Significance of Calcifications in Projection of Carotid Arteries on Orthopantomography for Detection of Carotid Artery Stenosis

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Abstract
Introduction: Orthopantomography is amongst the most commonly used dental imaging modalities. Calcifications in the projection of carotids on orthopantomographs are found in 3-15% of general population and commonly represent calcified atherosclerotic plaques. Carotid atherosclerotic changes are one of the most frequent causes of stroke, which is the second most common cause of death and the leading cause of disability globally. Our aim was to determine the relationship between calcifications in the projection of carotids on orthopantomographs, carotid stenosis and stroke, and the correlation between stroke risk factors, calcifications on orthopantomographs and the degree of carotid stenosis.

Materials and methods: Doppler ultrasound and brain MRI were performed in 41 patients with unilateral or bilateral calcifications on orthopantomographs. Anamnestic data relevant to stroke risk were gathered. Results: Significant stenosis >50% was found in almost 15% of our patients. There was a significant correlation between hypertension and carotid calcifications. No statistically significant correlation between calcifications and significant stenosis was found. Patients with previous stroke were approximately 5 years older than those without stroke. Conclusion: Preliminary results show no statistically significant correlation between calcifications on orthopantomographs and significant carotid stenosis, but further investigation is needed.

Introduction
Stroke is the second most common cause of death and the leading cause of adult disability worldwide. In 2019, there have been 12.2 million strokes and 6.5 million stroke-related deaths globally (1,2). There are 1.1 million strokes and consequently 440,000 deaths in the European Union annually (3).

Atherosclerotic changes of extracranial arteries, especially carotids, are one of the most common causes of stroke. They are associated with clot formation at the site of a plaque or, more commonly, with the embolization distally, and
therefore responsible for approximately 50% of all ischemic strokes (4). The most important risk factors for atherosclerosis are age, male sex, hypertension, dyslipidemia, diabetes mellitus, high body mass index (BMI), metabolic syndrome, previous cardiovascular and cerebrovascular diseases, hypercoagulative state, physical inactivity and smoking (5,6). Atherosclerotic changes of carotids are most commonly found at the bifurcation and in the proximal 1-2cm of the internal carotid artery (7,8). The plaques can calcify and thus can be seen radiographically.

Orthopantomography (OPG) is one of the most frequently used X-ray imaging methods in dental medicine. Due to its large field of view, the most susceptible area for carotid atherosclerotic plaques is shown on most OPGs. Calcified plaques are usually seen as one or more nodular, verticolinear or irregular mineral opacities, 1.5cm inferior and 2.5cm posterior to mandibular angle, at the level of C3 and C4 vertebra, unilaterally or bilaterally (8,9). They should radiomorphologically be differentiated from the hyoid bone, styloid process, thyroid cartilage, epiglottis, stylohyoid and styломandibular ligament calcifications, tonsilloliths, sialoliths, calcified lymph nodes, and especially the trichilem cartilage (8-14). The prevalence of calcifications in the projection of carotids on OPGs ranges from 3-15% in general population (4,8,12,15,16), but it is higher in diabetics, persons with metabolic syndrome (11,17), in physically inactive individuals (18) and smokers (18,19).

Color Doppler ultrasound (CD-US) is considered to be the method of choice for diagnosing carotid artery atherosclerotic changes, and determining their degree of stenosis by numerous authors (4,5,16,19), due to its high sensitivity and specificity (98%, respectively 88% for PSV (peak systolic velocity) ≥ 130cm/s and stenosis ≥ 50%, and 90%, respectively 94% for PSV ≥ 200cm/s and stenosis ≥ 70%) (20). It is highy-available and allows for the real-time analysis of vessel morphology, inner plaque structure, blood flow direction and velocity, as well as the estimation of the stenosis degree.

Brain magnetic resonance imaging (MRI) is the dominant imaging modality for brain parenchyma due to its superior contrast resolution for soft tissues, and therefore is a very sensitive method for detecting the signs of brain vessel atherosclerotic disease and stroke.

A number of studies have mentioned the clinical importance of noticing the calcifications in the projection of carotids on orthopantomographs (4,5,11-13,15,20) due to the correlation between the atherosclerotic carotid plaques and stroke (5,6,11,12,21), but the relationship between the calcifications and the significant carotid artery stenosis (>50%) remains indeterminate (4,15,22-24).

In this study we evaluated the correlation between the calcifications in the projection of carotid arteries on OPGs and the carotid stenosis degree on CD-US. Our hypothesis was that the presence of calcifications in the projection of carotids on OPGs incitated a carotid stenosis >50% on CD-US. We also analyzed the relationship between stroke risk factors, calcifications in the carotid artery projection on OPGs and the degree of carotid stenosis, as well as the frequency of gathered sociodemographic data, habits and previous
cerebrovascular/cardiovascular diseases of the examinees. The prevalence of stroke on brain MRI among the patients with carotid artery calcifications has also been investigated, as well as the difference among the risk factors and the stenosis degree between the patients with the stroke and the patients with no previous stroke.

Material and methods

The study has been conducted at the Department of General and Dental Radiology, School of Dental medicine, University of Zagreb, and at the Department of Diagnostic and Interventional Radiology, University Hospital Center (UHC) Sestre milosrdnice in Zagreb. It has been approved by the Ethics Committee of UHC Sestre milosrdnice in Zagreb, and by the Ethics Committee of School of Dental Medicine, University of Zagreb.

Participants

Examinees in this study were patients with either unilateral or bilateral calcifications in the projection of carotids on the OPGs. All OPGs were previously taken due to dental indications, at the UHC Sestre milosrdnice and at the School of Dental Medicine, University of Zagreb. The patients have all been informed and have consented to participate in the study.

We are showing the preliminary results of this study, gathered on 41 patients.

Procedures

743 digital OPGs in DICOM format, obtained in September and October 2021, have been analyzed by a board-certified radiologist, using the digital orthopantomography software (Scanora). Unilateral or bilateral calcifications in the projection of carotids, radiomorphologically suspicious for atherosclerotic plaques (Figure 1), have been detected in 60 patients (8.07%). 41 patients consented to participate in the study and fulfilled the study inclusion criteria (no contraindications for MRI, 50 year old or older).

CD-US of carotid arteries and the brain MRI have been performed at the Department of Diagnostic and Interventional Radiology, UHC Sestre milosrdnice, Zagreb, Croatia. Carotid CD ultrasound was performed using a GE Healthcare Logiq S8 from 2018, and MRI with a Siemens Aera 1.5T terija na ortopantomogramima i stupnja karotidne stenoze i učestalost prikupljenih sociodemografskih obilježja, navika i dosadašnjih cerebrovaskularnih/kardiovaskularnih bolesti ispitanika. Također smo željeli odrediti prevalenciju preboljeloga moždanoga udara na MR-u možda bolesnika s kalcifikacijama karotidnih arterija te razliku između čimbenika rizika i stupnja stenoze bolesnika s preboljelim moždanim udarom i onih bez prethodnoga moždanog udara.

Materijal i metode

Istraživanje je provedeno na Katedri za opću i dentalnu radiologiju Stomatološkog fakulteta Sveučilišta u Zagrebu te u Zavodu za dijagnostičku i intervencijsku radiologiju KBC-a Sestre milosrdnice u Zagrebu. Odobrilo ga je Etičko povjerenstvo KBC-a Sestre milosrdnice te Etičko povjerenstvo Stomatološkog fakulteta Sveučilišta u Zagrebu.

Ispitanici

U istraživanje su uključeni pacijenti s jednostranim ili obostranim kalcifikacijama u projekciji karotidnih arterija na ortopantomogramima. Ortopantomogrami su snimljeni zbog stomatoloških indikacija u KBC-u Sestre milosrdnice i na Stomatološkom fakultetu Sveučilišta u Zagrebu. Svi ispitanici pristali su sudjelovati u studiji i potpisali su informirani pristanak.

Prikazani su preliminarni rezultati studije prikupljeni za 41 pacijenta.

Metode

U rujnu i listopadu 2021. snimljena su 743 digitalna ortopantomograma u DICOM formatu koja su pregledali specijalisti kliničke radiologije koristeći se softverom za digitalnu ortopantomografiju (Scanora). Unilateralne ili bilateralne kalcifikacije u projekciji karotidnih arterija, radiomorfološki suspektne za aterosklerotske plakove (slika 1.), otkrivene su kod 60 pacijenata (8,07 %). U istraživanju je pristao sudjelovati 41 pacijent s ispunjenim kriterijima za uključivanje u studiju (bez kontraindikacija za MR, 50 godina ili više).

CD-UZV karotidnih arterija i MR mozga učinjeni su u Zavodu za dijagnostičku i intervencijsku radiologiju KBC-a Sestre milosrdnice, Zagreb, Hrvatska. Ispitanici su pregledani doplerskim ultrazvukom na uređaju GE Healthcare Logiq S8 iz 2018. godine, a MR mozga učinjen je na aparatu Sie-
from 2018. The exams were conducted and read by experienced radiologists.

Bilateral common, internal and proximal external carotids have been examined with ultrasound, using a linear, high-frequency probe. Grayscale ultrasound, CD ultrasound and spectral analysis have been performed. The flow velocities and arterial spectres in common carotid artery (CCA), internal carotid artery (ICA) and external carotid artery (ECA) on both sides have been determined, as well as the degree of stenosis. The patients have been divided into two categories – the first group consisted of patients with stenosis <50%, and the second group of those with stenosis >50% (considered clinically significant). The criteria for >50% stenosis were PSV >125 cm/s, with the additional criteria being ICA/CCA PSV ratio between 2 and 4 and ICA EDV >40 cm/s, based on the Society of Radiologists in Ultrasound (SRU) consensus (25).

Pulsed spin-echo sequences (sagittal T1-weighted images, axial T2-weighted images), inversion recovery sequence FLAIR (fluid attenuated inversion recovery), especially sensitive to periventricular and peripheral brain lesions, and the gradient sequence T2*GRE for the detection of hemosiderin deposits, have been used in the brain MRI protocol. Changes in brain morphology and signal intensities concordant with previous lacunar, small, or large territorial brain infarcts were analyzed.

Anamnestic data on age, sex, height and weight, smoking, physical activity and existing hypertension, diabetes mellitus, hyperlipidemia, cardiovascular and cerebrovascular diseases, i.e. examinees‘ sociodemographic characteristics, functions and previous diseases and treatments relevant for cerebrovascular disease have also been gathered.

Statistical analysis
Variable intercorrelation has been done by point-biserial correlation coefficient for dichotomous variables, and by Phi coefficient for two dichotomous variables. The Fisher and Mann-Whitney U test were conducted for correlation of stenosis degree on CD-US for ACC, ACI and ACE bilaterally and the calcifications on OPGs on both sides. The correlation of age and weight with the stroke has been performed using the Welch t-test, and the correlation between the stroke and the other risk factors has been done using the Fisher test. The statistically significant level was set at p=0.05. The statistical analyses were performed using IBM SPSS Statistics 26 software.

Results
Forty-one subjects, among which twenty-eight women (68.3%) and thirty men (31.7%) participated in the study, with the mean age of 66 years (range 52-80). All of them had calcifications in the projection of carotid arteries on OPGs, either unilaterally (N=20; 48.8%) or bilaterally (N=21; 51.2%).

**Table 1**
| Broj kalcifikata u projekciji karotida na ortopantomogramima, ovisno o strani |
|-----------------|-----------------|------------------|
|                  | Right • Desno   | Left • Lijevo    | Bilateral • Obostrano |
| **n**           | **%**           | **n**            | **%**           |
| 32              | 78.0            | 30               | 73.2            |
| 20              | 48.8            |                  |                 |
| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Sex (0-F, 1-M) • Spol (0-Ž, 1-M) | 1 |
| Age • Dob | .047 1 |
| Weight (kg) • Tjelesna masa (kg) | .474** -.267 1 |
| BMI | .114 -.239 .874** 1 |
| Hypertension (0-no, 1-yes) • Hipertenzija (0-ne, 1-da) | .361* .102 .339* .238 1 |
| Diabetes (0-no, 1-yes) • Dijabetes (0-ne, 1-da) | -.254 -.089 .154 .283 .314* 1 |
| Hyperlipidemia (0-no, 1-yes) • Hiperlipidemija (0-ne, 1-da) | -.462** .048 -.015 .201 .183 .283 1 |
| Cardiovascular diseases (0-no, 1-yes) • Kardiovaskularne bolesti (0-ne, 1-da) | -.176 .443** -.252 -.102 .174 .111 .346* 1 |
| Cerebrovascular diseases (0-no, 1-yes) • Cerebrovaskularne bolesti (0-ne, 1-da) | .022 .066 -.13 -.13 -.111 -.076 .043 -.027 1 |
| Smoking (0-no, 1-yes) • Pušenje (0-ne, 1-da) | -.003 -.276 .247 .303 .087 .102 -.208 -.011 .047 1 |
| Physical activity (0-no, 1-yes) • Tjelesna aktivnost (0-ne, 1-da) | .203 .062 -.031 -.078 -.04 -.005 .009 -.119 .181 -.16 1 |
| CD-US stenosis ACC dex • CD-UZV stenoza ACC dex | b b b b b b b b b b b b b b b |
| CD-US stenosis ACE dex • CD-UZV stenoza ACE dex | -.154 .097 .127 .173 -.039 .262 .172 -.137 .352*.017 .111 b 1 |
| CD-US stenosis ACI dex • CD-UZV stenoza ACI dex | .089 -.154 .112 .097 -.039 .262 -.063 -.137 .352*.244 .111 b .474** 1 |
| CD-US stenosis ACC sin • CD-UZV stenoza ACC sin | b b b b b b b b b b b b b b b |
| CD-US stenosis ACE sin • CD-UZV stenoza ACE sin | .01 -.094 .12 .121 -.144 .182 .019 -.17 .437** .115 .138 b .806** .806** b 1 |
| CD-US stenosis ACI sin • CD-UZV stenoza ACI sin | .066 -.011 .031 -.008 .011 .089 -.026 .111 .252 .252 -.005 b .262 .608** b .468** 1 |
| Calification on OPG on the right (0-no, 1-yes) • Kalcifikati na ortopantomogramu desno (0-ne, 1-da) | -.145 .108 -.066 -.008 .271 .018 .209 .055 -.047 .138 -.112 b .12 -.153 b -.077 -.163 1 |
| Calification on OPG on the left (0-no, 1-yes) • Kalcifikati na ortopantomogramu lijevo (0-ne, 1-da) | .294 -.213 .263 .115 .384*.226 -.003 .118 .027 .011 -.159 b -.118 .137 b -.041 .226 -.321* 1 |
| Stroke on MRI (0-no, 1-yes) • Ishemija na MR-u (0-ne, 1-da) | .163 .232 -.015 -.145 .208 .057 -.115 .061 .492** .307 -.144 b .227 .227 b .149 .267 .053 .251 |

For dichotomous variables point-biserial correlation coefficients are shown for quantitative variables, and Phi-coefficients of association for two dichotomous variables. • Za dihotomne varijable koeficijenti pobjedarske korelacije prikazani su za kvantitativne varijable, a Phi- koeficijenti asocijacije za dvije dihotomne varijable.

* p<0.05; ** p<0.01
*<50%≤1, >50%=2

Not possible to calculate the correlation because the variable is constant (it has only one value) • Nije moguće izračunati korelaciju jer je varijabla konstantna (ima samo jednu vrijednost)
Calcifications were seen on the right side in 32 patients (78%), and on the left side in 30 patients (73.2%) (Table 1). There was no statistically relevant correlation between the calcifications on either side and the risk factors for stroke, except for the hypertension and the calculations on the left side (p<0.05). Negative correlation has been found between the calcifications on the left and on the right side (p<0.05) (Table 2).

Stenosis of >50% on CD-US was found in 6 patients (14.63%), overall in 12 arteries. All other patients had stenosis of <50% seen on CD-US (Table 3). No statistically relevant correlation between the significant stenosis on CD-US and the calcification on the OPG was found.

We have collected our subjects’ sociodemographic and anamnestic data relevant to stroke risk. Hyperlipidemia was found in almost two-thirds (63.4%) of our examinees, hypertension in more than half (58.5%), diabetics in 12.2%, cardiovascular diseases were found in 26.8%, and cerebrovascular diseases in 29.3% of our patients. Nineteen (46.3%) patients were smokers, with another 12.2% being former smokers, and 33 (80.5%) were physically active (Table 4). Statistically significant intercorrelations were found between the male sex and weight (p<0.01), as well as with male sex and hypertension (p<0.05), between female

(N = 20; 48.8%) or obostrano (N = 21; 51.2%). Kalcifikacije su uočene desno kod 32 bolesnika (78 %), a lijevo kod njih 30 (73,2 %) (tablica 1.). Nije bilo statistički značajne korelacije između kalcifikacija na bilo kojoj strani i čimbenika rizika za moždani udar, osim za hipertenziju i kalcifikacije na lijevoj strani (p < 0,05). Utvrđena je negativna korelacija između kalcifikacija na lijevoj i desnoj strani (p < 0,05) (tablica 2.).

Stenoza >50 % na CD-UZV-u pronađena je kod 6 pacijenata (14,63 %), ukupno u 12 arterija. Svi ostali imali su stenozu < 50 % na CD-UZV-u (tablica 3.). Nije pronađena statistički relevantna korelacija između signifikantne stenoze na CD-UZV-u i kalcifikacija na ortopantomogramima.

Prikupljeni su sociodemografski i anamnestički podaci ispitanika relevantni za rizik od moždanog udara. Hiperlipidemiju je imalo gotovo dvije trećine (63,4 %) pacijenata, hipertenziju više od polovine (58,5 %), dijabetes 12,2 %, kardiovaskularne bolesti 26,8 %, a cerebrovaskularne bolesti njih 29,3 %. Devetnaest (46,3 %) ispitanika puši, još 12,2 % bivši su pušači, a 33 (80,5 %) tjelesno su aktivni (tablica 4.). Utvrđene su statistički značajne interkorelacije između muškog spola i tjelesne težine (p<0.01), muškog spola i hipertenzije (p<0.05), ženskog spola i hiperlipidemije (p<0.01),

| CD-US stenosis • CD-UZV stenoza | ACC dex | ACE dex | ACI dex | ACC sin | ACE sin | ACI sin |
|----------------------------------|--------|--------|--------|--------|--------|--------|
| n %                              | n %    | n %    | n %    |
| <50%                             | 41 100 | 39 95.1| 39 95.1|
| >50%                             | 0 0    | 2 4.9  | 2 4.9  |

Table 3 Number of patients with <50% and >50% stenosis on Color Doppler ultrasound (CD-US) for each artery

| Hypertension • Hipertenzija | Diabetes • Dijabetes | Hyperlipidemia • Hiperlipidemija | Cardiovasc. diseases • Kardiovask. bolesti | Cerebrovasc. diseases • Cerebrovask. bolesti | Smoking • Pušenje | Physical activity • Tjelesna aktivnost |
|------------------------------|----------------------|----------------------------------|---------------------------------------------|---------------------------------------------|------------------|-------------------------------------|
| n %                          | n %                  | n %                              | n %                                         | n %                                         | n %              | n %                                |
| 24 58.5                      | 5 12.2               | 26 63.4                          | 11 26.8                                     | 12 29.3                                     | 19 46.3          | 33 80.5                             |

Table 4 Stroke risk factors distribution

| Stroke on MRI • Ishemija na MR-u | Average age • Prosječna dob | t; df; p |
|----------------------------------|-----------------------------|---------|
| n %                              |                            |         |
| No • Ne 35                       | 85.4                        | 65.49   |
| Yes • Da 6                       | 14.6                        | 70.50   |

* p<0.05; ** p<0.01
* Welch test • Welchov test

| Stroke on MR • Moždani udar na MR-u | Cerebrovascular diseases • Cerebrovaskularna bolest | Fisher test • Fisherov test |
|-------------------------------------|------------------------------------------------------|----------------------------|
| n %                                 | n %                                                  |                           |
| No • Ne 28 80                        | 7 20                                                  | .005**                     |
| Yes • Da 1 16.7                      | 5 83.3                                                |                           |

* p<0.05; ** p<0.01

Table 5 Stroke correlation with age

Table 6 Correlation between stroke and cerebrovascular disease

| Stroke on MR • Moždani udar na MR-u | Cerebrovascular diseases • Cerebrovaskularna bolest | Fisher test • Fisherov test |
|-------------------------------------|------------------------------------------------------|----------------------------|
| n %                                 | n %                                                  |                           |
| No • Ne 28 80                        | 7 20                                                  | .005**                     |
| Yes • Da 1 16.7                      | 5 83.3                                                |                           |

* p<0.05; ** p<0.01
sex and hyperlipidemia (p<0.01), and also between the hypertension and weight (p<0.05) and hypertension and diabetes (p<0.05), and between the cardiovascular diseases and the age (p<0.01) and cardiovascular diseases and hyperlipidemia (p<0.05) (Table 2).

Six patients had signs of previous stroke on brain MRI (14.6%). Two patients had territorial infarcts and four patients had small cortical or lacunar infarcts in basal ganglia and brainstem. Their mean age was five years higher than of those without the previous stroke (p<0.05) (Table 5). There was a positive correlation with cerebrovascular diseases in these patients (p<0.01) (Table 6). No statistically significant difference in weight, hypertension, diabetes, hyperlipidemia, cardiovascular diseases, smoking or physical activities has been found between the examinees with or without stroke.

Discussion

The prevalence of calcifications with radiomorphologic characteristics suggestive of calcified atherosclerotic plaques on OPGs in our study was 8.07%. Previously reported prevalence in the general population has been 3-15% (4,8,12,15,16,26), which is in concordance with our finding.

We had a larger number of women with calcifications in the projection of carotid arteries in our study (68.3%) compared to men (31.7%). In their review article, Alves et al. confirm this finding (9), as well as Gonçalves et al. who also had a higher percentage of female patients with calcifications (26). In our study, the number of bilateral and unilateral calcifications was almost equal, with a slight advantage in favor of unilateral findings (51.2%) and with no strong predilection for right or left side. We also found a negative correlation between the calcifications on the left and the right side (p<0.05), which means that patients with a calcification on one side are less likely to have another calcification on the other side. These findings agree with those of Alves et al. who reported that calcifications are usually unilateral, but that there is no predilection for either side (9).

Our subjects’ sociodemographic and anamnestic data relevant to stroke risk have been collected and correlated with the calcifications on OPGs. Hypertension, diabetes and smoking have shown positive correlations with calcifications, and physical activity showed negative correlation with calculations, but the only statistically significant correlation was with hypertension (p<0.05), which was present in 58.5% of our examinees. Abecasis et al. had a hypertension prevalence of almost 62% in their study, and their results showed that patients with hypertension have more than 5 times greater probability to develop atheromatous plaques (27). A significant correlation between the number of years of smoking and carotid plaques has been mentioned by Abecasis et al. and Kumagai et al. in their previous studies (27,28), as well as the association of calculations and diabetes by Friedlander et al. and Johansson et al. (11,24). Regular physical activity is a protective factor for vascular diseases (29), and activity is inversely associated with carotid plaque formation, especially in patients with increased vascular risk (30,31). However, the literature on correlation between calcified carotid plaques on
OPGs and physical activity seems to be scarce. The study of Helmi et al. showed a positive correlation between the plaque formation and irregular exercise, but with no statistical significance (32).

In this study, clinically significant stenosis of >50% on CD-US was found in 6 patients (14.63%), in 12 arteries respectively. Constantine et al. obtained similar results with 15.4% patients with calcifications having a carotid stenosis of over 50%, and showing a threefold higher risk of significant stenosis compared to those without calcifications (33). Several studies have shown higher percentage of significant carotid stenosis. Friedlander et al. have found >50% carotid stenosis on CD-US in 23% asymptomatic patients with calcified carotid plaques (15), and Almog et al. in 50% of sonographically examined arteries in their study (4). On the other hand, Johansson and al. found a significant stenosis in only 7% of the patients with positive OPG calcifications (24).

Studies that performed the OPGs after the significant carotid stenosis had already been proven and before the carotid endarterectomy was been carried out showed high percentages of visible calcifications on OPGs. Griantsos et al. had positive calcification findings on 70% orthopantomographs of such patients (22) and Garoff et al. in 84% of examinees (23).

Our study showed no statistically relevant correlation between the significant stenosis on CD-US and the calcifications on the OPG. These results are coherent with the study of Johansson et al. (24) and Constantine et al. (33), but in disagreement with the results of Almog et al. (4) and Abecais et al. (27). For instance, the latter study found fifteen times greater risk of stenosis >70% on CD-US in the group of patients with calcified plaques (27).

The connection between stroke and calcified carotid artery calcifications seen on OPGs has been discussed by several authors (12,22,27,33,35-37). In a retrospective study, Cohen et al. have shown that 34% of the patients with calcifications in the projection of carotids on orthopantomographs have subsequently developed a myocardial infarction or stroke in the period of 3.5 years (12). Freidlander et al. have claimed that individuals with calcified carotid atheromas have a higher risk of experiencing similar major vascular events in the future (37). In our sample, nearly 15% of patients have had a stroke. Cerebrovascular disease and older age are known risk factors for stroke (3,34), which was confirmed by our results.

There was a significant correlation (p<0.01) between existing cerebrovascular disease and stroke, and our patients with stroke were approximately 5 years older than those with no previous stroke (p<0.05).

The study findings are preliminary, based on the first 41 patients participating in a larger, ongoing study. More comprehensive evaluation with a larger sample is needed to investigate the significance of calcified carotid plaques on OPGs for detection of carotid artery stenosis in general population, and to determine their correlation with stroke.
Conclusion

Our study aimed to determine a correlation between the calcifications in the projection of carotids on OPGs and the carotid stenosis on CD-US and to analyze the relationship between stroke risk factors, calcifications in the projection of carotids on OPGs and the degree of carotid stenosis. Significant stenosis of over 50% was found in almost 15% of our patients, but no statistically significant correlation between calcifications on OPGs and significant stenosis on CD-US was found. Therefore, our hypothesis has not been confirmed by our preliminary results. Positive correlations with calcifications were shown for hypertension, diabetes and smoking, and negative correlation for physical activity, although the only statistically significant correlation was with hypertension. Nearly 15% of our examinees have had a stroke, and they were approximately 5 years older than those with no previous stroke. Further investigation and a larger sample is needed to determine the importance of calcifications in the projection of carotids on OPGs and their relationship with the significant stenosis and stroke.

Sukob interesa

Autorske ključne riječi:
- otkrivanje stenoze karotidnih arterija;
- MR snimke;
- kalcifikacija krvnih živaca;
- stenoza karotidnih arterija;
- ortopantomografija;
- MeSH pojmovi:
  - kalcifikacija krvnih živaca;
  - stenoza karotidnih arterija;
  - panoramic radiography;
  - ortopantomografija

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