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Utjecaj socijalno-ekonomskog statusa, pušenja i zdravstvenog statusa pacijenata na neuspjeh implantološke terapije

Patients' Socio-Economic Status, Tobacco and Medical History Associated with Implant Failure

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Sažetak

Svrha: Željela se istražiti moguća veza između pacijenata kod kojih se dogodilo odbacivanje implantata i onih s uspješnom implantoprotetičkom terapijom. **Materijali i metode:** Ovo retrospektivno istraživanje temelji se na 186 slučajeva s odbacivanjem implantata i 186 uspješnih slučajeva s usporedivom dobi i spolom, što je činilo ukupno 372 pacijenta. Zabilježeni su dob tijekom postupka, spol, povijest bolesti, pušenje, status zdravstvenog osiguranja, poštanski broj i ishod liječenja (odbacivanje implantata/uspješno liječenje implantatom). **Rezultati:** Sudjelovalo je 47,6 % žena, 48,9 % pojedinaca sa zdravstvenim osiguranjem i 9,7 % pušača. Pronađena je statistički značajna povezanost ($p \leq 0,05$) između odbacivanja implantata i uspješne implantoprotetičke terapije s obzirom na pušenje, socijalno-ekonomski status i povijest bolesti. Status zdravstvenog osiguranja i područje implantacije (regija, zubni luk) nisu statistički značajno utjecali ($p > 0,05$) na rezultat implantoprotetičke terapije. **Zaključci:** Uzimajući u obzir ograničenja ove retrospektivne studije slučaja, pojedinci s visokim socijalno-ekonomskim statusom, a pritom nepušači i s preboljelim srčanim udarom, imali su veću vjerojatnost za uspješno liječenje implantatima od onih s niskim socijalno-ekonomskim statusom i bez srčanog udara u povijesti bolesti.

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Uvod

Dentalni implantati postali su općeprihvaćena terapijska mogućnost u posljednjih nekoliko desetljeća zbog manje psihološke traume za pacijenta te funkcionalnijeg ishoda liječenja s boljim estetskim rezultatom, u usporedbi s konvencionalnim restaurativnim zahvatima (1, 2). Stope uspješnosti dentalnih implantata iznose od 96,7 % do 97,5 % za pojedinačne implantate i od 92,5 % do 93,6 % za fiksne mostove u razdoblju od šest do sedam godina (3). Iako je uporaba oseointegriranih dentalnih implantata postala predvidiva mogućnost liječenja, mogu se pojaviti komplikacije koje rezultiraju gubitkom implantata tijekom faze opterećenja i održavanja (4). Čimbenici koji utječu na preživljavanje implantata različiti su i povezani su s pacijentovim rizičnim čimbenicima kao što su pušenje, parodontne bolesti, parodontne patogene bakterije, gustoća kosti, sistemske bolesti i atrofija kostiju, mikro- i makrostruktura implantata te kirurške tehnike (5, 6).

Introduction

Dental implants have become a preferred treatment option over the last several decades because of the reduced psychological trauma and the high functional and esthetic treatment outcome when compared to conventional restorative treatments (1,2). The reported success rates of dental implants range from 96.7% to 97.5% for single implants and 92.5% to 93.6% for fixed partial restorations over a period of 6 to 7 years (3). Although the use of osseointegrated dental implants have become a predictable treatment option, complications leading to implant loss may still occur during loading and maintenance (4). Factors that affect implant survival are diverse and have been associated with patient's risk factors such as smoking, periodontal disease, periodontal pathogenic bacteria, bone density, systemic diseases and bone atrophy as well as implant micro- and macrostructure and surgical techniques (5,6).

Neuspjesi implantoprotetičke terapije mogu se podijeliti na rane i kasne, prema razdoblju kada su se dogodili (4). Rani neuspjesi obično se otkrivaju u prvih tri do šest mjeseci, a obilježava ih slaba oseointegracija. Kasni neuspjesi mogu nastati nakon što se implantat oseointegrirao, a obilježava ih neadekvatno očuvanje koštane potpore. Odbacivanje implantata karakterizira radiolucencija oko cijelog opsega implantata s nedostatkom kontakta između implantata i kosti te pomičnost, a implantati kojima prijete neuspjeh sporo i kontinuirano gube marginalnu kost bez kliničke mobilnosti (4). Odbacivanje implantata velik je problem za pacijente, kirurge i osiguravajuća društva te su potrebna daljnja istraživanja kako bi se identificirali mogući rizični čimbenici.

Odbacivanje implantata i periimplantitis pojavljuju se kod 5 % svih ugrađenih implantata (7). Za pacijenata s odbacnim implantatom nadomještanje novim katkad je jedina dostupna opcija za izradu fiksnog ili mobilnog nadomjestka. No ishod s implantatima ugrađenima na položaje odbacjenih još nije jasan (8, 9). U sustavnom pregledu literature, preživljavanje i uspješnost ugrađenih implantata u takvim slučajevima bili su između 71 % i 100 % (10). Iznimno je važno utvrditi etiologiju i identificirati potencijalne rizične čimbenike za gubitak implantata i minimizirati tu pojavu.

Razumijevanje potencijalnih rizičnih čimbenika za odbacivanje implantata prije početka liječenja može pospješiti dugoročno preživljavanje implantata, zdravlje periimplantarnog tkiva i preživljavanje proteze retinirane implantatima. Naime, važno je prepoznati rizik od gubitka i u skladu s tim prilagoditi plan liječenja. Istraživanje je pokazalo da su sociološki i okolišni parametri ključni za zdravstvene rezultate (11). Traženje zdravstvene zaštite također je usko povezano sa statusom zdravstvenog osiguranja, što posljedično utječe na ishod liječenja (12, 13). U dentalnoj medicini dokazano je da osobe s nižim socijalno-ekonomskim statusom imaju povećan rizik od oralnih bolesti od onih s višim (14). Nizak socijalno-ekonomski status i nedostatak zdravstvenog osiguranja povezani su s povećanim potrebama za stomatološkim zahvatima zbog premalo znanja o oralnom zdravlju, nedovoljnog pristupa stomatološkoj skrbi ili loših oralno-higijenskih navika (14, 15). Štoviše, u dentalnoj implantologiji manjkava stomatološka skrb ili loša oralna higijena nakon implantoprotetičke terapije mogu utjecati na dugotrajnost rezultata liječenja. Socijalno-ekonomski status pacijenata i zdravstveno osiguranje nisu u literaturi istraženi kao potencijalni čimbenici rizika od gubitka implantata. Zato je cilj ove retrospektivne studije bio ispitati svaku potencijalnu vezu između socijalno-ekonomskog statusa, povijesti bolesti, pušenja i zdravstvenog osiguranja pacijenata kod kojih se dogodilo odbacivanje implantata i onih s uspješnom implantoprotetičkom terapijom.

Materijali i metode

Uzorak

Podatci za ovu retrospektivnu studiju prikupljeni su iz elektroničkih zapisa terapija provedenih između 2010. i 2016. na Stomatološkom fakultetu Sveučilišta u Minnesoti. Odobrio ju je fakultetski Institucionalni odbor za reviziju. Medicinska dokumentacija pacijenata kojima su ugrađeni i uklonjeni implantati na Stomatološkom fakultetu dobiveni

Implant failures can be divided into early and late based on the time of the failure (4). Early implant failure is usually detected within the first 3-6 months and is characterized by poor osseointegration. Late failure may occur after the implant is osseointegrated and is characterized by inadequate preservation of the bone support. Failed implants are characterized by radiolucency around the entire circumference of the implant with lack of implant-to-bone contact and mobility, while failing implants demonstrate slow and continuous marginal bone loss with absence of clinical mobility (4). Implant failure is a significant concern for patients, implant surgeons and insurance companies and further investigation is required to identify potential factors of implant failure.

The frequency of implant failure and peri-implantitis has been reported in 5% of all placed implants (7). In patients with failed implants, replacement with a new implant is sometimes the only available treatment option for fixed or removable rehabilitation. However, the outcome of implants placed in previously failed implant sites is still unclear (8,9). In a systematic review of the literature, the survival and success rates of implant placement in previously failed implant sites ranged between 71% and 100% (10). It is of paramount importance to determine the etiology and identify potential factors of implant failure and minimize its occurrence.

Understanding potential risk factors of implant failure prior to the initiation of the treatment may foster long-term implant survival, peri-implant tissue health and implant supported prosthesis survival. It is critical to recognize the risk of implant loss and therefore treatment plan accordingly. Research has revealed that social and environmental parameters play a critical role in general health and health outcomes (11). Seeking health care is also closely related to health insurance status which subsequently affects the treatment outcome (12,13). In dentistry, it has been demonstrated that individuals with a lower socio-economic status exhibit an increased risk for oral diseases rather than in those with a higher socio-economic status (14). Low socio-economic status and lack of dental insurance are associated with increased dental treatment needs due to lack of oral health knowledge, poor access to dental care or poor oral hygiene habits (14,15). Moreover, in implant dentistry, infrequent dental care or poor oral hygiene following an implant treatment may affect the long-term treatment outcome. Patient's socio-economic status and dental insurance have not been examined in the literature as potential risk factors of implant failure. Therefore, the aim of this retrospective case-control study was to examine any potential association between socio-economic status, medical history, tobacco status and dental insurance of patients that experienced implant failure and those who had a successful implant treatment.

Material and methods

Subject population

Data for this retrospective case-control study were obtained from the electronic records at the University of Minnesota School of Dentistry for treatment provided between 2010 and 2016 to patients attending the dental clinics. The study was approved by the Institutional Review Board of the University of Minnesota School of Dentistry for medical re-

su iz fakultetske elektroničke baze i podudarali se prema dobi i spolu kako bi se smanjio rizik od pristranosti odabira. Pacijenti su morali imati najmanje 18 godina s navedenim potpunim demografskim podacima i statusom zdravstvenog osiguranja te potpuno ispunjenim anamnestičkim upitnikom. U tablicu su uneseni broj kartona pacijenata, dob tijekom postupka, spol, ima li ili nema zdravstveno osiguranje, povijest bolesti, pušenje, poštanski broj i ishod liječenja.

Prikupljanje podataka

Sistemska medicinska stanja koja su obuhvaćena uključivala su povišeni krvni tlak, srčani udar, visoki kolesterol, astmu, šećernu bolest, poremećaje rada štitnjače, poremećaje rada bubrega, artritis, umjetne zglobove, osteoporozu, depresiju, anksioznost, rak i liječenje raka. Medicinska povijest bolesti, spol, pušenje i zdravstveno osiguranje uključeni su kao binarni parametri. Dob tijekom postupka uvrštena je u analizu kao kontinuirani parametar, a pacijenti su podijeljeni u četiri podskupine u skupini s uspješnom implantoprotetičkom terapijom i u skupini s odbacivanjem implantata prema percentilima dobi: < 54 godina (od 25. do 50. percentila), od 61 do 67 godina (od 50. do 75. percentila) ili ≥ 68 godina (od 75. percentila naviše). Položaj implantata kategoriziran je prema luku (maksila/mandibula) i regiji (prednja/stražnja).

Pošanski brojevi pacijenata korišteni su u istraživanju za procjenu socijalno-ekonomskog statusa na temelju ankete Američke zajednice od 2010. do 2014., te petogodišnje procjene Ureda za popis stanovništva SAD-a. Prema toj anketi prosječni godišnji prihod kućanstva procijenjen je na 90.488,46 dolara. Svaki uključen pacijent klasificiran je na osnovi percentila dohotka u skupine niskog (manje od 25. percentila), niskog do umjerenog (od 25. do 50. percentila), umjerenog do visokog (od 50. do 75. percentila) ili visokog socijalno-ekonomskog statusa (75. percentila i više), ako je prosječan godišnji prihod kućanstva prema poštanskom broju grada u kojem je živio bio manji od 68.707 dolara, između 68.708 i 85.598 dolara, između 85.599 i 103.788 dolara ili više od 103.789 dolara.

Vrsta terapije

Vrsta terapije identificirana je na temelju kodova ADA-e: D 6010 (kirurška ugradnja endosealnog implantata) i D 6100 (uklanjanje implantata – neuspjeh). Sve uključene implantate kirurški su ugradili ili uklonili specijalisti s Odjela za parodontologiju, oralnu i maksilofacijalnu kirurgiju, protetiku i endodonciju Stomatološkog fakulteta Sveučilišta u Minnesoti. Svi pacijenti kojima su uklonjeni implantati (n = 186) uključeni su u analizu, a oni s uspješnom implantoprotetičkom terapijom (n = 186) odabrani su nasumično da bi poslužili kao kontrola.

Statistička analiza

Uobičajeni problem retrospektivnih studija slučaja s kontrolom jest odabir usporedive kontrolne skupine. Naime, trebaju se odabrati osobe slične distribucije izloženosti. Kontrolna skupina u ovom istraživanju slučajno je odabrana iz iste populacije, uz prilagodbu dobi i spola zbog minimizira-

cord chart review. Dental records of patients who had implant placement and implant removal in the dental school were retrieved from the electronic database of the School of Dentistry and were matched for age and gender to reduce any risk of selection bias. Patients had to be at least 18 years of age with complete demographic characteristics and insurance status as well as completely answering the medical history questionnaire. Patient's chart number, age at the time of the procedure, gender, presence/absence of dental insurance, medical history, tobacco use, ZIP code and type of treatment provided were all included in a datasheet.

Data collection

The examined systemic medical conditions consisted of self-reported high blood pressure, heart attack, high cholesterol, asthma, diabetes, thyroid disorder, kidney disorder, arthritis, artificial joint, osteoporosis, depression, anxiety, cancer and cancer treatment. Medical history, gender, tobacco use and dental insurance were included as binary parameters. Age at the time of the procedure was included in the analysis as a continuous parameter, while patients were also divided into four sub-study groups in the implant success and the implant failure study groups based on the percentiles of age with <54 years (under the 25th percentile), 54-60 years (25th to 50th percentile), 61-67 years (50th to 75th percentile) or ≥68 years of age (75th percentile and above). Implant location was categorized into arch (maxilla/mandible) and region (anterior/posterior).

Patient ZIP codes were utilized in the study to assess socio-economic status based on the 2010-2014 American Community Survey 5-year estimates of the U.S. Census Bureau. This survey reported that the mean annual household income was estimated to be \$90,488.46. Each included patient was classified based on percentiles of income with a low (under the 25th percentile), low to moderate (25th to 50th percentile), moderate to high (50th to 75th percentile) or high socio-economic status (75th percentile and above) if the mean annual household income of the ZIP code where he/she lived was below \$68,707, between \$68,708 and \$85,598, between \$85,599 and \$103,788 or above \$103,789, respectively.

Type of treatment

The type of treatment provided was identified based on the ADA codes: D6010 (surgical placement, endosteal implant) and D6100 (implant removal-failure). All included implants were surgically placed or removed by faculty or residents in the Division of Periodontology, Oral and Maxillofacial surgery, Prosthodontics and Endodontics at the University of Minnesota School of Dentistry. All patients that had implant removal (n=186) were included in the analysis, while patients with a successful implant treatment (n=186) were randomly selected to serve as control.

Statistical analysis

An inherent problem in retrospective case-control studies is the selection of a comparable control group. The aim is to select individuals with similar distribution of exposure status. The control group in the present study was randomly selected from the same population and was matched for age and gender due

nja potencijalnog rizika od pristranosti. Prikupljeni podatci uneseni su u računalnu bazu podataka i analizirani statističkim programom. Korištena je deskriptivna statistika, uključujući frekvencije, srednje vrijednosti i standardne devijacije. Obavljen je hi-kvadrat test za procjenu značajnosti položaja implantata (luk, regija), učestalosti medicinskih stanja, statusa zdravstvenog osiguranja i socijalno-ekonomskog statusa s obzirom na zavisnu varijablu (uklanjanje implantata). Omjeri vjerojatnosti i odgovarajuće p-vrijednosti za uzorak analizirani su logističkom regresijskom analizom. Svi testovi značajnosti procijenjeni su na razini pogreške od 0,05, s pomoću statističkog softvera (SPSS v.21.0, IBM, Armonk, NY, SAD).

Rezultati

U ispitnu skupinu uključeno je ukupno 186 zapisa o uklanjanju implantata pronađenih u elektroničkoj bazi podataka Stomatološkog fakulteta Sveučilišta u Minnesoti. Oni s uspješnim ugradnjama implantata koje su obavili specijalisti ili nastavnici toga fakulteta na početku su pregledani da bi se provjerila prihvatljivost na temelju uključnih i isključnih kriterija, a 186 zapisa koji su se prema dobi i spolu podudarali s ispitnom skupinom slučajno su odabrani i izvršeni u kontrolnu skupinu. Zato su u konačnu analizu uključena ukupno 372 zapisa o dentalnim implantatima kako bi se ustanovilo jesu li status zdravstvenog osiguranja, socijalno-ekonomski status, pušenje i medicinski uvjeti bili povezani s gubitkom implantata. Prosječna dob pacijenata bila je $61,26 \pm 11,02$ s 23,7 % populacije koja je bila < 54 godina, 22,8 % u dobi od 54 do 60 godina, 26,6 % u dobi između 61 i 67 godina i 26,9 % \geq 68 godina. Populaciju je činilo je 52,4 % muškaraca i 47,6 % žena.

to minimize the potential risk of selection bias due to the presence of confounding factors. The data from the included dental charts were collected and recorded in a computer database and analyzed utilizing a statistical program. Descriptive statistics including frequencies, means and standard deviations were calculated for patients' characteristics. Chi-square tests were performed to assess implant location (arch, region), prevalence of medical conditions, insurance status and socio-economic status in regards to the dependent variable (implant removal). The odds ratios and corresponding p-values for the sample were analyzed by logistic regression analysis. All tests of significance were evaluated at the 0.05 error level with a statistical software program (SPSS v.21.0, IBM, Armonk, NY, USA).

Results

A total of 186 dental records of implant removal were identified in the electronic database of the University of Minnesota School of Dentistry and included in the test group. Records of successful implants placed by residents or faculty members of the University of Minnesota School of Dentistry were initially screened for eligibility based on the inclusion and exclusion criteria of the study and 186 age and gender matched records were randomly selected and included in the control group. Therefore, a total of 372 records of dental implants were included in the final analysis to determine whether dental insurance, socio-economic status, tobacco use and medical conditions are associated with implant failure. The mean age of the included 372 patients was 61.26 ± 11.02 with 23.7% of the population being <54 years of age, 22.8% 54-60 years, 26.6% between 61 and 67 years and 26.9% \geq 68 years. The included population consisted of 52.4% males and 47.6% females.

Tablica 1. Status zdravstvenog osiguranja, socijalno-ekonomski status i pušenje ukupne populacije i usporedba između pacijenata s uspješnom i neuspješnom implantoprotetičkom terapijom
Table 1 Insurance status, socio-economic status and tobacco use of the total population and comparison between patients with implant failure and successful implants

Parametar • Characteristics	Ukupno • Total (n=372)	Odbacivanje implantata • Implant failure (n=186)	Uspješna implantoprotetička terapija • Successful implant treatment (n=186)	p-vrijednost* • p-value*
Socijalno-ekonomski status • Socio-economic status				
Nizak • Low (%)	100 (26.9)	48 (48.0)	52 (52.0)	0.021
Nizak do umjeren • Low to moderate (%)	88 (23.7)	54 (61.4)	34 (38.6)	
Umjeren do visok • Moderate to high (%)	91 (24.4)	48 (52.7)	43 (47.3)	
Visok • High (%)	93 (25.0)	36 (38.7)	57 (61.3)	
Zdravstveno osiguranje • Dental insurance				0.300
Da • Yes (%)	182 (48.9)	96 (52.7)	86 (47.3)	
Ne • No (%)	190 (51.1)	90 (47.4)	100 (52.6)	
Pušenje • Tobacco use				0.002
Da • Yes (%)	36 (9.7)	27 (75.0)	9 (25.0)	
Ne • No (%)	336 (90.3)	159 (47.3)	177 (52.7)	
Područje implantacije • Implant region				0.102
Prednje • Anterior (%)	81 (21.8)	47 (58.0)	34 (42.0)	
Stražnje • Posterior (%)	291 (78.2)	139 (47.8)	152 (52.2)	
Luk • Implant arch				0.398
Maksila • Maxilla (%)	222 (59.7)	107 (48.2)	115 (51.8)	
Mandibula • Mandible (%)	150 (40.3)	79 (52.7)	71 (47.3)	

* Statistički značajna razlika među skupinama s p-vrijednošću \leq 0,05. Za stomatološko osiguranje, socioekonomski status, korištenje duhana, mjesto implantacije (regija i zubni luk), korišten je hi-kvadrat test. Povećane vrijednosti predstavljaju statistički značajne razlike. • Statistical significant difference between study groups with p-values \leq 0.05. For dental insurance, socio-economic status, tobacco use, implant location (region and arch), chi-square test was used. Bold values represent statistically significant differences.

U tablici 1. prikazani su status zdravstvenog osiguranja, socijalno-ekonomski status i navika pušenja ukupne populacije te usporedba pacijenata s gubitkom implantata i s uspješno oseointegriranim implantatima. Socijalno-ekonomsko stanje za 26,9 % ocijenjeno je kao nisko, za 23,7 % kao nisko do umjereno, za 24,5 % kao umjereno do visoko i za 25,0 % kao visoko. Socijalno-ekonomski status dosegnuo je razinu statističke značajnosti (hi-kvadrat test, $p = 0,021$), što pokazuje da osobe s visokim socijalno-ekonomskim statusom (≥ 103.789 dolara), u usporedbi s onima s niskim, imaju ve-

Insurance status, socio-economic status and tobacco use of the total population and comparison between patients with implant failure and successful implants are shown in Table 1. In regards to the socio-economic status, 26.9% were classified as low, 23.7% as low to moderate, 24.5% as moderate to high and 25.0% as high socio-economic status. The socio-economic status reached the significance level (chi-square test, $p=0.021$) demonstrating that individuals with high a socio-economic status ($\geq 103,789$) when compared to those with a low socio-economic status are more likely to have a

Tablica 2. Prevalencija sistemskih stanja u ukupnoj populaciji i između pacijenata kojima je uklonjen implantat i onih s uspješnom terapijom
Table 2 Prevalence of systemic conditions in the total population and between patients that had an implant removal and a successful implant treatment.

Stanje • Characteristics	Ukupno • Total (n=372)	Odbacivanje implantata • Implant failure (n=186)	Uspješna implantoprotetička terapija • Successful implant treatment (n=186)	p -vrijednost* • p-value*
Visoki krvni tlak • High blood pressure Da • Yes (%) Ne • No (%)	110 (29.6) 262 (70.4)	56 (50.9) 130 (49.6)	54 (49.1) 132 (50.4)	0.820
Srčani udar • Heart attack Da • Yes (%) Ne • No (%)	14 (3.8) 358 (96.2)	3 (21.4) 183 (51.1)	11 (78.6) 175 (48.9)	0.029
Visoka razina kolesterola • High cholesterol Da • Yes (%) Ne • No (%)	91 (24.7) 280 (75.3)	43 (46.7) 143 (51.1)	49 (53.3) 137 (48.9)	0.471
Astma • Asthma Da • Yes (%) Ne • No (%)	19 (5.1) 353 (94.9)	11 (57.9) 175 (49.6)	8 (42.1) 178 (50.4)	0.480
Dijabetes • Diabetes Da • Yes (%) Ne • No (%)	40 (10.8) 332 (89.2)	18 (45.0) 168 (50.6)	22 (55.0) 164 (49.4)	0.503
Poremećaj rada štitnjače • Thyroid disorder Da • Yes (%) Ne • No (%)	36 (9.7) 336 (90.3)	23 (63.9) 163 (48.5)	13 (36.1) 73 (51.5)	0.079
Bolest bubrega • Kidney disease Da • Yes (%) Ne • No (%)	4 (1.1) 368 (98.9)	2 (50.0) 184 (50)	2 (50.0) 184 (50.0)	1.000
Artritis • Arthritis Da • Yes (%) Ne • No (%)	94 (25.3) 278 (74.7)	51 (54.3) 135 (48.6)	43 (45.7) 143 (51.4)	0.340
Umjetni zglobovi • Artificial joint Da • Yes (%) Ne • No (%)	41 (11.0) 331 (89.0)	26 (63.4) 160 (48.3)	15 (36.6) 171 (51.7)	0.069
Osteoporozna • Osteoporosis Da • Yes (%) Ne • No (%)	22 (5.9) 350 (94.1)	15 (68.2) 171 (48.9)	7 (31.8) 179 (51.1)	0.079
Depresija • Depression Da • Yes (%) Ne • No (%)	52 (14.0) 320 (86.0)	30 (57.7) 156 (48.8)	22 (42.3) 164 (51.2)	0.232
Anksioznost • Anxiety Da • Yes (%) Ne • No (%)	46 (12.4) 326 (87.6)	24 (52.2) 162 (49.7)	22 (47.8) 164 (50.3)	0.753
Rak • Cancer Da • Yes (%) Ne • No (%)	42 (11.3) 330 (88.7)	19 (45.2) 167 (50.6)	23 (54.8) 163 (49.4)	0.512
Liječenje raka • Cancer treatment Da • Yes (%) Ne • No (%)	25 (6.7) 347 (93.3)	8 (32.0) 178 (51.3)	17 (68.0) 169 (48.7)	0.062

* Statistički značajna razlika među skupinama je p-vrijednost $\leq 0,05$, podebljane vrijednosti pokazuju statistički značajnu razliku na temelju hi-kvadrat testa • Statistical significance between study groups with $p\text{-value}\leq 0.05$. Bold value represents statistically significant differences obtained from chi-square test.

ću vjerojatnost za uspješno liječenje implantatom i manji rizik od potrebe za uklanjanjem implantata. Pojedinci s niskim socijalno-ekonomskim statusom imali su omjer vjerojatnosti 0,469 (logistička regresijska analiza, 95 % CI: 0,237 – 0,929, $p = 0,030$) kad je riječ o uspješnoj implantoprotetičkoj terapiji.

U vezi sa statusom zdravstvenog osiguranja istaknimo da je 48,9 % stanovništva bilo osigurano, a 51,1 % nije. Taj status nije statistički značajno utjecao na ishod liječenja (hi-kvadrat test, $p = 0,300$) i u obje skupine (s osiguranjem ili bez osiguranja) rezultat liječenja bio je sličan. Pušenje je prijavilo 9,7 % pacijenata, a većina je navela (90,3 %) da ne konzumira duhan. Kod većine uključenih konzumenata duhana (75 %) dogodilo se odbacivanje implantata i to je statistički značajno različito (hi-kvadrat test, $p = 0,002$) u usporedbi s pojedincima koji nisu pušili (47,3 %). Pušači su s 3,710 (95 % CI: 1,319 – 10,440) imali statistički značajno veći omjer vjerojatnosti od gubitka implantata (logistička regresijska analiza, $p = 0,013$). Otprilike tri četvrtine uključenih implantata (78,2 %) bilo je u stražnjoj regiji i 59,7 % u maksili, ali njihov položaj nije značajno utjecao na rizik od gubitka implantata za određenu regiju (hi-square test, $p = 0,102$) i za luk (kvadratni kvadrat, $p = 0,398$).

U tablici 2. prikazana je prevalencija sistemskih stanja u ukupnoj populaciji i između pacijenata s uspješnom i neuspješnom implantoprotetičkom terapijom. Visok krvni tlak (29,6 %), visok kolesterol (24,7 %), artritis (25,3 %) i depresija (14,0 %) bile su najčešće navedene opće bolesti. Srčani udar (hi-kvadrat test, $p = 0,029$) pokazao je statistički značajnu povezanost s ishodom liječenja. Konkretno, osobe s preboljelim srčanim udarom imale su veću vjerojatnost za uspješno liječenje implantatom (78,9 %) u usporedbi s onima bez srčanog udara u povijesti bolesti (48,9 %) (hi-kvadrat test, $p = 0,029$). Nijedan od ostalih ispitivanih sistemskih parametara nije ocijenjen kao značajno povezan s ishodom liječenja.

Rasprava

Identifikacija čimbenika koji utječu na ishod liječenja može dati vrijedne informacije da bi se razlikovali pacijenti s rizikom od odbacivanja implantata od onih s uspješnim odgovorom na liječenje. Prepoznavanje varijabli kod pacijenata koje mogu utjecati na ishod liječenja potiču na bolje promišljanje (16). U ovom istraživanju nastojali smo ustanoviti kako socijalno-ekonomski status, status zdravstvenog osiguranja, sistemske bolesti i pušenje utječu na ishod liječenja. Otkrili smo da osobe s visokim socijalno-ekonomskim statusom, nepušači i bolesnici s preboljelim srčanim udarom imaju veću vjerojatnost za uspješnu implantoprotetičku terapiju od onih s niskim socijalno-ekonomskim statusom, pušačima i bez srčanog udara u povijesti bolesti.

U procesu donošenja odluka kliničari mogu biti pod utjecajem obilježja pacijenata kao što su dob, spol, razina obrazovanja, osobnost i socijalno-ekonomski status (17). Socijalno-ekonomski status bio je statistički značajan prediktor za odbacivanje i uklanjanje implantata. U ovom istraživanju pojedinci nižega socijalno-ekonomskog statusa imali su veći ri-

successful implant treatment and less risk of implant removal. Individuals with a low socio-economic status had an odds ratio of 0.469 (logistic regression analysis, 95% CI: 0.237-0.929, $p=0.030$) for having a successful implant.

With respect to insurance, 48.9% of the population had dental insurance, while 51.1% had no dental insurance. In regards to the treatment outcome, insurance status did not show any significant differences (chi-square test, $p=0.300$) and both groups (presence or absence of insurance) showed similar treatment outcome. Tobacco use was self-reported by 9.7% of the patients, whereas the majority of the population (90.3%) indicated they did not use tobacco. The majority of the included tobacco users (75%) had implant failure and this was found to be statistically significantly (chi-square test, $p=0.002$) different compared to individuals who did not use tobacco (47.3%). Tobacco users exhibited a statistically significant (logistic regression analysis, $p=0.013$) odds ratio of 3.710 (95% CI: 1.319-10.440) of having implant failure. Approximately three quarters of the included implants (78.2%) were in the posterior region and 59.7% in the maxilla, but implant location did not affect significantly the risk of implant failure for region (chi-square test, $p=0.102$) and for arch (chi-square test, $p=0.398$).

Prevalence of systemic conditions in the total population and between patients that had an implant failure and a successful implant treatment is shown in Table 2. High blood pressure (29.6%), high cholesterol (24.7%), arthritis (25.3%) and depression (14.0%) were the most commonly self-reported medical diseases. Heart attack (chi-square test, $p=0.029$) showed statistically significant association with the treatment outcome. In particular, individuals with heart attack were more likely to have a successful implant treatment (78.9%) as compared to individuals with no history of heart attack (48.9%) (chi-square test, $p=0.029$). None of the other examined systemic disease parameters evaluated were found to be significantly associated with the treatment outcome.

Discussion

Identification of patient characteristics influencing treatment outcomes may provide valuable information in order to distinguish patients at risk of implant failure from patients with successful treatment response. Recognizing patient-level variables that affects treatment outcomes has the potential to enhance clinical reasoning (16). In this study, we aimed to identify socio-economic parameters, insurance status, medical conditions and history of tobacco use that would have the potential to demonstrate treatment effect modification. We found that individuals with high socio-economic status, tobacco non-users and patients with a history of heart attack were significantly more likely to have a successful implant than those with a low socio-economic status, tobacco users and with no history of heart attack.

In the decision-making process, clinicians may be influenced by characteristics of patients such as age, gender, education level, personality and socio-economic status (17). Socio-economic status was a statistically significant predictor of implant failure and removal. In the present study, individu-

zik od odbacivanja implantata. Važno je napomenuti da su takvi pojedinci lošijega zdravstvenog stanja zbog teže dostupnih resursa i ograničenog pristupa zdravstvenoj zaštiti (18). Nemogućnost redovitog obavljanja profilaktičkog čišćenja ili parodontoloških pregleda može biti problem. U literaturi je zabilježena povezanost između socijalno-ekonomskog statusa i četkanja zuba ≥ 3 puta dnevno, pri čemu su osobe s većim dohotkom i višim stupnjem obrazovanja imale omjere vjerojatnosti od 1,264 do 2,686 (19). Neadekvatne navike oralne higijene također mogu opravdati naše rezultate. U ovom istraživanju, informacije o stupnju obrazovanja pacijenata nisu bile dostupne zbog retrospektivnog oblika istraživanja.

Stomatološki fakultet Sveučilišta u Minnesoti ne traži informacije o stupnju obrazovanja tijekom prijma pacijenata. Učinak socijalno-ekonomskog statusa u ovom istraživanju procijenjen je poštanskim brojem adrese pacijenata, kao pomoć pri određivanju individualnog socijalno-ekonomskog statusa, što je u prošlosti potvrđeno drugim epidemiološkim istraživanjima (21, 22). U ovom istraživanju pacijenti sa zdravstvenim osiguranjem imali su slične ishode liječenja u usporedbi s neosiguranima. Činjenica da pacijent ima zdravstveno osiguranje nije utjecala na preživljavanje implantata kao što se na početku pretpostavljalo. To otkriće može se pripisati niskom trošku profilaktičkih postupaka i godišnjih pregleda koji su dostupni i neosiguranim pacijentima, posebno u sveučilišnim stomatološkim klinikama. Neosigurani pacijenti mogu biti u stanju osobno financirati profilaktičke postupke te slijediti upute nakon liječenja bez obzira na to imaju li ili nemaju zdravstveno osiguranje. Prema autorovim spoznajama, ovo je prvo istraživanje u kojemu se analizirao učinak statusa zdravstvenog osiguranja na ishod liječenja implantatima.

U ovom istraživanju nisu ustanovljene razlike u stopama preživljavanja prema položaju implantata, što je u skladu s retrospektivnim istraživanjem Eckerta i suradnika koje je pokazalo da položaj implantata nema nikakva utjecaja na preživljavanje implantata, učestalost lomljenja implantata, popuštanje vijaka ili pucanje vijaka (23). Za dentalne implantate u maksili zabilježena je i trostruko veća stopa neuspjeha negoli za one u mandibuli (4). Drugi autori ističu da su najniže stope uspjeha u stražnjem dijelu gornje čeljusti (91,4 %), zatim u prednjem dijelu gornje čeljusti (97 %), u stražnjem dijelu donje čeljusti (96,3 %) te u prednjem dijelu donje čeljusti (97,9 %) (24).

Osnovne sistemske bolesti mogu utjecati na preživljavanje implantata i rizik od periimplantitisa (25). Autori su pretpostavili da su pojedinci s određenim sistemskim bolestima/stanjima i pušači skloniji odbacivanju implantata u usporedbi sa zdravom kontrolom. Sistemske bolesti povezane s komplikacijama u implantoprotetičkoj terapiji uključuju kardiovaskularne bolesti, poremećaje rada štitnjače, dijabetes, hepatitis, HIV, Crohnovu bolest, osteoporozu te pušenje (25, 26). No stupanj ozbiljnosti određene sistemske bolesti može biti važniji od njezine prirode. U ovom istraživanju dijabetes nije bio povezan s odbacivanjem implantata, što bi se moglo objasniti kontroliranim razinama glikemije. Pojedinci s preboljelim srčanim udarom imali su statistički značajno veću vjerojatnost za uspješno liječenje implantatima u usporedbi s onima bez srčanog udara u povijesti bolesti. To se može pri-

als with a lower socio-economic status demonstrated a higher risk of experiencing implant failure that led to implant failure. It is noteworthy that individuals of a lower socioeconomic status showed poorer health outcomes as a result of less available resources and the limited access to health care (18). The potential difficulties in attending hygiene appointments or having a comprehensive periodontal examination may explain this finding. An association between socio-economic status and oral health behaviors for tooth brushing ≥ 3 times/day has been reported in the literature with individuals of high income and education level presenting with odds ratios of 1.264 and 2.686, respectively (19). Less optimal oral hygiene habits may also justify our results. In the present investigation, information about patients' education level was not available due to the retrospective design of the study. The School of Dentistry at the University of Minnesota does not require information on the level of education received as part of their admission of patients. The effect of socio-economic status in the present study was solely evaluated by neighborhood-level measures that have often been used in the literature (20). We utilized a patient's zip code as a surrogate measure to determine individual socio-economic status, which has been validated in the past by other epidemiological investigations (21,22). In the present study, patients with dental insurance exhibited similar implant treatment outcomes when compared to uninsured patients. The presence of dental insurance did not affect the survival of the implants as it was initially hypothesized. This finding may be attributed to the low cost of prophylactic treatments and annual recall appointments which are not deterrent to uninsured patients especially in university dental clinics. Uninsured patients may also be financially capable of paying out of pocket for their dental care as well as following the post-treatment instructions regardless of the presence of dental insurance. To the best of the authors' knowledge, this is the first study that has evaluated the effect of insurance status on the outcome of implant treatment.

In the current study, no difference in the survival rate in regards to the implant region and arch could be detected which is in agreement with another retrospective study by Eckert and colleagues who showed that location of implants did not have any effect on implant survival, implant fracture rates, screw loosening or screw fracture (23). Dental implants placed in the maxilla have been associated with a three times higher rate of failures than in the mandible (4). Other reports demonstrated that the posterior maxillary region exhibits the lowest success rate (91.4%) when compared to the anterior maxillary region (97%), posterior mandible (96.3%) and anterior mandible (97.9%) (24).

Underlying systemic diseases may influence implant failure and the risk of peri-implantitis (25). The authors hypothesized that individuals with certain systemic diseases/conditions and tobacco use would be more prone to have implant failure when compared to systemically healthy controls. Systemic conditions that have been associated with implant-related complications include cardiovascular diseases, thyroid disorders, diabetes, hepatitis, HIV, Crohn's disease, osteoporosis as well as tobacco use (25,26). However, the degree of severity of a specific disease may be more important than the nature of the systemic disorder. In the present investigation, diabetes was

pisati općim promjenama životnih navika pacijenata koji su doživjeli srčani udar, što uključuje usvajanje zdravijih navika negoli prije bolesti. Pacijentima su možda njihovi kardiolozi i liječnici opće prakse preporučili da redovito posjećuju stomatologa kako bi eliminirali mogućnost opće infekcije. Slične komplikacije s dentalnim implantatima između pacijenata sa sistemskim bolestima i zdravih pojedinaca zabilježene su u sistemiziranom pregledu literature, što je pokazalo da su potrebna opsežnija istraživanja (27). U ovom istraživanju pušači su imali 3710 puta veću vjerojatnost za odbacivanje implantata u usporedbi s nepušačima. Pušenje se smatra jednim od glavnih rizičnih čimbenika koji utječe na dugoročno preživljavanje dentalnih implantata (25). Povezanost između navike pušenja i preživljavanja implantata pripisuje se uglavnom djelovanju pušenja na osteogenezu i angiogenezu, te na parametre ponašanja jer pušači rjeđe vode brigu o oralnom zdravlju, rjeđe posjećuju stomatologa i lošije održavaju oralnu higijenu (28 – 31).

Neuspjesi u implantoprotetičkoj terapiji mogu se pripisati različitim uvjetima ili situacijama. To uključuje izostanak oseointegracije, loše planiranje terapije i/ili manjak kirurškog iskustva, što može rezultirati lošim pozicioniranjem implantata, defektom mekih tkiva i biomehaničkim problemima, a to uključuje popuštanje vijaka i pucanje komponenti implantata (32). Zbog retrospektivnog istraživanja podaci o pacijentovim navikama oralne higijene nisu bili dostupni za analizu. To je ograničenje ovog istraživanja s obzirom na štetno djelovanje loše oralne higijene na zdravlje tkiva oko implantata i njegovo preživljavanje (33, 34). Uklanjanje implantata zahtijeva od pacijenta dodatne troškove i postupke te frustrira terapeute. Zato odgovarajući odabir pacijenata i pravilno planiranje terapije mogu rezultirati uspješnim dugoročnim ishodom implantoprotetičke terapije s funkcionalnim i estetskim nadomjescima. Identifikacija parametara koji mogu potaknuti odbacivanje implantata iznimno je važna i za kliničare i za pacijente.

Zaključci

Uzimajući u obzir ograničenja ove retrospektivne studije slučaja, pojedinci s visokim društveno-ekonomskim statusom, poviješću pušenja i srčanog udara imali su veću vjerojatnost za uspješno liječenje implantatima od onih s niskim socijalno-ekonomskim statusom i bez srčanog udara u povijesti bolesti. Rezultati ovog istraživanja daju doktorima dentalne medicine vrijedne informacije o odabiru pacijenata za uspješno liječenje implantatima, ali nema dokaza da je povijest bolesti povezana s ishodom terapije. Daljnja, opsežnija istraživanja trebala bi dodatno otkriti učinak statusa zdravstvenog osiguranja, socijalno-ekonomskog statusa, povijesti bolesti i pušenja na rizik od odbacivanja implantata.

Sukob interesa

Autori navode da nisu bili u sukobu interesa.

not related to implant failure which may possibly be associated with controlled glycemic levels. Individuals with a history of heart attack were statistically significantly more likely to have a successful implant treatment compared to those without heart attack. This may be attributed to the general lifestyle shifts of patients who underwent heart attack which includes adoption of healthier social habits than prior to the heart attack. Patients may have been recommended by their cardiologists and general medical practitioners to receive dental treatment regularly in order to eliminate any potential risk of general infection. Similar complications and failures of dental implants between medically compromised patients and healthy individuals were reported in a systematic review of the literature revealing the need for larger studies (27). In the current study, tobacco users were 3.710 times more likely to have an implant failure when compared to non-smokers. Smoking is considered one of the major risk factors that impacts the long-term survival of dental implants (25). The association between smoking habits and implant survival has been attributed mainly to its effect on osteogenesis and angiogenesis as well as to behavioral parameters such as smokers' less optimal oral health, infrequent dental visits and less favorable oral hygiene habits (28-31).

Implant failures in dentistry can be attributed to a variety of conditions or situations. These include loss of osseointegration, poor treatment planning and/or poor surgical experience that lead to positional failure, soft tissue defects and biomechanical failures that include a variety of incidences that range from screw loosening to implant or implant component fracture (32). Due to the retrospective design of the study, data on patients' oral hygiene habits and plaque control were not available for the analysis. This is a limitation of the study due to the detrimental effect of poor oral hygiene on peri-implant tissue health and implant survival (33,34). The aftermath of implant removal leads to further cost and additional procedures for the patient as well as a clinician's frustration. Therefore, appropriate patient selection and proper treatment planning may result in successful long-term dental implants with functional and esthetic implant supported restorations. The identification of parameters that may lead to implant failure is of paramount importance for both clinicians and patients.

Conclusions

Within the limitation of this retrospective case-control study, individuals with high socio-economic status, no history of tobacco use and history of heart attack were more likely to have a successful implant treatment than those with a low socio-economic status, tobacco users and without a history of heart attack. The results of the present study provide valuable information for dental professionals about patient selection for successful implant treatment, but there is lack of evidence to suggest that medical history is associated with implant treatment outcome. Further prospective large scale studies should assess the effect of insurance status, socio-economic status, medical history and tobacco use on the risk of implant failure.

Conflict of interest

The authors declare no conflicts of interests.

Abstract

Objective: To examine the potential association between patients' characteristics that experienced implant failure and those who had successful implant treatment. **Materials and methods:** This retrospective case-control study is based on 186 dental records of implant failure and 186 age and gender matched successful treatments for a total of 372 patients. Age at the time of the procedure, gender, medical history, tobacco use, dental insurance status, ZIP code and type of treatment provided (implant failure/successful implant treatment) were recorded. **Results:** The population consisted of 47.6% females, 48.9% individuals with dental insurance and 9.7% self-reported tobacco users. A statistically significant association ($p \leq 0.05$) was found between implant failure and successful implant treatment in regards to tobacco use, socio-economic status and medical history. Insurance status and implant location (region, arch) did not affect significantly ($p > 0.05$) the outcome of implant therapy. **Conclusions:** Within the limitation of this retrospective case-control study, individuals with high socio-economic status, no history of tobacco use and history of heart attack were more likely to have a successful implant treatment than those with a low socio-economic status, tobacco users and without history of heart attack.

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