

## Imaging of periodontal disease in patients with ischemic stroke

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### Abstract

*Objectives:* Links between periodontal diseases and systemic diseases have been well documented by epidemiological studies. Cardiovascular diseases are one of the main causes of morbidity and mortality in the European countries, including Romania. One focus of interest is atherosclerosis, the underlying event of cardiovascular diseases due to its serious health impact. The aim of this study was to analyze a possible association between ischemic stroke and periodontitis by marginal bone loss assessment on panoramic radiography (PR), Dental CT or CBCT.

*Material and methods:* 103 patients, 28 to 50 years old, with recent history of ischemic stroke or transient ischemic attack diagnosed by specialist doctors (neurologists) were selected. Several parameters were evaluated in first five days in the dental office according to the health questionnaire and the recommended blood tests (cholesterol, triglycerides, complete hemoleucogram, C-reactive protein etc.). The same examiner and also two radiologist assessed the odontal and periodontal status of each patient on the PR, Dental CT or CBCT. We analyzed irredeemable teeth,

periapical lesions, interradicular lesions, 4-5mm bone loss from the enamel-cement junction (ECJ) and >6mm bone loss from the enamel-cement junction (ECJ).

*Results:* The study group analyzed by PR, Dental CT or CBCT presented high percents of irredeemable teeth (12%), teeth with periapical lesions (>3 mm; 3%), interradicular lesions (10%), 4-5 mm proximal bone loss (11%) and >6 mm bone loss (19%) associated with different localization of ischemic stroke.

*Conclusions:* The present study confirms the existence of correlations between endodontic infections, periodontal infections demonstrated by panoramic radiography, CT/CBCT and ischemic stroke.

**Keywords:** ischemic stroke, periodontal disease

### Introduction

Cerebrovascular disease presently affects even the young people. Annual incidence for stroke in adults under 55 is of 34/100000 in Sweden, 10/100000 in Mayo Clinic for women ages 15 to 29 and about 10/100 000 in United Kingdom (4). Some West-European studies have shown incidence rates up to three times higher (5).

Differential diagnosis for the evaluation of stroke potential etiologies in young adults is more extensive compared to older patients, even if the symptoms as well as the clinical management are similar. Principal causes are cardioembolism, nonatherosclerotic arteriopathies, drug abuse, hematological disorders, trauma, arterial dissection, oral contraceptives use, pregnancy, postpartum states, migraine and also atherosclerosis. This is an important risk factor for atherothrombotic stroke in young adults. Premature ATS is present in 2% of young adults aged from 15 to 30 and in 30-35% of those aged from 30 to 45 (1)(2). Traditional risk factors such as hypertension, smoking, hyperlipidemia, diabetes mellitus are associated with stroke in young patients, but there are also some uncommon etiologies also. These refer to homocystinuria, folic acid or pyridoxin deficits, hypercoagulable states etc. The correlation between poor oral hygiene and cardiovascular disease have been studied since 1980. Studies on this issue were started again in 2000. The only study done in Romania was a retrospective one, performed by Wolf and col. Authors found that in subjects with clinical and /or subclinical atherosclerosis, periodontal indexes are changed statistically significant compared with control group. Their study reveals an association of ATS with periodontal disease, the latter proving to be in this case a risk factor for ATS (8).

The aim of our study was to analyze by a prospective study a possible association between recent ischemic stroke and periodontitis by marginal bone loss assessment on a panoramic radiography (PR), Dental Computer tomography (Dental CT) and Cone Beam CT (CBCT) in the North East Romanian population.

## Material and methods

We realized a prospective study on a total of 103 patients, 28 to 48 years old, with history of ischemic stroke (50 patients) or transient ischemic attack (53 patients) selected from patients admitted for neurological treatment during 2009 - 2011 in the Neurology Department of Emergency Hospital "Prof. N. Oblu" Iași. All patients were evaluated by neurologist, radiologist using cerebrovascular CT scan followed by a clinical evaluation of two periodontologists and by dental imaging exams (PR, Dental CT or CBCT). We grouped the patients into the following age groups: from 20 years old to 30 years old, from 30 years old to 40 years old and from 40 years old to 50 years old. We also divided the subjects with ischemic stroke in different cerebrovascular regions into 3 groups comprising: first group with periodontitis and panoramic radiography exams (n=73 patients), second group with periodontitis and Dental CT scan (n= 25 patients) and the last group with periodontitis and CBCT exams (n=5 patients). All patients agreed the procedure by signing a consent regarding the neurological treatment, the radiological exams and the periodontologic evaluation considered: plaque index, irremediable teeth, periapical lesions, interradicular lesions, probing pocket depth, clinical attachment loss and missing teeth. The distance between bone loss from the enamel-cement junction, and number of missing teeth were studied by two experienced radiologist (DH) and (MH) using the radiological exams realized by a spiral CT scan (Siemens Emotion using 1mm axial acquisition protocol, with Dental scan software with panoramic and paraxial reconstructions, and same parameters:

120Kv, 80mAs), a panoramic scan (Siemens Ortophos Plus 90 Kv and 60 mAs) and a Cone Beam CT (New Tom 3G: 80 KV and 15mAs). All patients received a questionnaire with by self-modality of perceiving oral health status (dental health, non-treated caries, extracted teeth, satisfaction by appearance of own teeth, dental pain, gingival condition, gum bleeding) and also oral health habits (toothbrushing, flossing, mouthrinse frequency, dental visiting).

### Results

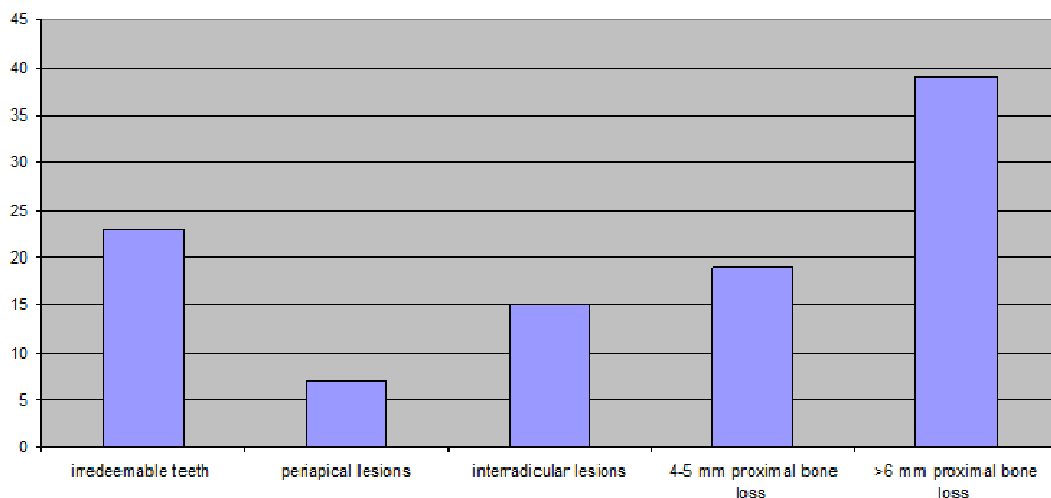
Regarding the distribution of subjects based on the age group and the prevalence area, subjects who came from urban areas were majority (73 cases) that from the rural areas (30 cases). There were majority smokers among the examined subjects (86 cases), without significant difference between female and men. There were a majority transient ischemic attack (33 cases) and also ischemic stroke (25 cases) in the three age groups (from 40 years old to 50

years old), without important significant difference between female and men (31 female and 28 men). There were significant differences between female and men in distribution of the cases in the second age group from 30 years old to 40 years old, with majority of transient ischemic attack (30 cases) and ischemic stroke (21 cases) to the women (33 female and 18 men) with interesting history of smoking and contraceptive administration for twelve women of this group. In the first age group (4 patients) there were three women also with interesting history of smoking and contraceptive administration and only one man with unknown high serum cholesterol level and periodontal lesions.

From the 2937 teeth we analyzed on the panoramic radiography 12% irredeemable teeth, 3% periapical lesions, 10% interradicular lesions, 11% cases with 4-5 mm bone loss from the enamel-cement junction (ECJ), and 19% with more than 6mm bone loss from the enamel-cement junction (Table 1).

**TABLE 1**

**Percent of periapical and periodontal lesions visible on the panoramic radiography**





**Figure 1** NECT in a 49 years old patient presented with high density in the left proximal middle cerebral artery and acute infarction with loss off the definition of gray-with bourders

There were a great numbers of extracted teeth or non- treated caries associated with sever periodontal lesions in the three age groups with ischemic stroke (from 40 years old to 50 years old). We present a significant imaging case from this lot of patients.

A 49 year old man presented to the emergency room 1 hour after collapsing at his dining table, becoming weak on the right side, and speechless. The computed tomography (CT) of the head without contrast shows a hyperdense left middle cerebral artery (MCA) and a hypodensity in the left temporal lobe with blurring the cortical ribbon and loss of definition of gray- with borders, signs with are a consistent with an acute infarction in the MCA (Figure 1).

The patient present a long history of extracted teeth in the premolar and molars area, non-treated caries and a sever paeriodontal disease with horizontal and vertical bone loss very all vizable on the panoramic examen (Figure 2) with furcation involent readily viewed on the apex of 26 and 48.



**Figure 2** Panoramic radiography to a 34 year old patient presents with aggressive marginal periodontitis with periodontal ligaments destroyed around the apex of 25, 26 and 28

Clinically pocket depths and attachment loss are greater than 6 mm around 28 and the furcation involvement and mobility of 26 and 28 are more severe.

For the second group of patient age with ischemic stroke the dental imaging characteristics were progressive marginal periodontitis with horizontal and vertical damage around the premolar apex and missing posterior teeth like in this 34 year old patient (Figure 3).

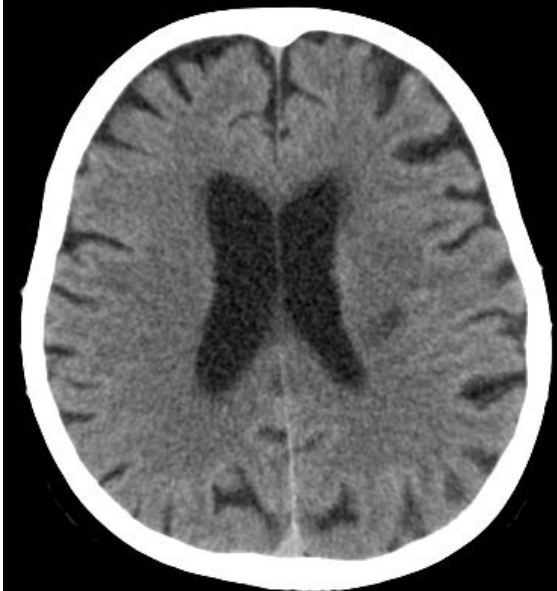
This woman is presented to the emergency room 2 hours after collapsing at his kitchen room. The computed tomography (CT) of the head without contrast shows a small hypodensity in the left centrum semiovale near the left lateral ventricle characteristically for an acute small ischemic stroke (Figure 4). This patient presents a long history of contraceptive pills and was a smoker without hypertensive history.



**Figure 3** Panoramic radiography to a 34 year old patient presents progressive marginal periodontitis with horizontal and vertical severe damage around the tooth apex 35



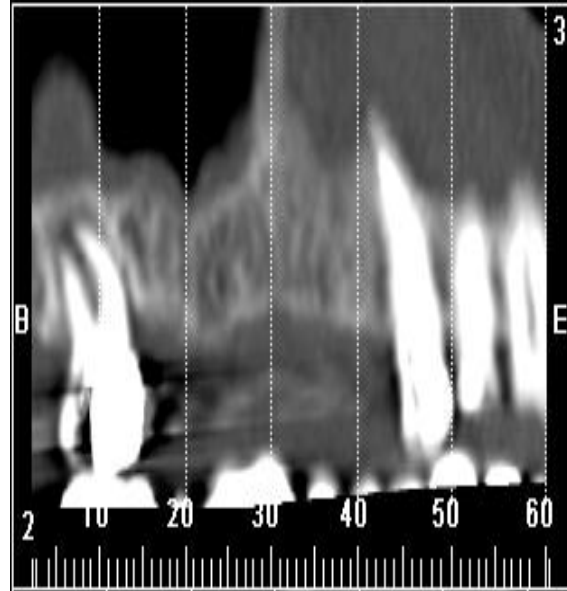
**Figure 5** Panoramic radiography to a 29 year old patient with severe marginal periodontitis with horizontal and vertical severe defects in tooth roots around 16,17,24,25 and 47, with have the appearance of "floating teeth"



**Figure 4** NCCT to a 34 year old patient with progressive marginal periodontitis and acute small ischemic stroke in the left centrum semiovale



**Figure 6** NECT to a 29 year old patient with progressive marginal periodontitis and presented after six our, with debut of right arm hypoesthesia and lacunar infarction in the left internal capsula



**Figure 7** Dental CT exam with right lateral and posterior paraxial reconstruction showed the furcation area of the maxillary second molar associated with vertical bone loss



**Figure 8** Cone Beam CT examination with good visibility of vestibular and horizontal bone loses in right posterior mandibular area, very well visible with the very small oblique longitudinal reconstruction on the marginal bone loss

In the fist group of patient age withe ischemic stroke we are four smokers, three women and one 29 years old man with a long history of dentals lesions.

The panoramic radiography proved a severe marginal periodontitis with horizontal and vertical severe defects in tooth root remains around the 16, 17, 24, 25 and 47 which have the appearance of "floating teeth" (Figure 5). Because he is presented to the emergency room 6 hours after right arm hypoesthesia the CT scan proved a small milimetric hypodensity in the left anterior arm of the left internal capsula (Figure 6). The biological exams proved also unknown high serum cholesterol level.

All the transient ischemic attack younger patients present different aspect of progressive marginal periodontitis with clinical attachment loss, moderate horizontal or vertical bone loss visible in the panoramic radiography but better analyses with computed tomography (CT) examination and with dental CT reconstruction in the paraxial plane (Figure 7). In our study a small number of transient ischemic attack younger patients with periodontal diseases were the financial possibility to have a Cone Beam CT examination with a very good visibility of unwound furcation lesion in the maxillary area very well visible with the very small oblique longitudinal reconstruction on the marginal bone loss (Figure 8).

### Discussions

The great heterogeneity between studies in assessment of oral disease make comparison of results difficult. There are controversies and debate on the correlation still persist. A contributing factor for this issue is the lack of an internationally accepted and standardized protocol for the assessment of oral health. Results from various studies suggest the utility for some parameters, which should be tested in young

patient with ischemic stroke: the number of teeth with periodontal pockets ( $PD > 3\text{mm}$ ), the total number of lost teeth, gingival bleeding index, oral hygiene index, cavity intensity index (8). Our analyses show that the proximal bone loss evaluated on panoramic radiography (PR), Dental CT or CBCT of the patient with transient ischemic attack or ischemic stroke is higher in the lateral areas (premolar-molars) compared to the anterior areas (incisive – canines). Some studies suggest that baseline periodontal disease and tooth loss may be associated with an increased risk of ischemic stroke (2), like in our ischemic patients. A report from the National Health and Nutrition Examination Survey (3) found an association between periodontal disease and increased risk of ischemic stroke compared with persons with no periodontitis, gingivitis, or tooth loss. Our statistical data base confirms the existence of correlations between endodontic infections, periodontal infections and cerebrovascular accidents; idea supported by A.R. Pradeep (7) and Pekka Ylostalo (6). We also found the same association between periodontal disease and the posterior tooth loss so baseline tooth loss was significantly associated with ischemic stroke, whereas recent tooth loss showed little association. For this reason periodontal examination and treatment should be part of the overall treatment of patients with transient ischemic attack or ischemic stroke.

### Conclusion

The present study confirms the existence of correlations between endodontic infections, periodontal infections demonstrated by panoramic radiography, CT/CBCT and ischemic

stroke. Testing the correlation between periodontal disease and ATS is very important because reversal of the periodontal disease might prevent atherosclerotic events. Interventional randomized clinical trials to test the effect of periodontal treatment on ATS are needed.

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### **References**

1. Bogousslavsky J., Regli F., Ischemic stroke in adults younger than 30 years of age. *Arch Neurol* 1987; 44: 479-82.
2. Carolei A., Marini C., Ferranti E., Frontoni M., Prencipe M., Fieschi C. and the National Research Council Study Group. A prospective study of cerebral ischaemia in the young: analysis of pathogenic determinants. *Stroke* 1993; 24:362-7.
3. Joshipura K.J., Hung H.C., Rimm E.B., Periodontal disease, tooth loss, and incidence of ischemic stroke. *Stroke*. 2003; 34: 47-52.
4. Marcoux M., Stroke in Young adults, *Stroke*, vol 11, No 2.
5. Martin P.J., Enevoldson T.P., Causes of Ischemic Stroke in the young, *Postgrad Med* 1997; 73; 18-6.
6. Pekka Ylostalo, Sirpa Antilla, Ulla Rajala, Markku Paivnsalo, Sirkka Keinanen Kiukaanniemi, Tero Sakki and Matti Knuutila, Periodontal infection and subclinical atherosclerosis: the role of high-density lipoprotein as modifying factor, *J. Clin. Periodontol* 2010; 37: 617-624.
7. Pradeep A.R., Hadge P., Arjun Raju P., Shetty S.R., Shareef K., Gurupsasad C.N., Periodontitis as a risk factor for cerebrovascular accidents: a case – control study in the Indian population, *J Periodont Res* 2010;45:223-228.
8. Wolf A.R., Bogdan M., Avram R., Clinical Correlations between periodontal disease and atherosclerosis, *Journal of Experimental Medical & Surgical Research*, Year XVII • Nr.4/2010; 295 - 304.
9. Wu T., Trevisan M., Genco R.J., Dorn J.P., Falkner K.L., Sempos C.T., Periodontal disease and risk of cerebrovascular disease: the first national health and nutrition examination survey and its follow-up study. *Arch Int Med*. 2000;160:2749–2755.