35.02 - control devices operated without releasing the steering wheel and accessories (including knob, lever).

An incredible chance to return to driving is the driver's re-education after a stroke. Diagnosis and referral to training should be carried out by qualified medical and instructing personnel with the participation of a transport psychologist. High requirements in this respect should be an absolute

priority. In the described case of a person who suffered a stroke of the right hemisphere of the brain, the re-education of psychophysical abilities during the training was effectively a functional rehabilitation while driving. The initial stage of the training involved performing simple vehicle control activities (learning how to use a multifunction remote control), mastering the use of the available adaptive devices and introducing elements of cognitive rehabilitation in order to activate the neglected function of seeing/feeling the left side of the body by a person participating in the training. The conducted experiment indicates important problems, recommending further research in this area in order to define diagnostic criteria.

5. Adaptive devices, driving restrictions after a stroke

Presented technical solutions are to illustrate the possibilities that a disabled driver has to use following a stroke in order to be able to drive a vehicle. Vehicle adaptation is an individual process, the final effect of which should also improve road safety. Drivers with motor disabilities use additional equipment depending on their individual needs. A car adapted to the needs of a disabled driver may be equipped with adaptive devices mounted on the steering wheel and on the pedals.

The first discussed type of devices enabling driving a vehicle was instrumentation such as a handle in the form of a knob with a remote control function - a multifunction device (Fig. 3). The device is used in various configurations and allows to operate levers of devices such as: indicators, wipers, lights. The handle, installed in the so-called adapter on the steering wheel, allows to steer the vehicle with a healthy upper limb. Various adaptive solutions to be used in the case of a person who uses one of the upper limbs include:

- a handle in the form of a knob with a remote control function (with the possibility of operating the switches of such devices as wipers, lights, sound signal, direction indicators) - Fig. 3;
- knob-shaped handle without remote control function - Fig. 4;
- only the remote control to operate the indicators (Polish production, less frequently used) [15].

Fig. 3. A handle in the form of a knob with a remote control function



Source: ITS

Fig. 4. Knob-shaped handle without remote control function and remote control mounted separately



Source: ITS

The second type are devices that enable the control of vehicle acceleration and braking with the left leg. The adaptation device requires the installation of an alternating accelerator (gas) pedal, either mechanical or electronic one (Fig. 5). This type of adaptation allows the vehicle to be used also by the driver without a disability, as the factory-fitted accelerator pedal retains its functionality. Regarding safety when using this solution, the manufacturer recommends disconnection (deactivation), in the electronic version, with the use of a button, while in the mechanical version - disassembly when the driver intends to use the factory-fitted accelerator pedal. After following the device manufacturer's guidelines, one can safely drive the vehicle.

Fig. 5. Electronic (left) and mechanical (right) versions of the accelerator pedals



Source: <https://emico.pl/>

In addition to the above-mentioned amenities, the vehicle can be adapted in the form of a lever that allows to move the direction indicators, lights or wipers control switches. The devices can be installed in sets or separately. The entire adaptation process is highly personalized. Therefore, the place of their installation and the type are determined by the individual predispositions of the user. In addition to the adaptive devices, a vehicle adapted to the needs of the driver after a stroke should be equipped with an automatic transmission.

Additional technical solutions are adaptive devices enabling the driver or passenger to get in and out [16]. One of them is a bench mounted on the left hand side of the driver's seat. This solution can also be used on the passenger side, depending on the needs. The bench is unfolded for the time of transferring during a stop, while when driving, the bench is folded.

Fig. 6. A bench for transferring



Source: ITS

Another solution that makes it easier to transfer is the door handle. The device is attached, when transferring, to the lock catch located on the door pillar on the driver's or passenger's side. This type of solution does not require installation of additional parts needed for its use, so it can be used in various vehicles. The device is to support the transfer process and make it safer [7].

For the described case, the devices described in this chapter are recommended.

6. Summary

The described case of re-education training of a person after stroke with unilateral neglect syndrome represents the beginning of considerations on the legitimacy of returning these people to driving, and thus on the possibility of substituting their limitations by using specialized adaptive devices. Returning to driving by these people is demanding and time-consuming, but in many situations it is a fundamental factor in determining oneself and one's whereabouts. Independence and the possibility of undergoing re-education in driving significantly improves the psychosocial functioning of patients with UNS. Self-awareness of deficits as well as rehabilitation and exercises to improve capabilities of people after a stroke before training and while driving are to direct such people to self-determination and return to work and social activity.

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Beata Stasiak-Cieślak

cum@its.waw.pl

Motor Transport Institute

Piotr Malawko

piotr.malawko@its.waw.pl

Motor Transport Institute

Tomasz Szczepański

tomasz.szczepanski@its.waw.pl

Motor Transport Institute

Piotr Kosmowski

kosmos.piotr.kosmowski@gmail.com