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## Utjecaj dentalnog statusa, dobi i spola na kortikalnu širinu donjeg ruba mandibule i mandibularni kortikalni indeks

### *Influence of Dental Status, Age and Gender on the Cortical Width of the Lower Border of the Mandible and Mandibular Cortical Index*

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#### Sažetak

Svrha istraživanja bila je odrediti utjecaj dentalnog statusa, dobi i spola na mandibularni kortikalni indeks (MCI). Oba su određena na temelju 120 ortopantomograma. **Rezultati:** Srednja vrijednost indeksa MI bila je najviša kod pacijenata s potpunom denticijom, niža kod onih s djelomičnom ozubljenosti (Kennedyjeva klasa I), a najniža kod potpuno bezubih. Post-hoc testovi pokazali su statistički značajnu razliku za indeks MI na objema stranama između Kennedyjeve klase I i potpuno ozubljenih pacijenata ( $p \leq 0,001$ ) te između potpuno ozubljenih i bezubih pacijenata ( $p \leq 0,001$ ), ali ne i između Kennedyjeve klase I i potpuno bezubih pacijenata ( $p = 0,470$ ). Potpuno ozubljeni pacijenti ujedno su bili i najmlađa skupina pacijenata. Pacijentice su imale mnogo niže vrijednosti indeksa od pacijenata. Chi-square test pokazao je statistički značajnu razliku za indeks MCI između skupina pacijenata različitog dentalnog statusa, ali ne i između onih grupiranih prema spolu. **Zaključak:** Dentalni status i godine mogu utjecati na MI i MCI.

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#### Ključne riječi

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#### Uvod

Radiološka analiza *kvalitete kostiju* važan je čimbenik u planiranju stomatološkog tretmana. Ona najčešća u općoj stomatološkoj praksi jest ortopantomografska snimka. Pojedini kvalitativni i kvantitativni indikatori mjerenja ortopantomograma, primjerice, mandibularni kortikalni indeks (MCI), panoramski mandibularni indeks (PMI) i mandibularna kortikalna debljina različitih dijelova donjeg ruba mandibule, rabe se pri procjeni kvalitete kosti te prepoznavanja znakova resorpcije i osteoporozе (1). U Japanu pojedini kliničari posvećuju posebnu pozornost određenim parametrima ortopantomograma kao što su MCI i debljina mandibularnog korteksa kako bi identificirali starije pacijente kojima treba procjena mineralne gustoće kostiju (BMD) (2). U dosadašnjim studijama istaknuta je znatna povezanost između BMD-a i debljine mandibularnog korteksa (3, 4, 5). Prema stajalištu Watanabea i njegovih suradnika (6) stomatolozi bi morali biti sposobni detektirati pojedine znakove kroničnih bolesti kod pacijenata, primjerice osteoporozu ili dijabetes melitus, analizirajući ortopantomografsku sliku.

Kortikalna debljina donjeg ruba mandibule može se s laćoćom oćitati s ortopantomograma te je zato koristan parametar u određivanju statusa mandibularne kosti (1). Jedan

#### Introduction

Radiographic assessment of "bone quantity" is of great value in dental treatment planning. The most common radiographic method for application in general practice is panoramic radiograph, which is often used for the diagnosis and treatment planning. Some qualitative, as well as quantitative indices measured or assessed on panoramic radiographs, such as mandibular cortical index (MCI), panoramic mandibular index (PMI) and mandibular cortical thickness at different regions of the lower border of the mandible have been used to assess the bone quality and to find the signs of resorption and osteoporosis (1). In Japan, clinicians have started to focus on some mandibular panoramic indices, such as MCI and mandibular cortical thickness, for the identification of elderly individuals who should undergo BMD (bone mineral density) assessment (2). Earlier studies demonstrated a significant correlation between BMD and mandibular cortical thickness (3, 4, 5). According to Watanabe et al. (6), although some controversy remains concerning the value of using panoramic radiographs in the screening of systemic diseases (osteoporosis, diabetes mellitus), the dentist should be capable of detecting features of such conditions on panoramic radiographs.

je od popularnijih indeksa zato što ne zahtijeva specijalizirane ustanove (7). Debljina korteksa ispod mentalnog otvora (MI) te kod goniona (GI) i antegoniona (AI) točke su kojima se u različitim istraživanjima najčešće služimo pri usporedbi gustoće mandibularne kosti s ostalim točkama na mandibuli (8,9).

Toraman i kolege (10) pokazali su u svojem istraživanju da su ortopantomogrami snimljeni digitalnom tehnikom vrlo korisni u procjenjivanju MI-a. Mogućnost preciznog ponavljanja digitalnih snimaka pokazala se kao korisna opcija kod opetovanog mjerenja MI-a.

Mandibularni kortikalni indeks (MCI) vrlo je važan za procjenu kvalitete mandibularne kosti. Neki autori (11, 12) smatraju da vrijednosti MCI-a omogućuju prepoznavanje razlike između žene s osteoporozom i bez te bolesti. MCI se temelji na Klemettijevoj klasifikaciji promjena u donjem korteksu mandibule izmjerenih na ortopantomografskoj slici (13).

Svrha ovog istraživanja bila je odrediti utjecaj dentalnog statusa na mentalni (MI) i mandibularni kortikalni indeks (MCI).

## Pacijenti i metode

### Pacijenti

U istraživanju je sudjelovalo 120 pacijenata (43 muškarca i 77 žena) i svi su bili podvrgnuti snimanju ortopantomograma zbog dijagnosticanja i planiranja stomatološkog tretmana. Svrha istraživanja objašnjena je svima i svi su potpisali informirani pristanak. Istraživanje je provedeno u Zavodu za stomatološku protetiku Stomatološkog fakulteta Univerziteta u Sarajevu.

Pacijenti su podijeljeni u tri skupine: pacijenti sa svim zubima u mandibuli (potpuno ozubljeni), djelomično ozubljeni pacijenti (Kennedyjeva klasa I) i potpuno bezubi.

Potpuno ozubljenu skupinu sa svim antagonističkim kontaktima činila su 42 pacijenta, 38 ih je bilo u onoj djelomično ozubljenj (Kennedyjeva klasa I), a u potpuno bezuboj skupini nalazilo se njih 40. Pacijenti su također bili podijeljeni u tri skupine prema godinama (prva od 21 do 40 godina; druga od 41 do 60 godina; treća – pacijenti u dobi od 60 godina).

Kriterij za isključivanje iz studije bili su sistemski poremećaji koji uzrokuju gustoću kostiju, metaboličke bolesti kostiju, tumori s koštanim metastazama i korištenje lijekova koji utječu na metabolizam kostiju (kortikosteroidi, heparin, kalcij, kalcitonin, vitamin D, bisfosfonati).

### Metode

Ortopantomogrami su snimljeni uređajem Ortopantomograph OP 100 (Instrumentarium, Tuusula, Finska). Položaj glave određen je standardnom tehnikom koristeći se cephalostatom. Svi filmovi razvijeni su automatski za sedam

The cortical thickness of the lower border of the mandible could be easily observed on panoramic radiograph and therefore it is a useful parameter for the assessment of the status of the mandibular bone (1). This is also a popular index because it requires no specialized facilities (7). Cortical widths below mental foramen (MI), at gonion (GI) and antegonion (AI) have been the most common sites, the thickness of which was compared with bone density of mandible in different studies (8, 9).

In their study, Toraman et al. (10) found that digital panoramic radiographs may be used to evaluate MI. Reproducibility and repeatability of digital panoramic images were found to be high for measurements of MI.

Mandibular cortical index (MCI) is a very important index for assessment of bone quality of the mandible. Some authors (11, 12) consider that MCI enables to distinguish between normal and osteoporotic women. The MCI is based on Klemetti's classification of changes in inferior cortex of the mandible which can be observed on panoramic x-ray images. (13)

The aim of this study was to evaluate the influence of dental status on mental index (MI) and mandibular cortical index (MCI).

## Patients and methods

### Patients

In this study, 120 patients (43 male and 77 female patients), who had undergone a dental panoramic radiograph examination for the need of diagnosis and future treatment planning were included. The purpose of research was presented to all the participants and they gave written consent. The research was conducted at the Department of Prosthodontics at the School of Dental Medicine, University of Sarajevo.

The subjects were divided into three groups: subjects who had all teeth in the mandible (fully dentate), subjects who were partially dentate (Kennedy Class I) and subjects who were completely edentulous.

According to dental status, there were 42 patients who had all teeth in the mandible and all antagonistic contacts, 38 patients who were partially dentate (Kennedy Class I) and without antagonistic contacts in posterior regions and 40 patients who were completely edentulous.

Patients were grouped also according to age into three age groups (1 = 21 to 40 years; 2 = 41 to 60 years; 3 = more than 60 years).

Exclusion criteria included: presence of systemic disorders which affect bone mineral density, metabolic bone diseases, cancer with bone metastasis, use of medications that affect bone metabolism (corticosteroid, heparin, calcium, calcitonin, vitamin D, bisphosphonates).

### Methods

Dental panoramic radiographs were taken using Ortopantomograph OP 100 (Instrumentarium, Tuusula, Finland). The position of the head was standardized, using cephalostat. All films were processed in automatic dark

minuta u tamnoj komori (XR 24 Nova, Dürr Dental). Slike su snimljene Kodakovim filmovima. Svi ortopantomogrami pregledani su na negatoskopu u poluzamračenju sobi.

Kortikalna debljina mandibule ispod foramena mentale (MI) izmjerena je na svakom ortopanu s lijeve i desne strane mandibule (14). Zatim je na svakome iscrtana linija paralelna s dugom osi mandibule i tangencijalna s donjim rubom mandibule te točkasta crta okomita na tu tangentu tako da presijeca donji rub ispod foramena mentale gdje je izmjerena mandibularna kortikalna debljina (MI). Sva mjerenja obavljena su precizno povećalom i šestarom do točnosti od 0,01 milimetar.

Oblik mandibularnog korteksa promatran je bilateralno i posteriorno od mentalnog foramena prema metodi Klemetti i suradnika (13) na sljedeći način: C1 – normalni korteks, endosealna granica korteksa jednolika je i oštih linija na objema stranama; C2 – srednje do uznapredovalo erodiran korteks, ednosealna granica sadržava polumjesečaste defekte (lakunarna resorpcija) ili se pojavljuju endosealni kortikalni ostaci na jednoj strani ili objema stranama; C3 – jako erodirani korteks, kortikalni sloj formiran je od ostataka endosealnog korteksa i očito je da je porozan.

## Statistička analiza

Dobiveni podaci analizirani su statističkim paketom SPSS 13,0 (deskriptivna statistika, testiranje distribucije, analiza varijacije, chi-square). Kolmogorov-Smirnovim testom provjeravala se distribucija varijacije. Analiza varijacije (ANOVA), post-hoc testovi prema Scheffeu te chi-square test primijenjeni su kako bi se odredile razlike između pojedinih skupina. P-vrijednosti uzete su kao statistički značajne na razini od 0,05. Parni studentski t-test korišten je kako bi se usporedile vrijednosti mentalnog indeksa s lijeve i desne strane mandibule.

## Rezultati

U studiji je sudjelovalo 120 pacijenata u rasponu godina od 21 do 80 (srednja vrijednost = 50,5).

Srednja vrijednost godina za potpuno ozubljene pacijente bila je 28, a raspon godina u toj skupini iznosio je od 21 do 65. Srednja vrijednost godina za djelomično ozubljene pacijente (Kennedyjeva klasa I) bio je 54,5 godina, a raspon između 34 i 70. Srednja vrijednost godina za potpuno bezube pacijente bila je 59,5 a raspon od 40 do 80.

Srednja vrijednost i standardna devijacija mentalnog indeksa (MI) za sve skupine nalazi se u tablici 1.

T-test nije pokazao statistički značajne razlike između MI-a izmjenjenog na desnoj i lijevoj strani mandibule ( $t = 1,032$  ;  $p = 0,304$ ).

Uzimajući u obzir dentalni status, srednje vrijednosti indeksa MI bile su najviše kod pacijenata sa svim zubima, niže kod djelomično ozubljenih (Kennedyjeva klasa I) te najniže kod potpuno bezubih. Analiza ANOVA-om pokazala je statističku razliku za vrijednosti MI-a između skupina (za desnu stranu –  $F=14,599$ ,  $p \leq 0,001$ ; za lijevu stranu –  $F=23,423$ ,

chamber processor (XR 24 Nova, Dürr Dental) for 7 minutes. The images were processed using Kodak film. The dental panoramic radiographs were viewed using a flat view box in a room with subdued light.

Cortical thickness below mental foramen (MI) was measured on each radiograph on the left and on the right side of the mandible (14). The line parallel to the long axis of the mandible and tangential to the inferior border of the mandible was also drawn and another dotted line was constructed perpendicularly to this tangent in a way that it intersected the inferior border of the mental foramen, along which the mandibular cortical width was measured (MI). Measurements of mental index were made using a magnifying loupe and a precise digital caliper with the precision of 0.01 mm.

Mandibular cortical shape on dental panoramic radiographs was determined by observing the mandible posteriorly from the mental foramen bilaterally according to the method described by Klemetti et al. (13) as follows: C1- normal cortex, the endosteal margin of the cortex is even and sharp on both sides, C2- mildly to moderately eroded cortex, the endosteal margin shows semilunar defects (lacunar resorption) or appears to form endosteal cortical residues on one or both sides, C3- severely eroded cortex, the cortical layer forms heavy endosteal cortical residues and is clearly porous.

## Statistical analysis

The data were analyzed using the SPSS 13.0 statistical package (descriptive statistics, testing the normality of the distribution, analysis of variance, chi-square). Normality of variance distribution was verified using the Kolmogorov-Smirnov test. Analysis of variance (ANOVA), post-hoc tests according to Scheffé and chi-square tests were performed to determine group differences. P values were considered to be statistically significant at the level 0.05.

Paired Student's t test was applied to compare the values for mental index on the right and left sides of the mandible.

## Results

A hundred and twenty patients participated in this study and their ages ranged from 21 to 80 years (median = 50.5).

The median age of the fully dentate subjects was 28 years and age range was 21 – 65 years. The median age of partially dentate Kennedy class I group was 54.5 years and age range was 34 – 70 years. The median age of the completely edentulous subjects was 59.5 years and age range was 40 – 80 years.

The mean values and standard deviations of the mental index (MI) in different dental status groups are presented in Table 1.

The t-test showed no statistically significant difference between MI measured on the right and left side of the mandible ( $t=1.032$ ;  $p=0.304$ ).

Considering dental status, mean MI values were the highest in patients with full dentition, lower in patients who were partially dentate (Kennedy Class I) and the lowest in those patients who were completely edentulous. The ANOVA (univariate) demonstrated a statistically significant dif-

**Tablica 1.** Srednje vrijednosti i standardna devijacija mentalnog indeksa (MI-a) ovisno o dentalnom statusu  
**Table 1** The mean values and standard deviations of mental index (MI) depending on dental status

MI po dentalnom statusu • MI according to age groups					
	N	Desna strana mandibule • Right side of the mandible		Lijeva strana mandibule • Left side of the mandible	
		x ± stand. devijacija • x ± SD	95% int. pouzdanosti • 95% CI	x ± stand. devijacija • x ± SD	95% int. pouzdanosti • 95% CI
Ozubljeni • Fully dentate	42	4.9588±0.91631	4.673-5.244	4.9983±0.76704	4.759-5.237
Kennedy I	38	4.2508±0.82062	3.981-4.521	4.2042±0.91637	3.903-4.505
Bezubi • Completely edentulous	40	4.0220±0.70286	3.797-4.247	3.8510±0.63508	3.648-4.054
Ukupno • Total	120	4.4223±0.90852	4.258-4.857	4.3644±0.91357	4.199-4.529

$p \leq 0,001$ ). Post-hoc test prema Scheffeu otkrio je statistički značajne razlike za vrijednosti MI-a s obje strane mandibule između djelomično i potpuno ozubljenih pacijenata ( $p \leq 0,001$ ) te između potpuno ozubljenih i potpuno bezubih ( $p \leq 0,001$ ), ali ne i između djelomično ozubljenih i potpuno bezubih ( $p=0,470$ ).

Analiza ANOVA-om pokazala je statistički značajne razlike za vrijednosti MI-a između godišta skupina ( $F=22,595$ ;  $p \leq 0,001$  na desnoj strani i  $F=20,595$ ;  $p \leq 0,001$  na lijevoj strani). Post-hoc test prema Scheffeu otkrio je statistički značajne razlike za vrijednosti MI-a na objema stranama mandibule za skupinu pacijenata od 20 do 40 godina i onu između 41 do 60 godina ( $p \leq 0,001$ ), te također za skupinu od 20 do 40 godina i za pacijente starije od 60 godina ( $p \leq 0,001$ ), ali ne i za skupinu sudionika od 40 do 60 godina i one starije od 60 godina ( $p=0,803$  na desnoj strani;  $p=0,737$  na lijevoj strani).

ference for MI between dental status groups (for right side -  $F=14,599$ ,  $p \leq 0,001$ ; for left side -  $F=23,423$ ,  $p \leq 0,001$ ). Post-hoc tests according to Scheffe revealed a statistically significant difference for the MI on both sides of the mandible between the Kennedy I and fully dentate subjects ( $p \leq 0,001$ ), as well as between fully dentate and completely edentulous individuals ( $p \leq 0,001$ ), but not between Kennedy I and completely edentulous groups ( $p=0,470$ ).

The ANOVA (univariate) demonstrated statistically significant difference for MI between age groups ( $F=22,595$ ;  $p \leq 0,001$  on the right side, and  $F=20,595$ ;  $p \leq 0,001$  on the left side).

Post-hoc test according to Scheffe revealed a statistically significant difference for the MI on both sides of the mandible between subjects aged 20-40 years and subjects aged 41-60 years ( $p \leq 0,001$ ), as well as between subjects aged 20-40 years and subjects older than 60 years ( $p \leq 0,001$ ), but not between subjects aged 40-60 years and subjects older than 60 years ( $p=0,803$  on the right side;  $p=0,737$  on the left side).

**Tablica 2.** Srednje vrijednosti i standardna devijacija mentalnog indeksa (MI-a) ovisno o dobi  
**Table 2** The mean values and standard deviations of mental index (MI) depending on age groups

MI po skupinama • MI according to age groups					
	N	Desna strana mandibule • Right side of the mandible		Lijeva strana mandibule • Left side of the mandible	
		x ± stand. devijacija • x ± SD	95% int. pouzdanosti • 95% CI	x ± stand. devijacija • x ± SD	95% int. pouzdanosti • 95% CI
21-40 godina • 21-40 years	48	4.9123±0.89012	4.654-5.171	4.9288±0.78607	4.701-5.157
41-60 godina • 41-60 years	43	4.1484±0.80441	3.901-4.396	4.0481±0.82135	3.795-4.301
Više od 60 g. • More than 60 years	29	4.0176±0.71483	3.746-4.289	3.8993±0.75788	3.611-4.188
Ukupno • Total	120	4.4223±0.90852	4.258-4.587	4.3644±0.91357	4.199-4.529

Uzimajući u obzir spol, srednje vrijednosti MI-a bile su niže kod pacijentica negoli kod pacijenata na objema stranama mandibule. T-test za neovisne uzorke pokazao je statistički značajne razlike za vrijednosti MI-a između skupina podijeljenih prema spolu (za desnu stranu:  $t=4,127$ ;  $P \leq 0,001$ , za lijevu stranu:  $t=3,110$ ;  $p=0,002$ ).

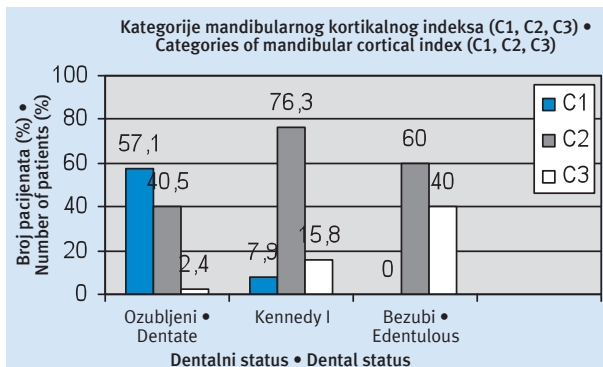
Slika 1. prikazuje distribuciju kategorije MCI-a prema dentalnom statusu na desnoj strani mandibule.

Kod procjene MCI-a na desnoj strani, u skupini pacijenata s potpunom denticijom, njih 57, 1 posto imalo je C1, 40,5 posto imalo je C2, a 2,4 posto C3. U skupini s djelomičnom ozubljenosti većina – njih 76,3 posto, imala je C2, 15,8 posto C3, a tek 7,9 posto imalo je C1.

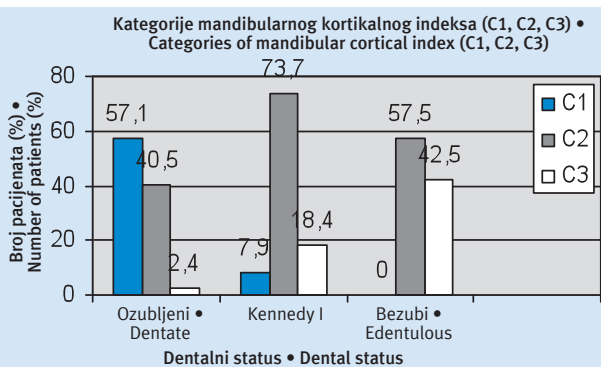
Considering gender, mean MI values were lower in females than in males on both sides of the mandible. The t-test for independent samples demonstrated a statistically significant difference for MI between gender groups (for right side:  $t=4,127$ ;  $P \leq 0,001$ , for left side:  $t=3,110$ ;  $p=0,002$ ).

Figure 1 shows the distribution of MCI categories according to dental status on the right side of the mandible.

In evaluation of the MCI on the right side, in group of patients with full dentition, 57.1% of them had C1, 40.5% had C2 and 2.4% had C3. In group of patients who were partially dentate (Kennedy Class I), the majority (76.3%) demonstrated C2, 15.8% patients had C3 and the smallest number of patients, 7.9%, had C1.



Slika 1. Distribucija kategorija MCI-a (C1, C2 i C3) ovisno o dentalnom statusu desne strane mandibule  
 Figure 1 The distribution of categories MCI (C1, C2 and C3) according to dental status on right side



Slika 2. Distribucija kategorija MCI-a (C1, C2 i C3) ovisno o dentalnom statusu lijeve strane  
 Figure 2 The distribution of categories MCI (C1, C2 and C3) according to dental status on left side

U skupini potpuno bezubih pacijenata, većina (60%) imala je C2, a ostali (40%) su imali C3. Chi-square test pokazao je statistički značajnu razliku u vrijednostima MCI-a s desne strane između skupina dentalnog statusa ( $\chi^2 = 54,885$ ;  $p \leq 0,001$ ).

Slika 2. prikazuje distribuciju kategorija MCI-a prema dentalnom statusu na lijevoj strani mandibule.

Kod procjene MCI-a lijeve strane, u skupini pacijenata s potpunom denticijom njih 57,1 posto imalo je C1, 40,4 posto C2 te 2,4 posto C3. U djelomično ozubljenoj skupini većina pacijenata (73,7 %) imala je C2, njih 7,9 posto imalo je C1 i 18,4 posto C3.

U potpuno bezuboj skupini pacijenata većina (57,7 %) je imala C2, a ostali (42,5 %) C3. Chi-square test pokazao je statistički značajnu razliku vrijednosti MCI-a lijeve strane mandibule među skupinama dentalnog statusa ( $\chi^2=52,613$ ;  $p \leq 0,001$ ). Chi-square test nije pokazao statistički značajne razlike vrijednosti MCI-a između skupina podijeljenih prema spolu u odnosu na lijevu i desnu stranu mandibule ( $\chi^2=2,355$ ;  $p=0,308$ ).

Rasprava

Pojedine promjene u korteksu upućuju na promjene u mineralnom statusu kostura. Prema mišljenju nekih autora, oblik i širina mandibularnog korteksa prikazanog na ortopantomogramu može poslužiti kao indikator za pacijente s niskom gustoćom minerala u kostima i s visokim rizikom od osteoporotičnih fraktura (3, 15–20).

Mandibularni kortikalni indeks (MCI) i kortikalna širina služe za procjenu kvalitete kosti mandibule. Ortopantomogramima često se koriste stomatolozi kako bi mogli uspješno procijeniti kvalitetu kosti mandibule. Nekoliko posljednjih desetljeća mnogi su se istraživači bavili povezanošću između kortikalnih indeksa i različitih čimbenika (sistemskih i lokalnih) kao što su godine, spol, broj zuba, hormonalni status (menopauza) itd. Ti isti istraživači koji su uspoređivali odnos dentalnog statusa i MI-a podijelili su pacijente u tri skupine: pacijenti sa svim zubima u mandibuli, djelomično ozubljeni (Kennedyjeva klasa I) i potpuno bezubi (21, 22).

In the group of patients who were completely edentulous, the majority (60%) were demonstrating C2, while the remainder (40%) was demonstrating C3. The Chi-square test showed a statistically significant difference for MCI on the right side between dental status groups. ( $\chi^2 = 54.885$ ;  $p \leq 0.001$ ).

The Figure 2 shows the distribution of MCI categories according to dental status on the left side of the mandible.

In evaluation of the MCI on the left side, in group of patients with full dentition, 57.1% of them had C1, 40.5% had C2 and 2.4% had C3. In the group of patients who were partially dentate (Kennedy Class I), the majority (73.7%) demonstrated C2, 7.9% patients had C1 and 18.4% patients had C3.

In the group of patients who were completely edentulous, the majority (57.5%) demonstrated C2, while the remainder (42.5%) demonstrated C3. The Chi-square test revealed a statistically significant difference for MCI on the left side between dental status groups ( $\chi^2=52.613$ ;  $p \leq 0.001$ ). The Chi-square test demonstrated no statistically significant difference for MCI between gender groups on right and left side ( $\chi^2= 2.355$ ;  $p=0.308$ ).

Discussion

Some cortical changes of the mandible are signs of changes of mineral status of the skeleton. According to some authors, mandibular cortical shape and width on panoramic radiographs can be useful for identification of people with low bone mineral densities or high risk for osteoporotic fracture (3, 15-20).

The mandibular cortical index (MCI) and cortical width are used for assessment of bone quality of the mandible. Panoramic radiographs are widely used in dentistry; therefore, dentists can often and successfully assess bone quality of the mandible. In recent decades, many authors investigated the relationship between those indices and different factors (systemic and local) such as age, gender, number of teeth, hormonal status (menopause) etc. The authors, who investigated the relationship between the dental status and the MI, divided the subjects into three groups: subjects who had all the teeth in the mandible, subjects who were partially dentate

U Brkićevu istraživanju (23) pacijenti su podijeljeni u dvije skupine: pacijenti koji su imali antagonističke kontakte u distalnoj regiji mandibule i pacijenti bez antagonističkih kontakata u distalnoj regiji mandibule. Rezultati tog istog istraživanja pokazali su da je širina kortikalne regije ispod mentalnog foramena lijeve strane mandibule bila manja kada nije bilo antagonističkih kontakata, odnosno veća ako su postojali, ali vrijednosti nisu bile statistički značajne. Na desnoj strani mandibule kortikalna širina ispod foramena mentale znatno je ovisila o antagonističkim kontaktima u distalnoj regiji.

Taguchi i suradnici (24) istražili su utjecaj broja zuba na širinu mandibularnog korteksa. Kod pacijenata nije postojala značajna povezanost između broja zuba i širine kortikalne kosti mandibule, a kod pacijentica u sedmom desetljeću s 15 ili više zuba kortikalna je širina bila mnogo veća nego kod onih s manje zuba. Polat i njegovi kolege (25) izmjerili su u svojem istraživanju kortikalnu širinu koristeći se kvantitativnom kompjutoriziranom tomografijom (QCT) kod pacijenata s različitim brojem zuba. Njihov zaključak bio je da širina mandibularnog korteksa ovisi o broju zuba u mandibuli.

Istraživanje kolegice Knezović-Zlatarić i suradnika (26) bilo je usmjereno na gustoću koštanih minerala i radiomorfometrijske indekse (MI, AI, GI) mandibule kod starijih pacijenata s različitim vrstama proteza. Sve izmjerene vrijednosti bile su veće kod onih s djelomičnim protezama u usporedbi s pacijentima koji su imali potpune proteze. Rezultati ovih istraživanja podupiru činjenicu da prisutnost prednjih zuba u mandibuli pridonosi većim silama žvakanja i jačoj kontrakciji masetera koji su vezani za korteks mandibule te svojom akcijom održavaju volumen kosti (26). Nakon kontrolnog pregleda obavljenog poslije šest mjeseci uočeno je da su se vrijednosti BMD-a ispod distalnih rubova potpunih proteza smanjile, a povećale su se kod pacijenata s djelomičnim protezama (27).

Rezultati ovog istraživanja pokazali su da su srednje vrijednosti MI-a najveće kod pacijenata s potpunom denticijom, niže kod onih s djelomično ozubljenom čeljusti te najniže kod potpuno bezubih. Naši rezultati u skladu su s istraživanjem Hastara i njegovih suradnika (21) u kojem su istaknute statistički značajne razlike za srednje vrijednosti MI-a koje ovisе o dentalnom statusu.

Također treba reći da dob utječe na širinu MI-a zbog toga što su u našoj studiji ozubljeni pacijenti bili mlađi od djelomično ozubljenih i potpuno bezubih. Pronašli smo statistički značajnu razliku za vrijednosti MI-a između dobnih skupina te je najveća vrijednost bila kod najmlađih pacijenata koji su uglavnom imali sve zube.

Rezultati ovih istraživanja pokazali su značajne razlike za kategorije MCI-a ovisnih o dentalnom statusu. Potpuno ozubljeni pacijenti imali su uglavnom C1 i C2, te u najmanjem broju slučajeva C3.

Djelomično bezubi pacijenti (Kennedyjeva klasa I) i potpuno bezubi pretežno su imali C2, uglavnom u djelomično bezuboj grupi.

Hastar i suradnici (21) u svojem su istraživanju zaključili da dentalni status ima znatan učinak na MCI. Dodali su da potpuno bezubi pacijenti imaju porozniji mandibularni kor-

(Kennedy Class I) and subjects who were completely edentulous (21, 22).

In a study by Brkić (23), subjects were divided into two groups: subjects who had antagonistic contacts of distal areas and subjects who had no antagonistic contact of distal areas. The results of this study showed that cortical width of the mandible beneath mental foramen on the left side was smaller when there were no antagonistic contacts than when there were antagonistic contacts, but the values did not reach the level of significance. On the right side, cortical width of the mandible beneath the mental foramen depends significantly on antagonistic contacts in distal areas.

Taguchi et al. (24) investigated the influence of the number of teeth on the mandibular cortical width. In male subjects, there was no significant correlation between the number of teeth present and the mandibular cortical width. Among women in their seventh decade, those with 15 or more teeth showed significantly greater mandibular cortical width than those with fewer teeth.

Polat et al. (25) measured mandibular cortical width using quantitative computerized tomography (QCT) in patients with different number of teeth. They concluded that mandibular cortical width is affected by the number of teeth in the mandible.

Knezović-Zlatarić et al. (26) examined bone mineral density and radiomorphometric indices (MI, AI, GI) of the mandible in elderly patients with different types of dentures. All measured values were higher in removable partial denture (RPD) wearers than in complete denture (CD) wearers. The results of that study support the fact that the presence of the anterior dentition within the mandible probably contributed to higher values of masticatory forces and stronger masseter contraction, as well as consequent higher values of strain forces of the masseter attached to the cortex of the mandible thus preserving the bone tissue (26). The results of six month follow-up study revealed that the BMD values under distal end of the CD saddles decreased, and in contrast, the BMD values under distal end of the RPD saddles increased during the six month period (27).

The results of this study showed that mean MI values were the highest in patients with full dentition, lower in patients who were partially dentate and the lowest in patients who were completely edentulous. Our results are in agreement with the results of Hastar et al. (21), which revealed significant difference for mean MI values depending on dental status.

The influence of age on the MI width has to be discussed, because dentate subjects in our study were younger than partially dentate and completely edentulous individuals. We found a statistically significant difference for MI between age groups with the highest MI width in the youngest individuals, who, in most cases, also had all their teeth.

The results of this study showed significant difference for categories of MCI depending on dental status. In most cases, fully dentate patients had C1, then C2, and in the least cases C3.

Partially edentulous (Kennedy Class I) and completely edentulous patients had C2 in most cases, which was more frequent in partially edentulous patients.

teks nego oni djelomično ozubljeni. Vlasidis i njegovi kolege (28) istaknuli su da dob, godine nakon menopauze, širina mandibularnog korteksa i broj izgubljenih zuba imaju statistički značajan učinak na gubitak kortikalne kosti. Gubitak samo jednog zuba povećava za šest posto mogućnost erozije kortikalne kosti. Uysal i suradnici (29) uključili su u svoje istraživanje 189 pacijenata i svi su bili ortopantomografski snimljeni radi planiranja stomatološke terapije te nisu bolovali od sistemskih bolesti koje utječu na gustoću kostiju. Većina pacijenata s C1 imala je kompletnu denticiju, a pacijenti s C3 bili su potpuno bezubi.

Gulsahi i suradnici (22) zaključili su kako je mogućnost da će se pojaviti kategorija C3 kod potpuno bezubih i djelomično ozubljenih pacijenata 27,30, odnosno 2,68 puta veća nego kod potpuno ozubljenih. Brkić (23) je u svojem znanstvenom radu istaknuo da je kod većine pacijenata koji imaju antagonistički kontakt u lateralnoj regiji mandibule lijeve i desne strane, marginalni rub korteksa mandibule jednolik i oštro se pruža na obje strane mandibule.

Nedostatak ovog istraživanja je mali broj pacijenata u svakoj skupini te velika razlika u godinama. Kako bismo odredili utjecaj dentalnog statusa na MI i MCI, trebalo bi uključiti više pacijenata u istraživanje i svaka bi skupina pacijenata prema dentalnom statusu trebala biti iste dobi i spola.

## Zaključak

1. Na širinu MI-a izravno utječu dentalni status, dob i spol. Njegove srednje vrijednosti bile su najviše kod pacijenata s potpunom denticijom, niže kod djelomično ozubljenih (Kennedyeva klasa I) te najniže kod potpuno bezubih. Unatoč rezultatima, potpuno ozubljeni pacijenti ujedno su bili najmlađi.
2. Dentalni status, dob i spol znatno utječu na kategoriju MCI-a.

Hastar et al. (21) concluded that dental status was significantly associated with the occurrence of the MCI. They found that completely edentulous patients had more porous cortex of the mandible than partially edentulous or fully dentate patients. Vlasidis et al. (28) reported that age, years since menopause, mandibular cortical width of mandible and the number of the teeth lost had a statistically important effect on the incidence of moderate or severe cortical erosion. An increase by 1 unit in the number of lost teeth increased the likelihood of moderate or severe cortical erosion to 6 %. Uysal et al. (29) included in their study 189 participants who had undergone a dental panoramic radiograph examination for the need of diagnosis and future treatment planning and did not have systemic disorders affecting bone density. Most participants with C1 had full dentition, and participants with C3 were completely edentulous.

Gulsahi et al. (22) found that the likelihood of the C3 category in edentulous and partially dentate patients was 27.30 and 2.68 times higher than in fully dentate patients, respectively.

Brkić (23) reported that in most participants who had antagonistic contacts in distal right and left distal areas, the endosteal margin of the cortex is even and sharp on both sides of mandible.

The limitations of the present study lie in a relatively small number of individuals in each group and in the difference in age between groups. To evaluate the influence of dental status to MI and MCI, a greater number of patients should be included and each dental status group should be of approximately equal age and gender.

## Conclusions

1. The MI width is affected by dental status, age and gender. Mean MI values were the highest in patients with full dentition, lower in patients who were partially dentate (Kennedy Class I) and the lowest in patients who were completely edentulous. However, fully dentate subjects were also the youngest group.
2. Dental status, age and gender also significantly influenced the MCI category.

## Abstract

**Material and methods:** The aim of this study was to evaluate the influence of dental status, age and gender on the mental (MI) and mandibular cortical indices (MCI). The mental index and the mandibular cortical index were determined on 120 panoramic radiographs. **Results:** Mean MI values were the highest in patients with full dentition, lower in patients who were partially dentate (Kennedy Class I) and the lowest in patients who were completely edentulous. *Post-hoc* tests indicated statistically significant difference for MI on both sides between Kennedy I and fully dentate subjects ( $p \leq 0.001$ ), as well as between fully dentate and completely edentulous subjects ( $p \leq 0.001$ ), but not between Kennedy I and completely edentulous subjects ( $p = 0.470$ ). Fully dentate subjects were also the youngest group. Females had significantly lower values than males. Chi-square test demonstrated a statistically significant difference for MCI between dental status groups, but not between different genders. **Conclusion:** MI and MCI may be affected by dental status and age.

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### Key words

DMF Index; Health Status Indicators;  
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