Dehiscence Detection Using Video Prints of Enhanced Images Acquired with a CCD Intra-Oral Detector

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Summary

Objectives: *The radiographic determination of dehiscence in the alveolar bone adjacent to teeth is problematic unless it occurs over time and can be displayed by radiographic subtraction. Hence a study was performed to determine whether enhancement of digitally-acquired images might facilitate detection of this condition.*

Methods: *Fresh, non-embalmed dentulous cadavers served as the test model. Areas of natural dehiscence were recorded. In the absence of natural dehiscence, defects were created in regions of the buccal or labial alveolar bone using a#15 scalpel. The created defects were categorized either as "natural simulation" or "well-defined". Other areas were left intact as normal controls. Periapical radiographs were made using a RVG-S® with an Irix 70® X-ray generator (Trophy Radiologie, Vincennes, France). Constant projection geometry and exposure parameters were maintained. The observers were six orthodontists who examined video prints of enhanced images individually under identical viewing conditions.*

Results: *The effect of presence and type of alveolar bone defect was statistically significant ($p \leq 0.002$); however, the mode of image contrast enhancement had no significant impact ($p \leq 0.05$). The overall sensitivity for detection of the bony defects was only 30%, with a specificity of 79% and overall accuracy of 48%.*

Conclusions. *Irrespective of the mode of contrast enhancement used, video prints from digital readout of images of the teeth and surrounding bone showed low sensitivity for the detection of naturally occurring dehiscence and created defects simulating this condition.*

Key words: *dehiscence, digital image enhancement, periodontium, dental radiography*

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Introduction

Stahl et.al. (1963) studied the human skull collection at the Museum of natural History in New York, that had been assembled from autopsies in that city (41 skulls), 24 skulls of American Indian origin from various archeological investigations and 97 Chinese skulls assembled for teaching purposes (1). They found a total 750 defects in 4438 socket sites or an incidence of 16.9% for buccal plate dehiscence. The incidence was similar for the three groups examined, being 18.2, 20.2 and 15.8% respectively.

The causes of dehiscence, aside from iatrogenic results of orthodontic tooth movement, are not well understood although misalignments of teeth leading to natural tooth displacement could be a possibility. Nevertheless, Kakehashi et.al. (1963) found labial plate dehiscence in fresh gorilla skulls, and involved teeth were only rarely out of good arch form and alignment. This led them to propose a development cortical osseous defect etiology (2).

Irrespective of origin, the discovery of dehiscence; whether before or after the initiation of orthodontic therapy, is desirable: this could modify the forces to be applied for tooth movement and would certainly also protect the orthodontist against subsequent allegations of causing periodontal bone loss. It has also been shown in experiments using monkeys that when a displaced root is moved back into bone the cortical plate can be repaired with slight additional thickening of the cortical plate (3).

While the use of intraoral radiographs as an adjunct to periodontal evaluation is well established, this method essentially only illustrates the condition of the interproximal bone height, as the buccal and lingual plates are superimposed by the shadow of the tooth itself (4 - 7). To obviate this problem, subtraction radiography has been used; however, this merely shows changes that occur with time. Should a dehiscence be static rather than progressive, or there may only be a radiograph from one time then subtraction radiography is not useful (8,9).

Motz and Danos have shown that the important issues in discrimination of details within a diagnostic image include the strength of the signal and the inherent tissue contrast. The higher the contrast the lower the signal needed to depict information (10). In the case of dehiscence the contrast is very low and generally the condition will not be seen, irrespective of the exposure parameters employed. However, it is possible to apply mathematical filters to enhance digital or digitized images. Reichl et al. demonstrated the feasibility of detecting defects simulating enamel dental caries beneath steel orthodontic bands following contrast enhancement of RVG-S® (Trophy Radiologie, Vincennes, France) images (11).

The present study was designed to determine whether the contrast enhancement capabilities of the RVG-S® would facilitate the detection of alveolar bone dehiscence in human.

Material and methods

This human cadaver study was designed to produce digital images of alveolar dehiscence as they would appear *in vivo.* Fresh, non-embalmed, human cadavers was chosen for the test model. To qualify for inclusion, each cadaver needed to possess a maxillary dentition consisting of no fewer teeth than first premolar through first premolar, and a mandibular dentition of no fewer teeth than canine through canine. Most cadavers had a fuller dentition than that necessary to qualify for inclusion.

In each cadaver, a signal pericoronal incision was made traversing the papillae to free the facial and buccal gingivae of every tooth from its dento-gingival attachment. Several vertical releasing incisions were made as needed to permit the full reflection on the gingivae without tearing. Each cadaver was then visually inspected for the presence of existing interproximal or infra bony vertical defects; and if found cadaver was disqualified from inclusion. In the absence of such defects, the alveolus was inspected for naturally occurring dehiscence and such were recorded. In the absence of natural dehiscence, sites were randomly chosen for creation of simulated natural dehiscence (SND) with feathered borders, or well-defined defects (WDD) with clearly notched margins using a No.15 scalpel blade and being careful not to introduce bone chips or other radiopaque materials. These simulated lesions were also carefully recorded together with details of their thickness in. 1 mm intervals at the bony margins. The gingivae with placed in their original position before imaging commenced.

Periapical radiographs were then taken using a CCD-based receptor (RVG-S®, Trophy Radiologie, Vincennes, France) using a single phase Irix 70® X-ray generator (Trophy Radiologie, Vincennes, France) with constant projection geometry and exposure parameters. The X-ray head was aligned so that the central beam was perpendicular to the sensor and the source-to-object distance was kept constant at 24 cm.

In total 36 regions of interest were imaged and two video prints were made of each, one with optimum linear contrast enhancement oand one with steep gradient enhancement (x-function). The observers were six orthodontists who each examined the video prints individually under identical viewing conditions. They were asked to look for areas of alveolar dehiscence, but were not informed that some of the lesions were natural and that some were artificial. The x-function prints were presented together, and the linear enhanced prints were shown 24 hours later. The simple response was "yes" or "no" to the presence of dehiscence for the tooth in each image. No time limits were set for viewing each print. One month later the viewers examined the 72 images again, this time paired to show both enhancements of each image simultaneously. A simple yes/no response was again elicited.

Two null hypotheses were explored: (1) there is no significant difference in the correct decisions for control, natural dehiscence, SND and WDD areas; (2) enhancement modes examined caused no significant differences to occur. Statistical analyses were performed using a two-factor analysis of variance (ANOVA), with the percentage of correct decisions as the dependent variable and the independent variables being defect types and modes of image enhancement. The *à priori* α was set at $p \leq 0.05$.

Results

Bone status:

The mean percentages of correct decisions for all control, natural dehiscence, SND and WDD alveolar bone conditions are illustrated in Figure 1. Natural dehiscence were only correctly determined in 13 per cent of instances compared to 40 per cent for artificial (WDD) defects. However, these averages hide wide ranges between the sites studied in the different specimens (Figure 2).

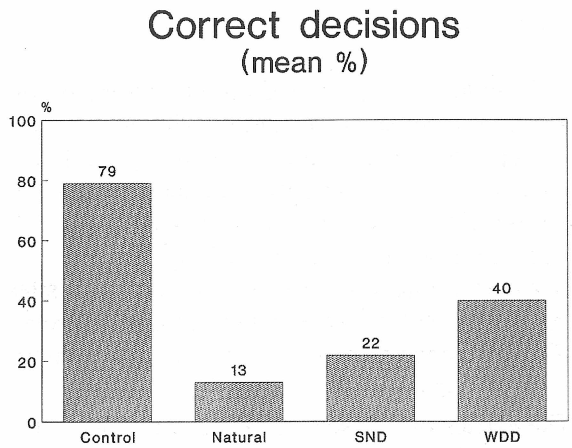

Figure 1. *The mean % of correct decisions is shown pooling all sites and all observers. Controls were sites of intact cortical plates. "Natural" represents areas of naturally occurring dehiscence. "SND" were areas in which artificial defects with smooth outlines simulating natural dehiscence were present. "WDD" were areas in which artificial defects that were well-defined were present*

Slika 1. *Prikazan je srednji % korektnih odluka, povezujući sve položaje i sve promatrače. Kontrole su bile položaj netaknutih kortiklanih ploča. "Natural" predstavlja površine prirodno nastalih dehiscencija. "SND" su bile površine s umjetnim defektima blagih obrisa; simulirajući prirodne dehiscencije: "WDD" su bile površine s umjetnim defektima, koji su bili dobro izraženi*

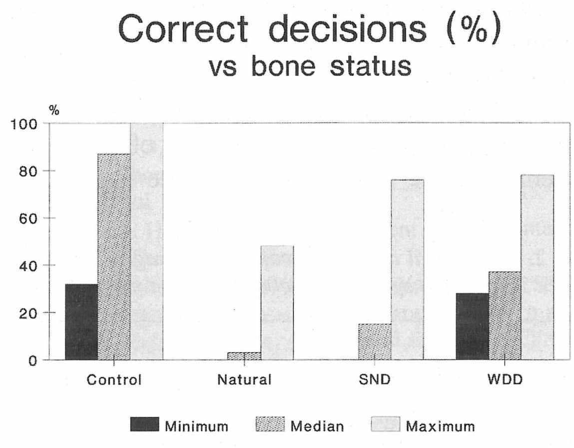

Figure 2. *Minimum, maximum and median percentage correct decisions for each bone status are displayed. Ranges for correct decisions varied in each bone status in the different sites studied and in the different specimens studied*

Slika 2. *Prikazan je najmanji, najveći i srednji postotak korektnih odluka za svaki od statusa kosti. Područja korektnih odluka varirala su za svaki status kosti na različitim studiranim položajima i u različitim uzorcima*

Table 1 presents the results of the ANOVA for bone defect type and also factors possible variations in the abilities of the individual clinicians. No significant difference was found in clinician performance (p>0.05). Significant differences were found in the ability to accurately detect different forms of defects and controls (p<0.002). Differences in the ability to detect natural dehiscence, SND, WDD and controls accounted for 59.5% of the total error. Artificial defects were easier to detect than were areas of natural dehiscence.

Table 1. *Statistical analysis summary for clinician performance and effect of bone status (ANOVA)*
Tablica 1. *Zbirni pregled statističke raščlambe performanca kliničara i učinak statusa kosti (ANOVA)*

Sources of variation Izvori varijacija	SS	df	MS	F	*p* value vrijednost *p*	% error contributed % pridonesene pogrješke
Clinicians - Kliničari	1676.68	5	335.34	0.625	0.683	7.025
Bone status* - Staus kosti*	14144.52	3	4714.84	8.791	0.001**	59.266
Unknown - Nepoznato	8044.89	15	536.33			33.708
Total - Ukupno	23866.09	23				

* Intact plate (control) vs natural dehiscence vs SND vs WDD
* Netaknuta ploča (kontrola): prema prirodnoj dehistenciji, prema SND, prema WDD
** Significant differences found in % of correct decisions for defect type
** Znatne rezlike pronađene u % korektnih odluka za vrstu defekta

Image enhancement

The percentage of correct decisions according to the viewed print enhancements are shown in Figure 3. Again the ranges in correct decisions amongst different sites and specimens were wide. The results of the ANOVA comparing the ability to detect the various alveolar bone states with the enhancement used are given in Table 2. The main effect of enhancement mode was not proven to be statistically significant (p≥0.05). Furthermore, the enhancement mode was found to contribute less than 0.2% to the total error, compared to 98.5% for the presence and type of bony defect.

Accuracy, specificity and sensitivity:

Averaging all responses, the total number of decisions was 648 and the total number of correct decisions was 312; hence the accuracy was.48%. The

Table 2. *Statistical analysis summary for image enhancement mode and effect of defect type (ANOVA)*
Tablica 2. *Zbirni pregled statističke raščlambe načina obogaćivanja i učinak vrste defekta (ANOVA)*

Sources of variation Izvori varijacija	SS	df	MS	F	*p* value vrijednost *p*	% error contributed % pridonesene pogrješke
Enhancem. mode - Način obogać.	10.17	2	5.08	0.294	0.756	0.137
Bone status* - Staus kosti*	7292.67	3	2340.88	140.469	0.000**	98.461
Unknown - Nepoznato	103.83	6	17.313			1.402
Total - Ukupno	7406.67	1				

* Intact plate (control) vs natural dehiscence vs SND vs WDD
* Netaknuta ploča (kontrola): prema prirodnoj dehistenciji, prema SND, prema WDD
** Significant differences found in % of correct decisions for defect type
** Znatne rezlike pronađene u % korektnih odluka za vrstu defekta

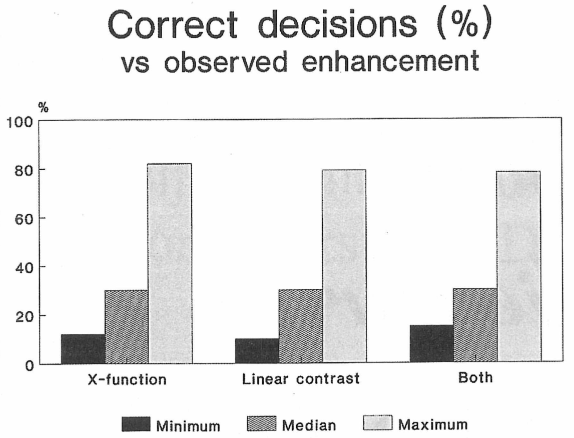

Figure 3. *Minimum, maximum and median percentage correct decisions for the modes of image enhancement available to the observers are displayed. Ranges for correct decisions in the different sites studied and in the different specimens studied*

Slika 3. *Prikazan je najmanji, najveći i srednji postotak korektnih odluka za svaki od načina obogaćivanja kontrasta slika koje su bile na raspolaganju promatračima. Prikazana su područja za korektne odluke za različite studirane položaje i za različite studirane uzorke*

number of true positives was 126 from an actual defect combined total 414, providing sensitivity of only 30%. The count of true negatives was 186 and the total number of controls was 234, resulting in a specificity score of 79%.

Discussion

The results of this study were essentially negative. That is, the enhancement capability of the RVG-S® did not facilitate a greater than chance ability to accurately diagnose bony dehiscence in the alveolar bone. An accuracy rate overall of 48% suggests that the clinician might have been more accurate in "tossing a coin and calling the side" than in viewing the enhanced video prints used in this study. More than on in five control areas were selected as showing dehiscence, but only 13% of naturally occurring dehiscence were detected. As the natural rate of dehiscence is around 20% (1) the chances of correctly diagnosing dehiscence from enhanced digital images is substantially less than the risk of misdiagnosing intact cortical plates as having defects.

You might wonder why a negative finding such as this should be published. In truth, most editors prefer to print positive findings as they seem to be more exciting and useful for the reader. The consequences of not presenting negative findings are that unsubstantiated claims can go unquestioned. Additionally, research projects such as that described here take a substantial amount of time in planning, obtaining permissions and carrying out. Should negative results not be presented other researchers are not made cognizant of the fact that the area already been investigated. There can then be many visits to the same "blind alley" rather than progress in building new knowledge.

The outcome of this investigation does question the validity of studies that rely on artificially created defects as a model for periodontology research. Artificial defects were easier to detect than naturally occurring dehiscence.

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Otkrivanje dehiscencije uporabom video crteža obogaćenih slika prikupljenih intraoralnim detektorom vrste CCD(*)

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Sažetak

Ciljevi: *Radiografsko određivanje dehiscencije u alveolarnoj kosti koja graniči sa zubom problematično je, ako se ne događa u vremenskim razmacima i ne može biti prikazano radiografskom suptrakcijom. Ova je studija provedena kako bi se ustanovilo može li obogaćenje digitalno prikupljenih slika omogućiti da se otkriju ta stanja.*

Metode: *Kao ispitni model poslužili su svježi, nebalzamirani mrtvi zubni uzorci. Zabilježena su područja prirodne dehiscencije. U slučaju izostanka prirodne dehiscencije, defekti su stvarani u regijama bukalne ili labijalno alveolarne kosti skalpelom veličine 15. Tako uzrokovani defekti bili su kategorizirani kao "pirodna simulacija" ili "dobro definirani". Ostala područja ostavljena su netaknutima da posluže kao normalne kontrolne vrijednosti. Periapikalne radiografije bile su izrađene sustavom RVG-S® s generatorom X-zraka Iris 70® (Trophy Radiologie, Vincennes, France). Projekciona geometrija i parametri ekspozicije bili su održavani stalnima. Šestorica stomatologa bili su promatrači. Oni su svaki zasebno, pod jednikim uvjetima promatranja ispitali otisnute video crteže obogaćenih slika.*

Rezultati: *Učinak postojanja i tipa defekata alveolarne kosti bio je statistički značajan ($p \leq 0,002$), no način obogaćivanja kontrasta slike nije imao veći utjecaj ($p \geq 0,05$). Ukupna osjetljivost za detekciju koštanih defekata bila je samo 30%, uz specifičnost od 79% i ukupnu točnost od 48%.*

Zaključci: *Neovisno o načinu obogaćivanja kontrasta, video ispisi digitalnog očitavanja slika zuba okruženog s kosti pokazali su malu osjetljivost za detekciju prirodno nastalih pojava dehiscencije i za izrađene defekte u svrhu simuliranja toga stanja.*

Ključne riječi: *dehiscencija, obogaćivanje digitalne slike, periodontium, dentalna radiografija*

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(*) Optički pretvornik vrste CCD (Charge-cupled Device) za pretvorbu slike u naboj.

Uvod

Stahl i suradnici (1963.) proučavali su kolekciju ljudskih lubanja Muzeja povijesti prirode u New Yorku. To je kolekcije, u svrhu učenja (1), bila skupljena od 41 lubanje autopsija u tome gradu, 24 lubanje američkin Indijanaca podrijetlom iz raznih arheoloških istraživanja, te 97 lubanja Kineza. Oni su pronašli ukupno 750 defekata u 4438 ležišta, ili incidenciju od 16,9% za dehiscenciju bukalne ploče. Incidencije su bile slične za tri ispitane skupine: 18,2, 20,2 i 15,8% po skupinama.

Uzroci dehiscencije, osim iatrogenetskih rezultata ortodontičkih pomicanja zuba, nisu dobro shvaćeni, premda bi iskrivljenost položaja zuba koja vodi prirodnom deplasmanu zuba mogla biti uzročnik. Unatoč tomu, Kakehashi i suradnici (1963.) otkrili su dehiscenciju usnene ploče u svježim lubanjama gorila, a obuhvaćeni zubi rijetko su bili izvan dobroga lučnog oblika i prilagođenosti. to ih je navelo da prelože etiologiju defekata kore kosti (2).

Kada se otkrije dehiscencija, bez obzira na izvor poželjno je poduzeti ortodontičku terapiju, prije ili poslije. To bi moglo modificirati sile koje djeluju na pomicanje zuba i zaštitilo bi stomatologa od supsekventnih zabluda o uzroku gubitka periodontalne kosti. Također je u pokusima s majmunima bilo pokazano da kada se izvađeni korijen vrati natrag u kost, vanjska kora ploče može se popraviti uz malo dodatno podebljanje površinske kore ploče (3).

Dok je intraoalna radiografija široko uspostavljena kao pomoćno sredstvo pri periodontalnim procjenama, ista metoda esencijalno samo prikazuje stanje visine interproksimalne kosti, jer su bukalna i lingualna ploča prekrivene sjenom samoga zuba (4-7). Da se taj problem izbjegne, upotrebljena je usptrakcijska radiografija; no ona u prvome redu pokazuje promjene koje se događaju tijekom vremena. Ako bi dehiscencija bila statična umjesto progresivne, ili je na raspolaganju radiografija prikupljena samo u istome vremenu, suptrakcijska radiografija nije primjenljiva (8,9).

Motz i Danons pokazali su da važna pitanja u diskriminaciji detalja unutar dijagnostičke slike obuhvaćaju jakost signala i svojstveni kontrast tkiva. Što je kontrast viši potreban je manji signal da predstavi informaciju (10). U slučaju dehiscencije kontrast je veoma malen i, općenito, stanje neće biti opaženo bez obzira na upotrebljene parametre eksponiranja. Međutim, moguće je primijeniti matematičke filtre za obogaćivanje digitalnih ili digitaliziranih slika. Reichl i suradnici demonstirali su sposobnost detekcije defekata simulirajući dentalni karijes cakline ispod čelične navlake, služeći se obogaćenjem kontrasta slika sustava RVG-S® (Trophy Radiologie, Vincennes, France) (11).

Zadaća ove studije bila je odrediti mogu li mogućnosti obogaćenja kontrasta sustava RVG-S® ostvariti detekciju dehiscencije alveolarne kosti u ljudi.

Materijali i metode

Zadaća ove studije mrtvih uzoraka ljudskoga podrijetla bila je proizvesti digitalne slike alveolarne dehiscencije onako kako bi bile *in vivo*. Svježi, nebalzamirani ljudski uzorci bili su odabrani za ispitne modele. Svaki od uzoraka je, da bi se kvalificirao za uključivanje morao imati maksilarnu denticiju koja sadržava ne manje od prvoga premolara do prvoga premolara, te mandibularnu denticiju od ne manje zuba od očnjaka do očnjaka. Većina uzoraka imala je više zuba nego što je bilo potrebno da bi se kvalificirali za uključivanje.

Na svakome uzorku izrađen je jednostruki periokoronalni urez, traverzirajući papilu, da se oslobodi facijalna i bukalna gingiva svakoga zuba od njegova dento-gingivalnog priključka. Bilo je izrađeno nekoliko okomitih, oslobađajućih ureza, koliko je bilo potrebno da se omogući potpuna reflekcija gingive, bez oderavanja. Svaki je od uzoraka nakon toga vizualno pregledan da se ustanovi postojanje interproksimalnih ili infrakoštanih vertikalnih defekata, pa ako su pronađeni, uzorak nije bio uključen u ispitnu skupinu. Ako nije bilo takvih defekata, alveole su bile pregledane postoje li prirodno nastale dehiscencije, pa su takve zabilježene. Ako nije bilo prirodnih dehiscencija, po slučajnom izbou određena su mjesta za simulirane prirodne dehiscencije (SND; simulated natural dehiscence) s oštrim granicama, ili dobro definirani defekti (WDD; well-defined defect) s jasno urezanim marginama s pomoću oštrice skalpela veličine 15 i uz pažnju da se ne uvedu iveri kosti ili drugačiji radiopakni materijali. Ta simulirana oštećenja bila su također pažljivo zabilježena, zajedno s pojedinostima o njihovoj debljini u intervalima od 0,1 mm uz rubove kosti. Prije početka snimanja gingiva je bila vraćena u svoj izvorni položaj.

Periapikalne radiografije snimane su receptorom temeljenog na načelu CCD (RVG S®, Trophy Radiologie, Vincennes, France) i jednofaznim generatotom X-zraka Irix 70® (RVG S®, Trophy Radiologie, Vincennes, France) uz stalnu projekcijsku geometriju i parametre eksponiranja. Glava za X-zrake bila je prilagođena tako da središnji snop bude okomit na osjetilo, a razmak izvor - objekt održavan je na 24 cm.

Ukupno je bilo snimljeno 36 zanimljivih regija, a za svaku od njih bila je izrađena dva video crteža - jedan s optimalnim linearnim obogaćenjem kontrasta, drugi sa strmim gradijentom obogaćivanja (x--funkcija). Promatrači su bila šestorica stomatologa. Svaki od njih individualno je ispitivao video kopije, pod jednakim uvjetima promatranja. Od njih se tražilo da nađu područja s alveolarnom dehiscenicijom, ali nisu bili obaviješteni da su neka oštećenja prirodna a neka umjetna. Najprije su zajedno predstavljene kopije izrađene upotrebom x-funkcije, a 24 sata kasnije kopije izrađene linearnim obogaćivanjem. Jednostavni odgovori na postojanje dehiscenecije za zub svake slike bili su "da" ili "ne". Za promatranje slike nije bilo postavljeno nikakvo vremensko ograničenje. Nakon mjesec dana promatrači su ponovno pregledali 76 slika, ovaj put upareno da se simultano prikažu oba obogaćenja iste slike. Ponovno je zatražen jednostavan odgovor "da" ili "ne".

Istraživane su bile dvije početne hipoteze: (1) nema znatnijih razlika u korektnim odlukama za kontrolna područja, područja prirodne dihiscencije, SND I WDD; (2) ispitivani načini obogaćivanja ne uzrokuju nastanak većih razlika. Statističke raščlambe su provedene dvofaktornim raščlambama varijanti (ANOVA), uz postotak korektnih odluka kao ovisne varijable, a neovisne varijable bile su tipovi defekata i načini obogaćivanja slika.

Vrijednost *à priori* α bila je postavljena na $p \leq 0,05$.

Rezultati

Status kosti

Srednji postotci korektnih odluka za sva stanja - kontrolno stanje, prirodne dehiscencije, SND i WDD, alveolarne kosti - prikazani su na Slici 1. Prirodna dehiscencija bila je korektno određena u samo 13% slučajeva, u usporedbi s 40 posto za umjetne (WDD) defekte. Međutim, ti postotci prikrivaju široka područja između položaja na različitim uzorcima (Slika 2).

Tablica 1 prikazuje rezultate ANOVA za tipove defekata kosti i također faktorira moguće varijacije u sposobnosti pojedinih kliničara. Nije ustanovljena znatna razlika u performancama kliničara ($p>0,05$). Znatne su razlike ustanovljene u sposobnosti otkrivanja različitih oblika defekata i kontrola ($p<0,002$). Razlike u sposobnosti otkrivanja prirodne dehiscencije, SND i WDD, te kontrolu, uračunate su za 59% ukupne pogrješke. Bilo je lakše otkriti umjetne defekte negoli područja prirodne dehiscencije.

Obogaćivanje kontrasta slika

Postotci korektnih odluka prema viđenim obogaćenim video slikama prikazali su na Slici 3. Ponovno su područja u korektnim odlukama između različitih položaja i uzoraka bila široka. Razultati raščlambe ANOVA, uspoređujući sposobnost otkrivanja različitih stanja alveolarne kosti uz upotrebljena obogaćenja, dani su u Tablici 2. Nije dokazano da je glavni učinak načina obogaćivanja statistički značajan ($p\geq 0,05$). Nadalje, bilo je ustanovljeno da način obogaćivanja pridonosi manje od 0,2% u ukupnoj pogrješki, u usporedbi s 98,5% za postojanje i tip koštanih defekata.

Točnost, specifičnost i osjetljivost

Uprosječivanjem svih odgovora ukupan broj odluka bi je 648, a ukupan broj korektnih odluka bio je 312; iz toga slijedi da je točnost bila 48%. Broj stvarnih pozitivnih odgovora bio je 126 od aktualnog kombiniranog zbroja defekata od 414, što daje osjetljivost od samo 30%. Broj stvarnih negativnih odgovora bio je 182, a ukupni broj kontrola bio je 234, što rezultira specifičnošću od 79%.

Rasprava

Rezultati ove studije bili su esencijalno negativni. To jest, sposobnost obogaćivanja kontrasta slike sustavom RVG-S® nije ostvarila više od prigode da se točno dijagnosticira dehiscenciju u alveolarnoj kosti. Vrijednost ukupne točnosti od 48% sugerira da bi kliničari mogli biti točniji da su "bacali novčić i pogađali stranu" nego što su bili pregledom obogaćenih video kopija upoptrebljenih u ovoj studiji. Više od jednog od pet kontrolnih područja bilo je odabrano kao da pokazuje dehiscenciju, ali je bilo otkriveno samo 13% prirodno nastalih dehiscencija. Budući da je bilo otrpilike 20% (1) prirodnih dehiscencija, prilike da se dehiscencija korektno dijagnosticira na temelju obogaćenih digitalnih slika znatno su manje nego rizik pogrešnog dijagnosticiranja da intaktne kortikalne ploče imaju defekte.

Možda se pitate zašto bi trebalo objaviti negativne nalaze kao što je ovaj. Uistinu, izdavači radije tiskaju pozitivne pronalaske, jer čini se da su oni uzbudljiviji i upotrebljiviji čitatelju. Konzekvencije neobjavljivanja negativnim nalaza jesu da neutemeljena traženja mogu prolaziti neupitno. Uz to, istraživački projekti kao što je ovaj, ovdje opisan, uzimaju mnogo vremena za planiranje, pribavljanje dozvola i provedbu. Ako negativni rezultati ne bi bili objavljeni, ostali istraživači bili bi neobavješteni o činjenici da se je to područje već istraživalo. Tako bi moglo biti više posjeta istoj "slijepoj ulici", umjesto napretka u stvaranju novih znanja.

Zaključci ovih istraživanja čine upitnim valjanost studija koje se oslanjaju na umjetno stvorene defekte kao modela za periodontologijsko istraživanje. Umjetne defekte bilo je lakše otkriti nego prirodno nastale dehiscencije.