# Dental status and oral health of patients with epilepsy: an epidemiological study

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**Abstract**

*Purpose*: We have performed a dental survey of epilepsy patients in order to examine their oral health by statistical means, and to provide a guide for the dental treatment of these patients.
*Methods*: We have first set up four 'dental' subgroups of epilepsy patients, based on the type of seizures, seizure frequency and mental state. 101 patients underwent a survey concerning their dental, medical and epilepsy history, which was followed by a dental examination. Indexes quantifying oral hygiene, the number and condition of the remaining teeth, periodontium and the degree of prosthetic treatment were measured. An age-matched control group of general (non-epileptic) population underwent an identical dental examination. Statistical comparison was performed between the patient and the control group and between subgroups of epilepsy patients.
*Results*: In almost all aspects of oral health and dental status, patients with epilepsy showed a significantly worse condition as compared with the control group. Comparison of the subgroups of epilepsy patients revealed that the most severe findings concern patients who have a poorly controlled epilepsy, especially those who have frequent generalised tonic-clonic seizures.
*Conclusions*: The observed difference is probably due to a combination of factors such as the effect of the seizures themselves, socio-economic reasons and the negative attitude of dentists. We recommend that the planning of dental treatment of such patients should start with the assessment of their disease and determination of the 'dental' subgroup they belong to. For each subgroup specific recommendations for interventions are given.

## Introduction

It is a general impression that patients with epilepsy tend to have poorer oral health and receive less adequate dental treatment in comparison to the general (non-epileptic) population.[1,2,3,4] We have set out to make a survey of oral health and dental status of patients with epilepsy in comparison with the non-epileptic population. In our knowledge, only one such survey has been published so far[3], which was however uncontrolled. Others concentrated on only the periodontal status in relation to antiepileptic medication.[5,6] Our aim was to test statistically whether these patients did indeed have a poorer oral health as compared with the non-epileptic population, and if yes to cast light on the possible reasons leading up to it and measures to be taken to avoid it. Oral health is an important aspect of quality of life and every effort should therefore be made to improve oral health, especially in a group of people already disadvantageously affected by their disease.

Epilepsy is a heterogeneous group of patients, comprising patients with a wide variety of etiology, seizure type, seizure frequency and mental symptoms. Therefore it seemed reasonable first to categorize patients from the point of view of dental risk factors and dental manageability, in order to be able to perform a valid assessment and comparison of their dental status. We have set up accordingly four 'dental' subgroups of epilepsy patients (*Table 1*), taking into account the type of seizures with special emphasis on the involvement of the masticatory apparatus, seizure frequency and patient compliance (mental state).[7] Our study also served to test the validity of this new classification.

## Patients and methods

The study was performed with the collaboration of the Dept. of Prosthetic Dentistry, Faculty of Dentistry and the Dept. of Neurology, Faculty of Medicine of the Semmelweis University in Budapest. Hundred and one non-selected epilepsy patients were entered into the study, who are in the regular care of the epilepsy out-patient unit of the Dept. of Neurology. All patients and control subjects gave informed consent. Data were collected by the same two investigators all throughout the study, the patient's neurologist (Zs.A) and the dentist (K.K.).

First, personal information and data pertaining to the epilepsy itself (including present and previous antiepileptic medication, type and frequency of seizures and psychiatric

symptoms) were collected and recorded on a questionnaire by the neurologist from the records of the patient and by questioning the patient. There were questions asking about any previous oral cavity injuries in connection with seizures and whether seizures affected the masticatory apparatus (clonisation of facial or masticatory muscles, oral automatisms, grinding of teeth etc.). The patient was placed by the neurologist into the appropriate 'dental' subgroup (*Table 1*). The patient was then handed over to the dentist, who first questioned him/her about general and dental health, medications other than antiepileptic drugs and oral hygiene (including frequency of visits to the dentist, frequency of tooth brushing) and about previous prosthetic treatments. Data were recorded on a questionnaire. The questionnaires were constructed in a way as to allow quantification and statistical analysis, i.e. numbers (codes) were assigned to the possible answers of all questions.

A dental examination then followed, performed under standard conditions in a dental chair with adequate light, using standard dental instruments. Criteria used for the diagnosis of oral disease were consistent with those recommended by the WHO.[8] Similarly to the questionnaires, all the data collected during the dental examination were recorded in numeric form on a prepared sheet. The examination included the following: *Oral hygiene* was assessed by inspecting the amount of dental plaque and calculus individually on each tooth. The amount of dental plaque and calculus was quantified separately by assigning numbers between 0 and 3 (0- none, 3- severe). The sum of these two numbers gives the *Greene-Vermillon Oral Hygiene Index*[9] of a tooth. The indexes of all the teeth was then averaged for the patient. The patient's *remaining teeth* were individually assessed and the number of *decayed, missing* and *filled* teeth was determined. The combination of these three give the *DMF-T Index*[8] of a patient, which of course has a maximum figure of 32. The degree of *abrasion* on the teeth was checked and recorded separately for the upper and lower dental arch: 1 meant no signs of abrasion, 2 superficial abrasion on several teeth and 3 severe abrasion, with enamel damage exposing the dentin. The *periodontal status* was assessed using a CPITN (Community Periodontal Index of Treatment Needs) probe. With the help of the probe the depth of the periodontal pocket was measured in mm at 3-3 points on both the oral and vestibular surface of the tooth. The *CPITN Index*[10,11] was determined as follows: 0- healthy gums, 1- no periodontal pockets but bleeding occurs upon probing, 2- presence of pockets no deeper than 3 mm, 3- pockets of 4-5 mm and 4- pockets deeper than 6

mm. One (the most severe) CPITN Index was recorded for each sextant and then averaged with the other sextants. The distance between the gingival edge and the cement-enamel border was also measured at the 6 points of probing. This distance is 'positive' if the gingival edge doesn't reach the cement-enamel border (gingival recession), or 'negative' if it reaches above this border (gingival hypertrophy). *Loss of gingival attachment* of a tooth was calculated by adding the depth of periodontal pocket and the distance between the gingival edge and the cement-enamel border. This number was averaged for one tooth, then for all the teeth. The degree of gingival bleeding provoked by periodontal probing was recorded separately as well. The severity of bleeding ranged from 0 to 4. One number was recorded for each tooth, which is called the *Mühlemann Index*[12], and the indexes of all the teeth were then averaged. The number and type of *prosthetic appliances* (fixed crowns or bridge works, removable partial or complete dentures) were recorded, including their material and means of fixation and splinting. The ratio of artificial and missing teeth was determined, expressed as the *Prosthetic Index*. The index in ideal case is 1 when all missing teeth are replaced by some form of prosthetics. Finally, stomatooncological examination was performed on each patient.

A dental examination identical to the one described above was performed by the same dentist on the age-matched control group. All control subjects were recruited at a community pulmonary X-ray screening station.

Statistical analysis was performed by SAS 8.2 for Windows software. Group means and standard deviations were calculated. Age groups of epilepsy patients and control subjects were compared using the Wilcoxon signed rank test. Comparison of abrasion was done using the chi square statistic. All the other indexes describing oral health (Greene-Vermillon Oral Hygiene Index, DMF-T Index etc.) were compared using the SAS General Linear Model (modified two-tailed t-test). Statistical significance was set at $p<0.05$.

**Results**

The age distribution of the patient and control group is presented in *Figure 1*. The average age of the patient and control group did not differ significantly ($p=0.8$). The 'dental' subgroups of epilepsy patients were as follows: 67.3% were in Group I, 7%

in Group II, 26% in Group III. There were no patients qualifying for Group IV, as these patients were not entered into the study because of lack of cooperation. The average age in the three patient groups did not differ significantly from each other (p=0.67).

51% of epilepsy patients were active workers, whereas 74% were active in the control group (p=0.03). 25% of epilepsy patients and 13% of the control group were on invalid pension. The latter figure showed no difference in the three subgroups of epilepsy patients, with 24%, 29% and 27% for Group I, II, III respectively.

Concerning antiepileptic medication at the time of the study, 50% of patients received valproate (2/3 of them in combination with other antiepileptic drugs), 41% carbamazepine (half of them in combination). 17% received lamotrigine, 5% primidone, 5% phenobarbital, 2% gabapentin, 7% clobasam and 2% clonazepam. With the exception of lamotrigine, these medications were always taken in combination. At the time of the study only one patient was on phenytoin; 35 patients had been taking phenytoin previously, but they were off the medication for more than one year.

17% of epilepsy patients visit the dentist on a regular basis (every 6-12 months), whereas this figure is 37% for the control group. The difference is significant (p<0.001).

*Oral hygiene*, as assessed by the *Greene-Vermillon Oral Hygiene Index* was similar in the patient (3.18±1.45) and the control (2.81±1.4) group. However, when only Group III of epilepsy patients (3.72±0.94) was compared with the control group, the difference reached significance (p=0.033).

The indexes assessing the state of *remaining teeth* and *periodontium* were as follows: The *DMF-T Index* is seen in *Figure 2*. The index is significantly higher in the patient group (p<0.001). Likewise it was significantly higher in Group III as compared with Group I (p=0.04). The three components that make up the DMF-T Index were as follows: The number of *decayed* teeth (untreated caries) was 6.37±4.37 in the epilepsy and 3.71±3.53 in the control group (p<0.001). The number of *missing* teeth was 9.46± 9.38 in the epilepsy and 6.63±7.89 in the control group (p=0.021). The number of *filled* teeth (treated caries) was 1.69±2.57 in the epilepsy and 3.37± 3.75 in the control group (p=0.021). Thus the number of decayed and missing teeth was significantly higher, but

the number of treated (filled) teeth was significantly lower in the epilepsy group than in the control group. Concerning *abrasion* of the teeth, it was demonstrated that abrasion of the lower dental arch was significantly more pronounced in Group III as compared with Group I ($p=0.015$). In Group III all patients had abrasion. When the whole patient group was compared with the control group, the difference was no longer significant ($p=0.25$). Abrasion of the upper dental arch showed no significant difference. The *CPITN Index* showed no significant difference neither between the epilepsy ($2.6\pm0.69$) and control group ($2.4\pm0.76$), nor among the patient subgroups. However, *loss of gingival attachment* was significantly more pronounced ($p=0.008$) in the patient group ($2.0\pm1.53$), as compared with the control group ($1.47\pm1.11$). When Group II and III were compared separately with the control group, the level of significance reached $p<0.001$. The loss of gingival attachment is more sensitive than the CPITN Index, because it averages the values of all teeth, not just one value from each sextant. *Gingival hypertrophy* was not observed in any one patient. The *Mühlemann Index*, indicating gingival bleeding, is shown in *Figure 3*. It was significantly higher in the patient than in the control group ($p<0.001$). The Mühlemann Index was the highest in Group III.

The *Prosthetic Index* (*Fig. 4*) was significantly lower in the patient than in the control group ($p<0.001$). The index was the lowest in Group III.

**Discussion**

Hundred and one epilepsy patients were altogether examined. The distribution of patients in the 'dental' subgroups, with 67% belonging to Group I of well controlled patients, and 33% to Group II and III of patients with frequent seizures, is well in line with the general experience that about 70% of epilepsy patients can be adequately controlled with antiepileptic medication. Patients with severe mental handicaps belonging to Group IV were not included in the study, as a precise dental survey would have been difficult if not impossible to carry out in these patients. Nonetheless from the point of view of dental manageability they constitute a separate group, with special needs during dental treatment.

We have shown with statistical means that in almost all aspects of oral health and dental status (i.e. the state of remaining teeth and periodontium, extent of restorative and

prosthetic treatment) patients with epilepsy show a significantly worse condition as compared with an age-matched group of general (non-epileptic) population. Comparison of the 'dental' subgroups of epilepsy patients, as set up according to our classification system based on theoretical considerations of dental risk factors and dental manageability, revealed that the most severe findings concern patients of Group III. In some aspects (oral hygiene and abrasion) where there was no significant difference between the epilepsy and the control group, statistical significance was reached when Group III was compared separately with the control subjects. In other words, patients who have a poorly controlled epilepsy with frequent generalised tonic-clonic seizures exhibit worse oral health in comparison with patients who are better controlled and/or have only seizures that do not involve the masticatory apparatus, and in comparison with the non-epileptic, general population.

The number of decayed and missing teeth (missing as a result of decay, injury or periodontal disease), the degree of abrasion and the indexes that describe periodontal condition, all of which are significantly worse in epilepsy patients, are related to each other. They are the consequence of the combined effect of neglected oral hygiene, oral cavity injuries and increased exertion on the teeth. Furthermore, epilepsy patients have significantly fewer teeth filled and significantly fewer missing teeth replaced by some form of prosthetics, indicating inadequate restorative and prosthetic dental treatment. These observations are probably the result of a combination of factors. The socio-economic background of epilepsy patients, especially those who are poorly controlled, tends to be worse, as a higher proportion of them live on pension for the disabled (25% as opposed to 13% of the control group). These figures, however, don't reflect true disability of epilepsy patients, but rather the difficulty of these patients to find employment. They all too often encounter prejudice and fear in connection with their condition when attempting to obtain employment. A poor socio-economic background is usually associated with unsatisfactory general and oral health. It might also explain the significantly lower frequency of dental visits, hence inadequate restorative and prosthetic care. Dental care is only partially reimbursed by health insurance in Hungary. Furthermore, the negative attitude of dentists themselves can be a restraining factor in providing appropriate dental treatment. Dentists are likely to consider the treatment of these patients as more cumbersome and tend to choose treatment options that are quick and simple, such as tooth extraction, foregoing more complicated procedures. Such an

attitude results in an early edentulous state, which adds to the difficulties of patients living with epilepsy. Inadequate knowledge about the disease and the fear of seizures occurring during treatment are possible causes of this attitude. While possible, a seizure in the dental chair is actually a rather unlikely event, we have not once encountered seizures during dental examination throughout the study. Finally, generalised tonic-clonic seizures very often cause minor oral cavity injuries, such as biting of the tongue or other areas of the oral mucosa[13], but also frequently lead to injuries of the teeth. In the study of Buck et al., 28 out of 344 epilepsy patients had seizure related tooth injuries within the time of one year.[14] These might occur as a result of the fall or of the forceful contraction of the masticatory muscles both during the tonic and clonic phase. Thus the exertion and risk of injury of the teeth of patients with frequent generalised tonic-clonic seizures (Group III) is very much increased, contributing to the observed poor dental status.

Controlled epidemiological studies investigating general oral health of epilepsy patients, apart from ours, are lacking. However periodontal condition, more specifically gingival overgrowth has been widely examined, as the best known dental complication related to epilepsy is phenytoin induced gingival hypertrophy.[5,6,15,16] About half of the patients on phenytoin will develop gingival hypertrophy within 1-2 years after initiation of treatment. However nowadays phenytoin has been replaced by drugs equally effective but with fewer side effects, such as carbamazepine and valproate. Indeed only one patient out of the 101 entered into our study was still on phenytoin, and not surprisingly gingival hypertrophy was not once observed among our patients. 35 patients had been taking phenytoin previously, but as gingival hypertrophy recedes within months after withdrawal of the medication[17], its effect was no longer to be seen. Antiepileptic medications currently in use have negligible effects on oral health. Xerostomia and stomatitis have been rarely reported as side effects of carbamazepine[2], but we have not observed it in any one patient out of the 41 on carbamazepine therapy. It is unlikely that the inferior periodontal condition of epilepsy patients observed in our study is related to the antiepileptic medication. These indexes showed connection with 'dental' subgroups, hence severity of the disease, but the types and proportion of medications was similar in all groups. Dahllof et al.[6] compared patients taking phenytoin and carbamazepine and found periodontal complications in only the phenytoin group.

The demonstration of poorer oral health of patients with poorly controlled epilepsy (in Group III) also serves to validate our classification of epilepsy patients with respect to dental risk factors and dental manageability. The practical consequence of such a classification is to provide a guide in the treatment of patients with epilepsy. Group I patients, in whom the disease doesn't or little affects their dental status, do not have any special needs, indeed it is encouraged that they should receive dental treatment as any other patient. In Group II, a slightly increased exertion is expected on the teeth. Thus for the restorative treatment of teeth, it is recommended to use materials that resist abrasion and injuries better, such as amalgam filling. Replacements of edges, use if ceramic inlays are best avoided. In Group III, exertion on the teeth and the likelihood of injury is greatly increased, fracture of teeth and prosthodontics, their dislodgement and aspiration is a danger[18]. Therefore in these patients, in addition to the considerations mentioned with Group II, special care is needed when designing prosthetic appliances. As a general rule, fixed prosthetics are recommended to avoid dislodgement during seizure. Bridgeworks should have more anchorage than usual. If partial removable dentures are not avoidable, they should be anchored with precisional attachments rather than with clips. In case complete dentures are needed, acrylate plates are absolutely discouraged, as these can easily break, metal plates are the appropriate choice in these patients. Treating patients in Group IV is a challenge to the dentist, however they comprise only a fraction of epilepsy patients. These are patients with mental disabilities, not necessarily in connection with epilepsy but also other neurological disorders. They are uncooperative and their oral hygiene is usually inadequate. In most cases general anesthesia is necessitated to carry out any interventions and esthetic considerations are forsaken for quick and simple procedures.

Limited recommendations concerning the dental treatment of epilepsy patients have been previously published[17,19,20,21,22], however it follows from our classification that patients should be handled differentially, depending on the characteristics of their disease. It must also be stressed that the majority of patients living with epilepsy can and should receive dental treatment without restrictions and be provided with functionally and esthetically adequate dental care.

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**Table 1.** Classification of epilepsy patients according to dental risk factors and dental manageability.

| | **Criteria of entrance** |
|---|---|
| **Group I** | – Patients who have been seizure free for years, either with or without medication<br>– Patients with rare seizures (less often than once a year)<br>– Patients exclusively with seizures that do not involve the masticatory apparatus (absence, myoclonus and certain partial seizures) |
| **Group II** | – Patients with frequent partial seizures involving the masticatory apparatus, such that are accompanied by clonisation of facial and masticatory muscles or oral automatisms (e.g. grinding of teeth). Generalised tonic-clonic seizures, if present, appear less often than once a year |
| **Group III** | – Patients with frequent generalised tonic-clonic seizures (more often than once a year) |
| **Group IV** | – Patients with mental disability, excluding compliance during dental treatment |

**Figure legends**

**Figure 1**

**Age distribution** of the patient and the control group.

**Figure 2**

**DMF-T Index** of the patient and the control group. "Number of teeth" refers to the number of teeth decayed, missing or filled. The patient group is presented first as a whole, then the 'dental' subgroups separately. Numbers represent group means and vertical lines standard deviation. Note that the index is significantly higher in the patient group. The separate analysis of the three components of the index (not shown in the figure) reveals that the number of decayed and missing teeth is significantly higher, the number of filled teeth is significantly lower in the patient than in the control group.

**Figure 3**

**Mühlemann Index** of the patient and the control group. This index shows the degree of gingival bleeding, indicative of periodontal disease. The patient group is presented first as a whole, then the 'dental' subgroups separately. Numbers represent group means and vertical lines standard deviation. Note that the index is significantly higher in the patient group.

**Figure 4**

**Prosthetic Index** of the patient and the control group. The index in ideal case is 1, when all missing teeth are replaced. The patient group is presented first as a whole, then the 'dental' subgroups separately. Numbers represent group means and vertical lines standard deviation. Note that the index is significantly lower in the patient group.

**Figure 1**

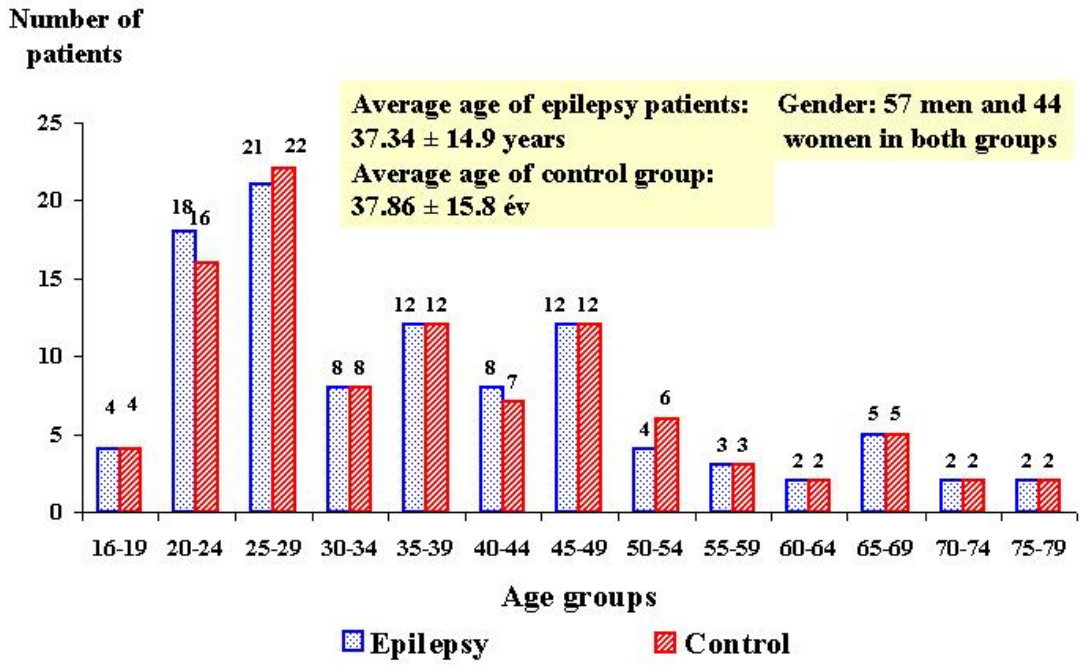

Number of patients
Average age of epilepsy patients: 37.34 ± 14.9 years
Average age of control group: 37.86 ± 15.8 év
Gender: 57 men and 44 women in both groups
25
20
15
10
5
0
4 4
18 16
21 22
8 8
12 12
8 7
12 12
4 6
3 3
2 2
5 5
2 2
2 2
16-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
Age groups
Epilepsy
Control

**Figure 2**

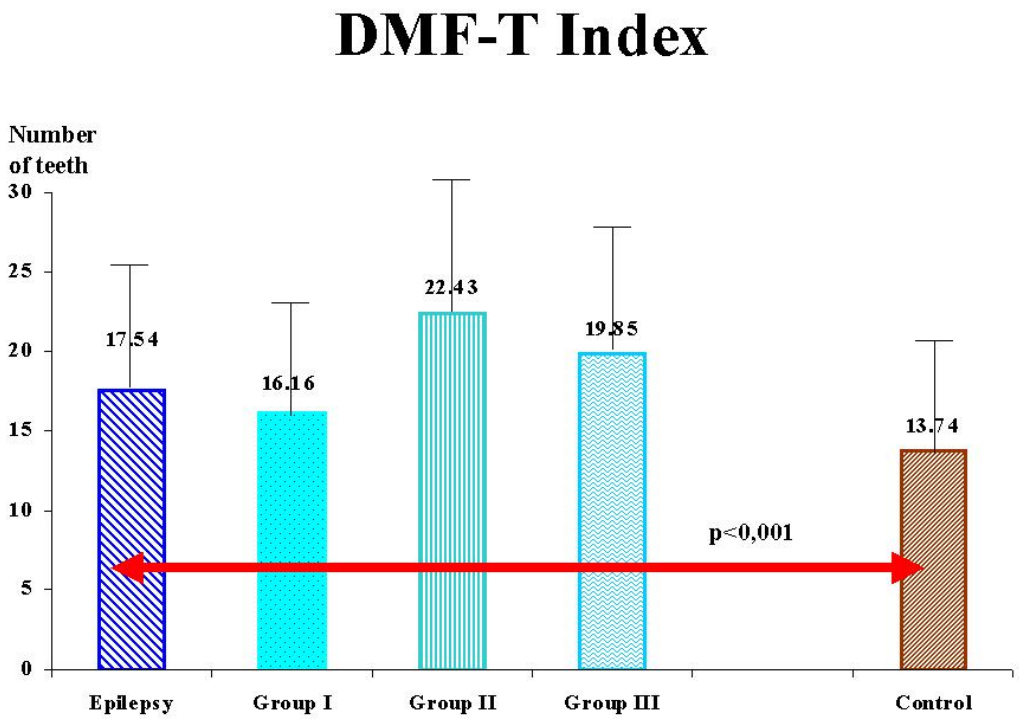

DMF-T Index
Number of teeth
30
25
20
15
10
5
0
17.54
16.16
22.43
19.85
13.74
p<0,001
Epilepsy
Group I
Group II
Group III
Control

**Figure 3**

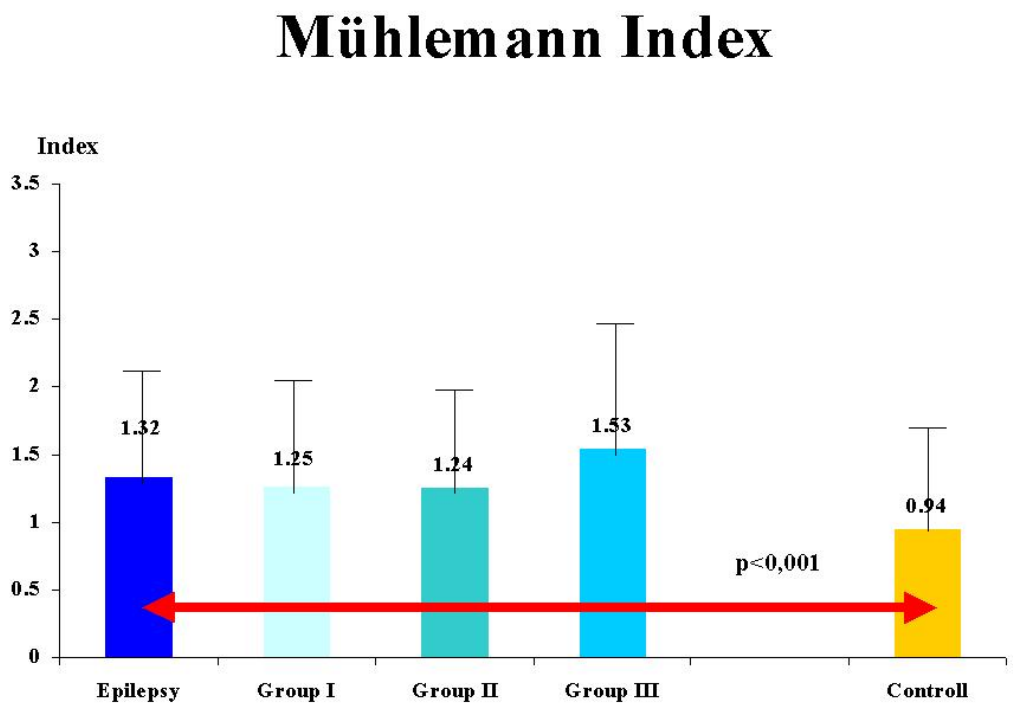
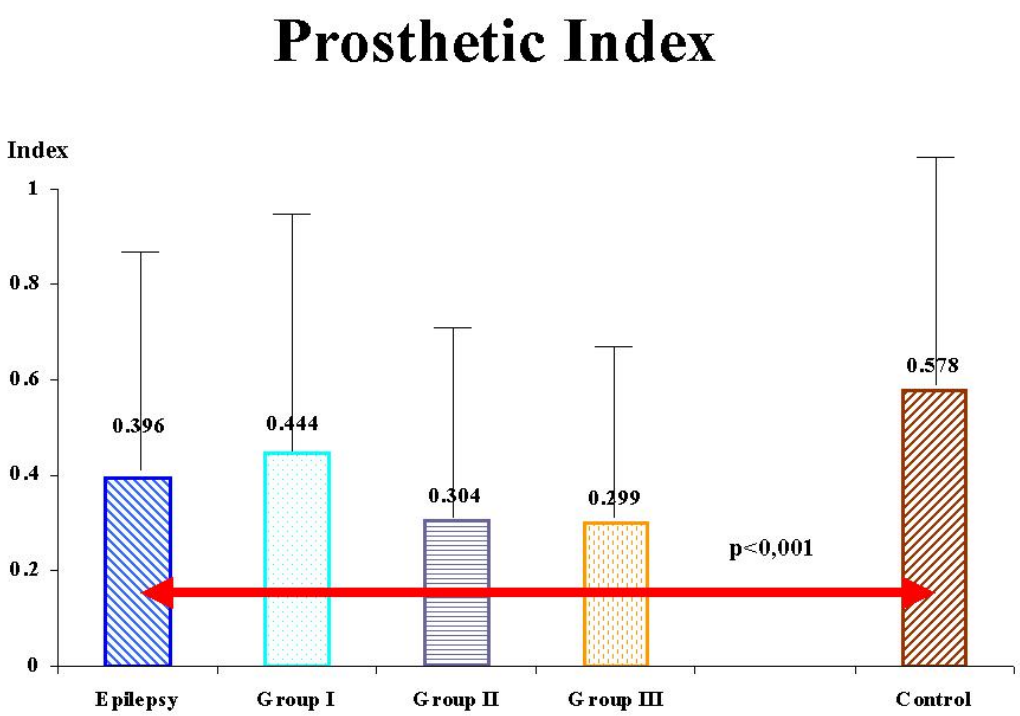

Mühlemann Index
Index
3.5
3
2.5
2
1.5
1
0.5
0
1.32
1.25
1.24
1.53
0.94
p<0,001
Epilepsy
Group I
Group II
Group III
Controll

**Figure 4**


Prosthetic Index
Index
1
0.8
0.6
0.4
0.2
0
0.396
0.444
0.304
0.299
0.578
p<0,001
Epilepsy
Group I
Group II
Group III
Control