Oral Health Status of Stroke Patients Related to Residual Symptoms: A Case-Control Epidemiological Study in Hungary

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Purpose: Stroke is a leading cause of death in developed countries. Recently, its connection with oral health has been a focus of the medical literature. The aim of this study was therefore to statistically examine the oral health of subjects who previously suffered from stroke and provide a guide for the dental treatment of these patients.

Materials and Methods: Stroke patients at least one year after the stroke episode and age- and sex-matched healthy controls were examined: dental and medical stroke histories were recorded, followed by a detailed orofacial examination. A categorisation into three 'dental' subgroups of stroke patients was carried out based on their residual symptoms, the functional deficiency of limbs, and chewing and swallowing difficulties. Indices quantifying oral hygiene (OHI-S), dental status explained by the number of decayed, missing, and filled teeth (DMFT), periodontal status (CAL, CPITN, Mühlemann index), and the status of prosthetic treatment (prosthetic index) were assessed. Statistical comparison was performed between the patient and age- and sex-matched control subjects, as well as between subgroups of stroke patients.

Results: One hundred two stroke patients and 98 healthy age- and sex-matched control subjects were examined. The oral health and dental status of stroke patients was worse compared with the control group. Stroke patients had significantly more decayed (2.3 ± 3 vs1.1 ± 1.8; $p = 0.01$) and missing (19.3 ± 9.5 vs 15.5 ± 9.3; $p = 0.005$) teeth, but significantly fewer filled (3.6 ± 4.7 vs 7.7 ± 5.6; $p < 0.001$) teeth than did the healthy controls. In stroke patients, clinical attachment loss (CAL) was double that of the control group ($p < 0.001$). A comparison between the subgroups of stroke patients revealed that the most severe findings were in patients who had chewing and swallowing disabilities.

Discussion: According to these results, the combination of risk factors of stroke, residual neurological signs after stroke, and poorer socioeconomic conditions results in poor oral hygiene, poor dental and periodontal conditions, and a lower prosthetic index. Special care and attention should be given to the oral hygiene and dental treatment of such patients, to enable good nourishment.

Key words: dental oral health, dysphagia, hemiparesis, periodontal, prosthetic, stroke

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Stroke is the third leading cause of death in the world following cardiovascular disease and cancer.[15,26,27] The risk is increased in people with diabetes, heart diseases, high blood pressure, obesity, high blood cholesterol level, and lifestyle choices such as cigarette smoking and alcohol consumption. The cerebral damage causes significant aftereffects and important social and physiological problems in patients.[15,16,23,25] Dysphagia often requires specific treatment to facilitate swallowing, and occasionally, it may result in impaction of the prosthesis in the oesophagus, unper-

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Table 1 Orofacial signs and symptoms related to extraoral residual symptoms in stroke patients (n = 102) following the classification of stroke patients according to residual symptoms and dental manageability

Post-stroke residual symptoms	Stroke patients (N = 102)	Stroke group Class I (n = 60)	Stroke group Class II (n = 34)	Stroke group Class III (n = 8)
Facial palsy	70	37	25	8
Mastication on non-paretic side *	42	19	17	6
Tongue paresis **	24	6	12	6
Soft palate paresis **	10	2	5	3
Dysphagia ***	33	9	18	6
Dysarthria	30	10	15	5
Aphasia (motoric)	19	11	4	4
Hand paresis	57	23	26	8
Limited tooth brushing ability as a result of paretic hand ***	20	6	7	7
Leg paresis with assisted walk ***	3	0	1	2
Toothbrushing difficulties due to paretic leg ***	20	5	11	4
Post-stroke depression	44	19	22	3
Post-stroke dementia *	20	9	6	51
Financial circumstances hinder dental treatment *	41	18	17	6
Regularly visiting the dentist	8	8	0	0

*p < 0.05, **p < 0.01, ***p < 0.001 (ANOVA) among the subgroups. Group I: patients do not need assistance in maintaining their oral hygiene. Group II: patients are able to clean their teeth, but they need professional assistance to maintain proper oral hygiene. Group III: patients are unable to maintain their oral hygiene alone, they need assistance for both food intake and oral hygiene procedures.

ceived by the patient.[6,16,20] Swallowing function is of primary importance for masticatory function and nutrition, and in compromised people, it can reflexively prevent aspiration of food and saliva.[18] Patients may frequently have problems with ingestion of food and drink, and may vomit owing to the lack of coordination between respiration and deglutition.[17] Dysarthria, aphasia and agnosia on the other hand, may cause significant problems in communication between patient and dentist.[21]

Nevertheless, the most disabling after-effects are hemiplegia, apraxia, hypoalgesia, hypoaesthesia, and hyperesthesia, which result in a significantly lower frequency of dental visits.[3,10,22] Only about 42% of stroke survivors are considered independent in terms of performing daily activities.[20,22,24] Depression, dementia and epilepsy, as an additional possible consequence of stroke, might further decrease the patient's compliance.[19]

It is also known that edentulousness, or decayed or mobile teeth can cause chewing disabilities, which detrimentally impact nourishment, motoric and sensory function of both masticatory and gastrointestinal function.

In the light of these considerations, the aim of the present study was to determine whether these patients have poorer oral health compared with that of a healthy population, as a result of a combination of risk factors, residual symptoms, and socioeconomic background. A further aim was to classify stroke patients into 3 subgroups concerning their orofacial treatment possibilities, by assessing their oral health conditions as reflected by their post-stroke orofacial and functionally related residual symptoms.

MATERIALS AND METHODS

This study was approved by the Medical Research Council, Scientific and Research Committee of Hungary (ETT-TUKEB) No: 23024/2011-EKU (728/PI/11), and was performed according to the Helsinki Declaration of Human Rights. All patients and control subjects gave their informed consent. Examination and data collection were carried out by the same two investigators throughout the study, the patients' neurologist (I.V. for neurological examination and classification) and the dentist (K.K. for orofacial examinations).

Patients

The study was performed in collaboration with the Department of Prosthetic Dentistry, Faculty of Dentistry and the Department of Neurology, Faculty of Medicine, Semmelweis University, Budapest.

One hundred two nonselected stroke patients (39 female, 63 male, average age: 63.8± 12.9 years) who suffered a stroke at least 1 year before the assessment, and 98 age- and sex-matched healthy controls (46 female, 52 male, average age: 63.9 ± 12.4 years) were included in the study. The size of the study group was calculated according to the reported number of surviving stroke patients undergoing regular control procedures (about 1000 persons/year) in the Stroke Care Outpatient Clinic in the Department of Neurology, Semmelweis University, Budapest. All of the stroke patients were under regular care at this outpatient stroke unit, while the controls were selected from the outpatient Dental Teaching Center Clinic of Semmelweis University, Budapest. To classify the stroke patients, three dental subgroups were established (Table 1) by a neurologist and a dentist together after thorough discussion. The three subgroups were defined according to the after-effects of the stroke, taking into consideration the patient's ability (e.g. manual skills) to perform good oral hygiene and visit the dentist, and whether or not the patient possessed sufficient social-financial means for proper treatment. The classification took residual symptoms with special emphasis on hand and leg hemiplegia, chewing and swallowing disabilities into account. Each patient was placed by the neurologist into the appropriate subgroup. The present study also tested the validity of this new classification.

Assessment of General and Neurological Status

Initially, personal information and data pertaining to general medical history and residual symptoms of stroke were collected and recorded using a questionnaire. Employment rate (0: unemployed; 1: active; 2: pensioner; 3: on disability pension) and educational level (0: < 8 class elementary school; 5: higher education) were recorded.

Questions were related to facial palsy, preferring the non-paretic side for biting, tongue paresis, soft palate paresis, dysarthria and aphasia (0: no; 1: yes), dysphagia (0: no; 1: mild: slowly eating normal food; 2: severe: eating soft/pulply diet). Patients were asked about right-hand (ie, skilled-hand) paresis (0: no; 1: mild; 2: medium; 3: severe; 4: minimal muscle contraction), leg paresis (0: no; 1: walking with cane; 2: personal help or wheelchair are necessary), post-stroke depression (0: no; 1: yes), dementia (0: no; 1: mild; 2: intermediate).

Orofacial Status Evaluation

Oral hygienic habits, ability for oral hygienic performance

Participants were asked about the frequency of visit to the dentist (0, only given complaints; 1, annually). Financial circumstances restricting the patient's dental treatment was also recorded (0: no; 1: yes). Data were recorded on questionnaires constructed to allow quantification and statistical analysis.

Oral hygiene was assessed by inspecting the amount of dental plaque and calculus individually on each tooth. The amount of plaque and calculus was quantified separately and assessed by the Greene-Vermillion Oral Hygiene Index.[7]

The caries status was determined using the DMFT index, i.e. the number of decayed, missing, and filled teeth individually with the use of a standard dental mirror and probe, and was expressed as the DMFT means.[28]

The periodontal status was evaluated as follows: The periodontal probing depth (PPD) was assessed with a calibrated William's periodontal probe (Astir Intermedica; London, UK) and was defined as the distance between the free gingival margin and the base of the gingival sulcus in millimetres. The PPD was measured at six sites of every tooth, the mean for the tooth was calculated, and all the teeth were averaged for the patient. Gingival recession (GR) was also recorded as the distance between the gingival margin and the cementoenamel junction also at six sites per tooth. Clinical attachment loss (CAL) of a tooth was calculated by adding the periodontal probing depth (PPD) and GR. This number was averaged for one tooth and then for all the teeth. The Community Periodontal Index for Treatment Needs (CPITN) was also determined.[1,4] The maximum CPI score was recorded for each sextant and then averaged with the other sextants.[1,4] The severity of gingival bleeding on probing ranged from 0 to 3, using the Mühlemann Index, and the indices of all the teeth were then averaged.[13]

The number and type of prosthetic appliances (fixed crowns, or bridgework, removable partial or complete dentures) were also recorded. The number of prosthetically replaced teeth (pontic, implant, artificial tooth of the removable denture) per person was calculated and the ratio of replaced to missing teeth was determined in the region between the maxillary/mandibular right first molar and maxillary/mandibular left first molar. Data were expressed in percentage as the Prosthetic Index. The index in ideal case is 100, when all missing teeth are replaced by some form of prosthetic appliance.[9]

Statistical Analysis

All data were analysed statistically using the Stata programme v 10.1 (Stata; College Station, TX, USA).

Continuous variables, including age and indices describing oral health (Greene-Vermillion Oral Hygiene Index, DMFT, CPITN, PPD, CAL and GR), were checked for normal distribution, and compared between groups using Student's two-sample t-test or ANOVA if parametric assumptions were satisfied. If not, Wilcoxon's rank-sum test or the Kruskal-Wallis test was applied. Statistical significance was set at $p < 0.05$.

RESULTS

The average age of the 102 stroke patients (39 female, 63 male) was 63.8 ± 12.9 years, and 63.9 ± 12.4 years of the 98 controls (46 female, 52 male) (Table 1).

Table 2 Orofacial diagnostic indices (mean ± SD): oral hygiene, cariological and periodontal status of stroke patients compared to healthy age- and sex-matched controls

Oral health index	Stroke (mean ± SD)	Control (mean ± SD)	Significance level
OHI-S	4.1 ± 1.5	1.8 ± 1.4	$p < 0.03$
DMFT	25 ± 7.5	24 ± 6.9	$p = 0.2$
D-T	2.3 ± 3	1.1 ± 1.8	$p = 0.01$
M-T	19.3 ± 9.5	15.5 ± 9.3	$p = 0.005$
F-T	3.6 ± 4.7	7.7 ± 5.6	$p < 0.001$
CAL	4.3 ± 2.3	2.2 ± 1.3	$p < 0.001$
CPITN	3.1 ± 0.6	1.8 ± 0.9	$p < 0.001$
Mühlemann index	2.59 ± 0.6	1 ± 0.7	$p < 0.001$
Prosthetic index	0.35 ± 0.3	0.44 ± 0.31	$p = 0.06$

Results show a significantly worse orofacial condition of stroke patients as compared to controls. OHI-S: Greene-Vermillon oral hygiene index; DMFT: number of decayed, missing, filled teeth; D-T: number of decayed teeth; M-T: number of missing teeth; F-T: number of filled teeth; CAL: clinical attachment loss; CPITN: Community Periodontal Index of Treatment Needs.

The dental subgroups of stroke patients were as follows (Table 1): 59% were group I, 33% group II, and 8% group III. The average age was the same in all the three patient subgroups.

Stroke Group I

Patients with little or no functional (hand and/or leg, orofacial) disability are able to maintain their oral hygiene. They are able to move their limbs (they are able to grasp the clinician's hand with both hands).

Stroke Group II

Patients with paretic hand and/or leg are not capable of performing oral hygiene alone. They are able to maintain their oral hygiene with external help. There is no or mild orofacial disability present with the following symptoms: paresis of the tongue or the soft palate, facial palsy, dysphagia, dysarthria, paresis of the hand and/or leg, and post-stroke depression.

Stroke Group III

These are patients with expressed orofacial disabilities: biting and/or chewing difficulties, dysphagia. In this group, the food consumed was mashed or pulpy, and it remained in the mouth longer than usual. Subjects have complete facial palsy and/or tongue paresis, severe dysphagia, perhaps severe dysarthria, motoric aphasia, complete hand paresis, limited toothbrushing ability. They are not able to maintain their oral health at all; they need continuous external assistance.

Activity

Of the stroke patients, 10% were active workers, whereas 31% were active in the control group; 37% of stroke patients (after the stroke incident) and 2% of control group received a disability pension ($p < 0.001$). In group III, 75% received a disability pension, which was signficantly more than in the other stroke subgroups ($p = 0.005$). Educational level was higher among the controls (high school diploma and/or university degree: 60% vs 28%; $p < 0.001$).

Orofacial Signs and Symptoms (Table 1)

Of the stroke patients, 69% exhibited central facial palsy and 41% preferred the non-paretic side for mastication, 24% had tongue paresis and 10% soft palate paresis. Dysphagia was mild in 28% (slowly eating normal food), and severe in 4% (eating mashed, pulpy food). Dysarthria appeared in 29% of the patients, and aphasia in 19%. Each residual symptom was significantly more frequent in group III, except aphasia. Hand paresis was mild in 36% of the patients with toothbrushing abilities, intermediate in 8%, and severe in 3%, while minimal muscle contraction was present in 9% with no toothbrushing abilities at all. This value was significantly decreased significantly between the subgroups (I-II, $p = 0.002$; II-III, $p = 0.001$).

Seventeen percent of stroke patients could walk only with a cane or walker, 3% needed personal help or a wheelchair. 17% of the patients reported feeling that their toothbrushing was clumsy due to leg paresis. Locomotion decreased significantly between the subgroups (I-II, $p = 0.006$; II-III, $p = 0.03$).

Post-stroke depression was found in 43% of stroke patients, and post-stroke dementia in 20%, where the only severe case belonged to group III.

Thirty-nine percent of stroke patients found dental treatment difficult due to limited financial circumstances, which was significantly higher in group III (I-III, $p = 0.01$).

Of stroke patients, only 2% visited the dentist on a regular basis (every 6-12 months), and they belonged to group I. In contrast, 44% visited the dentist on a regular basis in the control group ($p < 0.001$). No significant difference could be found between the subgroups ($p = 0.6$).

Table 3 Periodontal treatment needs (in percentage) of stroke patients compared to age- and sex-matched healthy controls (edentulous subjects are excluded)

CPITN	Controls % (n = 86)	Patients % (n = 81)	Patient group I % (n = 46)	Patient group II % (n = 29)	Patient group III % (n = 3)
0	8.14	0	0	0	0
1	23.3	1.2	2.2	0	0
2	43.0	18.5	28.3	3.5	0
3	**20.9**	**45.7**	**39.1**	**58.6**	**33.3**
4	**4.6**	**34.6**	**30.4**	**37.9**	**66.7**

The periodontal status of the stroke patients was worse than in the control group. Bold numbers show the increasing percentage of stroke patients of the different neurological subgroups with active periodontal inflammation (CPITN 3 and 4). Subgroup I: 69.5%; subgroup II: 97.5%; subgroup III: 100%; control group 25.5%.

Oral Conditions (Table 2)

Oral hygiene (assessed by the Greene-Vermillion Oral Hygiene Index) was significantly different between the patient (4.1 ± 1.5) and the control (1.8 ± 1.4) groups ($p < 0.001$). In group III, it was significantly higher (I-III, $p = 0.03$). The plaque index was 2.2 ± 0.75 in the stroke group and 1.16 ± 0.9 in the controls ($p < 0.001$), while the calculus index was 1.9 ± 0.96 in the stroke and 0.65 ± 0.67 in the control group ($p < 0.001$). The plaque index scores in the subgroups were 2.2 ± 0.7 in subgroup I, 2.1 ± 0.7 in subgroup II, and 3.0. in subgroup III ($p < 0.005$ between I and III, and between II and III). The calculus index scores in the subgroups were: 1.8 ± 0.9 in I, 1.8 ± 1.0 in II, and 2.2 ±1.0 in III ($p = 0.3$).

The status of remaining teeth was as follows: DMFT was somewhat but not significantly higher in the patient group (25 ± 7.5) than among the controls (24 ± 6.9; $p = 0.2$). In group III, it was significantly higher (II-III, $p = 0.005$). In terms of the individual components of the DMFT index, the number of decayed teeth was 2.3 ± 3 in stroke patients compared to 1.1 ± 1.8 in the control group ($p = 0.01$), the number of missing teeth was 19.3 ± 9.5 in the stroke group and 15.5 ± 9.3 in the controls ($p = 0.005$), and the number of filled teeth was 3.6 ± 4.7 in stroke group vs 7.7 ± 5.6 among the controls ($p < 0.001$). Thus, the number of decayed and missing teeth was higher, but this was compensated within the overall DMFT score by the significantly lower number of filled teeth, masking the poor dental status of stroke patients.

The periodontal condition was expressed by the average CAL (PPD + GR), which was 4.3 ± 2.3 in the stroke group and 2.2 ± 1.3 in the control group ($p < 0.001$). It was significantly higher in group III compared to group I ($p = 0.05$).

The CPITN index was 3.1 ± 0.6 in the stroke group and 1.8 ± 0.9 in the control group ($p < 0.001$), but showed no significant differences between the patient subgroups ($p = 0.1$). Regarding the CPITN, oral hygiene instruction (CPITN 1) was needed in 1.2% of the patient group and 23.3% of the control group, professional supragingival scaling (CPITN 2) in 18.5% of the patients and 43.2% of the controls, while non-surgical pocket therapy (CPITN 3) was needed in 45.7% of the patients and 20.9% of the controls. Surgical pocket therapy would have been necessary in 34.6% of the stroke patients and 4.7% of the controls. The periodontal treatment needs of the stroke patient subgroups can be seen in Table 3.

The Mühlemann index, indicating gingival bleeding, was significantly higher ($p < 0.001$) in the patient group than among controls (Table 2).

The prosthetic index (the percentage of restored missing teeth with pontics, implants, or artificial teeth of the removable prosthesis) per person was 0.35 ± 0.3 in the patient group and 0.44±0.31 in the control group, which was not a significant difference ($p = 0.06$).

Eighty-five fixed dental prostheses (FDP; crown, bridges, splints) were present in the patient group and approximately double (189) in the control group. Thirty-three stroke patients had 62 FDP, of which 230 were crowns and 117 pontics. In the control group, 62 patients had 145 FDP, of which 475 were crowns and 229 pontics. There was no FDP in group III at all. Mandibular removable dental prostheses were worn by 12 patients and 12 controls, whereas 17 and 10 individuals, respectively, had a maxillary removable dental prosthesis.

The number of acrylic-based removable dental prostheses was 30% in the patient and 22% in the control group. Precision attachments that would provide safer anchorage were found in only one case of the control group.

The number of complete dentures was 41% in the patient and 34% in the control group. According to the results of the questionnaire, patients had become edentulous significantly earlier than the control subjects ($p < 0.05$), since they had replaced their complete dentures significantly more often than had the control subjects. About 65% of the maxillary and mandibular dental arches were partially or completely edentulous in group III.

DISCUSSION

In the present study, 102 stroke patients were examined. In almost every respect, the oral health status of stroke patients was poorer than that of the 98 age- and sex-matched healthy control subjects from the general population (Table 2). Evaluation of the dental subgroups of stroke patients revealed the most severe findings in patients of group III. Thus, patients with impaired masticatory function exhibited a considerably worse oral health status compared to patients with only minor functional disabilities (group I).

CPITN scores of the subgroups showed that from the stroke group, no one had a CPITN score of 0, i.e. no one had a completely healthy periodontium. In subgroups II and III on the other hand, none of the subjects had a CPITN score of 1, and just 3.4% of the group II patients had CPITN 2, needing supragingival scaling and oral hygiene instructions. Patients having CPITN scores above 2 (69.5% in group I, 97.5% in group II, and 100% in group III) were in definite need of professional periodontal therapy, (non-surgical and surgical pocket treatment) to control the disease. For disabled patients with deep pockets (64% of the stroke group), improved supragingival oral hygiene provides only no or just minimal help. After professional pocket therapy in the maintenance phase, the use of special oral hygiene aids, e.g. electric toothbrush, will be of great benefit. In the sex- and age-matched healthy control group, only 26% of the subjects needed professional periodontal pocket therapy, which is a highly significant difference (Table 3).

Improving professional oral hygiene is emphasised, with the help of a special dental occupational therapist or caregiver,[2] in all study participants, but more urgently in the post-stroke subgroups II and III. Fullly automatic toothbrushes can clean the maxillary and mandibular teeth simultaneously. By fitting a clip on the prefabricated handle, a conventional toothbrush can be adapted to the reduced grip strength of a stroke patient.[14] Motivating patients of subgroup I to frequently visit the dentist is also necessary.

Cariological and periodontal parameters were significantly poorer in stroke patients and were interrelated. Deteriorating oral health status results from the combined effects of neglected oral hygiene as a consequence of post-stroke residual symptoms (e.g. hand paresis and mobility problems) as well as the risk factors leading to stroke (e.g. diabetes, smoking, faulty nutrition, stress).

Apart from the current study, controlled epidemiological studies investigating the general oral health of stroke patients influenced by the residual symptoms are lacking.[8] However, periodontal disease has been widely examined as a risk factor for ischemic stroke. Joshipura et al[8] suggested that chronic periodontal disease and tooth loss might be risk factors for ischemic stroke, while Desvarieux et al[5] investigated the relationship of periodontal disease and tooth loss with subclinical atherosclerosis.[5]

Limited data about tooth loss as an indicator for the risk of stroke did not show significant differences compared to healthy controls in a study by McMillan et al,[12] which was conducted in a rehabilitation unit 25 days after the stroke event ($p = 0.25$ for the overall DMFT score, and $p = 0.19$ for missing teeth). The patients involved were retirees who did not receive governmental social assistance. In our patients, the difference in DMFT scores between stroke patients and healthy controls was similar ($p = 0.2$), but each component was significantly worse $p = 0.01/0.005/0.001$, respectively, including the number of decayed teeth and the number of the remaining teeth. At the same time, based on a poor socioeconomic situation, the number of filled teeth was significantly lower in the stroke patients, and they also had fewer missing teeth replaced by any form of prosthesis, indicating inadequate restorative and prosthetic dental treatment. Any kind of difficulty (lack of compliance, communication problems) might inspire dentists to choose treatment options that are quick and simple, e.g. tooth extraction, foregoing more complicated procedures and yielding a higher edentulous rate.

A lower number of FDP and a higher number of removable and complete dentures (which more economical to prepare) support the observations described above. All the patients of group III wore removable dental prostheses. According to Liedberg et al,[11] this might result in a 'masticatory handicap', since the use of removable prostheses is accompanied by a reduced chewing ability as a consequence of the larger mucosal support and inferior stability compared to a fixed prosthesis. These patients choose soft foods, which contain more carbohydrates and fat, which might result in obesity. Complete denture wearers whose taste sensation is impaired might over-salt or over-sweeten their food, which can also be unhealthy.

Our observations were the result of a combination of several factors. The socioeconomic background of stroke patients tends to be worse, as a higher proportion of them live on a disability pension (37% as opposed to 2% of the control group) and have a considerably lower educational level as well ($p < 0.001$). A poor socioeconomic background is usually associated with unsatisfactory general and oral health, while dental care is only partially reimbursed by health insurance in Hungary. Hindrances in locomotion in addition might also explain the significantly lower frequency of dental visits, hence inadequate restorative care.

The poor oral health proven for stroke patients with more severe functional disabilities (chewing and biting difficulties) also validates our classification system with respect to dental risk factors and dental manageability. The practical consequence is that experts should provide dentists with special guidelines regarding the treatment of stroke patients. Group I patients, who have slight functional disabilities, do not have any special need. In group II, patients are not capable of adequate oral hygiene. In group III, dislodgement and aspiration of prostheses are sources of danger. Therefore, based on the authors' previous experience with epilepsy patients,[9] in these cases, it is suggested to design fixed dental prostheses or those that have both a fixed and a removable part. If removable dental prostheses are unavoidable, the authors suggest the use of precision attachments. The extraction of mobile teeth is important, just as the restoration of fractured and carious teeth.

CONCLUSION

Frequently, stroke patients do not recover completely from the different types and the severity of the disabilities of stroke. This and the further stroke risk factors significantly influence patients' oral health status. Restored oral conditions and reconstructed chewing abilities can promote healthy nutrition with well-proportioned intake of protein like meat as well as fats, carbohydrates, vitamins and minerals. The poor cariological and periodontal status of these patients emphasises the important role of careful oral health control.

Additionally, oral motor impairment can cause mastication and swallowing problems that necessitate those prosthetic treatment options that are more stable, and emphasise the importance of conservative dental treatment as opposed to tooth extractions.

It is important to mention that cooperation between the neurologist and the dentist should be encouraged to improve both the oral hygiene and nutritional status of stroke survivors.

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