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IZVORNI ZNANSTVENI RAD
ORIGINAL SCIENTIFIC PAPER

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Utjecaj teleskopskog Galilejeva sistema na oštrinu vida na blizinu kod liječnika dentalne medicine u simuliranim kliničkim uvjetima

Measuring the Influence of Galilean Loupe System on Near Visual Acuity of Dentists under Simulated Clinical Conditions

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Sažetak
Svrha rada: Svrha ispitivanja bila je usporediti vidnu oštrinu na blizinu stomatologa bez optičkog pomagala i vidnu oštrinu na blizinu s Galilejevim teleskopskim sistemom s povećanjem od 2,5 puta na žarišnoj udaljenosti od 350 milimetara u simuliranim kliničkim uvjetima. **Ispitanici i postupci:** U ispitivanju je sudjelovalo 50 stomatologa emetropa (centralna vidna oštrina 1,0). Minijaturni Snellenov optotip postavljen je u kavitet molara dentalnog fantoma u simuliranim kliničkim uvjetima. Vidna oštrina na blizinu ispitivala se: bez korekcije na udaljenosti od 300 do 400 mm, Galilejevim teleskopom s povećanjem od 2,5 puta, na žarišnoj udaljenosti od 350 mm. **Rezultati:** Distribucije vidnih oštrina zabilježenih korištenjem sistema VSC i VGA 2,5 uspoređene su testom Wilcoxon-Signed-Rank. Rezultati su upozorili na statistički značajnu razliku u distribuciji zabilježenih vidnih oštrina između optičkih sistema VSC i VGA 2,5 (W = - 403,5; p < 0,001). **Zaključak:** Sistemom VGA 2,5 zabilježene su veće vrijednosti vidne oštrine u odnosu na naturalni vid bez magnifikacijskih pomagala (VSC).

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Ključne riječi
leće; vidna oštrina; Galilejevi teleskopi; stomatolozi

Uvod

Korištenje magnifikacijskih (teleskopskih) pomagala u stomatologiji poboljšava vizualizaciju sitnih detalja unutar usne šupljine, kompenzira slabljenja akomodacijske sposobnosti očnog aparata nakon četrdesete godine (prezbiopija) i pridonosi ergonomskim poboljšanjima u redukciji mišićno-skeletnog stresa u svakodnevnom kliničkom radu stomatologa (1). Studentima stomatologije korištenje teleskopskih pomagala postaje sve uobičajenije i oni se prednostima magnifikacijskih pomagala koriste i pri postavljanju dijagnoze (2). Tako im adaptacija očiju na teleskopske sustave omogućuje da tijekom studija što bolje shvate korištenje magnifikacija u stomatologiji i medicini te da njima postižu bolju vidnu oštrinu, što im omogućuje točnije postavljanje dijagnoze i terapiju bolesti mekih i tvrdih tkiva glave i vrata (3). Vidna oštrina mjera je sposobnosti oka da dvije bliske točke vidi odvojeno (4). Središnji vid odnosi se na mogućnost oka da percipira oštru sliku predmeta koja nastaje u jamici žute pjege gdje je najveća koncentracija čunjića i mjesto je najoštrijega vida. Središnja vidna oštrina određuje se najmanjim kutom pod kojim oko može vidjeti dvije točke kao

Introduction

The use of optical magnification (telescopes) in dentistry enhances visualization of fine details in oral cavity, compensates for a weakened ability of visual apparatus to adjust after the age of forty (presbyopia) and contributes to the ergonomic benefits by reducing skeletal muscle stress in the dentists' daily clinical routine. (1). Telescopic aids have been widely used in dentistry by dental professionals and students because they may help them when they are making a diagnosis. Therefore, they take advantage of various magnifying aids (2). The period required for the eyes to adjust to telescopic systems allows the students not only to better understand the use of magnifying aids in dentistry and medicine, but it also enhances a better visual acuity in order to improve the diagnosis and therapy of head and neck soft and hard tissues (3). Visual acuity is the ability of the eye to resolve two close points separately (4). Central vision refers to the ability of the eye to perceive a sharp picture of an object in the *macula fovea* when the concentration of cones is the highest, thus enabling the keenest perception. Central visual acuity is determined by the smallest angle under which the eye perodvojene. Taj vidni kut naziva se minimalnim kutom razlučivanja (minimum separabile) (5). U emetropnom oku iznosi jednu kutnu minutu, što odgovara veličini od 4 mikrona i veličini baze jednog čunjića mrežnice te čini jedinicu vidne oštrine. Da bi se dvije točke vidjele odvojeno, moraju biti podražena najmanje dva čunjića između kojih je jedan nepodražen. Centralnu vidnu oštrinu za koju je odgovorna makula ispitujemo optotipom (6). Optotip čine slova, brojevi, slike ili znakovi različitih veličina, a konstruirani su na poseban način tako da je svaki znak upisan u jednom kvadratu čija stranica čini kut od 5 minuta, a petina stranice kvadrata čini kut od jedne minute. Unutar tog kvadrata nalazi se 25 kvadratića koji odgovaraju području od 25 čunjića gdje se stvara slika predmeta – optotip. (slika 1.) Najčešće su korišteni standardizirani optotipi prema Snellenu za ispitivanje vidne oštrine odraslih osoba (slika 2.). Sastoje od slova poredanih vertikalno od većih prema manjima, u 11 ili više redova. To što nema standardiziranog optotipa za ispitivanje vidne oštrine na blizinu pod magnifikacijom, uvjetovalo je i nedovoljan broj ispitivanja koja testiraju vidnu oštrinu u dentalnoj medicini. Za ispitivanja vidne oštrine na blizinu za potrebe ovog ispitivanja napravljen je minijaturni Snellenov optotip (slika 3.) zahvaljujući Hrvatskome državnom arhivu – središnjem fotolaboratoriju. Predložak A4 Snellenova optotipa napravljen je u visokoj rezoluciji, ispisan je i kao takav presnimljen na 35-milimetarski crno-bijeli mikrofilm. Za snimanje je korištena mikrofilmska kamera, dokumator Zeutscheu, te je napravljena najveća redukcija od 28,5 puta u odnosu na početnu veličinu predloška A4 Snellenova optotipa visoke rezolucije. Minijaturni Snellenov optotip za ispitivanje vidne oštrine u radu stomatologa na blizinu velik je 5,2 x 2,8 mm, a dimenzije optotipa su od 0,05 do najvećega optotipa od 0,6 mm. Reakcija na blizinu uključuje proces prilagodbe oka kada nastaju sinkineza konvergencije i mioze te je omogućen vid na blizinu (7). Magnifikacija se postiže sustavom leća koje se koriste u izradi teleskopskih naočala – Galilejev i Keplerov optički sistem**.** Galilejev optički sustav koristi se konveksnom i konkavnom lećom, a Keplerov teleskopski sustav ima dvije konveksne leće (8). Teleskopskim sustavima za magnifikaciju postiže se povećanje slike promatranog predmeta na mrežnici kombinacijom angularne magnifikacije i magnifikacije na osnovi mijenjanja udaljenosti promatranog predmeta (9). Važni pojmovi pri odabiru teleskopskog sustava su dubinska oštrina**,** žarišna udaljenost**,** vidno polje te optička apertura (*lens speed)* (10). Dubinska oštrina obuhvaća raspon udaljenosti pri kojoj je slika oštra. Žarišna udaljenost je udaljenost pri kojoj se za dano povećanje slika vidi oštro. Optička apertura (*lens speed*) ovisi o promjeru objektiva – veći promjer objektiva *skuplja* više svjetla, te tako omogućuje gledanje i pri slabijoj osvijetljenosti. Galilejevi sustavi imaju manju mogućnost povećanja od Keplerovih i iznose od 2,5 do 3,5 puta, manji su, jeftiniji te ne pretjerano osjetljivi na pad ili udarac kao Keplerovi. Teleskopski sustavi za promatranje predmeta na blizinu služe ponajprije za gledanje na blizinu na jednoj određenoj udaljenosti. Prednost je da se može koristiti i binokularno (11).

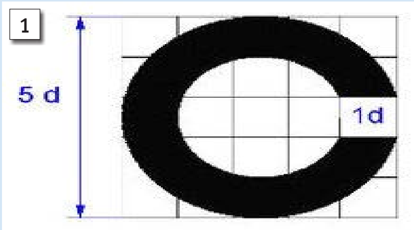
ceives two points separately. Such visual angle is called the minimum separable angle (5). In an emmetropic eye the angle equals one arcminute, which corresponds to the size of 4 microns and the size of one basis of the retina cone, thus measuring visual acuity. In order to perceive two points separately, at least two cones must be stimulated, one of which should remain non-stimulated. The macula, located at the back of the eye, is a small spot on the retina which is responsible for central vision. Central visual acuity is examined by an optotype (6). The optotype can be letters, numbers, pictures or signs of different sizes patterned in a special way so that each sign is written in a square the side of which makes 5 arcminutes and whose 1/5 of the side of a square makes the visual angle of one arcminute. There are 25 smaller squares in that grid corresponding to the field of 25 cones, where the picture of an object - optotype is created (Figure 1). Standardized optotypes, according to Snellen, are most frequently used to examine visual acuity of adult people (Figure 2). They consist of vertically placed letters, ordered from bigger to smaller ones, in eleven or more rows. The lack of standardized optotypes in the examination of near visual acuity under magnification has also been the result of insufficient number of examinations of visual acuity in the field of dental medicine. The near response implies the eye adjustment during which it comes to the synkinesis convergence and miosis, so that the near vision is enabled (7). Magnification is achieved through the system of lenses being used for the production of telescopic glasses: the Galilean and Kepler's optical system. The Galilean optical system uses convex and concave lens, whereas the Kepler's telescopic system has two convex lenses (8). Telescopic magnification systems achieve enlargement of a picture of an observed object on retina by combination of angular magnification and the magnification based on alteration of distance of the observed object. (9). The key words in the selection of the telescopic system are depth of field, focal length, visual field and lens speed (10). The depth of field is a distance span within which the picture is sharp. The focal length is a distance at which the picture is sharp under given magnification. The lens speed depends on the radius of the lens: a longer lens radius "gathers" more light, thus enabling to see under lower light. The Galilean system provides less magnification than the Kepler's, namely x2.5-x3.5; it is smaller, more affordable and less sensitive to fall or breakage than the Kepler system. Telescopic systems for the observation of near objects primarily serve for the near observation, at certain distance. The advantage is a possibility of binocular usage (11). The Galilean magnification systems which are used in clinical dentistry improve precision of work, manual skills and visual performance for dental professionals of all age groups.

Ispitanici i postupci

Ispitivanje je provedeno na Stomatološkom fakultetu Sveučilišta u Zagrebu. Sudjelovalo je 50 stomatologa emetropa (normovidni) obaju spolova u dobi između 21 i 28 godina. Imali su centralnu vidnu oštrinu 1,0, urednu bulbomotoriku i konvergenciju, urednu reakciju zjenica i ograničenu, u razini, glavu vidnoga živca. Klinički dio istraživanja obavljen je u prostorijama Pretklinike Stomatološkog fakulteta na dentalnom fantomu i s pomoću minijaturnoga Snellenova optotipa fiksiranog u kavitet molara. Teleskopske naočale imale su Galilejeve sisteme povećanja od 2,5 puta za udaljenost od 350 mm. Galilejev optički sistem originalno je bio postavljen u okvire naočala i fiksirani na plano leće (bez dioptrije). U ispitivanju je korišten GTX Galilejev optički sustav s povećanjem od 2,5 puta na žarišnoj udaljenosti od 350 mm, s dubinskom oštrinom u rasponu od 313 mm te širinom vidnoga polja od 57 mm (GTX, Zeiss, Oberkochen, Njemačka) (slika 4a-c). Ispitanicima se ispitivala vidna oštrina na blizinu bez korekcije te vidna oštrina na blizinu Galilejevim lećama s povećanjem od 2,5 puta na udaljenosti od 350 mm. Ispitanik je sjedio u radnoj stolici u uspravnom položaju sa stopalima koja su punom površinom dodirivala tlo te s koljenima smještenima ispod čeljusti dentalnog fantoma, a laktovima u njegovoj razini. Izvor svjetlosti bio je paralelan s vidnom osi ispitanika. Osvjetljenje prostorije i osvjetljenje u području radne zone mjereno je luksmetrom. U prostoriji osvijetljenoj sunčevom i umjetnom rasvjetom osvjetljenje je bilo od 250 do 500 luksmetara. Zona rada osvijetljena je operativnom svjetiljkom od 60 W. Ispitanik je imao maksimalan otklon glave do 25 stupnjeva prema naprijed (slika 5.). Tijek istraživanja, poziciju ispitanika, leće, udaljenost i položaj *oko – objekt* te čitanje minijaturnog Snellenova optotipa kontrolirao je isti ispitivač. Najmanji optotip minijaturnoga Snellenova optotipa koji je bio fiksiran u kavitet molara dentalnog fantoma, a koji je ispitanik uspio pročitati bez korekcije, a zatim i Galilejevim lećama, registrirao se kao veličina vidne oštrine na blizinu bez korekcije (VSC) i vidna oštrina na blizinu s Galilejevim lećama s povećanjem od 2,5 puta (VGA2,5) (slika 6.). Distribucije vidnih oštrina zabilježenih korištenjem sistema VSC i VGA 2,5 uspoređene su Wilcoxon-Signed-Rankovim testom. To je neparametarski test za usporedbu dviju grupa zavisnih mjerenja.

Materials and methods

This study was carried out at the School of Dental Medicine, University of Zagreb. There were 46 participants, dentists, emmetrops (normal-vision). The participants were of both sexes, aged 25-30. The participants' central visual acuity was 1.0, with regular ocular movement and convergence, regular pupil reaction which was limited at the level of the optic nerve head. Clinical research was carried out in a clinical trial clinic, the Pre-Clinic of the School of Dental Medicine, University of Zagreb, by use of miniaturized Snellen test that was fixed in the molar cavity of the dental phantom's head. In order to examine the near visual acuity, a miniaturized Snellen optotype was designed thanks to the Croatian State Archives, Central Photo laboratory (Figure 3). A sample of A4 Snellen optotype with high resolution was created, which was printed and subsequently copied to a 35mm BW microfilm. The microfilm camera for shooting, the Zeutscheu storage device, was used and the highest possible reduction of 28,5x was compared to the initial size of the sample of the A4 Snellen high-resolution optotype. The size of the miniaturized Snellen optotype for the examination of the near visual acuity in dentists is 5.2 x 2.8 mm and the optotype dimensions are varying from 0.05 to 0.6mm. Telescopic glasses have Galilean x2.5 magnification system, for a distance of 350mm. The Galilean optical systems were originally installed in glass frames, onto Plano lenses (without correction). The GTX Galilean optical system with x2.5 magnification and focal length of 350mm, the depth of the field of 313 mm and the width of the field of 57mm (GTX, Zeiss, Oberkochen, Germany) was used in this research (Figure 4a-c). The research participants' near visual acuity was examined without correction as well as their near visual acuity with the Galilean x2.5 loupe at the distance of 350 mm. The participants were sitting in their office chairs in the upright position with their feet fully placed on the floor, the knees placed below and their elbows placed at the level of dental phantom. The source of light was parallel to the research participants' visual axis. The lightning of the room and the work zone lightning were measured by a lux meter. In the room lit by both the sunlight and artificial light, the lightning ranged from 250 to 500 lux meters. The light task area was lit by the 60W surgical light bulb. The participants had a maximum head deflection of 25 degrees forwards (Figure 5). In the process of completing the research, the examiner controlled the participants' position, the loupe, the distance, the eye-object position and the reading of the miniaturized Snellen optotype. The smallest optotype of the miniaturized Snellen optotype, fixed in the molar cavity of dental phantom, which the research participant managed to read without correction, and thereafter with the assistance of Galilean loupe, was used for the visual acuity for vicinity without correction (VSC) and for visual acuity at vicinity with the Galilean x2.5 loupe (VGA2,5) (Figure 6.). The distribution of visual acuities that was registered by VSC and VGA2.5 systems was compared to the Wilcoxon Signed Rank test. The Wilcoxon Signed Rank test is a non-parameter test for the comparison of two groups of mutually dependent measurements.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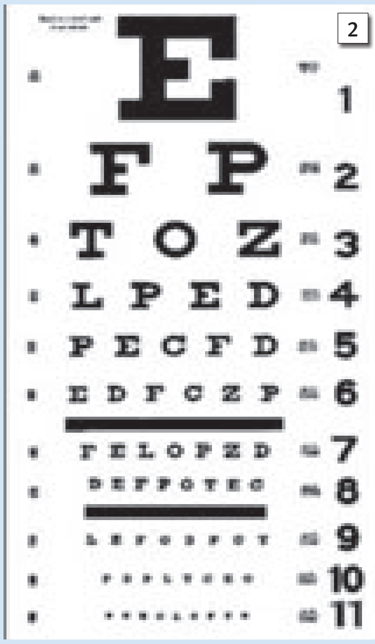
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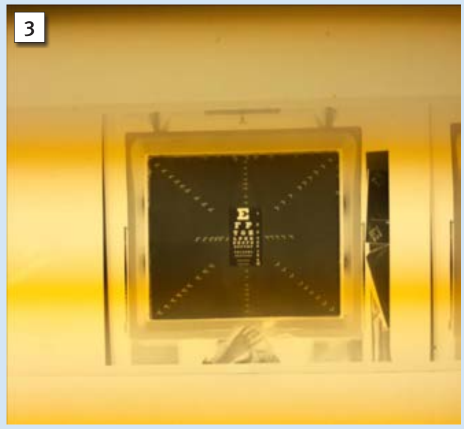
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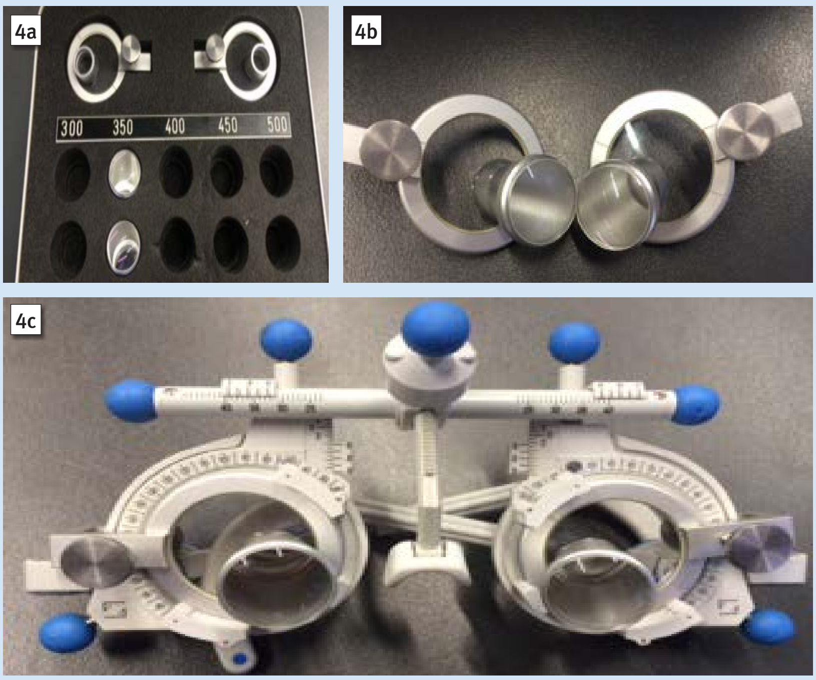
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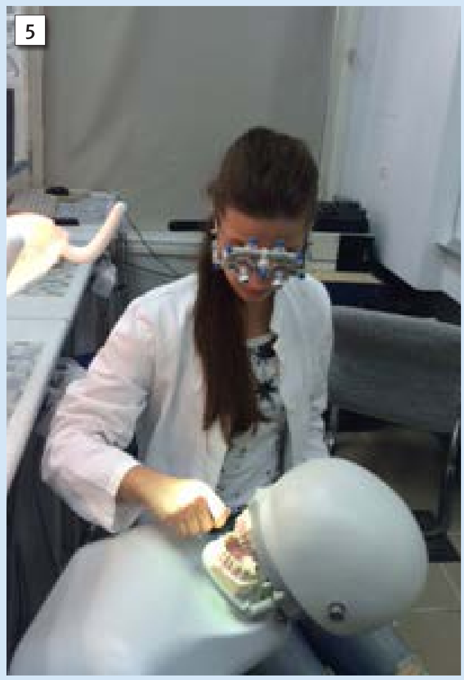
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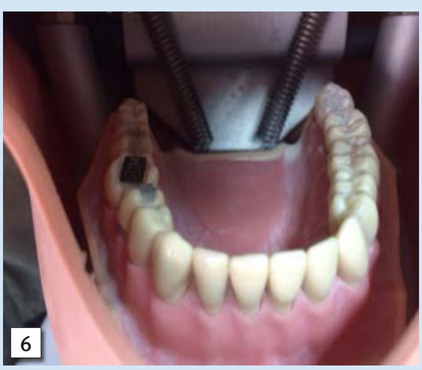
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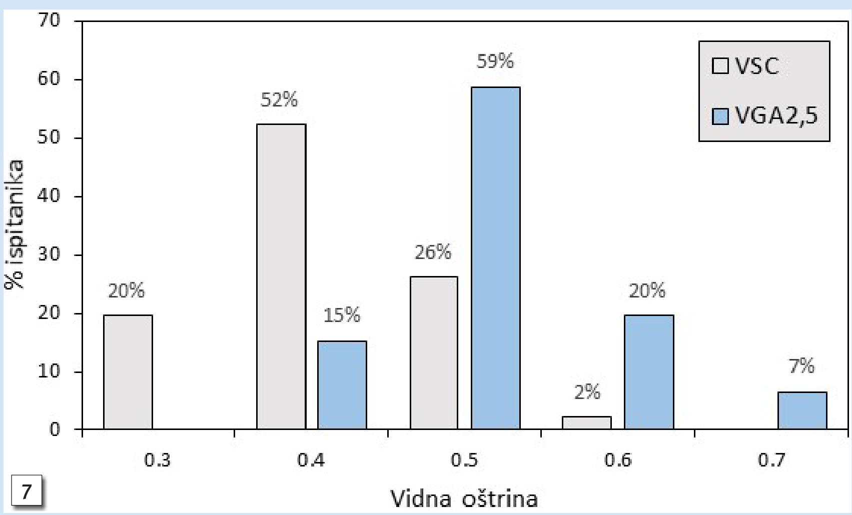
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Vidna oštrina

Rezultati

Distribucije zabilježenih vidnih oštrina korištenjem naturalnog vida bez magnifikacijskih pomagala na udaljenosti od 300 do 400 mm (VSC) te korištenjem Galilejevih leća magnifikacije od 2,5 puta na udaljenosti od 350 mm (VGA 2,5) vidi na slici 7. Numeričke vrijednosti osnovnih deskriptivnih pokazatelja nalaze se u tablici 1. Rezultati Wilcoxon-Signed-Rankova testa upozorili su na statistički značajnu razliku u distribuciji zabilježenih vidnih oštrina između optičkih sistema VSC i VGA 2,5 (W = - 403,5; p < 0,001). U skladu s rezultatima testa može se zaključiti da su korištenjem sistema VGA 2,5 općenito zabilježene veće vrijednosti vidne oštrine u odnosu na naturalni vid bez magnifikacijskih pomagala (VSC). Ta je distribucija prikazana na slici 7. Dob i spol ispitanika nisu imali značajan utjecaj na usporedbu dvaju optičkih sustava. Spearmanov koeficijent korelacije između dobi ispitanika i zabilježene razlike u vidnim oštrinama između dvaju optičkih sistema upućuje na nepostojanje korelacije, odnosno na povezanost između ovih varijabli (rs = 0,02; p = 0,898). Wilcoxon-Rank-Sumovim testom ispitan je efekt spola ispitanika na distribuciju razlike u vidnim oštrinama pri korištenju optičkih sistema VSC i VGA 2,5. Test nije upozorio na značajnu razliku u distribuciji mjerenja između žena i muškaraca (W = 298,5; p = 0,665).

Results

The distribution of the near visual acuity which was recorded using 'unaided eye', without magnification aid, at the distance of 300-400 mm (VSC) and the Galilean loupe of x2.5 magnification at the distance of 350mm (VGA2.5) are shown in Figure 7. Numerical values of basic descriptive indicators are shown in Table 1. The results of the Wilcoxon Signed Rank test pointed to a statistically significant difference in distribution of the recorded visual acuities between VSC and VGA2.5 optical systems (W = - 403.5; p < 0,001). From the obtained test results, it can be concluded that higher visual acuity values were recorded by the use of the VGA2.5 system than by use of 'unaided eyes', those without any magnification aid (VSC). The age and sex of participants did not significantly affect the comparison between the two optical systems. The Spearman coefficient of correlation between the participants' age as well as the recorded difference in visual acuity between the two optical systems showed no correlation/connection between these two variables (rs = 0.02; p = 0.898). The Wilcoxon Rank Sum test was used to test the impact which the participants' sex had on the distribution of difference in visual acuities when using VSC and VGA2.5 optical systems. The test did not reveal any significant difference in the distribution between female and male subjects (W = 298.5; p = 0.665).

Tablica 1. Deskriptivni pokazatelji distribucije vidnih oštrina zabilježenih korištenjem sistema VSC i VGA 2,5
Table 1 Descriptive indicators of visual acuity distribution recorded by application of VSC and VGA 2.5 systems

Optički sistem • Optical system	N	Arit. sredina • Arith. mean	SD	CV (%)	Medijan • Median	Q1	Q3	Min	Max
VSC	46	0,411	0,074	17,94	0,40	0,40	0,50	0,30	0,60
VGA2,5	46	0,517	0,077	14,86	0,50	0,50	0,60	0,40	0,70

Napomena: N – veličina uzorka; Arit. sredina – aritmetička sredina; SD – standardna devijacija; CV – koeficijent varijacije; Q1 – 1. kvartil; Q3 – 3. kvartil; Min. – minimum; Maks. – maksimum
Note: N – sample size; Arith. mean – arithmetic mean; SD – standard deviation; CV – variation coefficient; Q1 – 1st quartile; Q3 – 3rd quartile; Min – minimum; Max – maximum.

Rasprava

Uspoređivanjem vidnih oštrina stomatologa u simuliranim kliničkim uvjetima, koristeći se intraoralnim vidnim testom koji smo pripremili za potrebe ovog ispitivanja, uočena je značajna razlika u vidnim oštrinama bez korekcije i s pomoću magnifikacijskog pomagala. Raspon vidnih oštrina stomatologa urednoga očnog statusa koji se ne koriste optič-

Discussion

A comparison of the dentists' visual acuities in simulated clinical conditions, based on the intraoral visual test that was created for the purpose of this research, resulted in a significant difference between the visual acuities of participants 'in the vicinity' without correction and those 'in the vicinity' using magnifying aids and technology. The span of visual acuity

Slika 1. Optotip
Figure 1 Optotype
Slika 2. Snellenov optotip
Figure 2 Snellen optotype
Slika 3. Minijaturni Snellenov optotip (pod povećanjem od 2,5 puta)
Figure 3 Miniaturized Snellen optotype (3x magnification)
Slika 4a,b,c. Galilejev optički sistem GTX, 2,5 x, 350 mm, fiksiran na plano leću (bez dioptrije) i postavljen u probni okvir
Figure 4a,b,c Galilean optical system, GTX/x2.5, 350mm, fixed onto Plano lens (without correction) and integrated in the probation frame
Slika 5. Ispitivanje u simuliranim kliničkim uvjetima
Figure 5 Examination in simulated clinical conditions
Slika 6. Minijaturni Snellenov optotip u kavitetu molara
Figure 6 Miniaturized Snellen optotype in the molar cavity
Slika 7. Distribucija vidnih oštrina zabilježena korištenjem sistema VSC i VGA 2,5
Figure 7 Distribution of visual acuities recorded by application of VSC and VGA 2.5 systems

kim sistemima iznosi od 0,3 do 0,6, a pri korištenju Galilejeva optičkog sustava GTX 2,5 x, raspon oštrine vida je 0,4 do 0,7 na minijaturnom Snellenovu optotipu. Studija koja se koristila verzijom minijaturiziranog Snellenova optotipa pokazala je širok raspon vidne oštrine na blizinu stomatologa s korekcijom i bez korekcije (12). U našem ispitivanju 52 posto ispitanika postiglo je vidnu korekciju od 0,4 bez korekcije, a 59 posto poboljšalo je vidnu oštrinu za 10 posto koristeći se Galilejevim optičkim sistemom s povećanjem od 2,5 puta i postigli su vrijednost od 0,5 na minijaturnim Snellenovim optotipovima u simuliranim kliničkim uvjetima. Samo 2 posto ispitanika postiglo je vidnu oštrinu od 0,6 bez korekcije, a 20 posto s Galilejevim teleskopom postiglo je istu vidnu oštrinu. Sedam posto ispitanika s Galilejevim teleskopom imalo je vidnu oštrinu od 0,7. Korištenjem leća može se kompenzirati određeni stupanj vidne dekompenzacije (13). Eichenberger i suradnici dokazali su statistički značajno povećanje vidne oštrine i s Galilejevim i s Keplerovim optičkim sustavom i kod kliničara stomatologa koji su primarno slabovidni (12,13) Mlađim stomatolozima, u dobi do 40 godina, oštrina vida može se signifikantno poboljšati ako se reducira distancija *oko – objekt* (p = 0,001) ili ako se koriste lećama (p = 0,008) (14). U dosadašnjim člancima objavljenima u časopisima Galilejevi sistemi s povećanjem od 2,5 puta posebno se preporučuju studentima stomatologije i stomatolozima koji se u kliničkom radu još nisu koristili lećama. Razmjerno malo povećanje od 2,5 puta kojim se postiže znatno poboljšanje vizualizacije usne šupljine te lakoća primjene Galilejeva sustava, čine ga prihvatljivim u kliničkom radu i razvoju stomatologa (15). Studija koja je ispitivala opravdanost korištenja leća tijekom studija stomatologije uglavnom je odgovorila da su prednosti nošenja leća ergonomski čimbenici (93 %), bolje mjerenje parodontne sonde (90,3 %), detekcija karijesa (69,6 %), restorativna evaluacija (69,6 %), poboljšanje skrbi za pacijenta (61,2 %), radiološka interpretacija (59,5 %) i detekcija kamenca (16).

Uporaba Galilejeva teleskopa magnifikacije od 2,5 puta značajno poboljšava vidnu oštrinu na blizinu liječnika dentalne medicine u simuliranim kliničkim uvjetima u odnosu na vidnu oštrinu na blizinu bez korekcije. Koristeći se Galilejevim teleskopima s povećanjem od 2,5 puta poboljšavaju se vidne performanse unutar dentalnoga radnog prostora te posljedično i kvaliteta stomatološkoga rada.

Sukob interesa

Autori ističu da nije bilo sukoba interesa.

in research participants with normal visual status, using no optical systems, amounted from 0.3 to 0.6, whereas in case of usage of the Galilean optical system, GTX 2,5x, the visual acuity ranged from 0.4 to 0.7 on the miniaturized Snellen optotype. The study which used the miniaturized Snellen optotype version showed a broader span of the near visual acuity of the dentists with and without corrections (12). In this research, 52% of participants achieved uncorrected visual acuity of 0.4, whereas 59% of them improved their visual acuity for 10% when using the Galilean optical system 2,5x. They also achieved the value of 0.5 on the miniaturized Snellen optotypes in simulated clinical conditions. Only 2% of research participants achieved the visual acuity of 0.6 without correction, whereas 20% of them achieved the same visual acuity of 0.6 using the Galilean telescope. 7% of the students who were using the Galilean telescope had visual acuity of 0.7. A person can compensate visual decompensation to a certain degree if using a loupe (13). Eichenberger at al. noted a statistically significant improvement in visual acuity when primarily visually impaired clinical dentists used both the Galilean's and Kepler's optical systems (12, 13). For younger dentists, below the age of 40, visual acuity could be significantly improved by reduction of the eye-object distance (p=0.001) or by the use of a loupe (p=0.008) (14). In the literature, the Galilean systems with x2.5 magnification have been highly recommended to students and to dental professionals who had not used loupes as part of their clinical routine. There have been some benefits to the use of loupes. Apart from making a significant improvement in visualization of the oral cavity, the Galilean system is easy to use. (15). A study which examined the use of loupes in routine clinical practice proved that advantages of loupes are as follows: ergonomic factors (93%), more quality measurement by the periodontal probe (90.3%), caries detection (69,6%), restorative evaluation (69,6%), improved care for patient (61,2%), radiologic interpretation (59,5%) and detection of calculus (16).

The use of the Galilean telescope with x2.5 magnification considerably improves the near visual acuity of dentists compared to the near visual acuity of dentists without correction. The Galilean x2.5 magnification telescope improves visual performance in clinicians, thus enhancing the quality of their work.

Conflict of interest

None declared.

Abstract
Aim: The purpose of this study was to compare near visual acuity of dentists without optical aids (VSC) with near visual acuity of those using the Galilean telescope system (VGA2) with magnification of x 2.5, and the distance of 350 mm in simulated clinical conditions. **Methods:** The study included 46 dentists (visual acuity 1.0 without correction). A visual acuity testing was carried out using a miniaturized Snellen visual acuity chart which was placed in the cavity of molar teeth mounted in a phantom head in simulated clinical conditions. Near visual acuity for the vicinity was examined: 1) without correction at a distance of 300-400 mm (VSC); 2) with Galilean loupes with magnification of x2.5, focal length of 350mm. **Results:** The distributions of near visual acuity recorded using VSC and VGA2, 5 systems were compared by the Wilcoxon Signed Rank test. The results obtained by Wilcoxon Signed Rank test pointed to a statistically significant difference in the distribution of recorded visual acuity between the VSC and VGA2 optical systems (W = - 403.5; p <0.001). **Conclusion:** If using the VGA2, 5 systems, higher values of the near visual acuity were recorded and subsequently compared to near visual acuity without magnifying aids (VSC).

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Key words
Lenses; Visual Acuity; Telescopes; Dentists

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