

Fahad Umer¹, Farhan Raza Khan², Amna Khan³

“Zlatni omjer” vidljivoga zubnog osmijeha u pakistanskoj populaciji: eksperimentalno istraživanje

Golden Proportion in Visual Dental Smile in Pakistani Population: A Pilot Study

¹ Zavod za kirurgiju, The Aga Khan University Pakistan

Department of Surgery, The Aga Khan University Pakistan

² Zavod za opću stomatologiju, Aga Khan sveučilište i bolnica, Stadium Road, 74700 Karachi, Pakistan

Scholar Director, Operative Dentistry Residency, Aga Khan University & Hospital, Stadium Road, 74700 Karachi, Pakistan

³ Istraživački ured, The Aga Khan University, Pakistan

Writer in Residence, Research Office The Aga Khan University

Sažetak

Uvod: Oduvijek se raspravljalo o tome što čini dobru dentalnu estetiku, s obzirom na to da ona može varirati od osobe do osobe, ovisno o njezinu iskustvu i društvenom okružju. Zato se “zlatni omjer” smatra važnim kako bi se postigla estetika i skladan osmijeh. **Svrha:** Istraživanjem se željelo postići sljedeće: odrediti prevalenciju “zlatnog omjera” vidljive širine na odabranom uzorku pakistanske populacije; ispitati ima li spolnih razlika u stvarnim širinama gornjih prednjih zuba; ustanoviti korisnost *Levinove FI zubne ljestvice* kao prediktora “zlatnog omjera”. **Ispitanici i postupci:** Od stotinu pacijenata odabranih neprobabilističkim uzorkovanjem, samo je njih 44 bilo uključeno u istraživanje. Za mjerenje zuba stručnjaci su se koristili zubnim modelima odabranih ispitanika. Stvarna širina (meziostalna) mjerila se pomičnom mjerkom, a vidljiva (širina maksimalnih frontalnih zuba gledano sprijeda) ljestvicom i mjerkom. Predicirana širina izračunavala se korištenjem “zlatnog omjera” za gornji bočni sjekutić i gornji očnjak. Nakon toga su podaci bili statistički analizirani (deskriptivna statistika, Pearsonov koeficijent korelacije, t-test). **Rezultati:** Šezdeset i tri posto (63,6 %) uzorka (22 žene i 6 muškaraca) odgovaralo je ljestvici “zlatnog omjera” kad je riječ o vidljivoj širini gornjih prednjih zuba. Gledano sprijeda, vidljiva širina gornjih bočnih sjekutića iznosila je 75 posto stvarne širine središnjih sjekutića (središnji sjekutić bio je referentni zub te je zato korištena stvarna širina), a vidljiva širina očnjaka bila je 61,3 posto (gotovo “zlatni postotak”) vidljive širine bočnih sjekutića. Nije bilo veće spolne razlike u stvarnoj širini gornjih središnjih i bočnih sjekutića te očnjaka. **Zaključak:** *Zubna ljestvica FI* može biti korisna i dobra početna točka za predikciju “zlatnog omjera” kod 63 posto pakistanske populacije. Ipak, taj se omjer ne bi se trebao smatrati odlučujućim čimbenikom dentalne privlačnosti. To bi prije trebao biti raspon nego jedna vrijednost.

Zaprimljen: 19. lipnja 2009.

Prihvaćen: 4. srpanj 2010.

Adresa za dopisivanje

Fahad Umer
The Aga Khan University Pakistan
Department of Surgery
fahad.umer@aku.edu

Ključne riječi

estetika, dentalna; sjekutići; očnjaci; Pakistan

Uvod

Zadaća stomatologa nije samo liječiti, nego i održavati estetiku. Prije nekoliko desetljeća izgled restauracija bio je sekundaran i prednost se davala liječenju s dugotrajnim učinkom. Danas je, pak, pacijentima najvažnija estetska prihvatljivost, što stomatolozima znatno ograničava odabir restaurativnih varijanti, osobito ako pacijentima manjkaju zubi ili su im jako oštećeni (1).

Oduvijek se potanko raspravljalo o tome što čini dobru dentalnu estetiku, s obzirom na to da ona može varirati od osobe do osobe, ovisno o njezinu iskustvu i društvenom okružju. Ipak, linija usnice, ravnina zuba, simetrija, boja i incizalno poklapanje s linijom usnice, ostaju važne odrednice (2). Kako bi se postigla dopadljiva dentalna i facijalna estetika, uvijek se smatralo da važnu ulogu u tome imaju veličina

Introduction

The role of dental professionals in the modern era is not just limited to therapy, but also to maintain esthetics. Several decades ago, the appearance of restorations was of secondary importance as long lasting treatment was the preferred mode of cure. Today esthetic acceptability remains a primary concern for patients which creates great difficulty for dentists while considering restorative options, especially for patients who have missing or badly damaged teeth (1).

There has always been a long argument regarding what constitutes good dental esthetics, as it can vary from person to person depending on personal experiences and social surroundings. However, the lip line, alignment of teeth, symmetry, colour of teeth and incisal fit with the lip line, all remain important determinants (2). For achieving a pleasing

i oblik prednjih gornjih zuba (3). Mezioidistalna širina smatra se važnijom od incizo-gingivalne duljine te je predmet velike rasprave kako prediciirati širinu (4). Teorija "zlatnog omjera" može pokazati kako se određuje širina sjekutića mjereći njihovu duljinu. Također teoretski određuje idealnu veličinu zuba u njihovu međusobnom odnosu. Može biti vrlo korisna kao početna točka za postizanje skladnog i estetski prihvatljivog prednjeg segmenta.

Koncept "zlatnog omjera" fascinira znanstvenike, arhitekta i umjetnike više od 2400 godina. Premda je oduvijek postojao u matematici i u fizičkom svemiru, još se ne zna točno kada je otkriven i primijenjen. Grci su otkriće toga koncepta pripisivali Pitagori ili njegovim učenicima koji su zaključili da - kako bi nešto bilo lijepo - dijelovi toga trebaju biti u idealnom omjeru. Tek oko 1900. godine američki matematičar Mark Barr predstavio je *zlatni omjer* (zlatni rez) koristeći se za to slovom Φ iz grčkog alfabeta (ϕ , prema Fidiji, grčkom kiparu koji ga je često rabio u svojem radu) (5). Idealan omjer za estetski sklad bio bi od 0,618 prema 1,0 (6,7).

Lombardi je preporučio "zlatni omjer" kao važno sredstvo koje pomaže stomatologu u predviđanju širine prednjih zuba tijekom njihove restauracije (8). Levin (1978) je bio originalni izumitelj u primjeni "zlatnog omjera" u dentalnoj estetici. Ustanovio je da, ako se lice gleda sprijeda (vidljiva širina), širina središnjeg sjekutića treba biti u "zlatnom omjeru" sa širinom bočnog sjekutića, a lateralni sjekutić treba biti u "zlatnom omjeru" sa širinom očnjaka (9). Smatralo se da takav omjer stvara odgovarajuću ravnotežu koja diktira liječenje (10) i omogućuje estetski zadovoljavajuće osmijeh (11,12).

U stomatologiji taj se koncept može lako primijeniti, osobito za prednje gornje zube (od očnjaka do očnjaka), zadržavajući središnji sjekutić kao referentni. Stvarna (realna mezioidistalna) širina prednjih zuba, osobito očnjaka, veća je ako se mjeri mezioidistalno nego vidljiva širina (širina zuba kad se pacijent gleda sprijeda).

Ovo istraživanje određuje prevalenciju "zlatnog omjera" na odabranom uzorku pakistanske populacije. To je prvo takvo istraživanje u Pakistanu, jer za populaciju u toj zemlji nismo našli sličnih u stomatološkoj literaturi.

Svrha rada je istražiti prevalenciju "zlatnog omjera" na odabranom uzorku pakistanske populacije i primjenjivost *Levinove FI zubne ljestvice* te odrediti spolne razlike.

Ispitanici i postupci

Uzorak

Uzorak od 100 pacijenata (50 muškaraca i 50 žena) koji su posjećivali Stomatološku kliniku Sveučilišne bolnice Aga Khan (od ožujka 2008. do srpnja 2008.) procijenjen je

dental and facial esthetic, the size and the form of the maxillary anterior teeth have always been considered to play an important role (3). The mesio-distal width is suggested to be more important than inciso-gingival length and it has been a subject of great debate how the width should be predicted (4). The theory of the golden ratio can show how to determine the width of the incisors by measuring their height. It theoretically also determines the ideal size of the teeth in relation to each other. It can be very useful as a starting point in achieving a harmonious and esthetic anterior segment.

The concept of Golden proportion has fascinated scientists, architects and artists for more than 2,400 years. Although it has always existed in mathematics and in the physical universe, it is still not known exactly when it was first discovered and applied by mankind. The Greeks usually attributed discovery of this concept to Pythagoras or his followers who had come to the conclusion that in order to be beautiful, the repeating units should ideally be in proportion to one another. It was not until 1900s when an American mathematician named Mark Barr represented the *Golden Ratio* by using a Greek symbol Φ (phi, after Phidias, a Greek artist who used it extensively in his work) (5). The ideal proportion for esthetic harmony would be in the ratio of 0.618 to 1.0 (6,7).

Lombardi suggested the Golden proportion to be an important tool to help dentists in predicting the width of the anterior teeth while restoring them (8). Levin (1978) was the original innovator of the application of the golden proportion to dental aesthetics who stated that when the face was viewed from the front (apparent width), the width of the central incisor should be in golden proportion to the width of the lateral incisor and the lateral incisor should be in golden proportion to the width of the canine (9). It has been considered that the Golden proportion creates proper balance which dictates treatment (10) and develops esthetically pleasing smiles (11, 12).

In dentistry, this concept can be applied easily especially for the upper anterior dentition (from canine to canine) keeping the central incisor as a reference. The actual (real mesiodistal) width of these teeth, especially of the canine, is greater when measured mesiodistally than the apparent width (width of the teeth when the patient is viewed from the front).

The present study evaluates the prevalence of golden proportion in a selected sample of Pakistani population. This was the first research survey done in Pakistan, as we found no similar dental literature for the Pakistani population.

Objectives: To study the prevalence of golden proportion in a selected sample of Pakistani population and the applicability of *Dr. Levin's Phi Dental Grid*, and to determine gender differences.

Materials and Methods

Study Sample

A sample of 100 patients (50 males and 50 females) visiting the Dental clinic of the Aga Khan University Hospital (March 2008-July 2008) was evaluated using non-probabil-

kao uporaba neprobabilističkog (namjenskog) uzorkovanja. Odabrani su samo oni s trajnom denticijom i bilateralno I. klasom prema očnjaku. Raspon dobi bio je od 15 do 30 godina. Kriterij za nesudjelovanje bio je: ortodontsko liječenje u anamnezi, kompresija prednjih zuba ili krunice te mostovi u regiji prednjih zuba. Od ukupnog su broja 44 pacijenta (32 žene i 12 muškaraca) zadovoljila uvjete i odabrani su za istraživanje. Istraživanje je zapravo bilo opservacijska studija presjeka.

Prikupljanje podataka

Za mjerenja su se koristili zubni modeli odabranih ispitanika. Uzeti su im alginatni otisci (Zhermack, Njemačka) i odliveni u tvrdoj sadri (ISO tip II, Crystacal R, Njemačka). Stvarna širina (meziodistalna) mjerila se pomičnom mjerkom (Muenchner model Dentarum, Njemačka). Mezi-odistalne širine (stvarne širine) središnjih i bočnih sjekutića te očnjaka mjerile su se s labijalne strane pomičnom mjerkom s oštrim krakovima namještenima između najširih točaka svakog zuba.

Vidljiva širina (maksilarnih prednjih zuba gledano sprijeda) mjerena je zubnom ljestvicom FI (Slika 1.). Model se stavljao na zubnu ljestvicu i gledao sprijeda nakon što je bio postavljen u razini oka. Širine pojedinog zuba vidljive iz tog položaja obilježene su grafitnom olovkom te izmjerene istom pomičnom mjerkom (Slika 1.).

Predicirana širina izračunavala se formulom "zlatnog omjera" zadržavajući stvarnu širinu središnjeg sjekutića kao referenciju. Primjerice, ako znamo širinu središnjeg sjekutića (8 mm), vidljiva širina bočnog sjekutića može se lako predvidjeti množenjem širine središnjeg sjekutića s 0,618 ili dijeljenjem s 1,618 [(primjerice, vidljiva širina bočnog sjekutića = 8 mm x 0,618 = 5 mm; vidljiva širina očnjaka = vidljiva širina bočnog sjekutića x zlatni omjer: (5 mm x 0,618 = 3 mm)].

Nije bilo razlike između prednjih gornjih zuba lijeve i desne strane ($p > 0,05$). Zato su srednje vrijednosti između objiju strana uzete za statističku analizu.

Modeli su postavljeni na zubnu ljestvicu FI, gledani sprijeda u razini oka te ocjenjivani kao „da“ ako su zubi odgovarali referentnim linijama povučenima na ljestvici, ili kao „ne“ ako nisu.

Analiza podataka

Izračunavale su se distribucije frekvencija ispitanika. Dobile su srednje vrijednosti (\bar{x}) i standardne devijacije (SD) mjerenih širina zuba. Pearsonov koeficijent korelacije izračunat je kako bi se otkrila linearna povezanost između stvarne širine (kontaktnih točaka), širine predicirane prema formuli "zlatnog omjera" (gledano sprijeda) i vidljive širine (označene na ljestvici, gledano sprijeda). Odabrana je razina pouzdanosti od 0,01.

ity (purposive sampling). Only those patients were selected who had permanent dentition and bilateral class I canine. The age range of the study sample was 15-30 years. The exclusion criterion was: having any orthodontic treatment history, or anterior teeth crowding, or having crown restorations or bridge works in the region of anterior teeth. There were 44 patients (32 females and 12 males) who fulfilled the inclusion criteria and were selected for the study. The study design was cross sectional and descriptive.

Data Collection

The dental casts of the selected individuals were used for the measurements. Alginate impressions were made (Zhermack, Germany) and were poured in the hard stone (ISO type II, Crystacal R, Germany) Actual width (mesiodistal width) was measured using vernier calipers (Munchner model Dentarum, Germany). Mesiodistal widths (actual width) of central incisors, lateral incisors and canines were measured from the labial side using a sharp beaked vernier caliper positioned between the widest points of each tooth.

Apparent width (width of maxillary frontal teeth viewed from the front) was measured by means of a phi dental grid (Fig. 1). The cast was placed on a dental grid and was viewed from the front with the cast positioned at the eye level. The widths of each individual tooth visible from this view were marked with a lead pencil and were then measured using the same vernier calliper (Munchner model Dentarum, Germany) (Fig. 1).

Predicted width was calculated using Golden proportion formula keeping the actual width of central incisor as the reference. For example, if we know the width of the central incisor (8 mm), the apparent width of the lateral incisor can easily be predicted by multiplying the width of central by 0.618 or divide it with 1.618 [(eg. Apparent width of lateral incisor = 8 mm x 0.618 = 5 mm; Apparent width of canine = apparent width of lateral incisor x golden proportion: (5 mm x 0.618 = 3 mm)].

There was no difference between the left and the right side maxillary frontal teeth ($p > 0,05$). Therefore mean values between the left and the right side was taken for statistical analysis.

The casts were also placed on a Phi dental grid and were viewed from the front keeping them at eye level and were graded as yes if the teeth were fitting the reference lines drawn on the grid or no if not.

Data Analysis

Frequency distribution of the subjects were calculated. Mean values (\bar{x}) and Standard Deviations (SD) of the measured tooth widths were obtained. Pearson's Correlation Coefficient was calculated to reveal linear association among the actual (contact-contact) width, predicted width upon the Golden proportion formula (when viewed from the front) and visibly apparent (grid-marked) width (viewed from the front). The level of significance was set at 0.01.

Rezultati

Nakon primjene formule "zlatnog omjera" na prednje maksilarne zube gledane srijeda (vidljiva širina), 63,6 posto ispitanika (22 žene i 6 muškaraca) odgovaralo je Levinovoj FI zubnoj ljestvici, a 36,4 posto (10 žena i 6 muškaraca) nije odgovaralo (Slika 1).

Srednje vrijednosti i standardne devijacije stvarnih širina, "zlatnih" (prediciranih) širina i vidljivih (označenih) širina prednjih maksilarnih zuba, nalaze se na Tablici 1. Koeficijenti korelacije između stvarnih širina, "zlatnih" (prediciranih) širina i vidljivih (označenih) širina za bočne sjekutiće predstavljeni su na Tablici 2. te za očnjake u Tablici 3. Tu je pronađena statistički značajna korelacija između stvarne i vidljive širine ($r=0,491$, $p<0,01$) te između predicirane (zlatne) širine i stvarne širine ($r=0,462$; $p<0,01$) za bočni gornji sjekutić, a nije bilo znatne korelacije između "zlatne" (predicirane) i vidljive širine istog zuba. Nije bilo veće korelacije između bilo koje mjerene ili predicirane širine za maksilarni očnjak.

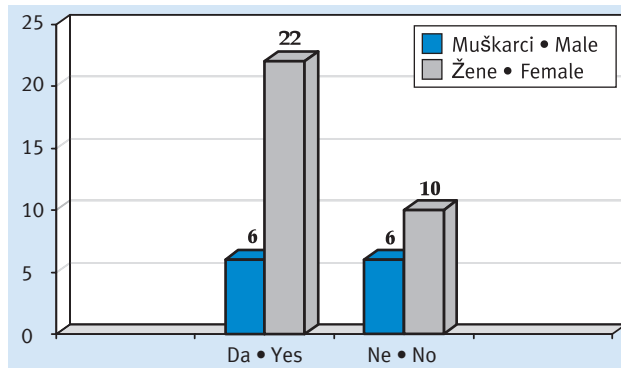
Gledano srijeda, vidljiva je širina bočnih maksilarnih sjekutića 75 posto stvarne širine središnjeg sjekutića te da je vidljiva širina očnjaka 61,3 posto (zlatni postotak) vidljive širine bočnog sjekutića, Slika 2.

Results

After applying the formula of golden proportion to the maxillary frontal teeth viewed from the front (apparent width), 63.6% subjects (22 females and 6 males) fitted, and 36.4% (10 females and 6 males) did not fit Levin's Phi dental grid (Figure 1).

The mean values and standard deviations of actual widths, golden (predicted) widths and apparent (marked) widths of the maxillary frontal teeth are presented in Table 1. Correlation coefficients between the actual widths, golden (predicted) widths and apparent (marked) widths for the lateral incisor are presented in the Table 2 and for the canine in the Table 3. There was a statistically significant correlation between the actual width and the apparent width ($r=0.491$, $p<0.01$), and between the predicted (golden) width and the actual width ($r=0.462$; $p<0.01$) for the lateral maxillary incisor, while there was no significant correlation between the Golden (predicted) and the apparent width of the same tooth, Figure 2. There was no significant correlation between any of the measured or predicted widths for the maxillary canine.

When viewed from the front, the apparent width of maxillary lateral incisor was found to be 75% of the apparent



Slika 1. Spolna raspodjela ispitanika prema Levinovoj FI zubnoj ljestvici

Figure 1 Gender distribution according to the fit of predicted Levin's Phi Grid

Tablica 1. Srednje vrijednosti i standardne devijacije stvarnih, "zlatnih" (prediciranih) i vidljivih širina središnjih i bočnih sjekutića te očnjaka.
Table 1 Mean values and standard deviations of the Actual, Apparent and Predicted widths of the central incisors, lateral incisors and canines

	Stvarna širina • Actual width (mean ± std)	Zlatna (predicirana) širina • Golden (predicted) width (mean ± std)	Vidljiva (označena) širina • Apparent (marked) width (mean ± std)
Središnji sjekutić • Central Incisor	8.94 ± 0.55	Referentna = stvarna širina • Reference = actual width	8.86 ± 0.54
Bočni sjekutić • Lateral Incisor	6.90 ± 0.60	5.52 ± 0.34	6.31 ± 0.75
Očnjak • Canine	7.89 ± 0.63	3.41 ± 0.21	3.80 ± 0.82

Tablica 2. Korelacije - bočni sjekutić
Table 2 Correlation - Lateral Incisor

	Stvarna širina • Actual width	Zlatna (predicirana) širina • Golden (predicted) width	Vidljiva (označena) širina • Apparent (marked) width
Stvarna širina • Actual width		0.462 (P = 0.002) *	0.491 (P = 0.001) *
Zlatna (predicirana) širina • Golden (predicted) width			0.002 (P-value 0.98)

Tablica 3. Korelacije - očnjak
Table 3 Correlation - Canine

	Stvarna širina • Actual width	Zlatna (predicirana) širina • Golden (predicted) width	Vidljiva (označena) širina • Apparent (marked) width
Stvarna širina • Actual width		0.23 (P = 0.13)	- 0.122 (P = 0.43)
Zlatna (predicirana) širina • Golden (predicted) width			- 0.21 (P = 0.17)

Tablica 4. Srednje vrijednosti i standardne devijacije širina maksilarnih središnjih i bočnih sjekutića te očnjaka prema spolu
Table 4 Gender mean values and standard deviations of the widths of the central maxillary incisor, the lateral maxillary incisor and the maxillary canine

	Muškarci / Males n=12 (mm)	Žene / Females n=32 (mm)
Središnji sjekutić / Central incisor	9.2 ± 0.54	8.84 ± 0.53
Bočni sjekutić / Lateral incisor	6.84 ± 0.52	6.92 ± 0.64
Očnjak / Canine	8.07 ± 0.57	7.82 ± 0.65



Slika 2. Zubni model i zubna ljestvica Fi
Figure 2 Dental Cast and Phi Dental Grid

Nije bilo znatne spolne razlike u širinama središnjih maksilarnih sjekutića, bočnih sjekutića i očnjaka, Tablica 2, ($p > 0,05$).

Rasprava

Rezultati istraživanja pokazuju da je "zlatni omjer" nađen na 63,6 posto uzorka populacije kada su prednji maksilarni zubi gledani srijeda. To podupiru studije Onga (2006.) i Mahshida (2004.) koji su također istaknuli da incidencija "zlatnog omjera" nije bila odlučujuća za dentalnu privlačnost (18, 19).

Gillen i suradnici su, rabeći zubne modele za mjerenje "zlatnog omjera", dokazali da ga rijetko tko ima (uzorak se sastojao od 54 ispitanika) (20). U drugim je istraživanjima također istaknuto da je frekvencija "zlatnog omjera" dosta niska kod oku ugodnih osmijeha (21). Nema dokaza koji bi upućivali na to da taj omjer treba uzeti u obzir kao idealan estetski standard ako se trebaju nadomjestiti bočni sjekutići

width of the central incisors actual width and it was also found that the canine's apparent width was 61.3% (golden percentage) of the lateral incisor's apparent width.

There was no significant gender difference considering the widths of central maxillary incisors, lateral incisors, and canines, Table 4 ($p > 0.05$).

Discussion

The results of our study reveal that golden proportion was found in 63.6% of the sample population when maxillary frontal teeth had been viewed from the front. This is supported by the studies of Ong (2006) and Mahshid (2004) who also found that the incidence of the golden proportion had not been a decisive factor of determining dental attractiveness (18, 19).

Gillen et al. showed that golden proportion was rarely observed (the sample consisted of 54 individuals) (20) using dental casts to measure golden proportion. Other studies have also found that the frequency of the golden proportion in agreeable smiles was quite low (21). There has been no evidence to suggest that the golden proportion should be

(22). Mi smo kod našeg uzorka našli varijacije u izmjerenom "zlatnom omjeru". Woelfelovo istraživanje (2002.) također je pokazalo da "zlatni omjer" nije uvijek uočljiv i da su česte varijacije (23). Na osnovi rezultata dobivenih u našem istraživanju i onih iz literature (20-23), možemo zaključiti da "zlatni omjer" ne bi trebao biti jedinstvena vrijednost, nego bi radije trebalo uzeti u obzir raspon. Ahmed (2005.) je ustvrdio da "zlatni omjer" može biti dobra početna točka kako bi se postigli zadovoljavajući estetski rezultati, ali da može biti prihvatljiv bilo koji omjer od 0,6 do 0,8 (4).

No, Preston je u sličnom istraživanju pregledao ukupno 58 zubnih modela studenata stomatologije i pokušao odrediti učestalost "zlatnog omjera". Kad je gledao modele sprijeda (vidljiva širina), zaključio je da je u "zlatnom omjeru" samo 17 posto središnjih maksilarnih sjekutića prema bočnim sjekutićima i 0 posto bočnih sjekutića prema očnjacima. Također je predložio da bočni sjekutići budu 66 posto uži od središnjih i da očnjaci trebaju biti 84 posto uži od bočnih sjekutića kad se gledaju sprijeda. Isticao je da, premda navedene vrijednosti mogu omogućiti estetski zadovoljavajući rezultat, to nisu prirodni omjeri (24). U našem istraživanju pronašli smo da je bočni gornji sjekutić 75 posto središnjeg sjekutića, a očnjak 61,3 posto (gotovo "zlatni omjer") bočnog sjekutića kad se gledaju sprijeda.

Rosenstiel (2000.) je istraživao kako na estetske preferencije stomatologa, kad je riječ o prednjim maksilarnim zubima, utječu različite proporcije i ustanovio da se prednost dala omjeru od 80 posto kad su gledani kratki ili vrlo kratki zubi, a "zlatnom omjeru" kad su gledani vrlo dugi zubi (25).

Pregled literature otkriva da "zlatni omjer" utječe na percepciju ljepote (13). No, u etnički različitim populacijama incidencija može biti različita, jer su odnosi veličina zuba među zubnim lukovima populacijski i spolno specifični (14-16). Neki autori smatraju da spol nema velik utjecaj kad se primjenjuje "zlatni omjer", ali da se trebaju uzeti u obzir etničke razlike kako bi se odredili točno oni postotci koji su doista zlatni (17). Premda je u našem istraživanju broj odabranih muškaraca bio vrlo mali ($n=12$) (zbog činjenice da su morali ispuniti uvjete za uključivanje u istraživanje), usporedba je pokazala da nema veće spolne razlike u srednjim meziodistalnim širinama središnjih i bočnih sjekutića te očnjaka (stvarne širine). No, Hasanreisoglu i suradnici istraživali su postojanost u širini prednjih zuba u turskoj populaciji i pronašli da dimenzije središnjih sjekutića i očnjaka variraju ovisno o spolu te da nema "zlatnog omjera" ni bilo koje druge rekurentne proporcije na zubima (26).

Trebalo bi poduzeti nova istraživanja na većem uzorku s podjednakim brojem muškaraca i žena kako bi se usporedilo postoji li bilo kakva spolna razlika u širinama središnjih i bočnih sjekutića te očnjaka u populaciji koja pripada azijskom etnicitetu.

Ali Fayyad je istaknuo kako je teorija "zlatnog omjera" možda moguća u povezivanju uzastopnih širina prednjih gornjih zuba, ako se postotci prilagode etničkoj pripadnosti populacije (17).

Uzimajući u obzir njegovo stajalište, proveli smo ovo istraživanje kao preliminarno za "zlatni omjer" u Pakistanu. Prema našim spoznajama, to još nije detaljnije istraženo u

considered the ideal esthetic standard when creating space for the replacement of the missing lateral incisors (22). We found variations in our study sample in terms of the measurements of golden proportion. The study of Woelfel (2002) also showed that Golden Proportion had not always been evident and variations had been frequently observed (23). Based on the results obtained in our study and on the results from the literature (20-23), we can come to the point that Golden Proportion should not be a single value but rather a range. Ahmed (2005) stated that golden ratio can be a good starting point in order to get aesthetically pleasing results, however any ratio of 0.6-0.8 may be esthetically acceptable (4).

However, Preston in a similar study examined a total of 58 dental students' dental casts and tried to determine the frequency of golden proportion. When observing the casts from the front (apparent width), he found only 17% of maxillary central incisors to lateral incisors and 0% of lateral incisors to canines to be in golden proportion. He also suggested that lateral incisors should be 66% narrower than the central and that the canines should be 84% narrower than lateral incisors when viewed from the front. He argued that although the advocated ratios may provide a result that is esthetically pleasing, they are not the ratios found in nature (24). In our study we found the maxillary lateral incisor to be 75% of the central incisor and the canine to be 61.3% (golden) of the lateral incisor when viewed from the front.

Rosenstiel (2000) studied dentists' esthetic preferences of the maxillary anterior teeth as influenced by different proportions and he found that 80 percent proportion was preferred when viewing short or very short teeth, and the golden proportion was preferred when viewing very tall teeth (25).

Review of literature reveals that Golden proportion influences the perception of beauty (13). However, the incidence of the Golden Proportion may be different for various ethnic populations as inter-arch tooth size relationships are population and gender specific (14-16). Some authors also argue that gender has no significant effect when the golden proportion is applied, but ethnic differences should be considered to determine exactly those percentages that are really golden (17). Although the selected number of males in our study sample was quite small ($n=12$) compared to females ($n=32$) (due to the fact that they had fulfilled the inclusion criteria), the comparison showed that there was no significant gender difference in the mean mesiodistal widths of central incisors, lateral incisors and canines (actual widths). However, Hasanreisoglu et al. studied consistency in width of anterior teeth amongst Turkish population and he found that the dimensions of the central incisors and canines varied by gender and that neither golden proportion nor any other recurrent proportions were present in the teeth (26).

New studies on a larger sample with equal distribution of males and females should be made to compare if any gender difference really exist considering widths of central incisors, lateral incisors and canines of the population belonging to the Asian ethnicity.

Ali Fayyad suggested that the golden theory seemed to be applicable to relate the successive widths of the maxillary anterior teeth if percentages were adjusted taking into consideration

drugim zemljama u Aziji. Kako u različitim populacijama mogu postojati mnogobrojni čimbenici, ograničenja i proporcije ovisno o etnicitetu i spolu, trebalo bi u većoj studiji o azijskoj populaciji ustanoviti varijacije u veličini zuba, njihovom obliku i rasporedu te incidenciji "zlatnog omjera". To će kliničarima omogućiti da bolje i lakše osmisle plan liječenja, uzimajući u obzir estetske zahtjeve pacijenata iz određene etniciteta.

Zaključak

Zubna ljestvica FI može biti korisna i dobra početna točka za predviđanje "zlatnog omjera" kod 63 posto pakistanske populacije. Ipak, taj se omjer ne bi trebao smatrati odlučujućim čimbenikom u određivanju dentalne privlačnosti.

Zahvala

Zahvaljujemo doktorima Nadiji Aman, Farhanu Razi Khanu i Farhani Ghaffar za njihovu trajnu potporu tijekom istraživanja.

the ethnicity of the population (17). Considering his viewpoint, we conducted this study as a preliminary research considering the golden proportion in Pakistan. To our knowledge, this area has also not yet been explored extensively by other countries falling in the Asian region. As numerous factors, limitations, and proportions may exist in all types of population based on their ethnicity and gender, a larger study should be administered on the Asian population to establish the variations in tooth size, shape, alignment and the incidence of Golden proportion. This will enable the clinicians' better understanding and designing or facilitating the "treatment plan phase" while considering the esthetic desires of patients belonging to a particular ethnicity.

Conclusion

Phi Dental Grid can be useful tool and a good starting point to predict golden proportion in 63% of the Pakistani population. However, golden proportion should not be considered as a decisive factor of determining dental attractiveness. It should be a range rather than a single value.

Acknowledgement

We would like to thank Drs. Nadia Aman, Farhan Raza Khan, Farhana Ghaffar for their continuous support throughout the course of this study.

Abstract

Introduction: It has always been argued as to what constitutes good dental esthetics, as it can vary from person to person depending on personal experiences and social surroundings. Golden proportion has been stated to be an important tool for achieving esthetics and harmony in smile. **Objectives:** The aim of this study was to find out prevalence of golden proportion of the apparent width in a selected sample of Pakistani population, to examine if there is gender difference considering actual maxillary frontal teeth widths, to determine the usefulness of *Levin's Phi Dental Grid* as a predictor of golden proportion. **Material and Method:** From one hundred patients evaluated using non-probability sampling, only 44 were included in the study. Dental casts of the selected individuals were used for teeth measurement. The actual width (measured mesiodistal width) was measured using vernier caliper, the apparent width (width of the maxillary frontal teeth when viewed from the front) was measured using the grid and the caliper, and the predicted width was calculated using the Golden proportion for the maxillary lateral incisor and the maxillary canine. Data was subjected to statistical analysis (descriptive statistics, Pearson's coefficient of correlation, t-test). **Results:** Sixty three percent of the sample (22 females and 6 males) fitted the scale of golden proportion considering the apparent width of the maxillary frontal teeth. When viewed from the front, maxillary lateral incisor's apparent width was 75% of the central incisor's actual width (central incisor was reference tooth therefore actual width was used) and the canine's apparent width was 61.3% (almost golden percentage) of the lateral incisor's apparent width. There was no significant gender difference for the actual widths of the maxillary central incisors, lateral incisors and canines. **Conclusion:** *Phi Dental Grid* can be useful tool and a good starting point to predict golden proportion in 63% of the Pakistani population. However, golden proportion should not be considered as a decisive factor of determining dental attractiveness. It should be a range rather than a single value.

Received: June 19, 2009

Accepted: July 4, 2010

Address for correspondence

Fahad Umer, Student
The Aga Khan University Pakistan
Department of Surgery
fahad.umer@aku.edu

Key words

Esthetics, Dental; Incisor; Cuspid; Pakistan

References

- Curtis DA, Lacy A, Chu R, Richards D, Plesh O, Kasrovi P et al. Treatment planning in the 21st century: What's new? *Oral Health*. 2003;93(6):43-55.
- Davis NC. Smile design. *Dent Clin North Am*. 2007 Apr;51(2):299-318, vii.
- Wolfart S, Brunzel S, Freitag S, Kern M. Assessment of dental appearance following changes in incisor angulation. *Int J Prosthodont*. 2004 Mar-Apr;17(2):150-4.
- Ahmad I. Anterior dental aesthetics: Dental perspective. *Br Dent J*. 2005 Aug 13;199(3):135-41.
- Seghers MJ, Longacre JJ, deStefano GA. The golden proportion and beauty. *Plast Reconstr Surg*. 1964;34:382-6.
- Ricketts RM. Divine proportion in facial esthetics. *Clin Plast Surg*. 1982 Oct;9(4):401-22.
- Ricketts RM. The biologic significance of the divine proportion and Fibonacci series. *Am J Orthod*. 1982 May;81(5):351-70.
- Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent*. 1973 Apr;29(4):358-82.
- Levin EI. Dental esthetics and the golden proportion. *J Prosthet Dent*. 1978 Sep;40(3):244-52.
- Blitz N. Direct bonding in diastema closure-high drama, immediate resolution. *Oral Health*. 1996 Jul;86(7):23-6.
- Poole S, Chan DC, Wataha JC, DeLeon E. Is the Golden Proportion

- tion a Clinical Endpoint of Orthodontic Treatment? J Dent Res. 2006;85(Special Issue A):Abstract #1636. Available from: www.dentalresearch.org.
12. Snow SR. Esthetic smile analysis of maxillary anterior tooth width: the golden percentage. J Esthet Dent. 1999;11(4):177-84.
 13. Jahanbin A, Basafa M, Alizadeh Y. Evaluation of the Divine Proportion in the facial profile of young females. Indian J Dent Res. 2008 Oct-Dec;19(4):292-6.
 14. Smith SS, Buschang PH, Watanabe E. Interarch tooth size relationships of 3 populations: "does Bolton's analysis apply?". Am J Orthod Dentofacial Orthop. 2000 Feb;117(2):169-74.
 15. Gillen RJ, Schwartz RS, Hilton TJ, Evans DB. An analysis of selected normative tooth proportions. Int J Prosthodont. 1994 Sep-Oct;7(5):410-7.
 16. Abdullah MA. Inner canthal distance and geometric progression as a predictor of maxillary central incisor width. J Prosthet Dent. 2002 Jul;88(1):16-20.
 17. Ali Fayyad M, Jamani KD, Agrabawi J. Geometric and mathematical proportions and their relations to maxillary anterior teeth. J Contemp Dent Pract. 2006 Nov 1;7(5):62-70.
 18. Ong E, Brown RA, Richmond S. Peer assessment of dental attractiveness. Am J Orthod Dentofacial Orthop. 2006 Aug;130(2):163-9.
 19. Mahshid M, Khoshvaghti A, Varshosaz M, Vallaei N. Evaluation of „golden proportion“ in individuals with an esthetic smile. J Esthet Restor Dent. 2004;16(3):185-92.
 20. Gillen RJ, Schwartz RS, Hilton TJ, Evans DB. An analysis of selected normative tooth proportions. Int J Prosthodont. 1994 Sep-Oct;7(5):410-7.
 21. de Castro MV, Santos NC, Ricardo LH. Assessment of the "golden proportion" in agreeable smiles. Quintessence Int. 2006 Sep;37(8):597-604.
 22. Bukhary SM, Gill DS, Tredwin CJ, Moles DR. The influence of varying maxillary lateral incisor dimensions on perceived smile aesthetics. Br Dent J. 2007 Dec 22;203(12):687-93.
 23. Woelfel JB, Scheid RC. Dental anatomy, its relevance to dentistry. Philadelphia: Lippincot-Williams; 2002.
 24. Preston JD. The golden proportion revisited. J Esthet Dent. 1993;5(6):247-51.
 25. Rosenstiel SF, Ward DH, Rashid RG. Dentists' preferences of anterior tooth proportion-a web-based study. J Prosthodont. 2000 Sep;9(3):123-36.
 26. Hasanreisoglu U, Berksun S, Aras K, Arslan I. An analysis of maxillary anterior teeth: facial and dental proportions. J Prosthet Dent. 2005 Dec;94(6):530-8.