A Model for Forensic Dental Education in the Predoctoral Dental School Curriculum

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Abstract: Forensic odontologists play an important role locally and nationally in assisting in the identification of the victims of mass fatality incidents, whether natural or human-made. With the recent passage of legislation by Congress identifying dentists as a first-responder resource, knowledge of their expanding role in disaster response is particularly important. The purpose of this article is to describe the forensic dental course being taught at Creighton University School of Dentistry in Omaha, Nebraska, as a model for providing a fundamental education in forensic dentistry and disaster preparedness at the predoctoral dental level. This model is designed to 1) provide students with a broad view of forensic odontology; 2) give them a functional knowledge of the tools and techniques of the modern forensic dentist; 3) provide basic knowledge of their potential role in disaster preparedness and response; and 4) encourage students to pursue further forensic education, become active in national forensic organizations, and get involved in disaster preparedness/response in their home communities following graduation. This article includes lecture topics, demonstrations, and hands-on exercises being used at Creighton to teach students the fundamentals of forensic odontology and disaster preparedness.

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Keywords: forensic dentistry, dental education, forensic odontology, disaster preparedness

Submitted for publication 5/15/11; accepted 10/28/11

If you were to ask, there would be those who would say that the field of forensic science began on October 6, 2000, and that the first forensic scientists were Dr. Gil Grissom and his team of forensic experts. Of course, they would be referring to the opening episode of the enormously popular TV program CSI: Crime Scene Investigation. CSI and the variety of TV spinoffs brought the field of forensic science into the living rooms of households worldwide. There may have been liberties taken with the science depicted on the show, but it made for a great story and raised awareness of the forensic sciences, among them forensic odontology. But the study of forensic odontology started long before CSI.

As early as the 1960s, the need for formal dental education in the identification of human remains for legal and humanitarian purposes was recognized. Yet despite early recognition of its importance, Herschaft and Rasmussen in an article published in 1978 reported that 42 percent of dental schools who responded to their survey still did not offer any formal education in forensic odontology at any level and 58 percent of those that did offer formal courses offered courses that were mostly didactic. They concluded in their report that “there appears to be a lack of depth in the forensic dental curriculum of a majority of American dental schools” and further suggested that “formal instruction in the principles of forensic dentistry should be a goal of organized dentistry in the United States.”

In 1979, these same two authors, writing in the Journal of the American Dental Association, proposed a model course for forensic dentistry, suggesting where to place it in the curriculum, the length of the course, and course content, including topics for each lecture unit. In 1982, further curriculum guidelines were suggested by Sprague et al. and revised in 1990 by the Forensic Dentistry Curriculum Guidelines Committee of the American Association of Dental Schools (AADS; now the American Dental Education Association, ADEA) Section on Oral Diagnosis/Oral Medicine and Section on Pathology. Nevertheless, in a 2007 report in the Journal of Forensic Sciences on forensic education in dental schools, Stoeckel et al. noted “little improvement in the number of [forensic] educational opportunities in dental schools over the last twenty-eight years.”

The lack of growth in forensic education in dental schools might be attributed to a number of...
factors, including a lack of qualified instructors, a lack of interest or time by dental school faculty to develop forensic courses, a lack of interest by dental school curriculum committees and administrators to implement forensic courses, or a lack of time in the busy dental school curriculum for more than a “show and tell” course on forensics. But in the aftermath of disasters such as the attack on the World Trade Center in 2001 and Hurricane Katrina in 2005, it is apparent that there is a need for dentists with training in forensic odontology. In a meeting of the National Disaster Medical System (NDMS) following Hurricane Katrina, it was noted that every deployable member of NDMS had been deployed at least once, suggesting that had the death toll from Katrina actually been 10,000 victims as initially predicted, there would have been enormous pressure placed on trained personnel, requiring them to be deployed for extended periods of time. And it should be noted that disasters do not occur just in large cities. No community, no matter how small, is exempt from a variety of natural and human-made disasters. From earthquakes on the West Coast to tornadoes in the Midwest to terrorist threats in the East, local dentists trained in forensic dentistry can be an enormously valuable resource in any community.

Forensic training of predoctoral dental students can therefore serve an important humanitarian function by not only supplying local communities with a much-needed forensic resource but by also providing a possible reserve force for a national response should it be required. To provide a trained reserve force requires more than a cursory overview or survey course in forensic odontology. It requires a thorough understanding of the procedures and protocols involved in the proper, respectful, accurate identification of human remains as well as a thorough knowledge of the operation and functionality of the tools and equipment used in modern mass fatality identification.

This article describes one school’s approach to forensic education in the predoctoral dental school curriculum. It is still a work in progress, but perhaps sharing what is being done at Creighton University School of Dentistry in Omaha, Nebraska, will encourage other schools to begin planning and consider implementing a course in forensic dental education.

Course Development

Forensic dentistry is often thought of as being very interesting—from a distance. The physical condition of human remains typically encountered by the forensic odontologist presents an emotional and psychological challenge that is outside the comfort zone of many people, including many dentists. The comment “I admire what you do but couldn’t do it myself” is often made to those involved in the identification of human remains. In developing this course, it had to be acknowledged that forensic dentistry, or more specifically identification of human remains, is not everyone’s “cup of tea.” With this in mind, early in the course development, the decision was made that it would be elective rather than mandatory. It was also recognized that time constraints would prohibit a course that could provide functional training in all aspects of forensic dentistry. Therefore, the decision was made to concentrate training on fatality identification and disaster preparedness with more of a “show and tell” approach regarding the other aspects of forensic dentistry. This decision was also based on the availability of excellent courses on forensic photography, workshops given by the American Board of Forensic Odontology on bite mark analysis and courtroom litigation in association with the annual American Academy of Forensic Sciences meeting, and a variety of other sources for continuing education in forensic dentistry following graduation. All topics involved in forensic odontology are discussed and demonstrated in the course, but the emphasis in training is placed on the role of the forensic dentist in identification of human remains and disaster preparedness.

The curriculum at Creighton provides opportunities for senior dental students to select from a variety of short elective courses. It was determined that the forensic course most appropriately would be offered as an elective rather than a mandatory course. However, it became immediately apparent that the course would require significantly more time than the traditional senior elective. Senior elective courses typically take place in the second semester of the senior year, meet only once or twice for a total of two to six hours, and occur at a time during the school day that is mutually agreeable to students and faculty members. Educational objectives for the forensic course plus the course content on disaster preparedness suggested that the proposed forensic course would require a minimum of twenty-six to twenty-eight class hours, making it consistent with the recommendation of Herschaft and Rasmussen’ but requiring significantly more time than the typical senior elective. A twenty-eight-hour course would be impractical to accomplish in a single semester, and finding a time in the busy curriculum for a course
Course Content

The purpose of the course is to provide training to enable the students to participate in the identification of human remains within their home communities upon graduation. It is intended to go beyond courses that merely tell about forensic dentistry, but rather to give the students a working knowledge of forensic dental identification and disaster response. The course is also intended to encourage participation in local and national organizations relating to forensic odontology, to further the students' training in additional aspects of forensic odontology, to train and encourage personal/community disaster preparedness, and to describe the role of the forensic dentist in community disaster planning and response.

This course teaches the participants the role of the forensic dentist in routine dental identifications and mass fatality incidents in significant detail. It further describes the role of the forensic odontologist in bite mark analysis as well as disaster and bioterrorism preparedness. The course includes lectures, demonstrations, and hands-on experience using the tools available to the modern forensic dentist. It also includes participation in local disaster drill opportunities as they become available. The final mass fatality exercise takes approximately six to seven hours to complete. The total in-class clock hours are approximately twenty-six to twenty-eight hours.

At the conclusion of the course, the students should have accomplished a number of objectives. These objectives include the following:

1. Understand the role, procedures, and responsibilities of the forensic dentist in routine dental identifications and mass fatality incidents, including the local, state, and national forensic organizations involved in the identification of human remains.

2. Have a working knowledge of the procedures and tools of the modern forensic odontologist, including WinID3 (Computer-Assist Identification Program developed by Dr. James McGivney), Nomad (Aribex, Inc., Orem, UT), and Dexis (Dexis Digital Diagnostic Imaging, Hatfield, PA).

3. Have a basic understanding of the procedures, terminology, capabilities, and limitations of the forensic odontologist in bite mark analysis.

4. Understand the National Incident Management System (NIMS) and its relationship to the forensic dentist and disaster response.

5. Participate in disaster preparedness, including personal/family strategies to prepare for a disaster.

6. Understand community and national preparedness concerns and have knowledge of the local, state, and national organizations involved in disaster response.
Key Features of the Course

The first meeting of the class is used for orientation and to introduce the students to the basics of forensic odontology. The students are encouraged to bring their laptops to class, and WinID3, available free online, is loaded onto their computers for their personal use. A copy of the American Society of Forensic Odontology’s Manual of Forensic Odontology is provided to each student. This class is conducted in a lecture format that begins with the history of forensic odontology and the legal basis for positive identification of the deceased. It introduces the students to the terms commonly used in forensic identification and demonstrates the who, why, and how of forensic dentistry through discussion and illustrations. The presentation also discusses in detail the procedures involved in the identification of single remains, including jurisdictional issues, law enforcement and governmental entities, and legal responsibilities.

The next unit involves a discussion of federal disaster response and the role the forensic odontologist plays in a mass fatality incident. It includes a brief history of federal assistance in disasters, the role of the National Transportation Safety Board (NTSB) in transportation disasters, the process that must be followed to request federal assistance, and authorization bills, such as the Stafford Act, that provide the legal basis for federal intervention. Drawing on the experiences of the course presenters, there is also a detailed discussion of a variety of mass fatality incidents. The discussion includes the process involved in the respectful and dignified recovery, identification, and processing of human remains and the role of the forensic dentist in that process. How the victims of a mass fatality incident are identified by their dentition and the important roles that WinID3, Dexis, and the Nomad play are described in detail. Local and national jurisdictional issues are discussed as well as the important role the Disaster Mortuary Operational Response Team (DMORT) plays in a mass fatality incident.

Unit three begins with a history of identification methods used in mass fatality incidents, including the introduction of the computer. It is followed by detailed instruction on WinID3, the computer-assisted identification program currently used by many forensic odontologists and DMORT to assist in the identification of human remains. The first portion of the class is in lecture format followed by a laboratory exercise in which the students practice entering ante mortem data provided by the faculty. They spend up to two additional hours practicing entering dental information into the WinID3 program on their computers and working with the practice module provided in the program.

The use of Dexis, the digital x-ray sensor and software, and the Nomad, the hand-held portable x-ray device, is discussed in the fourth unit. Didactic instruction includes the operation of the Nomad and Dexis and the important role these devices play in the identification of remains in mass fatality incidents. The students are then given hands-on experience taking digital x-rays on skulls provided by the anatomy department of the School of Dentistry. The students practice charting existing restorations, taking x-rays of the skulls’ dentition with the Nomad and the Dexis sensor, and transferring the Dexis images into WinID3. Instruction is then given on how to use WinID3 for comparison of ante and post mortem odontograms and radiographs to find possible matches. The students are generally surprised to find that they have matches within the data they have entered over the past two class periods because some of the ante mortem records provided by the instructors in unit three were taken from the skulls used for charting and post mortem radiographs for unit four.

The role of the forensic dentist in bite mark analysis is the topic of unit five. Discussion includes a history of bite mark analysis including legal cases involving bite marks, a review of common terminology, photographic techniques, and characteristics of the dentition used in evaluating a bite mark. This portion of the class is presented in lecture and discussion format. The remainder is spent in a demonstration of the use of Adobe Photoshop in generating overlays of the “suspect’s” dentition and overlaying the photo of the bite mark. It was originally thought that the process of generating the overlays could be turned into a class assignment, but that has not been possible due to students’ lack of familiarity of Adobe Photoshop.

In unit six, the discussion centers on incident command structure in mass fatality incidents and the local, state, and national disaster response organizations that may be called upon to respond. In preparation for this class, the students are given the web address of the Federal Emergency Management Agency (FEMA) and are encouraged to take the FEMA ICS 100, 200, 700, and 800 online courses. Making the FEMA courses mandatory has been
The final exercise is a scenario-based, mock mass fatality incident. Eight cadaver heads and six skulls from the dental school’s anatomy department are used for the exercise. The cadaver heads are sectioned through the sagittal plane to aid in the taking of x-rays on the embalmed cadavers. This past year, the scenario was loosely based on the crematory incident that occurred in Walker County, Georgia, in 2002, in which several hundred remains were discovered in various stages of decomposition on the grounds of Tri-State Crematory. The remains had been sent to the crematory from funeral homes in a three-state area for cremation. Urns that were thought to contain the cremated remains of their loved ones were returned to grieving families containing cement powder, dirt, and gravel. Instead of being cremated, the remains had been placed around the rural property and left to decompose. This incident provided a realistic backdrop for the use of fleshed and skeletonized remains in the exercise.

The date and time for the final exercise are established early in the course in an attempt to avoid conflicts with board examinations and other electives. It takes the students six to seven hours to complete the exercise. Fortunately, second-semester seniors have significantly more flexibility in their schedule than they previously had, allowing the exercise to begin during normal class hours, typically early afternoon and extending into the evening. The anatomy lab is used as the mortuary annex. The forensic faculty set up a computer network linking the computers in the ante mortem, post mortem, and comparison sections. Additional equipment and supplies are made available to the students, but faculty members perform no additional setup.

During the exercise, the students are expected to organize the dental operation, name a dental team leader, appoint section chiefs, and organize the ante mortem, post mortem, and comparison sections according to the NIMS structure. They are expected to be able to set up their stations, including the computers, the Nomads, Dexis, and scanners, with no assistance from the instructors beyond what has already been described. One faculty member plays the part of the mortuary officer, releasing ante and post mortem information in small segments as is typically encountered in an actual incident. In the exercise, the students are expected to adhere to the chain of command and the appropriate flow of information. The faculty members generate some of the ante mortem charts and radiographs from the cadavers and skulls that are used in the exercise. The charts and radiographs of the skulls can be reused, but the charts and radiographs for the cadavers need to be regenerated every year, as cadavers are not passed from one year to the next. The number of ante mortem charts released depends on how the students are doing for time. If they are entering ante mortem information faster than they are generating post mortem data, additional ante mortem charts and radiographs are released that have no post mortem match. During the exercise the students are encouraged to change sections, a practice discouraged in a real disaster but one that gives the students experience in all areas of the process.

Evaluation of the students’ proficiency is based upon their ability to efficiently set up a functional mortuary annex; follow incident command structure and chain of command; establish appropriate ante mortem, post mortem, and comparison sections; help each other and work as a team; follow instruc-
tions; treat the remains with dignity and respect; and make correct identifications of the “victims.” It is an amazing experience to be present when they start to identify the “remains.” The emotion and pure sense of accomplishment exhibited by the students are almost as intense as the feelings forensic dentists get when they participate in a positive identification in an actual disaster.

**Additional Opportunities**

Arrangements have also been made for the forensic dental students to observe autopsies at the Creighton University Medical Center. This is not a mandatory activity as the nature of autopsies dictates that the students are given very short notice and often have conflicts with classes and patients. Therefore, they participate as their time and schedule allows. However, during the year they are notified whenever an autopsy is being performed with the likelihood that they will be available to participate in at least one during the year. This is the first year this option has been available, but it has proved to be a valuable learning experience and very popular with the students. The hospital pathologists and pathology residents have also expressed their support for this practice, and it has been confirmed that this opportunity will continue.

At Creighton, one of the faculty members actively participates in local, regional, and state mass fatality disaster planning, including planning for disaster drills. Communities are always looking for volunteers to help in disaster drills as victims or assistants. The forensic students have participated in a number of disaster drills in the past and are invited and encouraged to participate in such drills as the opportunities arise. It is a valuable experience for the students, and they have the opportunity to see a disaster from the responder’s and victim’s point of view.

**Challenges and Possible Solutions**

The topics in this course would be familiar to any trained forensic dentist, and many of the materials used in the preparation for the course are available online from the American Society of Forensic Odontology, the American Board of Forensic Odontology, and many local Emergency Management Agencies. The challenge, in addition to finding time in the curriculum, is finding faculty members with the training, experience, and desire to teach a forensic dentistry course. Few dental schools have a forensic dentist on staff, so one possible solution is to train faculty members who are interested in forensics at one or more of the courses accredited by the American Society of Forensic Odontology. These courses include the following:

1. **Armed Forces Institute of Pathology (AFIP) Course on Forensic Odontology.** For years this course has served as the benchmark for forensic training. It is a week-long, intensive study of disaster victim identification and is typically held in March. Its current status is uncertain due to discontinuation of a number of AFIP educational programs. For information, contact Dr. Duane Schafer at Duane.Schafer@med.navy.mil.

2. **Forensic Odontology in a Medical Examiner’s Office, University of Detroit Mercy School of Dentistry.** This course is led by forensic odontologist, Dr. Allan Warnick. The four-day course, most recently held in October, is designed to give the participant an overall understanding of the forensic sciences and an in-depth training in victim identification. For information, e-mail kimberly.perry@udmercy.edu.

3. **McGill University Forensic Dentistry Course.** This is a new course delivered in five modules, with modules one through three available online. Modules four and five are laboratory exercises held at the Laboratoire de sciences judiciaires et de médecine légale in Montreal. The course director is Dr. Robert Dorion; for information, e-mail nikoo.taghavi@mcmill.ca.

4. **Fellowship in Forensic Odontology, University of Texas Health Science Center at San Antonio.** This extensive twenty-two-month course covers all topics in forensic dentistry. The participants apply and are selected to participate in this program, which meets in San Antonio, TX, approximately every six weeks for typically four-day weekends. For information, contact the course director, Dr. David Senn, at senn@uthscsa.edu.

5. **Southwest Symposium on Forensic Dentistry, offered by the Center for Education and Research in Forensics, University of Texas Health Science Center at San Antonio, Dental School in cooperation with the Bexar County Medical Examiner’s Office.** This five-day course consists of lectures and hands-on workshops covering a variety of forensic topics of importance to the forensic odontologist. For information, contact
the symposium director, Dr. David Senn, at senn@uthscsa.edu.

6. Tufts University Forensic Sciences Course. This three-day course combines lectures with a hands-on exercise on victim identification. It is presented by Dr. William Morlang, a prominent former Air Force forensic odontologist. For information, e-mail wmorlan@attglobal.net, or visit the Tufts University website.

Information regarding additional courses offered on forensic odontology throughout the country as well as some foreign countries can be found on the American Society of Forensic Odontology website (www.ASFO.org). The ASFO holds its annual meeting in conjunction with the annual meeting of the American Academy of Forensic Sciences in February. Dates for the meetings and membership information can be found at www.ASFO.org and www.AAFS.org.

Another possible solution to the lack of faculty trained in forensic odontology might be to locate a local forensic dentist willing to give the time to develop and teach the class. Most dental schools are located in large metropolitan areas to accommodate the need for a large patient base, and most metropolitan areas have access to a forensic dentist (or several) through their city/county/parish/state medical examiner or coroner’s office. The local medical examiner or coroner should be able to provide the name of the dentist or dentists who perform dental identifications for them locally. The state dental association may be another source from which to acquire the name of a local forensic dentist. Forensic dentists are a relatively small group and are found across the entire spectrum of dental practitioners. A few are dental school faculty members, and even fewer are strictly forensic dentists. Most are private practitioners who have full-time private dental practices and provide their forensic expertise as a community service. Often there are dentists trained in forensics within a community whose forensic activity or training is not widely known, so contacting the local medical examiner/coronor or the state dental association may be the best way to identify these individuals.

Another solution to the lack of forensic educators may be distance learning. Using available technology, schools without access to a forensic dentist could network with a school that has a forensic program. Most of the lecture/discussion topics and practice sessions could be accomplished by distance learning. If the schools are in somewhat close proximity, the students from one school could join the students from the home school for the final exercise. It would require some logistics, but it could be done. Another alternative would be to present the majority of the course by distance learning and have the faculty travel to the satellite schools to set up and direct the final exercise at each school.

Our hope is that this article will help convince dental school administrators and curriculum committee members of the importance and feasibility of providing forensic dental education and that they will look for ways to provide that training to their predoctoral students. Without the interest and commitment of the dental school administrators and curriculum committees, forensic dental training will not be given the important attention it requires, and the opportunity to provide communities a valuable and needed dental resource will be lost.

Lessons Learned

In addition to determining an ideal class size, many lessons have been learned through the development and implementation of this course. Some lessons have been learned via faculty observations, but most have come through the comments and evaluations made by the students. When the students were asked to rate the overall course, the audiovisual presentations, and the final exercise, all respondents gave all three of these metrics a 5 rating on a scale of 1 (poor) to 5 (excellent). They commented on how much they liked the “tell, show, do” approach taken in teaching the course. We also wanted to know if the course met its stated objectives and if it met the students’ expectations. In response to these two questions, all the students responded “yes,” as opposed to “partially” or “no.” Next, we asked what the students would recommend to improve the course. Not surprisingly, many suggested having the class during regular school hours, often mentioning that it made for a long day when meeting after school. Of course, they were all well aware that the meeting time was one issue that could not be altered significantly.

Near the middle of the course in the first year, some of the students approached us to ask if they might bring food into the class because they got really hungry before class was over, making it more difficult to concentrate. It seemed like a reasonable request, so food and beverages were permitted in class and that seemed to perk everyone up. By the
second year, word had spread regarding the class, and the students brought up the food issue at the first meeting. In this latest class, after consulting with the faculty, the students organized a potluck dinner at the start of each class. Initially, there was a concern that it would detract from the lesson, but in fact it helped by building cooperation and camaraderie among the class and the faculty (and no one ever sat through class hungry).

In response to our inquiry to whether the FEMA online courses should be mandatory, the class overwhelmingly said no. The reason is unclear, but students in both the first and second years voiced the same sentiment. As a result, something less than half the students in the first two classes actually completed the FEMA online courses. In the latest class, there are likely significantly fewer than half who completed the courses. The lack of interest in the FEMA courses is a concern. The students clearly do not want the courses to be mandatory, but there is valuable information in the online courses that we do not have time to discuss at length. Plus, most disaster response organizations require their members to take these courses.

The next inquiry on the students’ evaluation asked their opinion as to whether some forensic dental education should be taught as part of the required dental curriculum. The students unanimously said yes. Their response clearly shows the importance they assign to the subject and the value they place on their training in forensics. The final question on the evaluation asked if the course had increased, decreased, or left unchanged their interest in forensic dentistry. Unanimously, the students have responded that the course increased their interest in forensics. There are currently plans to follow up with the graduates to try to determine what percentage of our former students have found or pursued additional training in forensic dentistry or joined any of the forensic organizations available to them.

**Conclusions**

No community is exempt from natural or human-made disasters, and a dentist who has received training in forensic dentistry can be a valuable community resource. At Creighton University School of Dentistry, the forensic training is intended to provide the participants with a broad education in forensic dentistry and disaster preparedness and detailed training in victim identification. The course addresses victim identification training to a level that gives the students a working knowledge to take back to their home communities after graduation. This level of knowledge allows them to 1) become members of an established state or national response organization where they can receive further training and education; 2) possess the basic ability to assist local authorities in communities that may be without a forensic dental identification resource; 3) have the opportunity to assist a forensic dentist mentor who will help them further their training for communities that already have a forensic dentist; and 4) begin the process of membership in national forensic organizations like the American Academy of Forensic Sciences and the American Society of Forensic Odontology. The course will hopefully encourage them to further their education by taking additional forensic dentistry courses from among the many excellent ones offered throughout the country. It is our belief that the training of the next generation of forensic dentists should start at the predoctoral dental school level for those who have an interest and desire to give back to their nation and community in this unique, interesting, and challenging way.

**REFERENCES**

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