

Mia Maltar¹, Lucija Miloš¹, Sladana Milardović², Ines Kovačić³, Sanja Peršić³, Ivana Juroš⁴, Josip Kranjčić^{2,4}

Stajališta studenata Stomatološkog fakulteta u Zagrebu o primjeni CAD/CAM tehnologije

Attitudes of the Students from the School of Dental Medicine in Zagreb towards CAD/CAM

¹ Studentica šeste godine Stomatološkog fakulteta Sveučilišta u Zagrebu, Zagreb, Hrvatska
Sixth year undergraduate student, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

² Zavod za fiksnu protetiku Stomatološkog fakulteta Sveučilišta u Zagrebu, Zagreb, Hrvatska
Department of Fixed Prosthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

³ Zavod za mobilnu protetiku Stomatološkog fakulteta Sveučilišta u Zagrebu, Zagreb, Hrvatska
Department of Removable Prosthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

⁴ Klinički zavod za stomatološku protetiku Kliničke bolnice Dubrava, Zagreb, Hrvatska
Clinical Department of Prosthodontics, Clinical Hospital Dubrava, Zagreb, Croatia

Sažetak

Uvod: U doba digitalne dentalne tehnologije važno je osigurati odgovarajuću edukaciju studenata pretkliničke i kliničke nastave o CAD/CAM tehnologiji. Zato je svrha istraživanja bila ispitati informiranost i stajališta studenata pretkliničke (PS) i kliničke (CS) nastave Stomatološkog fakulteta u Zagrebu o toj tehnologiji jer bi dobiveni rezultati pokazali razinu znanja studenata i eventualnu potrebu za dodatnom izobrazbom. **Materijali i metode:** Istraživanje je provedeno na ukupno 216 studenata Stomatološkog fakulteta Sveučilišta u Zagrebu – 77 (35,6 %) studenata pretkliničke nastave (PS) i 139 (64,4 %) studenata kliničke nastave (CS). Ispitanici su ispunili anonimni upitnik sastavljen za potrebe ovog istraživanja. Dobiveni rezultati statistički su obrađeni na razini značajnosti $p < 0,05$. **Rezultati:** Većina studenata (182; 84,23 %) čula je za CAD/CAM tehnologiju tijekom redovite nastave na fakultetu ($p < 0,05$). Bez obzira na stupanj obrazovanja, većina (204; 94,4 %) nije pohadala ni jedan tečaj o CAD/CAM tehnologiji izvan nastave na fakultetu ($p < 0,05$). Većina PS studenata (72; 33,3 %) te većina CS studenata (133; 61,6 %) smatra da nije dovoljno informirana o CAD/CAM tehnologiji ($p < 0,05$). **Zaključak:** Iako je većina studenata (PS-a i CS-a) čula za CAD/CAM tehnologiju, može se zaključiti da nisu dovoljno informirani te da je potrebna dodatna edukacija o toj temi. CS studenti također nisu bolje informirani o CAD/CAM tehnologiji od PS studenata.

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Adresa za dopisivanje

Josip Kranjčić
Stomatološki fakultet Sveučilišta u Zagrebu
Klinička bolnica Dubrava, Av. G. Šuška
6, 10000 Zagreb, Croatia
Telefon: +385 1 290 3205
faks: +385 1 2864 248
kranjcc@sfzg.hr

Ključne riječi

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Uvod

Tehnologija računalom pomognutog oblikovanja (CAD) i računalom pomognute izrade (CAM) važna je i nezamjenjiva u suvremenoj dentalnoj medicini kako u svijetu tako i u Hrvatskoj. Razvoj CAD/CAM tehnologije počeo je u 60-im godinama prošlog stoljeća u zrakoplovnoj i automobilskoj industriji, a prvi CAD/CAM nadomjestak u dentalnoj medicini izrađen je u 80-ima (1, 2). Od prve primjene CAD/CAM tehnologije do danas svaki pomak u izradi CAD/CAM nadomjestaka tehnološki je napredovao zahvaljujući razvoju i napretku trodimenzionalnih skenera, preciznih i jednostavnih računalnih programa za oblikovanje te glodalica za preciznu izradu nadomjestaka (3). Prema mišljenju Davidowitza i suradnika (1), CAD/CAM tehnologija primarno je razvijena u svrhu poboljšanja čvrstoće i oblikovanja nadomjestaka prirodnog izgleda te njihove jednostavnije, preciznije i brže izrade.

Introduction

Computer-aided design (CAD) and computer-aided manufacturing (CAM) is an important and irreplaceable technology in contemporary dentistry in Croatia and worldwide. CAD/CAM technology was developed in 1960s first for aircraft and automotive industries, while the first CAD/CAM dental restoration was produced in 1980s (1,2). From the first use of CAD/CAM technology in dentistry until today, each step in CAD/CAM process was technologically improved through development and improvement of three-dimensional scanning devices, accurate and simpler softwares for design, and milling machines for precise manufacturing of dental restorations (3). According to Davidowitz et al. (1), CAD/CAM technology was basically developed in order to ensure adequate strength of restorations, to create dental restorations with natural appearance, as well as to enable the whole manufacturing process easier and faster with finally more accurate dental restorations.

CAD/CAM tehnologijom može se obrađivati širok spektar materijala – dentalne legure (kobalt-krom i legure titanija), voskovi, polimeri, kompozitni materijali i dentalna keramika. Stoga se ta tehnologija primjenjuje u mnogobrojnim granama dentalne medicine – u restaurativnoj dentalnoj medicini, protetici, implantologiji te ortodontiji. U protetici postoje dvije metode primjene CAD/CAM tehnologije – ordinacijski sustav (izrada nadomjestka direktno u ordinaciji) te postupak izrade nadomjestka koji uključuje i zubotehnički laboratorij (4 – 8). U odnosu prema konvencionalnoj izradi dentalnih nadomjestaka, CAD/CAM tehnologija omogućuje mnoge prednosti – brzinu i jednostavnost izrade, visoku kvalitetu, uštedu vremena i smanjenje troškova (1). Nedostaci su početni trošak za nabavu potrebne opreme te ulaganje vremena i novca u dodatnu izobrazbu.

Ako se uzme u obzir važnost CAD/CAM tehnologije u suvremenoj dentalnoj medicini, ključno je studentima pretkliničke i kliničke nastave osigurati adekvatnu edukaciju u sklopu studija. Iako je CAD/CAM tehnologija primarno namijenjena kliničkoj primjeni, primjena same tehnologije u svrhu izobrazbe studenata dentalne medicine novi je koncept koji je potaknulo samo nekoliko proizvođača (9). U tom smislu, u sklopu pretkliničke nastave, CAD/CAM tehnologija omogućuje studentima da usporede svoje preparacije zuba s optimalnim preparacijama. Također mogu u računalnom programu oblikovati dentalne nadomjestke i poslati ih na izradu u strojeve za glodanje. Uz praktični rad, teorijski dio edukacije omogućuje im potpuno razumijevanje primjene CAD/CAM tehnologije. Ako studenti shvate prednosti koje im može pružiti digitalna tehnologija u budućem kliničkom radu, veća je vjerojatnost da će je primjenjivati u svakodnevnoj praksi (10). Zato je svrha ovog istraživanja bila procijeniti informiranost i stajališta studenata pretkliničke i kliničke nastave Stomatološkog fakulteta Sveučilišta u Zagrebu o CAD/CAM tehnologiji kako bi dobiveni rezultati pomogli u eventualnoj prilagodbi nastavnog plana i programa te u planiranju dodatne izobrazbe o CAD/CAM tehnologiji.

Materijali i metode

U istraživanju je sudjelovalo 216 studenata dentalne medicine sa Stomatološkog fakulteta Sveučilišta u Zagrebu. Bili su podijeljeni u dvije skupine s obzirom na stupanj školovanja. U prvoj skupini bilo je 77 studenata koji pohađaju pretkliničku nastavu (PS) – treća godina studija, a druga skupina sastojala se od 139 studenata koji pohađaju kliničku nastavu (CS) – peta godina studija. Ukupan broj ispitanika iznosio je 32, a ispitanica je bilo 184. Svi su bili obaviješteni o ciljevima istraživanja te su potpisali informirani pristanak. Istraživanje je odobrilo Etičko povjerenstvo Stomatološkog fakulteta Sveučilišta u Zagrebu.

Svi ispitanici ispunili su upitnik sastavljen za potrebe ovog istraživanja. Sastojao se od dva dijela – u prvom su bila pitanja o osobnim podatcima ispitanika (dob, spol, stupanj obrazovanja – student pretkliničke/kliničke nastave), a drugi dio

A wide range of dental materials can be used by CAD/CAM technology: dental alloys (CoCr alloys, Ti alloys), waxes, polymers, composites, and ceramics. Therefore, CAD/CAM technology has application in many fields of dentistry: restorative dentistry, prosthetic dentistry, dental implantology and orthodontics. Also, there are two ways in prosthetic dentistry how to work with the CAD/CAM technology: chairside system (manufacturing of dental restorations in a clinic) and laboratory system (manufacturing of dental restorations in dental laboratory) (4-8). Finally, CAD/CAM technology for dental restorations has many advantages over traditional techniques: speed, ease of use, high quality of restorations, saving time for clinician and labor as well as reducing costs (1). An important disadvantage of CAD/CAM technology is its initial cost of the equipment and needed software, together with time and money needed for additional education.

Due to CAD/CAM importance in contemporary dentistry, it is important to provide appropriate education about CAD/CAM technology for preclinical and clinical dental students. Although the CAD/CAM technology was primarily developed for clinical application, the use of this technology with the aim of dental students' education is a new concept embraced by only a few manufacturers (9). In that view, in preclinical program CAD/CAM technology enables students to see the difference between their tooth preparations and optimal tooth preparations, as well as to quantify these differences. Students can also design dental restorations and send them to milling machines (9). Apart from practical work, theoretical education enables them to know all other details needed for the CAD/CAM usage. If students perceive how digital and electronic technologies are valuable for their future clinical work, there will be a greater chance of their more general acceptance in every day practice (10). Therefore, the aim of this study was to determine the knowledge and attitudes of preclinical and clinical dental students from the School of Dental Medicine, University of Zagreb towards CAD/CAM technology since the obtained results can serve as a guide in assessing the current curriculum as well as planning of additional education about CAD/CAM technology.

Materials and methods

This study included 216 undergraduate dental students from the School of Dental Medicine, University of Zagreb. The participants were divided into two groups according to the level of their education: first group consisted of 77 preclinical students (PS) – third year undergraduate dental students, and the second group consisted of 139 clinical students (CS) – fifth year undergraduate dental students. A total number of male participants was 32, while a total number of female participants was 184. The participants were informed about the aims of this study, and their consent for participation in study was obtained. This study was approved by the Ethics Committee of the School of Dental Medicine, University of Zagreb, Croatia.

All participants filled out the questionnaire specially designed for this study. The questionnaire consisted of two sec-

sastojao se od 14 pitanja za procjenu informiranosti ispitanika o CAD/CAM tehnologiji u protetici dentalne medicine:

1. Jeste li čuli za CAD/CAM tehnologiju?
2. Gdje ste čuli za CAD/CAM tehnologiju?
3. Jeste li vidjeli koji CAD/CAM nadomjestak?
4. Jeste li radili s CAD/CAM tehnologijom?
5. Jeste li pohađali tečaj o primjeni CAD/CAM tehnologije (izvan nastave na fakultetu)?
6. Treba li se o CAD/CAM tehnologiji više poučavati u sklopu fakultetske nastave?
7. Zašto mislite da je CAD/CAM tehnologija korisna?
8. Smatrate li da ste dovoljno informirani o CAD/CAM tehnologiji?
9. Je li digitalni intraoralni otisak obavezan u izradi protetičkih nadomjestaka CAD/CAM tehnologijom?
10. Koji se materijali upotrebljavaju u glodalicama?
11. Koliko vremena je potrebno za glodanje pojedinačne krunice?
12. Mogu li blokovi cirkonij-oksidge keramike imati faktor skupljanja?
13. Kojom vrstom CAD/CAM sustava bih se koristio/la?
14. CAD/CAM tehnologijom bih se koristio/la za.....

Prikupljeni podatci statistički su obrađeni u računalnom programu SPSS 15.0 (SPSS Inc., Chicago, Illinois, SAD) metodom deskriptivne statistike te primjenom Chi-kvadrat testa i Fischerova egzaktnog testa. Rezultati su analizirani na razini značajnosti $p < 0,05$.

Rezultati

Ukupno 216 ispitanika bilo je podijeljeno u dvije skupine – 77 studenata pretkliničke nastave (PS) ili 35,6 %, te 139 studenata kliničke nastave (CS) ili 64,4 %. PS studenti bili su u dobi od 20 do 24 godine (prosječno 22 godine), a CS studenti u dobi od 21 do 29 godina (prosječno 23 godine). U ukupnom su uzorku 32 ispitanika (14,8 %) bile osobe muškog spola, a njih 184 ženskoga (85,2 %). U skupini PS studenata 12 ispitanika (15,6 %) bili su muškarci, a žena je bilo 65 (84,4 %). U skupini CS studenata 20 ispitanika (14,4 %) bilo je muškog spola, a 119 ženskoga (85,6 %).

Rezultate istraživanja vidi u tablicama 1 i 2.

Većina odgovora iz upitnika bila je statistički značajna ($p < 0,05$). Svi ispitanici čuli su za CAD/CAM tehnologiju. Većina (182; 84,23 %), od kojih 60 PS studenata (27,73 %) te 122 CS studenta (56,5 %), čuli su za CAD/CAM tehnologiju u sklopu redovite nastave na fakultetu ($p < 0,05$). Bez obzira na stupanj obrazovanja, većina ispitanika (204; 94,4 %) nije pohađala ni jedan tečaj o CAD/CAM tehnologiji izvan nastave na fakultetu ($p < 0,05$). Većina PS studenata (72; 33,3%) te većina CS studenata (133; 61,6 %) smatrala je također da nisu dovoljno informirani o toj temi ($p < 0,05$). Među PS studentima njih 48 (22,3 %) odgovorilo je da nikada nisu vidjeli CAD/CAM nadomjestak ($p < 0,05$). U skupini CS studenata njih 69 (31,9 %) vidjelo je, a njih 70 (32,4 %) nikada nije vidjelo CAD/CAM nadomjestak ($p < 0,05$). Intraoralnim skenerom imalo je priliku koristiti se 39 PS studenata (18,1 %) i 81 CS student (37,5 %). Bez obzira na razinu obrazovanja, samo su dva (1 %) studenta odgovorila da CAD/CAM teh-

nologija. In the first section, there were questions about general data of participants (age, gender, and level of education – preclinical or clinical students). The second section of questionnaire consisted of 14 questions designed to evaluate the students' attitudes towards the CAD/CAM technology in prosthetic dentistry: 1. Have you heard about CAD/CAM? 2. Where did you hear about CAD/CAM? 3. Did you ever see any CAD/CAM restoration? 4. Did you work with CAD/CAM? 5. Did you attend any CAD/CAM course (out of regular lectures at the School? 6. Is it necessary to teach more about CAD/CAM within the regular lectures at the School? 7. Why is CAD/CAM technology useful? 8. Are you sufficiently informed about CAD/CAM technology? 9. Is digital intraoral impression obligatory in CAD/CAM fabrication of dental restoration? 10. Which materials are used in milling machines? 11. The time needed for milling a single crown? 12. Could zirconium oxide blocks have a shrinkage factor? 13. What type of CAD/CAM technology would I use? 14. I would use CAD/CAM technology for?.

The results obtained were statistically analyzed using computer software SPSS 15.0 (SPSS Inc., Chicago, Illinois, United States) by the method of descriptive statistics, χ^2 test and Fisher's exact test with a significance level of $p < 0.05$.

Results

Total number of 216 participants was divided into two groups: 77 (35.6%) PS, and 139 (64.4%) CS. Age range of PS was from 20 to 24 years (mean age was 22 years) and the age range of CS was from 21 to 29 years of age (mean age was 23 years). According to gender, this study included 32 (14.8%) male participants, and 184 (85.2%) female participants. Among PS group, 12 (15.6%) were males while 65 (84.4%) were females. Among CS group, 20 (14.4%) were males and 119 (85.6%) were females.

The results from questionnaire are present in table 1 and table 2. A great number of participants' answers from questionnaire were statistically significant ($p < 0.05$). All participants (PS and CS) had heard about CAD/CAM technology. Most of them (182, 84.23%) - 60 (27.73%) PS and 122 (56.5%) CS heard about CAD/CAM technology at regular lectures at the School ($p < 0.05$). Regardless of their level of education, most of participants (204, 94.4%) did not attend any CAD/CAM which were not organized within regular lectures at the School ($p < 0.05$). Also, most of PS (72, 33.3%) and most of CS (133, 61.6%) participants believe that they are not sufficiently informed about CAD/CAM technology ($p < 0.05$). Forty eight (22.3%) PS answered that they didn't see any CAD/CAM restoration ($p < 0.05$). Among CS group of participants, 69 (31.9%) participants saw CAD/CAM restoration and 70 (32.4%) participants did not see any CAD/CAM restoration ($p < 0.05$). Thirty nine (18.1%) of PS and 81 (37.5%) of CS had opportunity to use intraoral scanner ($p < 0.05$). Only 2 (1%) students (regardless of their level of

Tablica 1. Raspodjela odgovora o stajalištima studenata o CAD/CAM tehnologiji (pitanja od 1 do 8)
Table 1. Distribution of answers from the questionnaire about students' attitudes about CAD/CAM (questions from 1 to 8).

Studenti – pretklinička nastava • Preclinical dental students				Studenti – klinička nastava • Clinical dental students				SVI • ALL	p value
Jeste li čuli za CAD/CAM tehnologiju? • Have you heard about CAD/CAM?								216 100%	1.000
DA • YES	NE • NO			DA • YES	NE • NO				
77 35,6%	0 0%			139 64,4%	0 0%				
Gdje ste čuli za CAD/CAM tehnologiju? • Where did you hear about CAD/CAM?								216 100%	0.000
a	b	c	d	a	b	c	d		
60 27,73%	12 5,6%	5 2,3%	0 0%	122 56,5%	13 6,02%	4 1,85%	0 0%		
Jeste li vidjeli koji CAD/CAM nadomjestak? • Did you see any CAD/CAM restoration?								216% 100%	0.000
DA • YES	NE • NO			DA • YES	NE • NO				
29 13,4%	48 22,3%			69 31,9%	70 32,4%				
Jeste li radili s CAD/CAM tehnologijom? • Did you work with CAD/CAM?								216 100%	0.000
e	f	NE • NO		e	f	NE • NO			
0 0%	39 18,1%	38 17,6%		3 1,3%	81 37,5%	55 25,5%			
Jeste li pohađali koji tečaj (izvan nastave na fakultetu) o primjeni CAD/CAM tehnologije? • Did you attend any CAD/CAM course (out of regular lectures at the Faculty)?								216 100%	0.000
DA • YES	NE • NO			DA • YES	NE • NO				
2 1%	75 34,7%			10 4,6%	129 59,7%				
Treba li se o CAD/CAM tehnologiji više podučavati u sklopu fakultetske nastave? • Is it necessary to teach more about CAD/CAM within the regular lectures at the Faculty?								216 100%	0.929
g	h	DA • YES		g	h	DA • YES			
4 1.9%	0 0%	73 33.8%		10 4.6%	2 0.9%	127 58.8%			
Zašto mislite da je CAD/CAM tehnologija korisna? • Why is CAD/CAM technology useful?								216 100%	0.874
i	j	k		i	j	k			
24 11%	52 24.1%	1 0.5%		36 16.7%	102 47.2%	1 0.5%			
Smatrate li da ste dovoljno informirani o CAD/CAM tehnologiji? • Are you sufficiently informed about CAD/CAM technology?								216 100%	0.000
DA • YES	NE • NO			DA • YES	NE • NO				
5 2.3%	72 33.3%			6 2.8%	133 61.6%				

a – nastava na fakultetu; b – izvan redovite nastave na fakultetu; c – izvan fakulteta; d – nisam čuo; e – da, izradio cijeli nadomjestak; f – koristio sam se samo intraoralnim skenerom; g – ne, CAD/CAM je dovoljno uključen u nastavu; h – ne, CAD/CAM uopće ne treba uključivati u nastavu; i – bolja estetika i dugotrajnost nadomjestaka; j – kraće vrijeme izrade; k – CAD/CAM tehnologija nije korisna

a-regular lectures at School; b - at School but out of regular lectures; c-out of School; d-I did not hear; e-yes, I fabricated dental restoration; f-I used only intraoral scanner; g-no, CAD/CAM is enough involved in teaching; h-no, CAD/CAM should not be involved in teaching; i-better aesthetics and longevity of dental restoration; j-shorter fabrication time; k-CAD/CAM technology is not useful.

nologija nije korisna, no taj odgovor nije bio statistički značajan ($p > 0,05$). Samo je 15 PS studenata (6,9 %) te 42 CS studenta (19,4 %) znalo da intraoralni digitalni otisak nije nužan u izradi protetičkih radova CAD/CAM tehnologijom ($p < 0,05$). Samo su 74 studenta (34,3 %) – 29 PS-a (13,4 %) te 45 CS-a (20,9 %) znali da se svi navedeni materijali mogu obrađivati u glodalici ($p < 0,05$). Samo su 44 ispitanika (20,7 %) – 10 PS-a (4,6 %) i 34 CS-a (15,7 %), smatrali da blokovi cirkonij-oksidge keramike mogu imati faktor skupljanja ($p < 0,05$). Od ukupnog broja ispitanika, samo 63 (29,2 %) smatra da se neće koristiti CAD/CAM tehnologijom u budućem radu (33; 15,3 % PS studenta te 30; 13,9 % CS studenata) ($p < 0,05$). No 186 ispitanika (86,1 %) (61; 28,3 % PS-a i 125; 57,8 % CS-a) odgovorilo je da bi se koristili CAD/CAM tehnologijom za izradu krunica, mostova, inleja i onleja te za kombinaciju svih vrsta radova ($p < 0,05$).

education) thought that CAD/CAM technology is not useful, but the answer is not statistically significant ($p > 0,05$). Only 15 (6.9%) PS and 42 (19.4%) CS knew that digital intraoral impression is not obligatory phase in CAD/CAM fabrication of dental restoration ($p < 0,05$). Only 74 (34.3%) participants – 29 (13.4%) PS and 45 (20.9%) CS knew that all suggested materials could be processed in milling machines ($p < 0,05$). Only 44 (20.7%) participants – 10 (4.6%) PS and 34 (15.7%) CS thought that zirconium oxide blocks could have a shrinkage factor ($p < 0,05$). The minority of participants (63, 29.2%) stated that they would not use CAD/CAM technology in their future work (33, 15.3% of PS and 30, 13.9% of CS) ($p < 0,05$). Most (186, 86.1%) of students (61, 28.3% of PS and 125, 57.8% of CS) would use CAD/CAM technology for fabrication of crowns, bridges, inlays, onlays and combination of all other prosthetic modalities ($p < 0,05$).

Tablica 2. Raspodjela odgovora o stajalištima studenata o CAD/CAM tehnologiji (pitanja od 9 do 14)**Table 2.** Distribution of answers from the questionnaire about the students' attitudes about CAD/CAM (questions from 9 to 14).

Studenti – pretklinička nastava • Preclinical dental students					Studenti – klinička nastava • Clinical dental students					SVI • ALL	p value	
Digitalni intraoralni otisak obavezan je u izradi protetičkih radova CAD/CAM tehnologijom? • Is digital intraoral impression obligatory in CAD/CAM fabrication of dental restoration?												
DA • YES	NE • NO	l			DA • YES	NE • NO	l				216	0.000
34 15.7%	15 6.9%	28 13%			88 40.7%	42 19.4%	9 4.3%			100%		
Koji se materijali koriste u glodalicama? • Which materials are used in milling machines?												
m	n	o	p	q	m	n	o	p	q		216	0.000
0 0%	1 0.5%	23 10.6%	29 13.4%	24 11.1%	1 0.5%	2 0.9%	81 37.5%	45 20.9%	10 4.6%	100%		
Za glodanje pojedinačne krunice potrebno je: • The time needed for milling a single crown?												
≤1hour	>1hour	r			≤1hour	>1hour	r				216	0.137
34 15.7%	12 5.6%	31 14.4%			87 40.3%	14 6.4%	38 17.6%			100%		
Mogu li blokovi cirkonijeva oksida imati faktor skupljanja? • Could zirconium oxide blocks have a shrinkage factor?												
YES	NO	s			YES	NO	s				216	0.000
10 4.6%	14 6.5%	53 24.5%			34 15.7%	31 14.4%	74 34.3%			100%		
Kojom vrstom CAD/CAM sustava bih se koristio/la? • What type of CAD/CAM technology would I use?												
t	u	v			t	u	v				216	0.000
24 11%	20 9.3%	33 15.3%			44 20.4%	65 30.1%	30 13.9%			100%		
CAD/CAM tehnologijom koristio/la bih se za: • I would use CAD/CAM technology for?												
w	x	y	z	aa	w	x	y	z	aa		216	0.007
10 4.6%	6 2.8%	36 16.7%	0 0%	25 11.6%	8 3.7%	4 1.9%	85 39.4%	2 0.9%	40 18.4%	100%		

l – ne znam; m – vosak; n – metal; o – cirkonijev oksid; p – svi navedeni; q – ne znam; r – ne znam; s – ne znam; t – InLab sustav; u – InOffice sustav; v – ne koristim se / ne planiram se koristiti CAD/CAM-om; w – ne koristim se CAD/CAM-om; x – privremeni nadomjestci; y – inlej, onlej, ljuske, krunice i mostovi; z – teleskopske krunice i nadogradnje (abutmenti); aa – kombinacija svih nadomjestaka

I-I don't know; m-wax; n-alloy; o-zirconium oxide; p-all listed materials; q-I don't know; r-I don't know; s-I don't know; t-InLab system; u-InOffice system; v-I don't plan to use CAD/CAM technology; w-I don't plan to use CAD/CAM technology; x-provisional restorations; y-inlay, onlay, veneers, crowns and bridges; z-telescopic crowns and abutments; aa-combination of all prosthetic modalities.

Rasprava

Digitalna dentalna tehnologija nezaobilazna je u svakodnevnoj kliničkoj praksi. Generacije studenata odrastaju u digitalnom svijetu što posljedično utječe na njihove sklonosti, očekivanja i način usvajanja novoga znanja. Studenti sve više pokazuju sklonost za uvrštavanje digitalne tehnologije u nastavu i učenje (11). Brz razvoj digitalne tehnologije izazov je i nastavnicima te zahtijeva neprestane prilagodbe i promjene nastavnoga plana i programa. S obzirom na to da je primjena CAD/CAM tehnologije u snažnom porastu, mnogi stomatološki fakulteti u svijetu integrirali su je u plan i program pretkliničke i kliničke nastave (12 – 14). Zato je ovo istraživanje provedeno u svrhu procjene informiranosti i stajališta o CAD/CAM tehnologiji među PS i CS studentima Stomatološkog fakulteta Sveučilišta u Zagrebu. Dobiveni rezultati mogu upozoriti na eventualnu potrebu za dodatnom edukacijom, s obzirom na porast zastupljenosti primjene CAD/CAM tehnologije u ordinacijama dentalne medicine i dentalnim laboratorijima u Hrvatskoj. Podatci iz 2010. godine (15) pokazuju da je više od 27 000 CEREC sustava postav-

Discussion

Digital dental technology is unavoidable in everyday clinical practice. At present, dental students are growing up in a digital world, which consequently reflects their preferences, expectations and the way of acquiring new knowledge. Students increasingly show the affinity for including digital technology into teaching and education (11). Also, a rapid development of digital technology is a challenge for teachers and it requires constant adjustments and changes in the curriculum. Since the use of CAD/CAM technology is rapidly expanding, many Schools of Dental Medicine around the world have integrated it into their preclinical and clinical curriculum (12-14). Therefore, this study was performed with the aim to determine knowledge and attitudes about CAD/CAM technology of PS and CS at the School of Dental Medicine, University of Zagreb. The results obtained in this study can indicate if additional education of PS and CS about CAD/CAM technology is required due to the increasing popularity of CAD/CAM technology in dental clinics and laboratories in Croatia. According to the data from literature (15), in 2010,

ljeno u ordinacije dentalne medicine u više od 50 država, a u dentalnim laboratorijima koristilo se oko 4500 inLab jedinica. Iako postoji opsežna literatura o CAD/CAM tehnologiji (1–9, 16–20), malo je podataka dostupno o informiranosti studenata i doktora dentalne medicine o toj tehnologiji u svijetu te su provođenjem ovog istraživanja dobiveni prvi takvi podatci u Hrvatskoj.

Istraživanje je provedeno u dvjema skupinama studenata Stomatološkog fakulteta Sveučilišta u Zagrebu – PS i CS studentima. PS-i su bili studenti treće godine, a CS-i pete godine studija dentalne medicine. U svakoj skupini je broj ispitanika ženskog spola bio veći. Razlika u broju ispitanika s obzirom na spol može se pripisati sve većem broju žena u dentalnoj medicini u Europi, što vodi prema feminizaciji struke (21). Svi studenti sa Stomatološkog fakulteta u Zagrebu čuli su za CAD/CAM tehnologiju. Slične rezultate objavio je i Popa sa suradnicima (22) u čijem je istraživanju većina ispitanika također čula i vidjela CAD/CAM sustav. No većina ispitanika iz njihova istraživanja (22) nije vidjela CAD/CAM nadomjestak, što je slično odgovorima PS ispitanika iz ovoga istraživanja. Većina studenata sa Stomatološkog fakulteta u Zagrebu čula je za CAD/CAM tehnologiju tijekom redovite nastave na fakultetu, no nisu pohađali dodatne CAD/CAM tečajeve izvan fakultetske nastave. Usporedbi radi, Tran i suradnici (23) navode da stomatologe iz Ujedinjenog Kraljevstva o CAD/CAM tehnologiji uglavnom educiraju proizvođači toga sustava te da pohađaju privatne tečajeve ili uče od drugih korisnika te tehnologije, a nastavu na fakultetu uopće ne navode. Utvrđeno je da studenti dentalne medicine više preferiraju vizualno učenje u usporedbi s ostalim studentima (24), pa su tako stomatološki fakulteti na sveučilištima u američkim savezima Illinoisu i Indijani uveli CAD/CAM tehnologiju u svoje nastavne planove i programe te omogućili studentima da virtualno oblikuju krunice CAD tehnikama (13, 14). U literaturi (13, 14, 25) se navodi da uvrštavanje CAD/CAM tehnologije u plan i program pretkliničke i kliničke nastave pozitivno utječe na stajališta studenata o toj tehnologiji. Ovo istraživanje pokazalo je da većina PS i CS studenata smatra CAD/CAM tehnologiju korisnom te su mnogi kao glavnu prednost istaknuli kraće vrijeme izrade protetičkog nadomjestka. U istraživanju koje su proveli Popa i suradnici (22) većina studenata s velikim je entuzijazmom izjavila da je CAD/CAM tehnologija budućnost protetike.

Gotovo svi studenti u ovom istraživanju čuli su za CAD/CAM tehnologiju te su istaknuli pozitivno stajalište o njoj, ali su također naveli da nisu dovoljno informirani te da im je potrebna dodatna edukacija u sklopu nastave na fakultetu. Uspoređujući dvije skupine studenata, uglavnom je distribucija odgovora u upitniku bila slična. Tako je manjina PS i CS studenata znala da intraoralni digitalni otisak nije nužan u izradi nadomjestka CAD/CAM tehnologijom, s obzirom na to da sadreni model može biti skeniran u dentalnom laboratoriju (1). Samo je manjina PS i CS studenata navela da se svi navedeni materijali mogu obrađivati u glodalicama (vosak, legure, cirkonij-oksida keramika) te da blokovi cirkonij-oksida keramike mogu imati faktor skupljanja. U istraživanju koje su proveli Popa i suradnici (22) 19,1 % studenata, a u istra-

there were more than 27,000 CEREC systems placed in dental medicine in over 50 countries, while about 4500 in Lab units were used in dental laboratories. Although there is a wealth of literature (1-9, 16-20) about CAD/CAM technology, little is known about knowledge and awareness of CAD/CAM technology among students and dentists in the world; hence this is also the first study of this kind which was conducted in Croatia.

The study included two groups of students from the School of Dental Medicine at University of Zagreb: PS and CS group of students. PS students were the third year of undergraduate dental students while CS students were in their fifth year of undergraduate dental studies. In each group, the number of female participants was higher than the number of male participants. This difference in number of participants with regard to the gender could be explained by high and steadily rising percentage of women in European dentistry, which can also be described as the feminization of dental profession (21). All the students enrolled in the School of Dental Medicine in Zagreb heard about CAD/CAM technology. Similar results were found by Popa et al. (22) where majority of students also heard about CAD/CAM technology as well as saw CAD/CAM system. But majority of students from study by Popa et al. (22) did not see any CAD/CAM restoration, which is similar to answers of PS group of participants of this study. Most of the students from the School of Dental Medicine in Zagreb heard about CAD/CAM technology at their regular lectures held at the School, and usually they did not attend any additional courses that were held out of the School. For comparison, Tran et al. (23) reported that dentists from the United Kingdom had undertaken only training of CAD/CAM technology by companies providing CAD/CAM systems, private courses or were taught by other CAD/CAM users, while participants did not mention CAD/CAM education at the School. Due to the fact that dental students have a higher preference for visual learning than general student population (24), Illinois and Indiana University Schools of Dental Medicine incorporated CAD/CAM in their curriculum, in order to enable students to virtually design crowns using CAD techniques (13,14). The authors (13, 14, 25) reported that incorporating of CAD/CAM technology in pre-clinical and clinical curriculum positively affects students' attitudes regarding CAD/CAM technology. In this study, most of PS and CS students consider CAD/CAM technology useful, and many of them highlighted the shorter fabrication time as the main reason. In the study by Popa et al. (22) most of students stated with great enthusiasm that CAD/CAM technology represents the future of prosthetic dentistry.

Almost all of the students in the present study heard about CAD/CAM technology and have positive attitudes about it, but they also stated that were not sufficiently informed and that additional education within the regular lectures at the School is required. In most of the cases, distribution of answers from the questionnaire was similar among the PS and CS group of participants. Therefore, the minority of PS and CS participants knew that intraoral digital impression is not obligatory in CAD/CAM technology because a stone model can be scanned in laboratory (1), fewer PS and CS

živanju autora Kavarthapu i suradnika (26) 36,2 % studenata, znalo je da se svi navedeni materijali mogu obrađivati u glodalamicama. U istom istraživanju (26) samo je 11,4 % studenata znalo da blokovi cirkonij-oksidge keramike mogu imati faktor skupljanja. Zaključno se može reći da među studentima prevladava mišljenje da im je potrebna dodatna edukacija o CAD/CAM tehnologiji, ali ne može se zaključiti jesu li CS studenti bolje informirani od PS studenata. Najvažnija je činjenica da su studenti, bez obzira na stupanj obrazovanja, izrazili pozitivno stajalište o CAD/CAM tehnologiji te da je samo malo onih koji se tom tehnologijom ne planiraju koristiti u budućnosti.

Zaključak

Svi ispitanici (PS i CS studenti) čuli su za CAD/CAM tehnologiju, uglavnom u sklopu redovite nastave na Stomatološkom fakultetu. Prevladava pozitivno stajalište ispitanika o njezinu korištenju te se samo mali dio njih ne planira koristiti CAD/CAM tehnologijom u budućnosti. No općenito se može zaključiti da ispitanici nisu dovoljno informirani o CAD/CAM tehnologiji pa postoji potreba za dodatnom edukacijom. No ne može se zaključiti jesu li CS studenti bolje informirani o CAD/CAM tehnologiji od PS studenata.

Sukob interesa

Nema sukoba interesa.

participants stated that all suggested materials (wax, alloys, zirconium oxide) can be processed in CAD/CAM machines, and that zirconium oxide blocks can have a shrinkage factor. In a study by Popa et al. (22) only 19.1% of students, and in study by Kavarthapu *et al.* (26) 36.2% of students stated that all suggested materials could be processed in CAD/CAM machines. In the same study (26), only 11.4% of students knew that zirconium oxide CAD/CAM blocks have shrinkage factor. According to results from present study it could be concluded that additional education of students about CAD/CAM technology is required but it cannot be concluded that CS students have greater theoretical knowledge about CAD/CAM technology than PS students. The most important fact is that students, regardless of their level of education, have positive attitudes regarding the CAD/CAM technology and that just a small number of them is not planning to use CAD/CAM technology in the future.

Conclusion

All students (PS and CS) heard about CAD/CAM technology, mostly during their regular lectures at the School. The students have positive attitudes regarding CAD/CAM, and only the minority of them will not want to use CAD/CAM technology in the future. But according to the results it could be concluded that they are not sufficiently informed about CAD/CAM and that additional education about CAD/CAM technology would be a good option. It cannot be concluded that CS students have greater knowledge about CAD/CAM technology than PS students.

Competing interests

None declared.

Abstract

Aim: Due to fast and continuing advances in digital dental technology it is important to provide appropriate CAD/CAM education of preclinical (PS) and clinical (CS) dental students. Therefore, the aim of this study was to determine the knowledge and attitudes on CAD/CAM technology of PS and CS at the School of Dental Medicine, University of Zagreb since the obtained results can show the level of students' knowledge and possibly a need for additional education. **Materials and methods:** This study included 216 undergraduate dental students from the School of Dental Medicine in Zagreb: 77 (35.6%) of preclinical students (PS) and 139 (64.4%) of clinical students (CS). All participants filled out the questionnaire specially designed for this study. The obtained data were statistically analyzed with a significance level of $p < 0.05$. **Results:** Most of the students (182, 84.23%) heard about CAD/CAM technology at regular lectures held at the School ($p < 0.05$). Regardless of their level of education, most of the students (204, 94.4%) did not attend any CAD/CAM course which were not held within regular lectures at the School ($p < 0.05$). Most of PS (72, 33.3%) and most of CS (133, 61.6%) participants believe that they are not sufficiently informed about CAD/CAM technology ($p < 0.05$). **Conclusion:** Although most of the students (PS and CS) heard about CAD/CAM technology, it could be concluded that they are not sufficiently informed and that additional education on CAD/CAM technology is required. Also, CS students do not possess greater knowledge about CAD/CAM technology than PS students.

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Address for correspondence

Josip Kranjčić
University of Zagreb
School of Dental Medicine
Clinical Hospital Dubrava,
Av. G. Šuška 6, 10000 Zagreb, Croatia
Phone: +385 1 290 3205
Fax: +385 1 2864 248
kranjic@sfzg.hr

Key words

Computer-Aided Design; Dental Students; Dental Education, Graduate; Health Knowledge Attitudes Practice

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