Int. J. Morphol.,
31(2):399-408, 2013.

Forensic Dentistry as a Morphological Exercise in the Medico-legal Investigation of Death

La Odontología Forense como un Ejercicio de Morfología en la Investigación Medicolegal de la Muerte

Gabriel M. Fonseca[*]; Mario Cantín[,***,****] & Joaquín Lucena[*****,******]**

FONSECA, G. M.; CANTÍN, M. & LUCENA, J. Forensic dentistry as a morphological exercise in the medico-legal investigation of death. ***Int. J. Morphol., 31(2)***:399-408, 2013.

SUMMARY: In forensics, the nature of collected evidence makes analysis in many disciplines complex. Each type of trace evidence requires a unique systematic approach, and even though these approaches are significantly based on the size and morphology of the evidence being examined. In 1999, the Council of Europe Committee of Ministers adopted the Recommendation No. R (99)3 on the harmonization of medico-legal autopsies. This document promoted the adoption of internationally recognized and standardized protocols for forensic autopsies. Nevertheless, the interdisciplinary philosophy still needs integration of information from various investigative sources. An orientated and correct examination of the oral cavity requires specific knowledge of its anatomy and physiopathology, and of the procedures most adapted for its study, and thus the participation of a qualified odontologist is advisable. On the basis that there is not a current protocol that establishes the participation of the dentist during all medico-legal autopsies, we present a review based on that significant document, including reports and personal findings of oral injury patterns. Finally, a new paradigm on the participation of the forensic dentist in the medico-legal investigation of death is discussed.

KEY WORDS: Forensic dentistry; Morphology; Oral injuries; Autopsy protocols: Medico-Legal investigation of death.

INTRODUCTION

In one of the first scenes of the American thriller film "The Silence of the Lambs", young FBI agent Clarice Starling is assigned to investigate the body of Buffalo Bill's recently discovered victim. When Starling helps perform the autopsy, she manages to identify and extract the chrysalis of a death's-head Hawkmoth *(Acherontia atropos)* from the victim's mouth. Eventually, this finding was an important piece of evidence which lead to the capture of the serial killer. Less cinematographically, Wankhede (2000) reports four factual cases with the aim to underline that examination of the oral cavity, trachea, hands and all injuries is a vital part of post-mortem investigation. In the first one, a case of hanging, the suicide note was found in the oral cavity.

In forensics, the nature of collected evidence makes analysis in many disciplines complex. Each type of trace evidence requires a unique systematic approach, and even these approaches are significantly based on the size and morphology of the evidence being examined. Since morphology is the part of the biology that studies the form of organic beings and the modifications or transformations that it experiments, thanatology (the study of death and its mechanisms), and forensic pathology (the morphology of the cadaveric injuries), they justify the morphological perspective of the medico-legal analysis. Forensic pathology is essentially a visual exercise (El-Nageh *et al*., 1999).

Although the forensic dentistry is a well-recognized discipline, the term "Forensic Oral Pathology" is used to define the field of odontology that involves the "identification, documentation, recovery and preservation of all signs in soft and hard oral tissues to making available the legal evidence". This approach is more integral and comprehensive than the recognized but unjustly delimitated,

[*] Professor, Department of Legal and Forensic Dentistry, School of Dentistry, Universidad Católica de Cordoba, Cordoba, Argentina.
[**] Assistant Professor, Department of Integral Adult Dentistry, Faculty of Dentistry, Universidad de La Frontera, Temuco, Chile.
[***] Doctoral Program in Morphological Sciences; Faculty of Medicine, Universidad de La Frontera, Temuco, Chile.
[****] Centro de Investigación en Ciencias de la Salud, Universidad Autónoma de Chile, Chile.
[*****] Professor, Department of Forensic Medicine, Universidad de Cadiz, Cádiz, Spain.
[******]Forensic Pathology Service, Institute of Legal Medicine, Seville, Spain.
Financial support: Attraction and Insertion of Advanced Human Capital Program, MEC 80120014 – Conicyt, Chile.

procedure of dental identification (Fonseca, 2009). Nevertheless, there are no systematic reports, specific reviews or methodical trainings in accordance with this morphological point of view.

Recommendation No. R (99)3 of the Committee of Ministers to Member States on the Harmonization of Medico-Legal Autopsy Rules

In February 1999, at the 658th Meeting of the Minister Deputies, the Committee of Ministers to Member States adopted the Recommendation No. R (99)3 on the harmonization of medico-legal autopsy Rules (No authors listed, 2000). The Committee of Ministers, underlining the need for investigation, description, photographic documentation and sampling during medico-legal autopsy recommended the adoption of several principles and rules. Harmonized standards contained in this internationally accepted legal instrument allow for an improvement in the quality of medico-legal autopsy reports and is of great use at both international and national levels (Brinkmann, 1999). Based on that significant document, and including reports and personal findings of morphological oral patterns, we present a review to assess a new paradigm for the participation of the forensic dentist in the medico-legal investigation of death.

Principles and rules relating to medico-legal autopsy procedures (selected topics)

Principle III – Identification – Sub-section 4. Dental Identification

This principle was drafted according to the Disaster Victim Identification (DVI) Guide adopted by the General Assembly of Interpol in 1997. Even though there is a new current version of this DVI Guide (Interpol, 2009), the competences, qualifications and procedures of dentists are similar in essence. This sub-section states: "Where appropriate, the examination of teeth and jaws should be carried out by a dentist with medico-legal experience" (No authors listed). This is the only one mention that is made to the contribution of the dentist during autopsy. What does "where appropriate" mean? Who determines the most appropriate moment to call the forensic dentist?

There is no current protocol that establishes the participation of the dentist during the autopsy, which is included within the protocol of external and internal examination of the body (Fonseca & Sánchez, 2008). Brinkmann, in his explanatory memorandum about those Recommendations, mentions that dentists "have proven to be helpful when date is recorded, but far more valuable when the comparison and matching of data is undertaken". The participation of the professional odontologist has been relegated to an elementary comparison of antemortem (AM) and postmortem (PM) data in identification procedures (Fonseca & Sánchez). However, the Recommendations show another important aspect where the participation of a forensic dentist may be very useful.

Principle V – Autopsy procedures – Section I. External examination. Sub-section 2.e

"Description and careful investigation of the head and the facial orifices includes: color, length, density and distribution of hair (and beard); nasal skeleton; oral mucosa, dentition and tongue; ears, retro-auricular areas and external meati; eyes (colour of irises and sclera, regularity and appearance of pupils, sclera, conjunctivae); skin (presence and absence of pethechiae to be described); and if fluids have been evacuated from facial orifices, their colour and odour" (No authors listed).

The Recommendations discuss in great detail the question of autopsy procedures indicating that they should normally be divided into two stages, i.e. external and internal examination (Brinkmann). The term *internal* and the prefix *intra*, mean "within"; "or situated on the inside". Both words appear like synonymous but the autopsy procedure shows very different situations; the intraoral examination should be performed during the external examination of the body (Fonseca & Sánchez).

An orientated and correct examination of the oral cavity requires specific knowledge of its anatomy and physiopathology, and of the procedures most adapted for its study (utilization of dental mirrors, indirect vision, sampling, etc.), and thus the participation of a qualified odontologist is advisable (Sánchez & Fonseca, 2010). Odontologists are *per se* well suited to identify physical, psychological, social, cultural or behavioural patterns visible in the mouth. Who better than these professionals to explore those oral structures?

The oral mucosa, dentition and tongue are anatomical areas too complex to describe their injuries and their medico-legal analysis only in this subsection of the Reccomendations. For that reason, we are going to analyse step by step the different sub-sections from the point of view of the forensic dentist.

Principle V – Autopsy procedures – Section I. External examination– Sub-section 3

"All injuries, including abrasions, bruises, lacerations

and other marks have to be described by shape, exact measurement, direction, edges, angles and location relative to anatomical landmarks. Photographs should be taken. Bite marks shall be swabbed, and casts made where necessary" (No authors listed).

Human bitemarks are common findings in cases of assaults, child abuse or sexual abuse, and in a great number of homicide cases. Some authors advocated a multidisciplinary approach to identify and distinguish between human and animal bitemarks based on their awareness of animals present in the area and similarities of the injuries to the untrained eye (Bernitz *et al*., 2012; Fonseca & Palacios, 2013). The importance of the participation of forensic odontologists in the correct interpretation, collection, photographic documentation and the handling of the bite site injury, according to the specific recommendations of the American Board of Forensic Odontology (ABFO) have been highlighted (McNamee & Sweet, 2003; Sakelliadis *et al*., 2009).

Principle V – Autopsy procedures – Section I. External examination– Sub-section 7

"All signs of recent or old medical and surgical intervention and resuscitation must be described. Medical devices must not be removed from the body before the intervention of the medico-legal expert." (No authors listed).

Injuries produced as a result of medical intervention may lead to confusion in certain cases during investigation and postmortem examination. Proper documentation of all interventions with the injuries, if produced, is of vital importance. Tooth injuries, contusions, bruises, skin abrasions and lip lacerations produced by difficult intubations have been evaluated extensively in literature (Sánchez & Fonseca). Unfortunately, it is not uncommon that the paramedics remove the devices from deceased people. If the devices are not present at autopsy, the forensic pathologist "might be scratching around as to why the injury was caused" (Williams & Cordner, 2005).

Fig. 1. Tongue protrusion between clenched teeth is a common but unespecific finding in a typical hanging death (Institute of Forensic Medicine, Cordoba, Argentina).

Appendix - Specific procedures (selected samples)

For the demonstration of particular injury patterns, deviation from the normal procedure of dissection has to be accepted (Brinkmann). Although there is no mention of specific oral patterns or the participation of the odontologist at these moments, some data may contribute to clarify this point:

Sub-section 1. Constriction of neck (hanging, manual and ligature strangulation)

The typical hanging death involves tightening of a ligature. Petechiae have been described on the oral mucosa, base of tongue, and epiglottis. Tongue protrusion between clenched teeth is a common but unespecific finding (Dimaio & Dimaio, 2001; Shkrum & Ramsay, 2007; Prahlow, 2010) (Fig. 1).

Conjunctival petechiae, as well as facial and sometimes intraoral and/or laryngeal petechiae, are frequently observed in homicidal ligature strangulation cases (Prahlow). Anterior neck structures (tongue, larynx, and trachea with thyroid gland and attached strap muscles, and submandibular glands) must be removed. Tongue must to be inspected and cut (tip to base) to observe the hemorrhage within the deep musculature of the tongue. This procedure is useful for the diagnosis of deaths related to extrinsic compression of the neck (Sperry, 1988; Dix, 2000; Shkrum & Ramsay).

A smothering death may be suspicious for homicide and it is a classic method of infanticide (Dix; Shkrum & Ramsay). Even though no perioral or intraoral injuries are found, particularly if the child lacks dentition, there can be intraoral petechiae, and multiple cutaneous injuries and intraoral injuries raise the possibility of homicidal asphyxia (Shkrum & Ramsay). In older homicidal smothering victims, there may be evidence of face, chin, lip, and intraoral (tongue, inner cheek) trauma (Prahlow).

Chocking is a common cause of accidental death in children (Dix; Dimaio & Dimaio; Shkrum & Ramsay). Marks or injuries consistent with victim's head being held

may be observed, and perioral, teeth, tongue, and other intraoral injuries can result. Inflammation and reactive processes contributing to upper airway obstruction include palatine lingual edema of uvula, epiglottis, larynx (Shkrum & Ramsay; Prahlow). Individuals without teeth may have trouble chewing and aspirate into the airway.

Gagging combines features of smothering and choking. A gag in a victim's mouth or wrapped around the nose and mouth interferes with the ability to breathe and swallow. A foreign object can be inserted into the victim's mouth prior to gagging (Shkrum & Ramsay).

Sub-section 2. Drowning/Immersion

Froth is expressed around the mouth and nostrils in a typical "wet" drowning (Dix; Shkrum & Ramsay). Occasionally, water life, more often in salt water, may beat on the skin of the face, especially around the mouth, nose, and ears (Dix).

Sub-section 3. Sexually motivated murder

Several authors have reported a greater frequency of oral rather than anal penetration in sexual-related deaths (Riggs *et al.*, 2000; Grossin *et al*., 2003). Usually, medico-legal literature focuses only on the identification of anogenital findings not including the oral findings. The presence of erythema, petechiae and dilated blood vessels located on the soft palate secondary to fellatio was reported in living individuals (Kos & Shwayder, 2006; Fonseca, 2012). The postulated mechanism of injury is the combined muscular actions initiated through tactile stimulation and the negative pressure created through irrumation, both acting simultaneously on the mucosa of the soft palate (Fonseca, 2012). Nevertheless, there are no reports extrapolating these *in vivo* findings for dead bodies.

Sub-section 4. Death from child abuse and neglect

In homicidal childhood deaths, it is particularly important to perform an intraoral examination, looking for evidence of bruised or lacerated lips and gums (Fig. 2), or tongue, inner cheek and dental injuries, even scarring (in chronic abuse)(Dix; Stavrianos *et al*., 2007; Prahlow). Detection of the failure to provided dental care is another form of child abuse (Stavrianos *et al*.). In child sexual abuses, the presence of physical evidence is important for confirming the diagnosis. Despite the anal/vaginal injuries, the findings often involve oral penetration (Hobbs, 2012). The diagnosis of sexually transmitted diseases (STD) is important in determining the fact of sexual contact (Sakelliadis *et al*.).

Fig. 2. Tears on the upper lip and frenulum in a case of fatal child abuse. The death was due to choking by forced introduction of a soft objet into the mouth (Forensic Pathology Service, Institute of Legal Medicine, Seville, Spain).

Sub-section 6. Sudden death

Mortality is increased in epileptic patients. The fact that seizures occur without forewarning exposes individuals with epilepsy to the risk of injury. Several authors reported a correlation between epileptic seizures and facial and dental injuries (Nonato & Borges, 2011). At autopsy, there may be evidence of seizure activity in the form of lip injuries and bitemarks, especially of the tongue (Ulrich & Maxeiner, 2003; Shkrum & Ramsay). Benbadis *et al*. (1995) refer to tongue biting, particularly if it is lateral, as highly specific of generalized tonic-clonic seizures.

The main treatment options for patients suffering from epilepsy are anti-epileptic drugs (AEDs) and the most common drug is Phenytoin. Its use is associated with the initiation and progression of gingival hyperplasia (GH), and is characterized by the overgrowth of gingival supepithelial connective tissue and epithelium that develops about 1-3 months after the start of treatment. This tissue enlargement typically begins at the interdental papilla and encroaches on the crowns of all teeth (Cornacchio *et al*., 2011).

Sub-section 7. Shooting fatalities

Self-inflicted intraoral wounds are associated with soot deposition on the lips, teeth or tongue. Opening the mouth can reveal the powder from intraoral wounds because of the pigmentation on the tongue and on the roof of the mouth. Intraoral wounds can potentially not be identified or examined at the scene (Dix; Shkrum & Ramsay). Although

not described in some series, an intraoral wound does not exclude the possibility of homicide. Unlike a homicide, the tongue tends to be involved in suicidal intraoral wounds (Shkrum & Ramsay; Fonseca, 2009). A high-velocity wound to the mouth can be associated with extensive fractures of the skull and tears around the nose, eyes, and mouth. Perioral "stretch" lacerations are limited to mouth entries (Dix; Shkrum & Ramsay; Fonseca, 2009) (Fig. 3).

Fig. 3. Fracture of maxilla and extensive tears around the mouth in a suicide case with a high-velocity firearm. Note the soot deposition on the lips, teeth and tongue (Institute of Forensic Medicine, Cordoba, Argentina).

Sub-section 8. Death caused by explosives

Only a few cases have been described in the medico-legal literature regarding oral explosions (Blanco-Pampín, 2001; Ladham *et al*., 2005). The injuries found include body disruption and direct blast injury. In these cases, maybe the relatively small quantity and light potential of explosive, Blanco-Pampín considers that the effects of indirect exposure to air blast are minimal and trivial, in comparison to the indirect effects verified at the autopsy. The distribution of burns and injuries must be consistent with an explosion involving an explosive into the mouth.

Sub-section 9. Blunt and/or sharp force injuries

Biomechanics is a key factor in understanding traumatic injury and healing. Since the recognized work of Andreasen in the early 1972, the relation between oral trauma and the kinematics involved in impact has been extensively analyzed from the point of view of dental traumatology. Nevertheless, this fact has been scantily applied to the autopsy examination.

Smock (2000) reported the determination of an occupant's role in a motor vehicle collision was an important medico-legal question by describing the impact of teeth on the car dashboard. Similar findings were reported in drivers and passengers without seat belts (Ndiaye *et al.*, 2009). Airbag injuries have resulted in the deaths of infants and small children, in which significant facial abrasions, overlying the mandible, as well as abrasions on the cheeks, as the most common associated injury (Smock). Pedestrian-vehicle crashes have relevance because of the need to explore the circumstances of the accident. One of the most severe causes of death and disability is traumatic brain injury because of the impact of skull. In our casuistry, a close association between craniobase fractures and indirect oral trauma was found (Figs. 4).

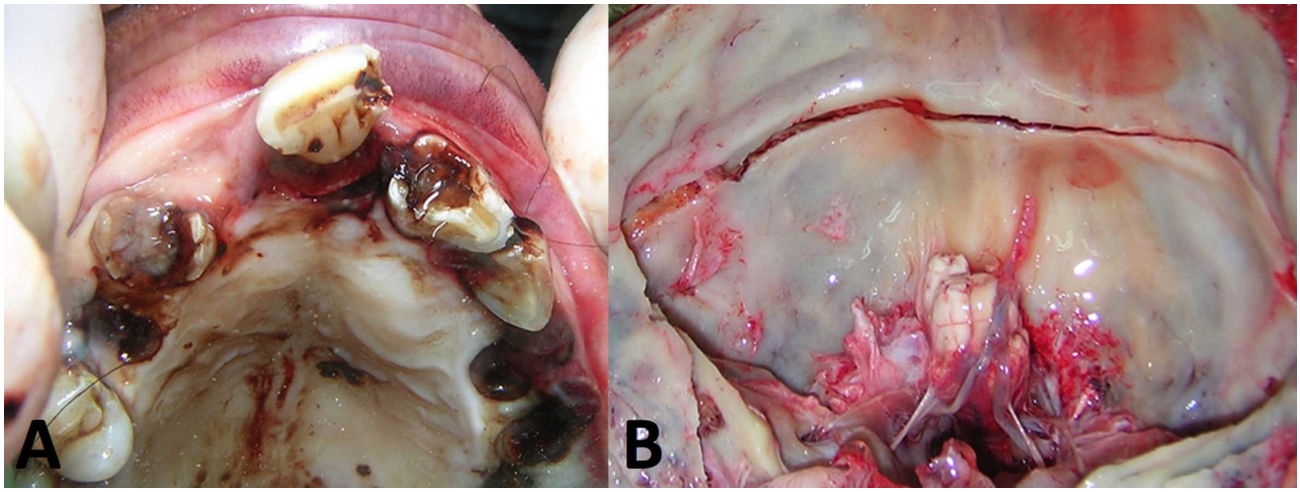

Fig. 4. a. Labial luxation of the left central incisor as an indirect oral trauma in a hit-and-run case. b. This indirect oral trauma was found associated with a craniobase fracture (Institute of Forensic Medicine, Cordoba, Argentina).

Although oral sharp-force injuries are widely reported in accidental events, they are scantly reported in non-accidental assaults. The face is a preferred "target" in assault because of its vulnerability. Detailed examination of sharp-force injuries can provide useful information regarding the type of weapon that likely inflicted the wounds (Dimaio & Dimaio). The isolated sharp-force injuries of the mouth are rarely associated with death. The few reports are accidental cases involving a child falling forward while holding an object in its mouth (Shkrum & Ramsay).

In many countries, brutal acts of violence have been used as a means of communicating a group's "sincerity" and strength. The so-called "Colombian necktie", in which the victim's tongue is pulled through a deep cut beneath the jaw and left dangling on the chest or the victims' genitalia have been stuffed in their mouths, are not just methods of killing, but also intimidation (Bowden, 2001). These patterns of behaviour have already been adopted in several actual cultures and countries, but with the same aim and results. "If the tongue is cut out, it means they talked too much. A man who snitched on the clan has his finger cut off and maybe put in his mouth (a snitch is known as a "dedo" or finger). If you are castrated, you may have slept with the woman of another man. Decapitation is another issue altogether: a statement of power, a warning to everybody, like public executions in ancient times. The difference is that in normal times, the dead were "disappeared", buried or dumped in the desert. Now they are displayed, in order to be seen, so that it becomes a war against the people" (Vulliamy, 2008). Curiously, there are no references of these practices in the scientific literature.

Sub-section 10. Fire Deaths

A significant indicator that provides evidence of breathing during a fire is the identification of soot and/or thermal injuries within the upper airways of fire victims at autopsy. On examination, soot is commonly found in the oral cavity, including on the tongue. If the mouth is open, and there is dense soot present, such a finding is nonspecific (Dix; Prahlow). There is no relationship between the degree of postmortem tongue protrusion and the amount of soot in the airway (Shkrum & Ramsay). Hemorrhage in the root of the tongue has been observed in fatal burns, particularly in victims with blood carboxyhemoglobin (COHb) concentrations lower than 30% (Hashimoto *et al*., 2003; Shkrum & Ramsay). Intramuscular bleeding of the tongue in fire victims may occur as a vital reaction to burns (Hashimoto *et al*.).

Sub-section 11. Suspicion of intoxication

During the autopsy, the forensic pathologist looks for certain clues, which may indicate that a poison was involved in the death. These clues could include irritated tissues (e.g. presence of burns in the mouth area or face; froth on lips in the case of cyanide poisoning) (Harris Trestail III, 2007).

Heavy metals are commons in the modern industrialized environment, and evaluation of a case of poisoning requires paying attention not only to the person but also to the context in which the individual was exposed to the toxin. This finding can be useful to secondary identification of fresh unidentified corpses. Burton's line is a blue-purplish line on the gums seen in lead poisoning (Prahlow). The chronic exposure to cadmium is characterized by gingivitis, teeth loss and caries, and a cadmium line around the necks of the teeth (yellow rings) (Bachanek *et al.*, 2000). Occupational exposure to inorganic mercury produces gingivitis and stomatitis in oral mucosa (Garnier, 1981). Stomatitis is a chronic symptom of arsenic exposure (Harris Trestail III), and bismuth excess leads to numerous tiny, black deposit spots on the oral and lower lip mucosa (Bachanek *et al*.).

Poor oral health is a common problem among drug addicts. There are several mechanisms by which drugs can directly affect oral health, including increased xerostomia (dry mouth) due to hyposalivation (lack of salivary flow), poor diet and self-care leading to higher rates of dental caries, enamel erosion, and periodontal disease (D'Amore *et al*., 2011). Cannabis smoking and chewing causes changes in the oral epithelium, termed "cannabis stomatitis", which includes leukoedema of the oral mucosa and hyperkeratosis (Cho *et al*., 2005). Busse *et al*. (2008) reported more than a hundred patients with symptoms of lead intoxication, most of them with "Burton's line". The recovered marijuana packages contained deliberately added lead particles to increase weight (and profit).

The systemic effects of cocaine abuse are well known, and several local effects are also documented involving above the oral mucosa. Vasoconstriction of small vessels due to cocaine use determines mucosal breakdown, gingival lesions, erosion of tooth surfaces, and loss of palatal bone (Silvestre *et al*., 2010). Chronic methamphetamine users frequently develop "meth mouth", a condition of poor oral hygiene, resulting in toothloss, probably related to a combination of drug-induced teeth-grinding (bruxism), dry mouth (xerostomia), and general lack of concern (Prahlow; Turkyilmaz, 2010).

Sub-section 12. Decomposed bodies

Pink teeth. Pink teeth have most often been observed in victims of drowning and there is general agreement that the condition of the surroundings (especially humidity) and a

head-down position must certainly play an important role in the development of this phenomenon (Campobasso *et al*., 2006; Shkrum & Ramsay). By histochemical methods and auto fluorescence, hemoglobin and its derivates have been identified as the most likely pigments responsible for this postmortem process that can be considered analogous to postmortem lividity (Campobasso *et al*.). Although several authors argue that the pink colour of teeth should not be considered as specific forensic evidence associated with the cause of death (Shkrum & Ramsay), some studies have shown that post mortem pink teeth is a common finding related to cases of asphyxia, such as strangulation, drowning or suffocation (Soriano *et al*., 2009). (Fig. 5)

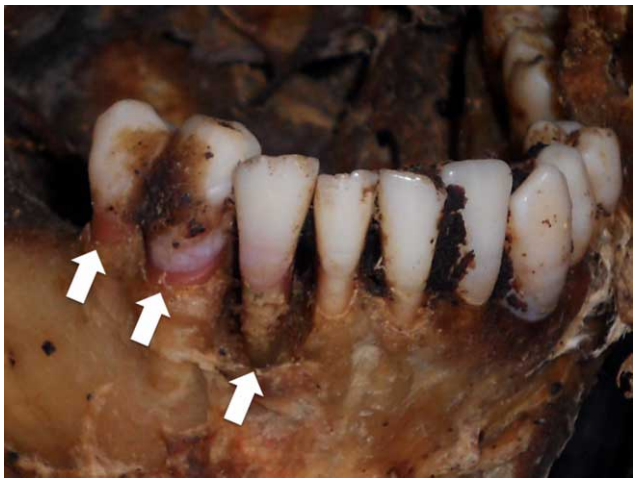

Fig. 5. The post mortem pink tooth is a common finding related to cases of asphyxia, such as strangulation, drowning or suffocation (Institute of Forensic Medicine, Cordoba, Argentina).

Miscellanea (not specified in the Recommendations)

Electrocution. More than 20% of all electrical injuries occur in children. Young children are predisposed to low-voltage injury because of their tendency to chew on objects (e.g. electric cords) while crawling and exploring. Considerable bleeding from an injured labial artery can occur when the scar tissue is removed some days later (Shkrum & Ramsay).

Chemical Burns. Caustic substances cause tissue destruction through liquefaction or coagulation reactions and the intensity of destruction depends on the type, concentration, time of contact and amount of the substance ingested. The most common caustic agent reported is alkaline followed by acidic and chlorine bleach. The most frequent manner for ingestion is accidental as opposed to attempted suicide (Arévalo-Silva, 2006). The external appearances reflect the corrosive damage to the tongue, lips, oral mucosa membrane and surrounding skin of the face. Solid alkalis produce deep burns where they adhere to the oral mucosa; in contrast, liquid alkalis can be easily swallowed and thus enter the esophagus, where they produce liquefaction necrosis, which exposes progressively deeper layers of tissue to the caustic agent and produces much more extensive injuries (Dimaio & Dimaio). Acids can produce burns on the tongue, and tanning scars on commissures and mucosa of the lips (Rico *et al*., 2007).

Misdiagnosis (not specified in the Recommendations)

Abrasions, contusions, and lacerations to the face and mouth may be misinterpreted (Dix). Oral lesions by intubation or epilepsy, may lead to confusion in certain cases during investigation and postmortem examination (Shkrum & Ramsay; Sánchez & Fonseca).

In decomposed bodies, the localized dark discoloration seen on a dried tongue or the lips mimics blunt injuries. Incision into the site reveals no hemorrhage (Shkrum & Ramsay).

Oral explosions could be misinterpreted as fatal gunshot cases (Ladham *et al*.).

Thermal or chemical burns, mechanical trauma (by denture, toothbrush, or iatrogenic dental procedures), blood discrasia, allergy, infections and pruritus can mimic the palatal erythema reported in fellatio (Fonseca, 2012).

Froth in the nose and mouth is also sign of drug overdose not only drowning (Dix).

Despite the controversies of the scientific basis for human bitemark analyses, human bites can mimic dermatoses, artefactual injuries, postmortem animal predation or other blunt lesion patterns (Dorion & Souviron, 2011). Sharp force injuries usually involve carnivore bites, most often from dogs with a “hole and tear” pattern of wounding. On occasion, sharp trauma from animal activity may be mistake with postmortem damage or with inflicted injury from an assault (Dorion & Souviron). Postmortem predation creates injuries that raise suspicions of homicide, and animal activity alters ante mortem injuries (Shkrum & Ramsay; Dorion & Souviron).

DISCUSSION

Forensic Pathology is based on morphological manifestations of disorder, and the ability of the pathologist to observe, document, and interpret the significance of these findings is fundamental to forensic practice. Inaccurate or incomplete documentation of external findings is a potential

pitfall for the pathologist (El-Nageh *et al.*; Shkrum & Ramsay). From the same point of view, the normal or abnormal morphology of the oral cavity can be perceived only by a trained, suitable and skillful eye. Nevertheless, scopes and potentials of the odontologist are underestimated, which generates incomplete examinations, misdiagnosis, inappropriate descriptions or inaccurate conclusions.

The most thorough examination of the internal organs involves their removal with subsequent dissection. An even more thorough examination involves the additional removal and examination of the tongue (Prahlow). Sperry mentions the lack of attention devoted to the tongue except in a handful of relatively well-defined situations. By discussing that affirmation, Simonsen (1989) consider the tongue examination as too rigorist to perform in all cases, and should be limited only to cases of asphyxia and cases in which the cause of death is uncertain. The question should not to be "what for?" but rather "why not?"

Shape, colour and movement constitute necessary parameters of visual perception able to assign property and dynamics to an object. This sort of data will be decoded through the personal and intellectual experience of those who observe: qualifications, skills and interdisciplinary practice become essential to avoid the loss of evidences. Training for the forensic community has two componentes: theoretical and practical, and is an ongoing need and essential to ensure that crime investigators deliver the best possible service to the criminal justice system.

The Recommendation No. R (99)3 was presented in a moment that although performed, autopsies in some European countries were deficient and therefore inappropriate to elucidate crime. According to Brinkmann, the major reasons for such omitances were lack of adequately specialized doctors; incomplete investigations including sampling and scheme or further investigations; lack of quality control; lack of independence of the investigating doctor; and lack of an internationally binding protocol. Undoubtedly this document promoted the adoption of harmonized, internationally recognized and standardized protocol for autopsies. Nevertheless, the interdisciplinary philosophy recommended by Interpol, still remains a utopia. Precisely, the interdisciplinary perspective allows for responding to the question mentioned above: "where is appropriate?" A pathologist does not work in isolation. A complete autopsy requires the integration of information from various investigative sources occurring in stepwise progression. Communication among the different investigators is essential. Deviations from the standards of investigative practice either by omission or commission increase the risk of failure of a medico-legal death investigation (Shkrum & Ramsay). Forensic practitioners usually do not have close familiarity with all aspects of the increasingly specialized practice of medicine and this limitation of knowledge should be recognized (El-Nageh *et al.*). Taking this into account, we may conclude that forensic dentists have a lot to learn and Forensic Oral Pathology may play and important role in the medico-legal investigation of death.

FONSECA, G. M.; CANTÍN, M. & LUCENA, J. La odontología forense como un ejercicio de Morfología en la investigación medicolegal de la muerte. ***Int. J. Morphol., 31(2)***:399-408, 2013.

RESUMEN: En ciencias forenses, la naturaleza de la evidencia recolectada deviene en análisis específicos realizados por muchas disciplinas complejas. Cada tipo de rastro requiere una aproximación única y sistemática, significativamente basada en el tamaño y la morfología de esa potencial evidencia. En 1999, el Consejo Europeo de Ministros adoptó la Recomendación No. R (99)3 para la armonización metodológica de las autopsias medicolegales. Este documento, promovió la adopción de protocolos estandarizados para las autopsias forenses de reconocimiento internacional. Sin embargo, la filosofía interdisciplinaria aún necesita integración de la información desde varias fuentes de investigación. Un examen orientado y correcto de la cavidad oral necesita de conocimientos específicos tanto de su anatomía y fisiopatología, de los procedimientos mejor desarrollados para su estudio, y de la participación de un odontólogo calificado para realizar este análisis. Sobre la base de que no existe un protocolo vigente que establezca la participación del odontólogo en todas las autopsias medicolegales, se presenta una revisión sobre este importante documento, incluyendo reportes y observaciones personales de algunos patrones de lesiones orales. Se discute además un nuevo paradigma respecto de la participación del odontólogo forense en la investigación médicolegal de la muerte.

PALABRAS CLAVE: Odontología Forense; Morfología; Lesiones orales; Protocolos de autopsia; Investigación médicolegal de la muerte.

REFERENCES

Andreasen, J. O. *Traumatic injuries of the teeth*. Munksgaard, Scandinavian University Books, 1972.

Arévalo-Silva, C.; Eliashar, R.; Wohlgelernter, J.; Elidan, J. & Gross, M. Ingestion of caustic substances: a 15-year experience. *Laryngoscope, 116(8)*:1422-6, 2006.

Bachanek, T.; Staroslawska, E.; Wolanska, E. & Jarmolinska, K. Heavy metal poisoning in glass worker characterised by severe. *Ann. Agric. Environ. Med., 7(1)*:51-3, 2000.

Benbadis, S. R.; Wolgamuth, B. R.; Goren, H.; Brener, S. & Fouad-Tarazi, F. Value of tongue biting in the diagnosis of seizures. *Arch. Intern. Med., 155(21)*:2346-9, 1995.

Bernitz, H.; Bernitz, Z.; Steenkamp, G.; Blumenthal, R. & Stols, G. The individualisation of a dog bite mark: a case study highlighting the bite mark analysis, with emphasis on differences between dog and human bite marks. *Int. J. Legal Med., 126(3)*:441-6, 2012.

Blanco-Pampín, J. M. Suicidal deaths using fireworks. *J. Forensic Sci., 46(2)*:402-5, 2001.

Bowden M. Killing Pablo. *The Hunt for the World's Greatest Outlaw*. New York, The Atlantic Monthly Press, 2001.

Brinkmann, B. Harmonization of medico-legal autopsy rules. Committee of Ministers. Council of Europe. *Int. J. Legal Med., 113(1)*:1-14, 1999.

Busse, F.; Omidi, L.; Timper, K.; Leichtle, A.; Windgassen, M.; Kluge, E. & Stumvoll, M. Lead poisoning due to adulterated marijuana. *N. Engl. J. Med., 358(15)*:1641-2, 2008.

Campobasso, C. P.; Di Vella, G.; De Donno, A.; Santoro, V.; Favia, G. & Introna, F. Pink teeth in a series of bodies recovered from a single shipwreck. *Am. J. Forensic Med. Pathol., 27(4)*:313-6, 2006.

Cho, C. M.; Hirsch, R. & Johnstone, S. General and oral health implications of cannabis use. *Aust. Dent. J., 50(2)*:70-4, 2005.

Cornacchio, A. L.; Burneo, J. G. & Aragon, C. E. The effects of antiepileptic drugs on oral health. *J. Can. Dent. Assoc., 77*:b140, 2011.

D'Amore, M. M.; Cheng, D. M.; Kressin, N. R.; Jones, J.; Samet, J. H.; Winter, M.; et al. Oral health of substance-dependent individuals: impact of specific substances. *J. Subst. Abuse Treat., 41(2)*:179-85, 2011.

Dimaio, V. J. & Dimaio, D. *Forensic Pathology*. 2nd ed. Boca Raton, CRC Press, 2001.

Dix, J. Color *Atlas of Forensic Pathology.* Boca Raton, CRC Press, 2000.

Dorion, R. B. J. & Souviron, R. R. *Patterns, Lesions, and Trauma-Mimicking Bitemarks. In*: Dorion, R. B. J. (Ed). Bitemark Evidence. 2nd ed. Boca Raton, CRC Press, 2011.

El-Nageh, M. M.; Linehan, B.; Cordner, S.; Wells, D. & McKelvie, H. *Ethical practice in laboratory medicine and forensic pathology*. Alexandria, World Health Organization. 1999.

Fonseca, G. M. Atypical entrance and exit wounds due to high velocity bullet with intraoral position. Suggested procedures in Forensic Oral Pathology. *Cuad. Med. Forense, 15(57)*:215-21, 2009.

Fonseca, G. M. Eritema en paladar por felación. Revisión a propósito de un caso. *Rev. Tamé, 1(1)*:19-23, 2012.

Fonseca, G. M. & Palacios, R. An Unusual Case of Predation: Dog Pack or Cougar Attack? *J. Forensic Sci., 58(1)*:224-7, 2013.

Fonseca, G. M. & Sánchez, M. C. Bucco-Maxillo-Facial Autopsy: Scope and Insertion in the Medical-Legal Autopsy Protocol. *Ciencia Odontologica, 5(1)*:34-43, 2008.

Garnier, R.; Fuster, J. M.; Conso, F.; Dautzenberg, B.; Sors, C. & Fournier, E. Acute mercury vapour poisoning. *Toxicol. Eur. Res., 3(2)*:77-86, 1981.

Grossin, C.; Sibille, I.; Lorin de la Grandmaison, G.; Banasr, A.; Brion, F. & Durigon, M. Analysis of 418 cases of sexual assault. *Forensic Sci. Int., 131(2-3)*:125-30, 2003.

Harris Trestail, III. J. *Investigational Guide for Law Enforcement, Toxicologists, Forensic Scientists, and Attorneys*. 2nd ed. Totowa, Humana Press, 2007.

Hashimoto, Y.; Moriya, F. & Nakanishi, A. Intramuscular bleeding of the tongue in the victims of house fire. *Leg. Med. (Tokyo), 5(Suppl. 1)*:S328-31, 2003.

Hobbs, C. J. Physical evidence of child sexual abuse. *Eur. J. Pediatr., 171(5)*:751-5, 2012.

Interpol. Disaster *Victim Identification*. 2009. Available on line in: *http://www.interpol.int/content/download/9158/68001/version/5/file/Guide.pdf*

Kos, L. & Shwayder, T. Cutaneous manifestations of child abuse. *Pediatr. Dermatol., 23(4)*:311-20, 2006.

Ladham, S.; Koehler, S. A.; Woods, P.; Huston, R.; Dominick, J.; Fochtman, F. W. & Wecht, C. H. A case of a death by explosives: the keys to a proper investigation. *J. Clin. Forensic Med., 12(2)*:85-92, 2005.

McNamee, A. H. & Sweet, D. Adherence of forensic odontologists to the ABFO guidelines for victim evidence collection. *J. Forensic Sci., 48(2)*:382-5, 2003.

Ndiaye, A.; Chambost, M. & Chiron, M. The fatal injuries of car drivers. *Forensic Sci. Int., 184(1-3)*:21-7, 2009.

No authors listed. Recommendation no. R (99) 3 of the Committee of Ministers to member states on the harmonization of medico-legal autopsy rules. *Forensic Sci. Int., 111(1-3)*:5-58, 2000.

Nonato, E. R. & Borges, M. A. Oral and maxillofacial trauma in

patients with epilepsy: prospective study based on an outpatient population. *Arq. Neuropsiquiatr., 69(3)*:491-95, 2011.

Prahlow, J. *Forensic Pathology for Police, Death Investigators, Attorneys, and Forensic Scientists.* South Bend, Humana Press, 2010.

Rico, A.; Lucena, J.; Santos, M.; Marín, R.; Blanco, M. & Barrero, E. Suicide by hydrochloric acid massive ingestion. *Cuad. Med. Forense, 13(50)*:283-90, 2007.

Riggs, N.; Houry, D.; Long, G.; Markovchick, V. & Feldhaus, K. M. Analysis of 1,076 cases of sexual assault. *Ann. Emerg. Med., 35(4)*:358-62, 2000.

Sakelliadis, E. I.; Spiliopoulou, C. A. & Papadodima, S. A. Forensic investigation of child victim with sexual abuse. *Indian Pediatr., 46(2)*:144-51, 2009.

Sánchez, M. C. & Fonseca, G. M. Identification of oral lesions by intubation during medicolegal autopsy procedure. *Oral, 11(35)*:638-41, 2010.

Shkrum, M. J. & Ramsay, D. A. *Forensic Pathology of Trauma. Common Problems for the Pathologist.* Totowa, Humana Press, 2007.

Silvestre, F. J.; Perez-Herbera, A.; Puente-Sandoval, A. & Bagán, J. V. Hard palate perforation in cocaine abusers: a systematic review. *Clin. Oral Investig., 14(6)*:621-8, 2010.

Simonsen, J. Discussion of "An Unusual, Deep Lingual Hemorrhage as a Consequence of Ligature Strangulation". *J. Forensic Sci., 34(3)*:529-31, 1989.

Smock, W. S. Accident Investigation. In: Siegel, J. A.; Knupfer, G. C. & Saukko, P. J. (Eds.). *Encyclopedia of Forensic Sciences, Three-Volume set*. Philadelphia, Academic Press, 2000.

Soriano, E. P.; Carvalho, M. V.; Santos, F. B.; Mendoza, C. C.; Araújo, M. D. & Campello, R. I. The post-mortem pink teeth phenomenon: a case report. *Med. Oral Patol. Oral Cir. Bucal, 14(7)*:E337-9, 2009.

Sperry, K. An unusual, deep lingual hemorrhage as a consequence of ligature strangulation. *J. Forensic Sci., 33(3)*:806-11, 1988.

Stavrianos, C.; Stavrianou, I.; Kafas, P. & Mastagas, D. The Responsibility of Dentists in Identifying and Reporting Child Abuse. *The Internet Journal of Law, Healthcare and Ethics, 5(1)*:00-00, 2007. Available in: *http://www.ispub.com/journal/the-internet-journal-of-law-healthcare-and-ethics/volume-5-number-1/the-responsibility-of-dentists-in-identifying-and-reporting-child-abuse.html#sthash.l7B04n6i.dpbs*

Turkyilmaz, I. Oral manifestations of "meth mouth": a case report. *J. Contemp. Dent. Pract., 11(1)*:E073-80, 2010.

Ulrich, J. & Maxeiner, H. Tongue bite injuries--a diagnostic criterium for death in epileptic seizure? *Arch. Kriminol., 212(1-2)*:19-29, 2003.

Vulliamy, E. *Day of the dead. The Observer*. December 7th, 2008. Available on line in: *http://www.guardian.co.uk/world/2008/dec/07/drugs-trade-mexico-cocaine-cartels?INTCMP=SRCH*

Wankhede, A. G. Importance of examination of buccal cavity, trachea, hand and all injuries. *Med. Sci. Law, 40(2)*:179-80, 2000.

Williams, B. & Cordner, S. *Removal of Invasive Devices from Deceased Persons: Forensic implications for Paramedics - A Victorian Perspective*. Interview with Professor Stephen Cordner on 11th May 2005, followed by responses from Dr. Hugh Grantham and Dr. Garry Wilkes. Journal of Emergency Primary Health Care, 3(4), 2005. Available on line in: *http://ro.ecu.edu.au/jephc/vol3/iss4/5*

Correspondence to:
Gabriel M. Fonseca, D.D.S., Ph.D.
Mariano Moreno 937, Cordoba
Zip code: X5000MRS.
ARGENTINA

Email: gabriel_fonseca@argentina.com

Received: 01-02-2013
Accepted: 03-03-2013