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REVIEW

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Zadaća stomatologa u slučaju velikih nesreća i bioterorizma

The Role of Dentistry in the Management of Mass Disasters and Bioterrorism

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Sažetak
Posljednjih se desetljeća određuje identitet ljudi koji su izgubili živote u velikim prirodnim katastrofama i ratovima. U identificiranju tijela stručnjaci se itekako mogu koristiti zubnim strukturama jer su najtvrđe i najotpornije. Teroristički napad 11. rujna 2001., dao je novo značenje pojmu bioterorizma. Svrha ovoga preglednog rada jest predstaviti važnost forenzične stomatologije i njezine metode u identifikaciji ljudi nakon masovnih nesreća.

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Uvod

U svim nesrećama i napadima nešto je specifično, ali ima i zajedničkih čimbenika. U nesrećama ili katastrofama može biti uništena i oštećena imovina, ozlijeđeni ljudi, a ima i drugih gubitaka. Pravi odgovor zahtijeva pripremu i uključuje pripremne studije, tj. moraju se pripremiti mogući scenariji te planirati kako pomoći i spasiti ugroženo stanovništvo (1).

Nažalost u takvim slučajevima ima i poginulih, pa su nužne i metode identifikacije, a to su usporedba lica, otisci prstiju, karakteristike zuba, tipizacija DNK, posebnosti tijela ili prijašnje medicinske informacije (2). Trupla se označavaju i spremaju u vreće, uzimaju se otisci prstiju, a zatim počinju raditi forenzični patolozi i stomatolozi (3). Taj je redoslijed isti u svakom postupku identifikacije žrtava.

Ljudski ostaci nakon velikih nesreća mogu biti vidljivi, traumatizirani, potopljeni, izgorjeli, raspadnuti i samo koštani (4). Na žrtvama požara koža može biti od lagano crvene do potpuno izgorjele. Temperatura i duljina izvrgnutosti toplini ili vodi u slučaju utapanja, važni su čimbenici koji utječu na stanje ostataka.

Vlaga u okolišu, temperatura i izloženost mikrobima potiču raspadanje ljudskih ostataka i utječu na postupak identifikacije. Posljednji stupanj raspadanja su samo koštane struk-

Introduction

Each disaster is unique but there are some aspects which are common to all of them. A disaster can cause property damage, injuries and other fatalities. The proper management requires preparation and includes mock disasters, i.e. potential disaster scenarios planning and management (1).

Methods used for identification are facial comparison, fingerprints, dental characteristics, DNA typing, unusual body characteristics or antemortem medical information (2). Four main steps are followed in each of them: body tagging and bagging, finger printing, forensic pathology and forensic dentistry (3). These steps are followed in every victim identification process.

Human remains of mass disasters may be viewable, traumatized, drowned, burned, decomposed and skeletonized(4). The condition of burned victims ranges from slightly reddened skin to incinerated remains. The temperature and length of exposure to heat or water in case of drowned victims are the important factors that influence the condition of these remnants.

Factors such as environmental humidity, temperature and exposure to microbial factors lead to decomposition of the human remains and affect the process of identification.

ture. Upozoravamo da se mora paziti na ispadanje zuba zbog manjka parodontalnog ligamenta (4).

U identifikaciji se koristimo različitim metodama (4):

I. Ako se tijelo može vizualno identificirati moramo ga:
   a. fotografirati
   b. osigurati radiograme
   c. ustanoviti zubni status
   d. uzeti otiske zuba
   e. sačuvati oralne strukture;
II. raspadnuto/spaljeno/traumatizirano tijelo moramo:
   a. fotografirati
   b. osigurati radiograme
   a. ustanoviti zubni status
   b. stabilizirati i/ili sačuvati ostatke;
III. koštane ostatke moramo:
   a. fotografirati
   b. osigurati radiograme
   c. ustanoviti zubni status
   a. odrediti artikulaciju čeljusti i analizirati okluzije
   b. sačuvati ostatke.

Pristup oralnoj šupljini

Forenzični stomatolog pomaže u postupku identifikacije tako što procjenjuje dob te određuje spol i rasu žrtava. Otisci zagriza također mogu biti korisni, kao i rugoskopija (provjera otisaka) te radiografija. Svako je zubalo jedinstveno, tako da su sve restauracije ili anomalije obilježja određene usne šupljine, što u slučaju forenzične obrade pomaže u identifikaciji trupla (5, 6). U obzir se mora uzeti i činjenica da zubi i zubalo imaju visok stupanj različitosti zato što svaki zub ima pet površina, a tu je još i dodatni materijal koji se rabio za restauraciju - od zlata do amalgama (2). U poslu forenzičara otkrivanje materijala sličnih zubu glavni je problem, jer ih je ponekad vrlo teško razlikovati od prirodnih. Zato je predložena nova metoda kojom se lakše otkrivaju restauracije od materijala sličnih zubima - to je jetkanje 37-postotnom ortofosfornom kiselinom (7).

Jednostavna metoda za pristup zubima uključuje rez kroz meko mišićno i masno tkivo od mandibularnog kuta do središnje sagitalne linije (8). Rez se nastavlja na lateralne površine baze mandibule tako da se meka tkiva vrata mogu oguliti prema gore (8). Pritom se incidiraju maseterični mišić i vestibularni pripoj. Slijedi uklanjanje mandibule (nakon incizije ramusa i pterigoidne muskulature) i maksile (Slika 1.). Taj se pristup zove i «Stryker Autopsy Saw Method» (9).

Obično je za pristup oralnoj šupljini žrtve dovoljna incizija maseteričnog mišića. Ako je nastupila mrtvačka ukočenost (rigor mortis), čini se ili pritisak na retromolarno područje mandibule ili se obavlja transmandibularna resekcija. U ostalim slučajevima još je jedna mogućnost - uklanjanje jezika i laringsa (4). Dodatna metoda, iako otvarači usta baš nisu omiljeni, jest primjena Arhimedova vijka. Njegovo se uporište postavlja između prvoga i drugoga pretkutnjaka te se vijak okreće dok se čeljusti ne odvoje (10).

Ostale tehnike koje se rabe za disekciju su:

The last state of decomposition is skeletonization. Care must be taken in order to avoid the falling out of the teeth due to the lack of periodontal ligament (4).

In the conditions described above different methods are used during the process of identification (4):

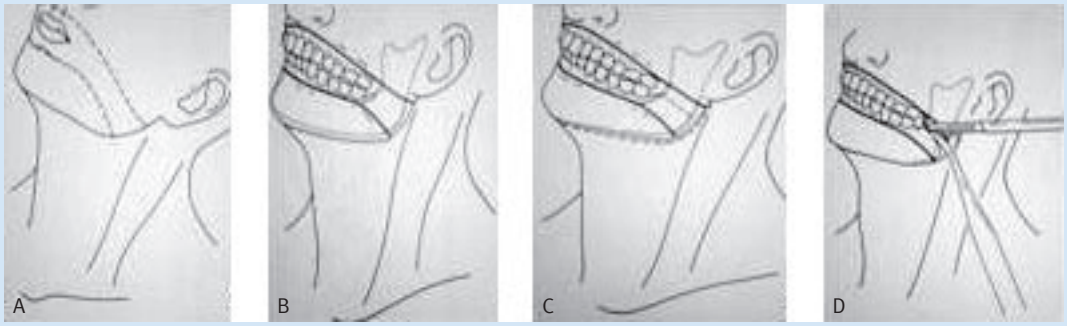
I. Visually Identifiable Body
   a. Photographs
   b. Radiographs
   c. Dental Charting
   d. Dental Impressions
   e. Preservation of Oral Structures
II. Decomposed/Incinerated/Traumatized Body
   a. Photographs
   b. Radiographs
   c. Dental Charting
   d. Stabilization and/or Preservation of Remains
III. Skeletonized Remains
   a. Photographs
   b. Radiographs
   c. Dental Charting
   d. Jaw articulation and Occlusal Analysis
   e. Preservation of Remains

Access to the oral cavity

Forensic dentistry contributes to the identification process by estimating age and determing sex and race of the corpses. Bite marks may also serve as useful material as well as rugoscopy and radiography. Each denture is unique, thus restorations or anomalies of teeth characterize a certain oral cavity and in case of forensic medicine, they help to identify the cadaver (5, 6). It must be taken into account that the dentition has a high amount of diversity due to the fact that each tooth has five surfaces and the material that can be used for a restoration may range from gold to amalgam (2). The detection of tooth-colored restoration is a main issue as it is very difficult to distinguish from the natural tooth. A new method was proposed, which improves the detection of tooth-colored restorations by etching with 37% phosphoric acid (7).

A simple method for the approach comprises the cutting of the soft tissues through the fat and muscles from the angle of the mandible to the midline (8). The incision continues to the lateral surfaces of the mandibular base so that the soft tissues of the neck can be stripped in an upward direction (8). The masseter muscles and the vestibular attachment are incised. The next steps involve the removal of the mandible (after the incision of the ramus and the pterygoid musculature) and maxilla (Figure 1). This approach is also called «Stryker Autopsy Saw Method» (9).

Particularly, in order to access the oral cavity of the victim an incision of the masticatory muscles is usually enough. In case where postmortem rigor (rigor mortis) is present the access is possible either by pushing on the retromolar pad of the mandible or by following a transmandibular resection. In other cases the removal of the tongue and larynx is another possible approach (4). Another method, although mouth-openers aren't preferred, is the application of an Archimedes



Slika 1. Različite disekcijske tehnike
Figure 1 Different dissection techniques
A: perioralna incizija • Perioral incision;
B: uklonjeno meko tkivo • Soft Tissues removed;
C: koštani rez ramusa i submentalno-milohioidna incizija • Ramus bony cut and submental-mylohyoid incision;
D: odvajanje ramusa i incizija pterigoidnog mišića (1) • Separating ramus and incision of the pterygoid muscles (1)

1. «Mallet-Chiselova metoda prema kojoj se frakturira čeljust po Le Fortovoj I liniji tako da se postavi dlijeto ispod zigomatičnog luka, visoko na zidove maksilarne sinuse bilateralno (9);
2. «Pruning-Shearsova metoda kada se oštrice škara postave unutar nosnica i utisnu u maksilarni sinus. Rez se radi iznad vrhova korijena maksilarnih zuba (9).

Stupanj uspješnosti je u vezi sa stupnjem preparacije tkiva (11). Ako je truplo u lošem stanju, mora se posvetiti pozornost mogućem gubitku zuba tijekom disekcije glave. Važno je obaviti i radiografsko snimanje prije repozicioniranja tijela. Na taj se način pomaže u bilježenju stvarnih odnosa između anatomskih struktura i obilježja tijela prije nego što se truplo preveze u mrtvačnicu jer se tijekom transporta mogu dogoditi promjene.

Ekstraoralne incizije odnose se na bilateralne incizije od oralnih komisura do tijela ramusa, u ravnini paralelnoj s ravninom okluzije. Inframandibularna incizija odnosi se na rez kroz kožu ispod mandibule i medijalno od nje u smjeru od uha preko središnje linije do suprotnog uha. Taj se pristup predlaže kod žrtava koje se mogu vizualno prepoznati. Kod resekcije mandibule koristi se Strykerova pila kako bi se zarezao uzlazni krak ramusa mandibule. Jezik i dno usne šupljine mogu se resecirati autopsijskim nožem. Maksila se može ukloniti Strykerivom pilom koja se postavlja na njezin najviši dio. Incizija počinje s jedne strane i nastavlja se na drugu preko središnje linije s pilom nagnutom prema gore izbjegavajući vrhove korijena zuba (4).

Naravno da postupci rezanja ili uklanjanja maksile ili rezanja lateralnih mišića oralne šupljine deformiraju facijalne karakteristike, što je neželjena posljedica identifikacije. Zato su Fereira i njegovi suradnici predložili novi pristup (6) prema kojemu se rabe uobičajeni forenzični instrumenti. Nakon toga se zbog identifikacije tijela fotografiraju, kako bi se zabilježili uvjeti u kojima je truplo nađeno te se obavljaju sljedeće incizije:

1. gornja incizija - od tragusa do tragusa drugog uha (6), uključujući i prednju nosnu spinu;
2. donja incizija - od mentalne eminencije čeljusti kod baze alveolarnih procesusa u stranu prema tijelu mandibule, paralelno s donjim rubom i križanjem ramusa te

screw. The point of the screw is placed between first and second bicuspids and turned until the jaws are separated (10).

Other techniques used for dissections are: 1) the «Mallet and Chisel Method», according to which a Le Fort I fracture is being induced, positioning the chisel below the zygomatic arch, high on the maxillary sinus walls bilaterally (9) and 2) the «Pruning Shears Method». The blade of the shears is placed within the nares and forced back into the maxillary sinus. The cut is made superiorly to the apices of the maxillary teeth (9).

The degree of success is correlated to the degree of preparation of the tissues(11). In case of badly maintained cadavers, attention must be drawn to the possibility of tooth loss during the process of head dissection. It is important to carry out the radiographic examination prior to the repositioning of the cadaver. This approach helps to record the true relationship between the anatomical landmarks of the body, before the cadaver is transferred to the morgue, as during transportation changes may occur.

Extraoral incisions refer to bilateral incisions from the oral commisures to the body of the ramus, on a plane parallel with the plane of occlusion. An inframandibular incision refers to dissection of the skin inferior and medial to the mandible in a direction from the ear across the midline to the opposite ear. This approach is suggested in case of viewable victims. The jaw resection includes the use of a Stryker saw in order to make a cut on the ascending ramus of the mandible. The tongue and the floor of the mouth can be resected with an autopsy knife. The removal of the maxilla can be made with a Stryker saw that is positioned on the most superior-posterior part of the maxilla. The incision starts from one side and is continued to the other side across the midline, with the saw angled superiorly, avoiding the area of the root of the teeth (4).

Of course, procedures that involve the cutting or removal of the maxilla, or the sectioning of the lateral muscles of the oral cavity, lead to deformations of the facial characteristics, which are not wanted. In this manner a new approach was suggested by Fereira et al. (6), which requires common instruments of forensic use. After adequately identified photographs are taken, in order to record the conditions under which the cadaver was found, the following incisions are made:

dolaskom na stražnju površinu, rezanjem maseteričnog mišića;
3. lateralna incizija - dvije, svaka na svojoj strani, spajajući već spomenute incizije (6).

Nakon što se pažljivo uklone usne i tkiva obraza, slijedi rezanje pterigoidnog mišića i kondilarnog i kapsularnog ligamenta temporomandibularnog zgloba (TMZ-a).

Ta se tkiva odvajaju od periosta kako bi se mogla repozicionirati. Proteze i druge naprave skidaju se te se opisuju anomalije i mapira okluzija, a prema potrebi slikaju se i okluzalne radiografije.

Zubni radiogrami daju dokaze o prijašnjim endodontskim terapijama, osnovama ispod restauracija, o njihovu obliku (klinički nedovoljno uočljivima) te o anatomiji maksilarnih sinusa (6). Ipak je potreban i vizualan pregled jer se, prema istraživanju Chesne i suradnika (12), 40 posto zubnih materijala ne može otkriti na radiogramima (12).

Kako bi se rekonstruirala tkiva prema stanju prije incizija, oralna se šupljina zatvara vraćanjem mandibule u ishodišnu poziciju i vraćanjem uklonjenog tkiva. Proteze i druge naprave opisuju se uzimajući u obzir njihovu vrstu, materijal, oblik i približno vrijeme uporabe (6).

U slučajevima kada se za identifikaciju testira DNK-a, zadržavaju se u laboratoriju veliki zubi bez ispuna i zahvata s velikom pulpnom komorom (3). Naravno to nije metoda izbora nego je samo jedan od oblika identifikacije te zahtijeva za usporedbu podatke i tkiva prije trenutka smrti. Ti podaci i dokumentacija trebaju uključivati i radiograme. Oni su korisni u velikim nesrećama, ali nisu prijeko potrebni u identifikaciji manjeg broja žrtava (13). Posljednja je takva bila obavljena nakon zrakoplovne nesreće u Nepalu godine 2002., kada je poginulo svih 18 putnika. Državljani iz europskih zemalja (14) bili su prevezeni u Središte sudske medicine u Frankfurtu, u Njemačkoj. Identifikacijski postupak temeljio se na medicinskoj dokumentaciji, ali nije uključivao stare radiograme (13).

Zadaća forenzične stomatologije u slučaju bioterorizma i velikih nesreća

Pod biološkim oružjem smatramo tvari (viruse, bakterije, mikroorganizme i toksine) koje mogu uzrokovati smrt ljudi i životinja. Osnovna su im svojstva virulencija, mala količina potrebna za kontaminaciju, ne postoji cjepivo, dakle, nema prevencije, jednostavno se proizvode i raspršuju, stabilne su i imaju kratko vrijeme inkubacije. Kako bi se odredila zadaća stomatologa u slučaju terorističkih napada, Američka udruga stomatologa (American Dental Association) organizirala je radionicu o temi «Zadaća stomatologa u borbi protiv biološkog terorizma». Nužnost da se bolje shvati ta problematika postala je očita nakon izgreda s antraksom u pošti u SAD-u (14, 15). Sjedinjene su Države tada osnovale Mikrobiološki forenzični laboratorij (National Bioforensics Analysis Cen-

1) Superior incision: from tragus to tragus of the ear (6) including the anterior nasal spine. 2) Inferior incision: from the mental eminence of the jaw, at the base of the alveolar process sideways to the body of the mandible, parallel to its inferior edge, crossing the ramus and arriving to its back edge, sectioning the masseter muscle. 3) Lateral incisions: two, one on each side, joining the two aforementioned sections (6).

After the careful removal of the lip and cheek tissues, the sectioning of the internal pterygoid muscles, the condyle and the capsular ligament of the TMJ follows. These tissues are separated directly from the periosteum in order to achieve repositioning. Prostheses and other appliances are being removed and description of the anomalies and charting of the occlusion are followed by occlusal radiographs, if necessary.

Dental radiography proves evidence of the presence of root canal treatments, the bases under restorations, and the shapes of restorations (clinically not distinguishable) and the anatomy of the maxillary sinuses (6). However, visual examination is also required as according to a study of Chesne et al. (12) 40% of the dental materials tested couldn't be detected on radiographs (12).

In order to reconstruct the tissues as they were before the incisions, the oral cavity is being closed by the displacement of the mandible to its original position and reposition of the formerly removed tissues. The prostheses and other appliances are described by taking into account their type, material, design and approximate period of use (6).

In cases where DNA profiling is a method of identification, untreated teeth with large pulp are maintained for the laboratory (3). Of course this approach isn't the method of choice and as in the other identification methods it requires comparative data that means antemortem records. The a.m. data should include radiographs. They are really helpful in mass disasters, but not essential for the identification in case of other disasters with a smaller number of victims (13). The last is shown in a disaster of an airplane crash in Nepal in 2002, where all 18 passengers were killed. The 14 European passengers were transferred to the Centre of Legal Medicine, Frankfurt, Germany. The identification process was based on ante- and postmortem data comparison, but with lack of antemortem radiographs (13).

The role of Forensic Dentistry in the management of bioterrorism and mass disasters

The term biological weapons implies biological substances (viruses, bacteria, micro-organisms, toxins) having the ability to cause the death of human beings and animals. Basic characteristics of biological weapons are their virulent action, the small amount of the weapon needed for contamination, the lack of vaccination, the simplicity of the production and dissemination, the stability and the short incubation time. In order to evaluate the role of dentistry in the management of terrorist's attacks; the American Dental Association convened a meeting, «Workshop on the Role of Dentistry in Bioterrorism». The need for a deep inside into this new reality became evident after the anthrax incidents in the U.S. Mail (14, 15). The U.S. established a microbial forensic lab-

ter) u suradnji s FBI-om (16) zbog većih mogućnosti u kapacitetu. Prema tvrdnjama Budowle i njezinih suradnika (17), mnogi se problemi još moraju riješiti. Važna pitanja su prikupljanje i postupak s uzorcima te protokoli o njihovu čuvanju jer sve te tvari mogu biti vrlo štetne i mikrobno različite. Tu su i baze podataka genoma i osobina (patogena i srodnika), metoda (genetske, kemijske i fizikalne) te utjecaji na učinke dekontaminacije kod dokaza. Zatim se mora poštovati sustavna procedura izabiranja i slaganja analitičkih metoda (stablo odluka) i što je najvažnije pronaći imunološki odgovor domaćina te farmakokinetika zaštitnih lijekova (17).

Stručnjaci su zaključili da stomatologija može stručnim osobljem znatno pridonijeti u pripremi u slučaju biološko-terorističkih napada i u neposrednom odgovoru na njih, ali i u stabilizaciji stanja. Sljedeći resursi mogu biti presudni u rješavanju stanja (18):

Forenzična stomatologija:

1. ispravlja "crnu" propagandu;
2. služi kao sustav nadzora, jer su stomatološke ordinacije ravnomjerno raspoređene u svakoj zajednici (18);
3. pomaže u nadzoru panike;
4. odražava opće mišljenje (14);
5. stomatolozi mogu raditi zajedno s ostalim liječnicima, pomažući u cijepljenju, pružanju prve pomoći i ostaloga;
6. prema zaključcima sa spomenutog sastanka Američke stomatološke udruge, zahvaljujući obrazovanju stomatologa:
   - mogu pomoći u zbrinjavanju ozljeda glave i lica;
   - mogu samostalno primijeniti anestetike ili asistirati u njihovoj primjeni;
   - postaviti venski put;
   - obavljati potrebne kirurške zahvate i šivanja;
   - asistirati u zbrinjavanju ljudi u šoku;
   - asistirati u stabiliziranju pacijenata;
   - prikupiti krvne uzorke prije primjene antibiotika;
   - upisati u povijest bolesti anamnestičke podatke;
   - obaviti kardiopulmonalnu reanimaciju (18).
7. U slučaju bioterorizma bolnice mogu biti prenatrpane te se moraju pronaći dodatna vanjska mjesta za pružanje zdravstvene zaštite. U tim slučajevima stomatolozi mogu pridonijeti svojim medicinskim znanjem i profesionalnim iskustvom.

Prema informacijama iz Instituta za stomatološka istraživanja američke vojske, usklađena pomoć u slučaju vojne nesreće počinje uspješnom suradnjom sa stomatolozima kako bi se skupili medicinski podaci o pacijentima prije smrti. Poteškoće zbog različitih sustava u obilježavanju zubala mogu se premostiti uporabom standardnoga obrasca za prikupljanje stomatoloških podataka prije smrti. U tom slučaju mapa zubnih kruna može pridonijeti jednostavnijem i bržem sustavu usporedbe podataka prije smrti i nakon nje (19). Prema tome se podaci dobiveni nakon smrti i podaci dobiveni radiografskom metodom pohranjuju u standardizirane postmortalne zubne kartone (2). Usporedba podataka obavlja se ručno. Rezultati se potvrđuju dodatnom usporedbom dentalnih radiograma prije i poslije smrti.

Kako bi se izbjegle pogreške, Odjel bioinženjerstva američke vojske u Institutu za istraživanja zuba, predložio je kom-

oratory known as the National Bioforensics Analysis Center in partnership with the Federal Bureau of Investigation (FBI) (16) to provide greater capacity. According to Budowle et al(17), there are many problems that must be solved. In particular, important issues are: sample collection, handling, and preservation protocols, as the material can be very harmful, microbial diversity, databases of genomes and signatures (of pathogens and near neighbours) and of methods (genetic, chemical, physical), effects of decontamination on evidence, systematic procedures for selecting and ordering analytical methods (decision trees) and host immune responses and pharmacokinetics of prophylactic drugs (17).

Experts came to the conclusion that «Dentistry can contribute valuable assets, both in personnel and facilities, to the preparation for and in the immediate response to a bioterrorist attack and its aftermath. These assets can make a significant difference in the outcome» (18).

Forensic dentistry:

1. rectifies black propaganda
2. serves as an surveillance resource, as dental offices are distributed across the community (18)
3. helps controlling the panic
4. quietens the common opinion (14)
5. Dentists can work at the side of physicians, contributing to the process of vaccination, first aid supply etc. According to the results of the meeting of the American Dental Association mentioned above, due to their education, dentists:
   - are able to help in the treatment of cranial and facial injuries, they also can:
   - provide or assist in the administration of anesthetics
   - start intravenous lines
   - perform appropriate surgery and suturing
   - assist in shock management
   - assist in stabilizing patients
   - collect preantibiotic blood samples
   - take medical histories
   - provide cardiopulmonary resuscitation (18)
6. In case of a bioterrorism attack hospital organizations may be overwhelmed and external areas for the provision of health care must be found. In these cases dentists can contribute by applying their medical knowledge and professional experience.

According to an information bulletin of the Institute of Dental Research of the United States Army, a coordinated approach in case of a Military Disaster starts with a successful cooperation with dentists in order to obtain the possible antemortem records of the victims. The difficulties that are present and are related to the different charting systems of the dentition can be overwhelmed by a standard charting dental form for the antemortem record. In this manner, a «crown chart» can contribute to a more easier and quick reference system for the comparison of ante- and postmortem records (19). Accordingly the postmortem data and the data obtained from the dental radiographic examination are charted into a standard postmortem dental record (2). The comparison of the antemortem and postmortem data evolves from the manual matching of the information. The results

pjutorsku identifikaciju (CAPMI). Točnije, podaci se mogu unositi tipkovnicom u prijenosno ili kućno računalo ili putem optičkog sustava čitanja (2). Korištenjem operativnog sustava DOS-a, proces usporedbe postaje jednostavan.

Rezultati pridonose lakšem ručnom pretraživanju podataka prije smrti i nakon nje.

Oni se prema sustavu usporedbe poklapaju, ne poklapaju ili imaju moguće sličnosti. Točnost identifikacije uz pomoć kompjutora velika je jer je kod pojedinaca sa sedam zubnih karakteristika točna podudarnost bila pri vrhu najvjerojatnijih identiteta i iznosila je 95 posto (2).

Organizacija stomatološkoga tima

Naravno, potrebno je odrediti osnovnu organizaciju stomatološkoga tima. Jasno je da se mora uzeti u obzir mnogo toga kako bi se složila ekipa specijalista koji bi mogli djelovati brzo i učinkovito.

Osnovne značajke su:

1. Osoblje tima: sastoji se od stomatologa i člana odbora forenzične stomatologije; oni osiguravaju odgovarajuću razinu znanja;
2. Standardi za uvježbavanje: kao i središta za izobrazbu osiguravaju neprekidno učenje, posebne ekspertize (oralna patologija, oralna kirurgija); na taj se način pomaže timu da fizički rješava složene situacije;
3. Pravna i zakonska regulativa: zapošljavanje dobrovoljaca ili zaposlenika, traženje potpisanoga pristanka, ograničenje njihova djelovanja; sve to objašnjava ciljeve organizacije.
4. Plan aktivacije u slučaju hitnosti, identifikacija članova tima, struktura tima, zalihe, sigurnost članova i zgrada: služe za odgovarajuću mobilizaciju i zaštitu.

Treba se baviti sa svakom stavkom i uzeti u obzir sve mogućnosti. Ističemo - u slučaju velike nesreće nepredvidive težine, identifikacija ne može biti uspješna nakon određenog razdoblja jer se tijela počinju raspadati. Zbog toga je važno uvijek imati spremne rashladne uređaje za držanje uzoraka ili trupala (3).

Nakon osnutka tima za krizna stanja slijedi usklađivanje njegova djelovanja. Clark (19) navodi da se to može postići podjelom u dva odvojena stomatološka tima. Prvi, kao "domaći" tim, smjestit će se u središtu za koordinaciju i usko će surađivati s policijom. Njegov je zadatak osigurati prijesmrtne dentalne podatke onih za koje se zna da su nestali ili su pogođeni katastrofom (19). Te su informacije osnova za rad „vanjskoga" tima smještenoga u mrtvačnici gdje se prikupljaju postmortalni podaci.

Stomatološka se ekipa dodatno može podijeliti u još dvije skupine – jednu za pregled i drugu za radiološka ispitivanja (3). Skupina za ispitivanja opisana je u odlomku „Pristup oralnom kavitetu", a obavlja disekciju za ispitivanje maksile i mandibulu. Vrsta disekcije bira se prema stanju žrtve. Nakon

are validated by a comparison of the ante- and postmortem dental radiographs.

In order to avoid human error, a computer assisted postmortem identification (CAPMI) is suggested by the bioengineering branch of the United States Army Institute of Dental Research. Particularly, data can be imported manually via the keyboard of a laptop or home computer or via an optical reading system (2). With the use of a simple operating system (DOS), the comparison process becomes an easy procedure. The result contributes to an easier manual search of the ante- and post mortem records that according to the Comparison Function of the system: Match, Mismatch or have possible matches. The accuracy of this computer assisted postmortem identification process is high, as for individuals with seven dental characteristics the correct match was at the top of the most likely identities list 95% of the time (2).

Dental team organization

Of course a specific outline of the dental team organisation is being needed. It becomes obvious that many aspects must be taken into account in order to organise a team of specialists that would be able to act fast and adequate in case of emergency. Basic prerequisites are:

1. the Team personnel: comprising odontologists and members of Forensic Odontology Boards. They provide the adequate knowledge.
2. Training standards: like training centers, continuing education, special expertise(Oral pathology, Oral surgery), help the team to be physically able to handle complex situations.
3. Legal and jurisdictional considerations: occupy volunteers or employees, ask for written agreement, limitations on their action. All these points clarify the aims of the organisation.
4. Activation plan in case of emergency, identification of team members, team structure, supplies, safety of team members and facilities, serve for the adequate mobilisation and for the protection of the team.

Each issue has to be dealt with, considering all aspects that it gives rise to. A special example is the following: in case of mass disasters of unpredictable graveness, the identification cannot successfully be carried out after a certain period of body decomposition. It appears important to make sure that refrigerated containers will be ready for use in order to maintain the cadavers (3).

The formation of a disaster management team is followed by its coordinated work. According to Clark(19), this can be achieved through the division of labour into two separate dental teams. The first, mentioned as home team, will reside at the coordinating center, having a close relationship with the police. Its aim is to obtain information from the antemortem dental records of those believed missing or involved in the catastrophe (19). This information builds the basis of the work of the <<away>> team. Its residence is the mortuary and its aim is the preparation of a postmortem record.

In addition to the above, the dental team can be divided into two separate teams, the examination group and the radi-

što je pregled završen dovoljna su dva tzv. „bitewing„ radiograma kako bi se dobilo dovoljno podataka o posebnim svojstvima zuba ili prijašnjim tretmanima (3).

U svijetu su dvije glavne vrste timova za masovne nesreće. Prema a*meričkom modelu,* stomatološki se tim aktivira prema potrebi te postaje dio koordinacije među više agencija (20). Za razliku od toga e*uropski model* svrstava stomatološku ekipu u dio planirane agencije koja radi pod nadzorom središnje organizacije (20).

Glass (10) tvrdi da je bitan lokalni tim jer ima najvažniju zadaću u rješavanju nesreća zato što se svaka događa u specifičnom području. Dodaje da se stomatološka ekipa može sastojati od mjesnog stomatologa, zubnog higijeničara, zubne asistentice, osoblja iz ordinacije i laboratorijskog osoblja, iako postupak identifikacije može najbolje obaviti stomatolog (10). Ako je moguće, drugi stomatolog može smanjiti mogućnost pogreške i pogrešne identifikacije te se takav način preferira.

Prema stajalištu Solheima i njegovih kolega (21), stomatološka i medicinska ekipa mora imati istu odgovornost kao dio tima za krizna stanja. To je s*kandinavski model* koji se slijedi u slučaju nesreća kada je policija autoritet i ima odgovornost u identifikaciji tijela (21). Solheim i suradnici (21) iz Instituta za forenzičnu medicinu, Sveučilišta u Oslu, uspjeli su identificirati 68 posto tijela s trajekta «Skandinavska zvijezda» koji je potonuo godine 1990.

Mreža pretraživanja

Kako bi se uspješno obradili ljudski ostaci na mjestu gdje se dogodila velika nesreća, područje se mora podijeliti na manje dijelove (6x8 incha ili 15x20 cm). Na taj se način omogućuje označiti točan položaj ostataka tijela žrtava. Naravno da stomatološki tim odlazi na mjesto nesreće tek nakon provjere sigurnosti (10).

Neovisno o organizaciji tima, osnovne su postavke za uspješan rad *priprema i planiranje* (20).

Učinkovitost

Webb i suradnici (22) analizirali su tijekom simulacija masovnih nesreća učinkovitost timova za krizna stanja u vezi s organizacijom, pripremljenošću te emocionalnim i psihološkim stanjima (22). Rezultat je pokazao tri velike manjkavosti:

- sudionici nisu bili spremni otići iz svojih ordinacija na dulje vrijeme;
- nisu bili svjesni psihološkog stresa u takvim slučajevima - nisu bili spremni razgovarati s obiteljima stradalih o uvjetima nesreće.

Ispitivanje nije moglo ocijeniti primarnu literaturu povezanu s velikim i masovnim nesrećama (22).

ology team(3). The examination group as described above in the paragraph <<access to the oral cavity>> performs a dissection to examine the maxilla and the mandible. The type of dissection is related to the condition of the victim. After the examination has been performed two bitewing radiographs are enough in order to obtain important information about the special features of the dentition or previous treatments (3).

Two main models for mass disaster team organization are used internationally. According to the *American model*, the dental team is activated as needed. It becomes a part of a multiagency coordination (20). In contrast, according to the *European model*, the dental team is part of a pre-planned agency working under the auspices of a centralized organization (20).

According to Glass (10), it is the local team that finally has the whole responsibility for the management of a disaster, because every disaster appears at a specific area. He adds that the dental team can be comprised of local dentists, dental hygienists, dental assistants, office personnel and laboratory technicians and that the identification process should be made only by one dentist, because this method is more reliable (10). Possibly, a second dentist may minimise the error of a false identification and this may be preferable.

According to Solheim et al. (21) the dental and the medical team should have equal responsibility as part of a disaster management team. They also present *the Scandinavian model* that is being followed in case of a disaster with the police being the authority that has the responsibility for the identification of corpses (21). Solheim (21) and colleagues at the Institute of Forensic Medicine, University of Oslo, succeeded into identifying 68% of the corpses of the «Scandinavian Star» ferry disaster in 1990.

Grid areas

In order to efficiently search for human remains at the area of the disaster, this area must be split into small pieces (6X8 inches). This helps during the process of recording the exact position of the remains and the victim to which they belong. Of course the placement of a dental team to the area of the disaster should commence after the check of the security conditions (10).

Independently of the model used for the organization of the team, *planning and preparation* are the basic keys for success (20).

Effectiveness

Webb et al. (22) analyze the effectiveness of a forensic dentistry mass disaster team in relation to team organization, preparedness, emotional and psychological issues through a training exercise on a mock disaster (22). The result shows three main weakness points:

- The participants were unprepared to leave offices and for a long period of time.
- They were not aware of the psychological stress that is involved in such cases and the post-traumatic stress disorder. They were also unwilling to discuss the features of the disaster with the family of the victims.

The study couldn't evaluate the primary literature pertaining to mass disasters. (22).

Problemi koji se događaju (1, 19):

- često obitelj stradaloga ne zna ime stomatologa koji ima podatke o mogućoj žrtvi;
- previše vremena prođe od skupljanja prijesmrtnih podataka i njihove dostave "domaćem" timu; to se može dogoditi zbog obrade podataka u mjesnoj policiji, ali i zbog udaljenosti jer u mnogo nesreća, posebice zrakoplovnih, unesrećeni su često strani državljani;
- ako su žrtve strani državljani, teško je doznati tko je bio njihov stomatolog;
- u zemljama s niskim standardom teško je dobiti korisne podatke za usporedbu (3).

Čini se da je u uspješno svladavanje krize u slučaju biološko-terorističkog napada prijeko potrebno uključiti stomatologe. Oni mogu pomoći na trima razinama: u prevenciji terorizma, pomoći ozlijeđenim žrtvama i identifikaciji trupala (14).

Pojam "prevencija" odnosi se na smjernice koje se moraju dati stanovništvu prije terorističkog napada kako bi se izbjegla panika i na vrijeme naučile osnovne mjere samozaštite. Nakon napada stomatolozi mogu pomoći bilježiti slučajeve, obaviti ranu dijagnozu, imunizaciju i cijepljenje populacije te propisivati i raspoređivati lijekove. Posljednji zadatak, ali ne i zadnja medicinska djelatnost, jest dezinfekcija žrtava i okoliša, što je posao stomatološkoga tima zbog prevladavanja preopterećenosti i nedostatka pomoći.

Navedene zadaće stomatologa u slučaju terorističkih napada ovise o okružju, bilo da se radi o ruralnoj ili urbanoj sredini. Ukratko, *urbano okružje* karakterizira gušća naseljenost za razliku od ruralne, što potiče brže širenje infektivnih bolesti. Druge negativne strane su sljedeće: gradske sredine podložnije su napadima, ali prednost je veći broj liječnika. Suprotno tome, u seoskim je krajevima manje stomatologa, pa je mještanima smanjen pristup medicinskim uslugama (18).

Visoko stomatološko obrazovanje

Poseban kontakt stomatologa s općom populacijom omogućuje im educirati pacijente. Drugi važan čimbenik jest taj što su u mogućnosti ispraviti dezinformacije kako se ne bi poticala panika (18).

U ovom slučaju stomatolozi imaju i odgovornost u osiguravanju dubljeg uvida u terorističke napade kako bi se mogli uspješno planirati protokoli te osigurati infrastruktura i sredstva (14). Kao i tečaj kardiopulmonalne reanimacije koji je obvezatan za studente u Sjedinjenim Državama i u europskim zemljama, i izobrazba stomatologa trebala bi biti stalna tako da bi mogli reagirati u slučaju potrebe (10).

Za točnu i ranu dijagnozu važno je osigurati znanje o oralnim manifestacijama bolesti uzrokovanih biološkim oružjima i o mogućim otrovnim tvarima. To uključuje pripremu kako bi stomatolog bio spreman pomoći u slučaju terorističkog napada. Posebne vještine nužne su ako se postavlja venski put ili obavlja trijaža. Potrebno je naravno razli-

Problems arising (1, 19).

- In many cases the name of the dentist with the antemortem records of those believed missing or dead is not known by their relatives.
- The time that elapses before the information that was gained from the antemortem records is transferred to the home team. This may be due to the requirement for processing the data also to the police. It may be also a matter of distance, as many disasters, in particular aircraft disasters, involve foreign citizens.
- In cases where the victims are foreign citizens, it is difficult to localize the dentists of the victims.
- In countries where the standard of living is very low, it is very difficult to obtain useful information for the comparison (3).

It appears that the successful management of a terrorist's attack with biological weapons needs the contribution of *dental experts*. Three levels of help support can be given: prevention of terrorism, relief of injured victims and identification of human cadavers (14).

The term «prevention» refers to guidelines that must be given to the population prior to a terrorist attack in order to avoid panic by learning how to obtain measurements for self-protection. During the attack dentists can help at recording the cases, monitoring and early diagnosis, immunization and vaccination of the population, prescribing drugs and managing the apportionment of drugs and pharmacy. Last but not least medical support and disinfection of victims and the environment by the dental team aims at overcoming the overload and lack of help.

The above mentioned role of the dentists in the management of terrorist attacks depends on the environment and whether it is rural or urban. Briefly, an *urban* environment is characterized by a denser concentration of the population in contrast to a rural environment, thus leading to a greater spread of an infectious disease. Other negative points are the following facts: the urban areas are more prone to get attacked, but they have the advantage of a larger amount of physicians. On the contrary, the rural areas have a reduced amount of dentists and a reduced access to medical facilities (18).

Dental higher education

The special contact of dentists with the general public gives the dentists the ability to educate their patients. Another important aspect as mentioned above is the correction of misinformation, as the later leads to panic that is not wished in such cases (18).

In this manner dental higher education has the responsibility to offer a deep inside into the management of terrorist attacks which in turn leads to a successful planning of a protocol in order to assure infrastructure and means (14). Like the annual cardiopulmonary resuscitation (CPR) class, that is mandatory for students in the U.S. and countries in Europe, forensic dentistry education should be continual, so that it is there when it is being needed (10).

It is important for the right and early diagnosis to retain knowledge about the oral manifestations of diseases caused by biological weapons and about the potential biological weapons. According to the above, it involves preparation so

kovati obvezno ili volontersko učenje posebnih vještina doktora stomatologije. Osnovne vještine trebale bi biti obvezatne za razliku od vještina u vezi s "odgovorom na događaje" ili onih koje zahtijevaju posebne tečajeve i potvrde o osposobljenosti za specijalizirane usluge (18).

Važna zadaća stomatologije u postupku identifikacije jasna je kada se uzme u obzir velik broj žrtava koje se identificiraju dentalnim pregledima (61%), kao što je bilo nakon cunamija sjeverno od otoka Sumatre 26. prosinca 2004. (3).

Pravni okvir

Pravni okvir stomatologa također je važna pojedinost o kojoj se mora raspravljati i odrediti ga.

U skladu s navedenim, poseban Nacionalni odbor ima zadatak koordinirati s obiteljima i rodbinom stradalih. U slučaju zrakoplovnih nesreća agencije za zračni promet nisu te koje vode taj težak posao. Važno je na državnoj razini imati plan u slučaju nesreća (3).

Važna je i suradnja centara te timova stomatologa koji organizirano pomažu u slučaju velikih nesreća. Takav tim može biti uključen u plan hitne pomoći koji je osmišljen tako da organizira spašavanje nakon velikih nesreća koje utječu na cijelu zemlju ili regiju (11). Može također biti dio stomatološke organizacije, kao što je Povjerenstvo stomatoloških ordinacija Američke stomatološke udruge (ADA-e) (11).

Pravne komplikacije mogu se smanjiti ako se poštuju osnovne forenzične procedure, čuva dokumentacija i znaju informacije o provedenim aktivnostima koje objavljuje isključivo koordinator (1).

Ophođenje medija s obiteljima

Važan dio je i zaštita rodbine žrtava od medija. To uključuje zakon i njegovo reguliranje u skladu s člankom objavljenim u časopisu New York Law Journal, a ta mjera uključuje "protukomunikacijsko pravilo" (15). Pravnici i druge stranke ne smiju kontaktirati s rodbinom žrtava 30 dana nakon nesreće (the "Act", 49 U.S.C. paragraphs 1136(g) (14). Na taj se način željelo izbjeći nepotrebne kontakte u traumatskom razdoblju. Dodatno se preporučuje da rodbina ima pravo poništiti bilo kakav pravni dokument potpisan nakon nesreće bez ikakvih pravnih posljedica 30 dana nakon potpisivanja takvog ugovora (15). To je pravilo stupilo na snagu nakon nesreće leta 800 tvrtke TWA, a predložio ga je Odbor odvjetnika (17). Točnije, članovi su predložili da bi se u slučaju velikih nesreća u timove trebali uvrstiti i pravnici- stručnjaci za različita područja. Spomenuto je i da će rodbina moći s njima razgovarati, no morat će biti obaviješteni o pravnom sustavu zemlje iz koje potječe rodbina (15). Članovi odbora ne smiju uzimati rodbinu kao potencijalne klijente (15).

S tim u skladu potrebni su resursi, osoblje i zalihe za uspješno rješavanje i pomoć u slučaju velikih nesreća, što je vrlo zahtjevno i ni jedna zemlja još ne može samostalno pomagati svojem stanovništvu. Ubuduće će se nesreće događati

that dentists will be able to assist in case of bioterrorist attacks. Special skills are needed to start intravenous lines or to provide triage. It is of course of high importance to distinguish between mandatory and voluntary education of dental specialist. Basic capabilities should be mandatory in contrast with skills related to «response to event» or other that should require specified training for the acquisition of a certificate for specialized services (18).

The important role of dentistry in the identification process seems to be clear when taking into account the high percentage of victims identified via dental examination (61%) in the Tsunami disaster of 26th of December in 2004, north of Sumatra Island (3).

Legal cover

Legal cover of the dentists is also an important issue that must be discussed and established.

According to the above, a specific National Board has the responsibility for coordinating services to the families of the victims. In case of aircraft accidents it is not the aircraft agency that leads the hard work of the disaster management. In case of mass disasters (3) it seems to be of high importance to activate a national disaster plan.

Another important issue is the coordination center of the team formed by dentists that assist the hard work of a mass disaster management. Such a team can be integrated into an Emergency Plan that is designed in order to manage disasters that affect a whole country or region (11). It may also be a part of a dental organization such as the Council of Dental Practice of the American Dental Association (11).

Legal complications can be reduced with a thorough forensic procedure, documentation of the data collected and information about the activities being announced only by the coordinator (1).

Treatment of families by the media

Another important issue is the protection of the relatives of the victims from the media. This issue involves the law and its regulations and according to a publication of the New York Law Journal, this measurement involves an «anti-communication rule» (15). Lawyers and other parties are not allowed to contact relatives of victims within 30 days of the accident (the "Act", 49 U.S.C. paragraphs 1136(g) (14). This contributes to the avoidance of unnecessary contacts at a tumultuous time. In addition, they recommend that the relatives have the right to rescind any retainer agreement, signed within 30 days of the occurrence, without obligation within 30 days after the agreement is signed (15). The aforementioned rules were filled up with the recommendation of a committee of layers formed after the crash disaster of the TWA Flight 800, on July 17, 1996. In particular, the members suggested that the disaster response team should consist of attorneys that are educated in many different areas of law. It is also mentioned that the relatives will be able to contact them in case of particular questions, with the prerequisite that they are familiar with the law of the native country of the relatives (15). The members of the committee are not allowed to deal with the relatives as potential clients (15).

još češće jer se neprestance putuje zrakom, kopnom i vodom, prijevozna su sredstva sve brža, biološka ravnoteža okoliša sve ugroženija zbog industrije i onečišćenja, a ljudsko nasilje, tj. ratovi vjerojatno će se i dalje voditi. Taj nas zaključak upućuje na to da je prijeko potrebno organizirati tim u slučaju velikih nesreća koji bi se neprestance educirao i surađivao sa stomatološkim timom. Stomatologija može imati glavnu ulogu u spašavanju nakon velikih nesreća.

According to the above, the facilities, the personnel and the supplies needed for a successful disaster management have been up to now difficult to organize, i.e. no country has had the ability to respond to a mass disaster of high magnitude. Disasters are going to increase as the transportation industry needs even more rapid transit equipment, the biological equilibrium of the environment is gradually being even more affected by the industry and pollution and the human violence actions by means of wars will not change. This conclusion gives rise to the need of a disaster team organization that follows continual education on mass disaster management and works in cooperation with a dental team. Dentistry can play a main role in the management of mass disasters.

Abstract
The task of determining the identity of human beings that lost their lives not due to a physical death but due to a mass disaster or a catastrophe caused by human beings such as a war, is a well-known fact in the last decades. Dental structures can be useful for the identification of human cadavers as they are the hardest and most resilient structures of the body. The tragic incident of the 11th of September 2001 has introduced a period in which bioterrorism has a new definition. The aim of the following review is to present the importance of forensic dentistry and its methods of human identification in cases of mass disasters.

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