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## Pregled retencijskih elemenata mobilnih djelomičnih proteza ovisno o vrsti bezubosti i zubima nosačima u komercijalnim laboratorijima u Ateni

### *A Survey of Removable Partial Denture (RPD) Retentive Elements in Relation to Type of Edentulism and Abutment Teeth in Commercial Laboratories in Athens*

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#### Sažetak

**Svrha:** Ovim se istraživanjem željelo istražiti retentivne elemente djelomičnih proteza (RPD) i zubne nosače kod djelomično bezubih pacijenata identifikacijom u komercijalnim atenskim zubnim laboratorijima. **Materijali i metode:** Procijenjeno je 628 sadrenih modela zajedno s lijevanim metalom koji se rabi za izradu djelomične skeletirane proteze. Modeli su fotografirani kako bi se mogao identificirati broj i smještaj postojećih zuba, zatim klase djelomične proteze i retentivni elementi. Za statističku analizu podataka korištene su tablice prevalencije i  $\chi^2$  testa ( $\alpha=.05$ ). **Rezultati:** Analizirano je 276 maksilarnih modela (43,9 %) i 352 mandibularna (56,1 %). Nedostatak maksilarnih zuba očitovao se u gotovo potpunom nedostatku desnoga (96,7%) i lijevog (96%) trećeg kutnjaka, a također je bilo premalo prvih i drugih kutnjaka. Gubitak zuba u stražnjim dijelovima mandibule pokazivao je sličan uzorak. Od uočenih retentivnih elemenata najčešće su bile kvačice (91,9 %), a zglobne veze (*attachment*) korištene su u 8,1 posto slučajeva. Od kvačica je 48,9 posto bilo Roachovih T-tipa, najčešće Kennedyjeve klase I, u usporedbi s ostalim klasama prema Kennedyju ( $p<0,01$ ). Cirkumferentnih kvačica bilo 19,3 posto od ukupnog broja kvačica i najrjeđe (8,8 %) su bile iz Kennedyjeve klase I ( $p<0,01$ ). **Zaključak:** Najčešće se koristimo Roachovim kvačicama, a RPI-kvačicama i zglobnim vezama (*attachment*) rijetko.

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#### Ključne riječi

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#### Uvod

Sve dulji životni vijek (1) pa zato i sve više starijih ljudi, razlog je da je sve češće potrebna protetska terapija (2, 3). Tako se u protetskoj restauraciji vrlo često koristimo skeletiranim djelomičnim protezama (RPD) jer su jeftinije, predvidive i funkcionalne (4 – 6).

Znati o kojoj je vrsti bezubosti riječ, kakav je raspored preostalih zuba u zubnim lukovima rekonstruiranim skeletiranim djelomičnim protezama i koji su zubi iskorišteni kao nosači, vrijedna je osnova za raspravu o planu terapije, obliku RDP-a, pravilnom korištenju RDP-komponenti skeleta i za promoviranje više kvalitete protetskih usluga (7 – 9). Poznato je da postoje mnoge klasifikacije sustava RDP-a (10 – 15) te da je najčešća ona prema Kennedyju s Applegateovim modifikacijama (16). Većina RDP-a sastoji se od metalnog okvira koji ima glavne i sporedne spojne dijelove, jednu ili više baza, ostatak i elemente retencije definirane kao direktni i indirektni ritejneri (17, 18). *Direktni ritejneri* (kvačice

#### Introduction

The increase in mean life expectancy (1) and the consecutive proportion of the older population have been related to increased need for prosthodontic treatment (2,3). Removable Partial Dentures (RPDs) are still widely used for prosthetic restoration because they are generally associated with lower costs with predictability and functionality (4-6).

The knowledge of the type of partial edentulism, the distribution of the remaining teeth in arches treated with RPDs and the abutment teeth used, is a valuable basis for debates about treatment plans, RPDs design and the proper use of RPDs framework components thus promoting higher quality prosthetic dental care services (7-9).

It is well known that there are multiple classification systems of RPDs (10-15) with the most widely accepted one being the Kennedy Classification with modifications by Applegate (16). Furthermore, the majority of RPDs comprise a cast metal framework which includes a major connector,

i zglobne veze ili attachmenti), spojeni su na primarno tijelo ili na zube nosače te osiguravaju potporu, retenciju i stabilnost. *Indirektni ritejneri* (okluzalni upirači, cingulum ili incizalna uporišta) spojeni su na sekundarne zube nosače te dodatno osiguravaju potporu i stabilnost (17 – 19). Kvačice su najčešće korišteni direktni *ritejneri*. Njihova svojstva i doista mnogobrojne vrste opisane su u literaturi (17 – 19). Vrlo je važno da se retentivni elementi RPD-a odaberu tako da ne narušavaju izgled i ne preopterećuju zube nosače. Osim toga, njihov oblik mora minimalno pokrivati zube kako bi se izbjeglo nakupljanje plaka (20). Pazeći na estetske parametre, za RPD možemo se koristiti i cirkumferentnim kvačicama, ako zubi imaju dovoljnu koštanu potporu. Prstenasta kvačica može se rabiti na stražnjim zubima s lingvalnim nagibom, ali mora se pažljivo oblikovati radi zadržavanja što manjih ostataka hrane (17, 18, 20). Povratna kvačica, kao modifikacija prstenaste, može se oblikovati na očnjacima i pretkutnjacima s dovoljno koštane strukture (17). Obuhvatna kvačica na stražnjim zubima osigurava dobru retenciju i stabilnost, ali zadržava hranu (17). Smatra se da prečke manje stresno prenose sile na zube nosače i većinom se oblikuju za potrebe Kennedyjeve klase I i II (17, 18, 20). Upirači, proksimalna ploča te I-prečka (RPI) primjenjuju se ako zubi imaju lošu potpornu kost jer dok su u funkciji stvaraju male sile. Istaknimo da RPI-kvačice sprječavaju zadržavanje ostataka hrane (17, 18, 20).

Treba istaknuti da bismo se, ako je estetika primarna, trebali koristiti spojnim zglobnim vezama uz preparaciju nosača i povezivanjem, no moguć je štetni utjecaj na parodontno tkivo, veći su troškovi i može biti teškoća u slučaju eventualnih popravaka (17, 18). Treba istaknuti da je u raznim zemljama provedeno nekoliko istraživanja o različitim aspektima oblika i konstrukcije RPD-a (7 – 9, 21 – 30). Analiza rezultata pokazala se korisnom za uvježbavanje liječnika dentalne medicine i zubnih tehničara.

Svrha ovog istraživanja bila je identifikacija retencijskih elemenata RPD-a, odnos oblika i vrste bezubosti te korištenih zuba nosača. Analiza je obavljena na modelima komercijalnih laboratorija u glavnome grčkom gradu.

## Materijali i metode

Nakon jednostavnog nasumičnog uzorkovanja, od deset licenciranih odabrana su tri komercijalna zubotehnička laboratorija s više od 15 zaposlenih. Svi su surađivali s liječnicima dentalne medicine u Ateni (Grčka).

Analizirani materijal u ovom istraživanju uključivao je 628 sadrenih modela (276 gornje i 352 donje čeljusti) i odgovarajući lijevani metalni okvir za RPD, a skupljali su se šest mjeseci. Modeli su bili procijenjeni na temelju:

- a.) relevantnih istraživanja (7, 9, 22, 24, 25)
- b.) maksimalne pogreške u uzorkovanju manje od  $\pm 3,9$ .

minor connectors, one or more bases, rests and retentive elements; the retentive elements have been defined as direct and indirect retainers (17,18). The *direct retainers* (clasps and attachments), attached to the main or primary abutment teeth, provide support, retention and stability. The *indirect* retainers (occlusal, cingulum or incisal rests) attached to the secondary abutment teeth ensure additional support and stability (17-19). The most used direct retainers are clasps. In literature (17-19), a number of different clasp systems with various properties have been described. It is of major importance that RPDs retentive elements have to be chosen in such a way that appearance is not disturbed and the abutment teeth are not excessively loaded. In addition, the design must ensure minimal tooth coverage to avoid plaque accumulation (20). Thus, the circumferential clasp may be applied in tooth supported RPDs, at adequate bone supported teeth, considering aesthetic parameters. The ring clasp may be used in posterior teeth presenting lingual inclination and should be designed carefully to minimize the entrapment of food and debris (17,18,20). The back-action clasp, modification of ring clasp, may be designed in canines and premolar teeth with sufficient bone support (17). The embrasure clasp may be applied in posterior teeth to provide good retention and stability but it is prone to debris impaction (17). The bar clasps are considered to transfer less stress to the abutment teeth compared to the occlusally approaching clasps and are mainly designed to address the needs of Kennedy Class I and II situations (17,18,20). Rest, Proximal plate, I-bar (RPI) clasp is preferred to be applied to poorly bone supported teeth because of inducing low leverage forces during function. In addition to that, RPI clasps prevent food debris trapping (17,18,20).

Concerning attachments, it is well documented that they should be used when aesthetics is of primary importance considering the need for abutment preparation, splinting, the possible harmful effect of periodontal tissue, higher cost and the difficulty when a repair is needed (17,18). Several surveys have been carried out in many countries concerning different aspects on RPDs design and construction (7-9,21-30). The analysis of their results has been proved to be helpful for the training of both dentists and dental technicians.

The purpose of this survey was to identify the retentive elements of RPDs and relate the designs to the type of edentulism and the abutment teeth used as noted in commercial dental laboratories in Athens, Greece.

## Materials and Methods

After simple random sampling, three commercial laboratories were chosen out of a total of 10 certified dental laboratories with more than 15 employees. All selected laboratories cooperated with dentists practicing in Athens, Greece.

The material of this study included 628 master casts (276 maxillary and 352 mandibular) and the corresponding cast metal frameworks for RPDs construction collected in a period of 6 months. The number of the casts collected was estimated on the basis: a) of relevant studies (7,9,22,24,25) and b) that maximum sampling error should be less than  $\pm 3.9$ .

Svaki model, zajedno s metalnim okvirom, snimljen je digitalnim fotoaparatom (Canon Digital Ixus 750, Canon UK, Surrey, UK) tako da se na svakoj slici mogla sa sigurnošću odrediti klasa prema Kennedyju i retencijski element metalnog okvira. Pri pregledavanju slike svakog modela na računalu, koristili smo se posebnim obrascem za bilješke. Točke interesa klasificirala su tri autora. Ako se nisu slagali, tada se kao relevantno prihvatilo mišljenje većine.

#### Klasifikacija djelomične bezubosti

Za klasifikaciju djelomične bezubosti korištena je klasifikacija prema Kennedyju uz Applegateova pravila (16).

Slučajevi s fiksnim protetskim radovima smatrali su se kao postojeći zubi, a označavali su se prema univerzalnom sustavu brojenja zuba.

#### Retencijski elementi

Elementi retencije RPD-a bilježili su se prema Rječniku protetskih termina (8. izdanje) (31) i klasičnim opisima u knjigama (17 – 19).

#### Direktni ritejneri

##### A) Kvačice

1. Cirkumferentne kvačice (okluzalni upirač, bukalna retencijska ručica i lingvalni recipročni luk)
2. Prstenasta kvačica (okluzalni upirač i prstenasti luk koji obuhvaća zub nosač)
3. Obuhvatna kvačica (dvije cirkumferentne kvačice okrenute jedna prema drugoj, spojene u zajedničko tijelo)
4. Povratna kvačica (modifikacija prstenaste kvačice)
5. Prečka ili Roacheva kvačica (kombinacija cirkumferentne kvačice – okluzalni upirač, lingvalni recipročni luk i bukalna retencijska ručica T, Y ili I oblika kao dijelovi lijevane metalne baze pristupaju retencijskim podminiranim područjima s cervikalnog smjera).
6. RPI-sustav kvačica (mezijalni okluzalni upirač, distalna proksimalna ploča, retencijski luk u I obliku).

Cirkumferentna, prstenasta, obuhvatna i povratna kvačica svrstane su u kvačice s okluzalnim smjerom umetanja, a Roacheva i RPI-kvačice ubrajaju su u kvačice s gingivalnim smjerom umetanja.

##### B) Svi tipovi zglobnih veza (attachmenta)

#### Indirektni ritejneri

Korištenje indirektnih zglobnih veza ovisi o svakom slučaju pojedinačno. Vrlo je važno postaviti ih, kod Kennedyjeve klase I, II i IV, uz produžena bezuba područja (18).

- a) Upirači (okluzalni, cingulumni, incizalni)
- b) Kontinuirana ili cingulumna prečka

Za statističku analizu podataka korištene su tablice prevalencije i  $\chi^2$  testa. Analiza je obavljena softverskim paketom SPSS14 (SPSS Inc. Chicago, SAD, 2005.), a razina statističke značajnosti bila je postavljena na  $\alpha=0.05$ .

Each cast, with the metal framework in place, was photographed by the same author, using a digital camera (Canon Digital Ixus 750, Canon UK, Surrey, UK) ensuring that the number of existing teeth, the Kennedy Classes and the retentive elements of the cast metal frameworks could be identified. A special form was used to record the physical findings, when the photographs of each cast were examined with a PC monitor. The three authors recognized and classified the features of interest. When they were in disagreement, the finding was the one that two of the authors agreed on.

#### Classification of partial edentulism

Kennedy Classes and Applegate's rules were used to classify partial edentulism (16).

The cases of fixed prosthetic restorations were recorded as existing teeth. Tooth numbering was in accordance with the Universal Numbering System.

#### Retentive elements

RPD retentive elements were recorded in accordance with the terminology of the Glossary of Prosthodontic Terms (8<sup>th</sup> edition) (31) and the classic text book descriptions below (17-19).

#### Direct retainers

##### A) Clasps

1. Circumferential clasp (occlusal rest, buccal retentive arm and lingual reciprocal arm).
2. Ring clasp (occlusal rest and a ring-like arm surrounding the abutment tooth).
3. Embrasure clasp (two circumferential clasps opposing each other, joined into a common body).
4. Back-action clasp (modification of the ring clasp).
5. Bar clasps or Roach clasps (combination of a circumferential clasp - an occlusal rest, a lingual reciprocal arm - and a buccal retentive arm - T, Y or I shaped - originating from the cast metal framework mesh and approaching the retentive undercut in a cervical direction).
6. RPI clasp system (mesial occlusal rest, distal proximal plate, I-shaped retentive arm).

Circumferential, Ring, Embrasure and Back-action clasps were considered to be occlusally approaching clasps, while Roach and RPI clasps were considered to be gingivally approaching clasps.

##### B) Attachments of all types

#### Indirect retainers

The use of indirect retainers depends on any given case. It is of utmost importance to apply an indirect retainer in Kennedy Class I, II and IV situation with expanded edentulous areas (18).

- a) Rests (occlusal, cingulum, incisal).
- b) Continuous bar or Cingulum bar.

Prevalence tables and the  $\chi^2$  test were used for the statistical analysis of the collected data. The software program used was the SPSS (SPSS14, SPSS Inc. Chicago 2005) and statistical significance level was determined at  $\alpha=0.05$ .

## Rezultati

### Preostali zubi

U 96,7 posto slučajeva nije bilo maksilarnog desnog kutnjaka, a lijevoga u 96,0 posto. Nedostatak ostalih maksilarnih zuba prikazan je na slici 1., a mandibularnih na slici 2.

### Direktni ritejneri i Kennedyjeva klasa

#### Kvačice

Direktni ritejneri korišteni su u 577 RPD-a, od njih 628 i to su uglavnom bile kvačice (91,9%), a u 51 slučaju zglobne veze (8,1%) ( $p < 0,001$ ).

Gotovo polovica ( $n=747$ ) (48,9%) od ukupnog broja kvačica ( $n=1527$ ) bile su Roachev T tip, a 65,6 posto ( $n=455$ ) bilo je Kennedyjeve klase I, što je statistički važno među Kennedyjevim klasama ( $p < 0,01$ ). Cirkumferentne kvačice bile su rjeđe korištene ( $n=294$ ) (19,3%) i njih 8,8 posto ( $n=61$ ) rabilo se kod Kennedyjeve klase I, što je statistički značajno među Kennedyjevim klasama ( $p < 0,01$ ) (tablica 1.).

Obuhvatne kvačice činile su 8 posto ( $n=122$ ) od ukupnog broja kvačica i češće su korištene kod Kennedyjeve klase II i IV RVP-oblika u usporedbi s Kennedyjevom klasom I ( $p < 0,01$ ). Roacheve I kvačice imale su u ukupnom broju kvačica udjel od 7,7 posto ( $n=118$ ) i nije bilo statistički značajne razlike među klasama. Prstenaste kvačice rabile su se u 6,5

## Results

### Remaining teeth

The rate of absent maxillary right third molars was 96.7% and 96.0% for maxillary left third molars. Regarding the rates of the other maxillary teeth the results are seen in Figure 1 and the rates of missing mandibular teeth are seen in Figure 2.

### Direct retainers and Kennedy Class

#### Clasps

The direct retainers used in 577 of 628 RPDs, were clasps (91.9%) while the attachments accounted for the remaining 51 (8.1%) ( $p < 0.001$ ). Almost one half  $n=747$  (48.9%) of the total clasps  $n=1527$  were Roach T type clasps, whereas 65.6 % ( $n=455$ ) of them concerned the Kennedy Class I finding that is statistical significant among Kennedy classes ( $p < 0.01$ ). Circumferential clasps were less frequently used  $n=294$  (19.3%), and 8.8% of them ( $n=61$ ) found in Kennedy Class I finding that is statistical significant among Kennedy classes ( $p < 0.01$ ) (Table 1).

The embrasure clasps represented 8% ( $n=122$ ) of total clasps been more common in Kennedy Classes III and IV RPD designs as compared to Class I ( $p < 0.01$ ). Roach I clasps represented 7.7% ( $n=118$ ) of all clasps; and there were no statistically significant differences among classes. Ring clasps encountered 6.5% ( $n=100$ ) of total clasps (2.7% in Class I and 10.8% in Classes III/IV) ( $p < 0.01$ ). Back action clasps

**Tablica 1.** Direktni i indirektni ritejneri u odnosu na Kennedyjevu klasu ( $n$  = broj ritejnera)  
**Table 1** Direct and indirect retainers in relation to Kennedy Class ( $n$ =number of retainers)

		Ukupno • Total n %	Klasa • Class I n %	Klasa • Class II n %	Klase • Classes III/IV n %
<b>a) Direktni ritejneri • Direct retainers</b>					
a1) Kvačice • Clasps	Cirkumferentni • Circumferential ( $P < 0.01$ )	294 19.3%	61 8.8%	140 24.0%	93 37.3%
	Obuhvatni • Embrasure ( $P < 0.01$ )	122 8.0%	11 1.6%	73 12.5%	38 15.3%
	Back action (ns)	45 2.9%	24 3.5%	17 2.9%	4 1.6%
	Prsten • Ring ( $P < 0.01$ )	100 6.5%	19 2.7%	54 9.2%	27 10.8%
	Roach T ( $P < 0.01$ )	747 48.9%	455 65.6%	229 39.2%	63 25.3%
	Roach Y (ns)	31 2.0%	22 3.2%	9 1.5%	0 0.0%
	Roach I (ns)	118 7.7%	60 8.6%	39 6.7%	19 7.6%
	RPI (ns)	12 0.8%	11 1.6%	1 0.2%	0 0.0%
	Ostale • Others (ns)	58 3.8%	31 4.5%	22 3.8%	5 2.0%
	Ukupno • Total	1527 100%	694 100%	584 100%	249 100%
a2) Zglobne veze • Attachments	U kombinaciji s kvačicama • In combination with clasp ( $P < 0.001$ )	21 41.2%	8 21.6%	8 88.9%	5 100.0%
	Bez kvačica • Without clasp ( $P < 0.001$ )	30 58.8%	29 78.4%	1 11.1%	0 0.0%
	Ukupno • Total	51 100%	37 100%	9 100%	5 100%
<b>b) Indirektni ritejneri • Indirect retainers</b>					
Tip indirektnih ritejnera • Type of indirect retainers	S indirektnim ritejnerima • With indirect retainers ( $P > 0.05$ )	389 61.9%	211 60.6%	136 66.0%	42 56.8%
	Bez indirektnih ritejnera • Without indirect retainers ( $P > 0.05$ )	239 38.1%	137 39.4%	70 34.0%	32 43.2%
	Ukupno • Total	628 100.0%	348 100.0%	206 100.0%	74 100.0%
	Upirać • Rest ( $P < 0.01$ )	316 81.2%	155 73.5%	122 89.7%	39 92.9%
	Cingulumna prečka • Cingulum bar ( $P < 0.01$ )	73 19.3%	56 26.5%	14 10.3%	3 7.1%
	Ukupno • Total	389 100.0%	211 100.0%	136 100.0%	42 100.0%

ns = Nije značajno • Non-significant



Slika 1. Preostali maksilarni zubi na 276 modela  
 Figure 1 Remaining Maxillary Teeth on 276 casts  
 Slika 2. Preostali mandibularni zubi na 352 modela  
 Figure 2 Remaining Mandibular Teeth on 352 casts  
 Slika 3. Kvačice umetnute u okluzalnom smjeru u odnosu na zubne nosače  
 Figure 3 Occlusally approaching clasps in relation to abutment teeth  
 Slika 4. Kvačice umetnute u gingivalnom smjera u odnosu na zubne nosače  
 Figure 4 Gingivally approaching clasps in relation to abutment teeth

postu (n=100) slučajeva (2,7 % kod klase I i 10,8 % kod klase III/IV) (p<0,01). Povratne kvačice rjeđe su korištene n=45 (2,9 %); a i Roacheve kvačice Y ( n=31) (2,0 %), RPI (n=12) (0,8 %) i ostale (n=58) (3,8 %) (tablica 1.).

**Vrsta kvačica i zubi nosači**

Većina cirkumferentnih kvačica, kao što se vidi na slici 1., bila je oblikovana za prve maksilarne kutnjake – 31 posto (n=49), druge kutnjake – 44 posto (n=71), prve mandibularne kutnjake – 23 posto (n=30) i druge molare – 38 posto (n=50). Nosači na koje su se najčešće postavljale obuhvatne kvačice bili su prvi maksilarni kutnjaci – 46 posto (n=33) i

were less frequently used n=45 (2.9%); the same was true for Roach Y n=31 (2.0%), RPI n=12 (0.8%) and other clasps n=58 (3.8%) (Table 1).

**Type of clasps and abutment teeth**

Descriptively, the majority of circumferential clasps, as seen in Figure 3, were designed for maxillary first molars 31% (n=49), second molars 44% (n=71); and mandibular first molars 23% (n=30), second molars 38% (n=50); the teeth most frequently used for embrasure clasps were maxillary and mandibular first molars 46% (n=33) and 39%



prvi mandibularni kutnjaci – 39 posto (n=20). Povratne kvačice uglavnom su bile postavljene na prvim maksilarnim premolarima – 50 posto (n=8) i na mandibularnim očnjacima – 45 posto (n=13). Prstenaste kvačice bile su izbor za drugi maksilarni kutnjak – 63 posto (n=34) i drugi mandibularni kutnjak – 54 posto (n=25) (slika 3). Svi oblici Roachovih kvačica uglavnom su bili postavljeni na maksilarne očnjake i prve mandibularne petkutnjake (slika 4.).

#### Zglobne veze (attachments)

U 21 slučaju (41,2 %) retentivne zglobne veze bile su postavljene u kombinaciji s kvačicama, a u preostalim 30 slučajeva (58,8 %) retencija je postignuta isključivo s pomoću attachmenta (tablica 1.).

#### Indirektni ritejneri i Kennedyjeva klasa

Indirektni ritejneri bili su ugrađeni u 389 modela (61,9 %) od ukupno 628. U odnosu na Kennedyjeve klase prevalencija je iznosila 60,6 posto (n=211) za klasu I, 66,0 posto (n=136) za klasu II i 56,8 posto (n=42) za klase III/IV (zubno nošeni RPD) (p=0,28). Za distalno produžene RPD-e (Kennedyjeve klase I i II) stopa indirektnih pomagala bila je 62,6 posto (tablica 1.).

Tipovi indirektnih ritejnera u ovom prikazu bili su okluzalno uporište (n=316) (81,2 %) i cingulumne prečke (n=73) (19,3 %). Kod klase I, cingulumne prečke nađene su u n=56 (26,5 %) od 389 okvira, u usporedbi s 10,3 posto (n=14) kod klase II i 7,1 posto (n=3) u preostalim klasama. Ti su nalazi statistički značajni za Kennedyjeve klase (p<0,01). Okluzalni upirači bili su primijenjeni u 73,5 posto slučajeva klase I, 89,7 posto kod klase II i 92,9 posto u ostalim klasama (p<0,01) među Kennedyjevom klasifikacijom (tablica 1.).

Kod 37 od 48 distalno produženih RPD-a oblika sa zglobnim vezama, indirektna retencija nije uočena (p<0,001).

#### Rasprava

U epidemiološkim i kliničkim istraživanjima primjenjivale su se različite metode bilježenja preostalih zuba, klase djelomične bezubosti i oblika metalnog okvira: pojedinačno, fotodokumentacija (7, 21), vizualni pregled modela (29, 30), klinički pregled (9, 32) i popunjavanje posebnih upitnika (22, 33, 34). Korištenje fotodokumentacije u ovom istraživanju odabrano je zato što svim autorima omogućuje da u bilo koje vrijeme izvan laboratorija analiziraju modele.

U ovom istraživanju aritmetička sredina preostalih maksilarnih zuba bila je 6,8, a mandibularnih 7,3, što je u skladu s istraživanjima u Poljskoj (23) (5,8 i 7), Švedskoj (24) (6,5 i 6,6) i Zapadnoj Njemačkoj (8) (6,29 i 6,57), ali ne slaže se s podacima Öwalla i suradnika dobivenima za Sjevernu Ameriku (7) (8,7 i 8,1) i Škotsku (25) (9,9 i 8,4). Može se reći, na temelju svih tih istraživanja, da se u razvijenim zemljama ne razlikuje znatno prosječan broj preostalih zuba. Treba istaknuti da su posljednji u ovom istraživanju bili zabilježeni prednji maksilarni i mandibularni zubi, što je slično rezultatima navedenih istraživanja (7, 8, 24, 25). Kvačice se trebaju birati na temelju svojstva, indikacije i ograničenja uporabe (17). U dosadašnjim istraživanjima upozorava se da je premalo podataka o pravilnom odabiru kvačica kada se oblikovao RPD.

(n=20). Back action clasps were mainly applied on first maxillary premolars 50% (n=8) and mandibular canines 45% (n=13). Ring clasps were chosen for second maxillary 63% (n=34) and mandibular molars 54% (n=25) (Figure 3).

All types of Roach clasps were mainly placed on maxillary canines and mandibular first premolars (Figure 4).

#### Attachments

In the twenty one (41.2%) cases of attachments, retention was achieved in combination with clasps, while in the remaining thirty (58.8%) cases retention was exclusively achieved through attachments (Table 1).

#### Indirect retainers and Kennedy Class

Indirect retainers were found in 389 (61.9%) of the 628 casts. In regard to Kennedy Classes, the prevalence was 60.6% (n=211) for class I, 66.0% (n=136) for class II and 56.8% (n=42) for classes III/IV (tooth supported RPDs) (p=0.28). For distal extension RPDs (Kennedy Class I and II), the rate of indirect retainers was 62.6% (Table 1).

The types of indirect retainers used in this report were occlusal rests n=316 (81.2%) and cingulum bars n=73 (19.3%). In class I, cingulum bars were found in n=56 (26.5%) of the 389 frameworks, as compared to 10.3% (n=14) in class II and 7.1% (n=3) in remaining classes, finding that is statistically significant among Kennedy classes (p<0.01), while occlusal rests were observed in 73.5% of cases in class I, 89.7% in class II and 92.9% in other classes (p<0.01) among Kennedy classes (Table 1).

In 37 of the 48 distal extension RPDs designs with attachments, indirect retention was not noted (p<0.001).

#### Discussion

Epidemiological and clinical studies have used different methods to record remaining teeth, classes of partial edentulism and designs of metal frameworks used: namely, photographic records (7,21), visual cast examination (29,30), clinical examination (9,32) and completing questionnaire forms (22,33,34). The reason for using photographic records in this study was because it allowed all authors to analyse data outside the laboratory at any convenient times.

In this study the mean number of remaining maxillary and mandibular teeth was 6.8 and 7.3, respectively; this is similar to what was reported in research studies performed in Poland (23) (5.8 and 7), Sweden (24) (6.5 and 6.6) and West Germany (8) (6.29 and 6.57), but contradicts findings by Öwall et al., in North America (7) (8.7 and 8.1) and Scotland (25) (9.9 and 8.4). It could be said that, according to these studies, the average number of remaining teeth did not significantly differ in developed countries.

It is noteworthy that the last remaining teeth recorded in this study were anterior maxillary and mandibular teeth, a finding that was similar to the results of the above mentioned studies (7, 8, 24, 25).

A clasp should be chosen on the basis of its characteristic features, indications and limitations of use (17). Previous re-

Prema ovom istraživanju, kvačice s gingivalnim smjerom umetanja korištene su u 59,4 posto slučajeva, uglavnom na maksilarnim očajnicima i mandibularnim pretkutnjacima. Ti su rezultati suprotni onima Öwalla i suradnika (25) koji su izvijestili da su takve kvačice korištene u 15,4 posto njihovih slučajeva.

Najčešće korištene kvačice pri distalno produženim sedlima kod djelomičnih proteza bile su one s gingivnim smjerom umetanja (79 % kod Kennedyjeve klase I i 47,6 % kod Kennedyjeve klase II). Naime, te kvačice ne stvaraju veće estetske probleme i pri funkciji prenose manje sile na zube nosače (17 – 19). Naši rezultati u skladu su s onima Niarchoua i suradnika (30) koji su izvijestili da je Roachev tip kvačice najčešće korišten (69,2 %).

Suprotno tomu, retentivni luk ovih kvačica – polažu se od dijelova smještenih u bezubom dijelu i pružaju horizontalno preko mekih tkiva (18) – predisponiran je za akumulaciju plaka, što im je glavni nedostatak (18, 20). Baker i suradnici (27) u istraživanju provedenom u Ujedinjenom Kraljevstvu pronašli su da postotak kvačica s gingivnim pristupom za produžena distalna sedla RPD-a iznosi 20 posto za maksilu i 32 posto za mandibulu.

Unatoč velikim prednostima RPI-kvačica njihov nizak udjel – samo 27, u ovom je istraživanju (1,6 %) u skladu s podacima Baskera i suradnika (1,7 %). Suprotno tomu naši rezultati razlikuju se od onih Curtisa i suradnika (28) o 29 posto od ukupnoga broja kvačica, te 75 posto kod AL-Dairyja (22) koji je uključivao samo pomagala klase I i II, uglavnom u mandibuli.

Kvačice s okluzalnim smjerom umetanja trebale bi smanjiti rizik od ozljeda okolnih tkiva (22). Naši rezultati pokazuju da su se takve kvačice rjeđe odabirale od Kennedyjeve klase I (16,6 %), što je statistički značajno u usporedbi s drugim klasama. Ti nalazi suprotni su rezultatima Baskera i suradnika (27) koji su izvijestili o udjelu od 58 posto za maksilu i 68 posto za mandibulu, Curtisa i suradnika (28) – istaknuli su da se kvačice s okluzalnim smjerom umetanja najčešće koriste, čak i u slučaju distalno produženih sedala, te istraživanju AL-Dairyja (22) koji je istaknuo da se u obje čeljusti najčešće postavljaju obuhvatne kvačice.

Činjenica da su cirkumferentne kvačice korištene u 19,3 posto slučajeva, u suprotnosti je s nalazima Curtisa i suradnika (28) koji su izvijestili o 62,7 posto. Prevalencija prstenastih kvačica u ovom istraživanju bila je slična u obje čeljusti (6,5 %), što je također u suprotnosti s izvještajem AL-Dairyja (22) prema čijim rezultatima se ta vrsta kvačice češće postavlja u mandibuli negoli u maksili zbog nagiba zuba. Povratne kvačice činile su 2,9 posto svih kvačica i najčešće su bile u Kennedyjevoj klasi I i II, što je slično rezultatima Curtisa i suradnika (28) (0,75 %).

Veći udjel Roachevih kvačica u usporedbi s ostalima vjerojatno je uvjetovan izborom pacijenata koji žele bolju estetiku te uspješnijom edukacijom liječnika dentalne medicine i zubnih tehničara o oblicima i konstrukcijama takvih kvačica.

Zglobne veze (attachmenti) korištene su u 8 posto RPD-slučajeva, slično kao i u istraživanju koje je u Zapadnoj Njemačkoj proveo Öwall sa suradnicima (8) te izvijestio o 15,3 posto udjela. Dakle, može se zaključiti da postoje različiti

search papers (26) indicate that there was a lack of data concerning the correct selection of clasps when designing RPDs.

According to the present study, gingivally approaching clasps were applied in 59.4% of clasp situations, mainly on maxillary canines and mandibular premolars. These results contradicted those of Öwall et al. (25) who reported that such clasps were noted in 15.4% of their cases.

The most frequently used clasps in distal extension removable partial denture designs were the gingivally approaching (79% and 47.6% in Kennedy Classes I & II, respectively); this was probably because such clasps create less of an aesthetic problem and their function apply lower forces on abutment teeth (17-19). Our results are in agreement with those of Niarchou et al. (30) who reported that the Roach type clasp was the most frequently used (69.2%). On the contrary, the retentive arm of these clasps - which typically originates from components located in the edentulous area and projects horizontally across the soft tissues (18) - predisposes to plaque accumulation, fact considered to be a major disadvantage (18,20). Basker et al. (27), in a study performed in the United Kingdom, found that the percentage of gingivally approaching clasps used in distal extension RPDs was 20% for the maxilla and 32% for the mandible.

Despite the indisputable advantages of RPI clasps, the low rate found in this study (1.6%) agrees with that of Basker et al. (27) (1.7%). In contrast, our result differs from the figure 29% reported by Curtis et al. (28) of the total number of clasps, and the 75% of AL-Dairy (22) which involved only class I and II situations, mainly for the mandible.

Occlusally approaching clasps are supposed to be reducing the risk of injury caused to surrounding tissues (22). Our results indicated that occlusally approaching clasps were chosen less frequently for Kennedy Class I (16.6%), as compared to other classes, a finding that is statistically significant. This contradicts the results of Basker et al. (27), who reported rates of 58% for the maxilla and 68% for the mandible, of Curtis et al. (28), who reported that occlusally approaching clasps were those most frequently used, even with distal extension partial dentures, and those of AL-Dairy (22), who reported that embrasure clasps were the most frequently used type for both jaws.

The fact that the circumferential clasps were found in 19.3% of clasp cases contradicts the findings of Curtis et al. (28), who reported rates of 62.7%.

The prevalence of ring clasps recorded in our study was similar in both jaws (6.5%), and this is in disagreement with what AL-Dairy (22) reported; according to his findings, this type of clasp was more frequently used in the mandible rather than the maxilla, due to teeth inclination.

Back action clasps were observed in 2.9% of all clasp cases and most frequently in Kennedy Classes I&II, findings similar to those reported by Curtis et al. (28) (0.75%). The higher rates of Roach clasp use, as compared to other clasp types, was probably due to patients' desire for a better aesthetic result and the greater familiarization of dentists and dental technicians with the design and construction of such clasps.

pristupi u odabiru kvačice za RPD. Premda je u literaturi opisano mnogo vrsta ritejnera, uz indikaciju za njihovu primjenu u odnosu na klasu djelomične bezubosti, u svakodnevnoj praksi rabimo samo nekoliko njih, čak i ne uvijek one koji su indicirani za pojedini slučaj. Smatramo da je potrebno posvetiti pozornost oblikovanju RPD-a.

## Zaključci

Rezultati ovog istraživanja su sljedeći:

1. zadnji zubi koji preostaju su donji očajnici,
2. kvačice Roacheva tipa koriste se u većini slučajeva,
3. rijetko se u dentalnoj praksi koristimo RPI-kvačicama, unatoč prednostima,
4. zglobnim vezama ne koristimo se često.

Attachments were employed in a mere of 8% of RPD cases, while a similar study performed in Western Germany by Öwall et al. (8) reported a rate of 15.3%.

What may be concluded from the above is that there are various approaches to be implemented when selecting the type of clasps to be used in RPDs. Although several types of retainers are described in the literature, providing clear indications for their application in relation to the class of partial edentulism, in daily practice only few of them are used, and not always those indicated for a particular case. We consider that further emphasis should be given to aspects of RPD design.

## Conclusions

The results of this study revealed that:

1. The last remaining teeth found were the lower canines.
2. Roach type clasps were used in numerous cases.
3. There were very low rates of using RPI clasps in dental practice, despite their indisputable advantages.
4. Attachments were not extensively used.

### Abstract

**Objective.** The aim of this survey was to record removable partial denture (RPD) retentive elements and abutment teeth in partially edentulous patients, identified in commercial laboratories in Athens, Greece. **Material and Methods.** 628 master casts with the corresponding cast metal frameworks used in the construction of RPDs were evaluated. Casts were photographed to identify the number and position of existing teeth, the partial edentulism class and the retentive elements. Prevalence tables and the  $\chi^2$  test were used for the statistical analysis of the collected data ( $\alpha=.05$ ). **Results.** There were 276 maxillary (43.9%) and 352 (56.1%) mandibular casts. Maxillary edentulism entailed almost a total absence of right third molars in 96.7% and left third molars 96.0% of casts, with lower rates for the first and second molars. Edentulism in the posterior mandible presented a similar pattern. The most profound findings concerning retentive elements were: 91.9% of the retainers used were clasps and the remaining 8.1% were attachments. Of the clasps used, 48.9% were of the Roach T type, a finding more common in Kennedy Class I as compared to other Kennedy Classes ( $p<0.01$ ). The circumferential clasps accounted for 19.3% of the total clasps used, and it was less frequently presented (8.8%) in Kennedy I Classes ( $p<0.01$ ). **Conclusions.** Roach clasps were used in the majority of cases whereas RPI clasps and attachments were rarely used.

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### Key words

Denture, Partial; Dental Abutments; Dental Clasps; Denture Precision Attachment; Denture Retention

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