BITE MARKS

By: Dr. Niha Ansari,
Assistant Professor
School of Forensic Sciences,
NFSU

Teeth Basics

- Approximately 32 teeth in adult mouth
- Four types of teeth
    - Molars
    - Premolars
    - Canine
    - Incisors
- Teeth differ in Size Shape Root type

INCISORS

- eight in number anterior teeth with wide crown and sharp, chisel like
- incisal/ cutting edge has a single root
- used for cutting purposes

CANINE

- four in number also called cuspid , as they have a sharp/pointed cusp
- has a single root
- used for tearing of the eatables

PREMOLARS

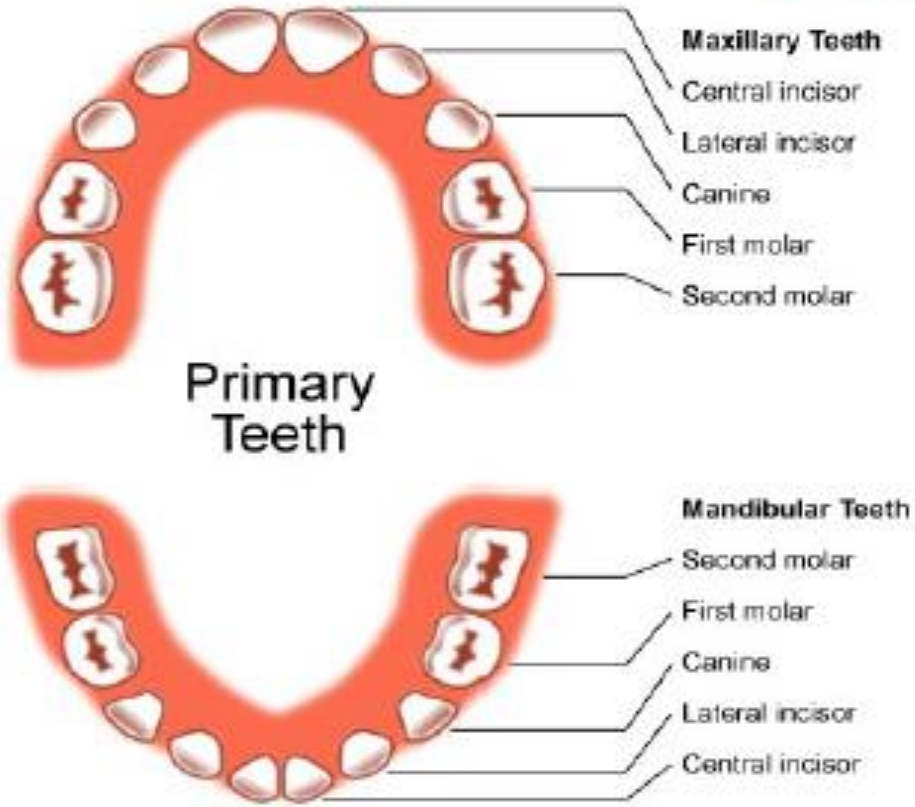
- eight in number
- present only in permanent dentition
- each premolar typically has two cusps
- premolars (other than 1st maxillary premolars which has two roots) possess a single root

MOLARS

- twelve in number
- usually have 3-5 cusps
- multi-rooted teeth
- wide surface adapted for chewing & crushing of food
- 3rd molar is the last tooth to erupt

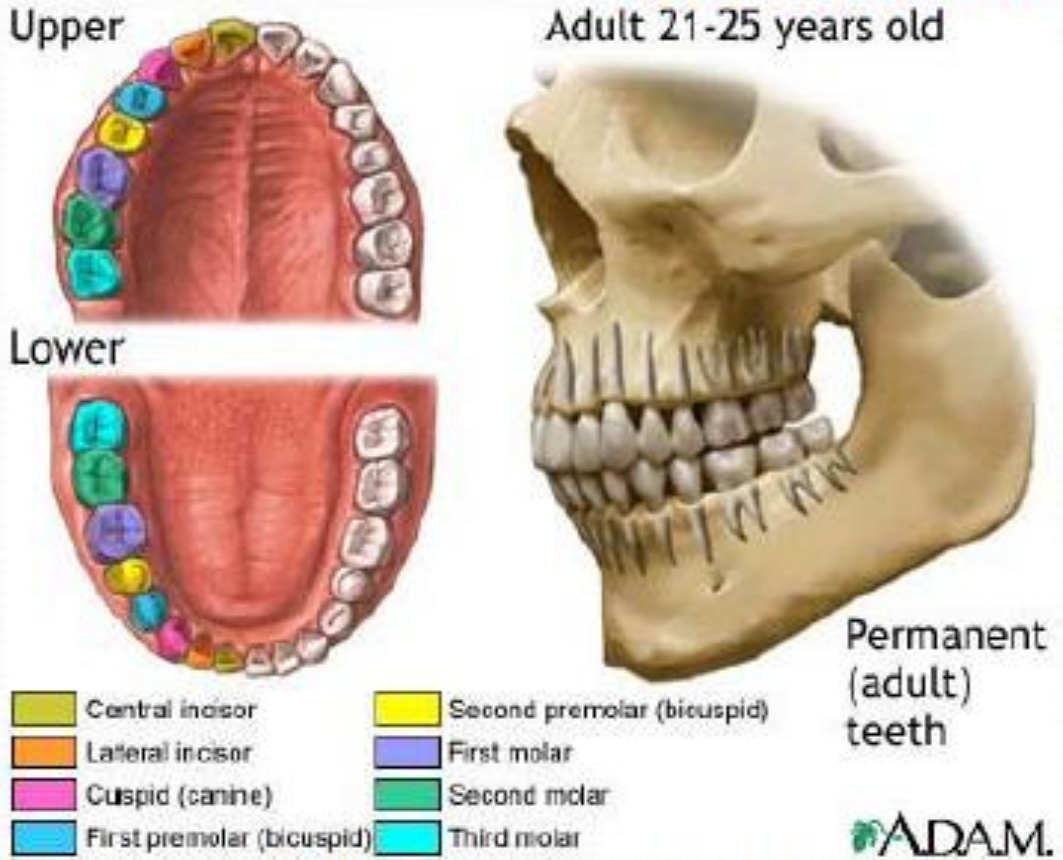
Teeth through the years

Childhood



Primary teeth sprout from milk buds and are temporary. Once they fall out, permanent
. teeth as seen on the other side appear

Adulthood



Permanent adult teeth come in when primary teeth fall out; they are permanent because they establish roots inside the gums. Third molar come in around the mid teenage
.years

Identifying ethnic origin from teeth

- Characteristic dental features have evolved over time as a result of genetic and environmental factors that have influenced different population groups (Caucasoid, Negroid, Mongoloid)

- In Caucasian races

lateral incisors in the upper jaw smaller than central especially in females

long pointed canine roots-carabelli’s cusp-

- In Mongoloid races

shovel –shaped upper central incisors

enamel –pearls

Sex determination by forensic odontologist

Gender can be determined based on data from:

1. Craniofacial morphology and dimensions
2. Sex differences in tooth size
3. Tooth morphology
4. Sex determination by DNA analysis

DEFINITIONS

- Distinctive tooth patterns in a wound that may have forensic or legal implications

or

- Bite marks can also be defined as patterned injuries in the skin produced by the teeth

or

- A representative pattern left in an object or tissues by the dental structures of an animal or human

or

- An injury in skin caused by contacting teeth (with or without lips or tounge) which shows the representational pattern of the oral structures

- Bitemarks have been defined by MacDonald as a*” mark caused by the teeth either alone or in combination with other mouth parts”*

- ABFO defines bite-marks as “*a pattern left in an object or tissue by the dental structures of an animal or human,”*

- During sexual attacks including sexual homicide, rape and child sexual abuse, bite marks are clustered around parts of body associated with sexuality

- Sweet and pretty- “The size, shape and pattern of the biting edges of the anterior teeth in the upper and lower dental arches are considered to be specific to an individual”.

- Rawson and associates have mathematically calculated that biting edges (incisal edges) of the twelve anterior teeth can be arranged in 1.36 X 1026 different combinations

Significance of Bite Marks

- All mounths are different and each dentition is unique.
- Even identical twins have different dentition.
- The imprints on the skin can help to individualize a person.
- Often refered to as“Dental Fingerprints.
- But not accurate as Finger prints.
- Presence of bite marks are suggestive of sexual abuse or child assault.
- SEXUAL INTERCOURSE WITH OR WITHOUT CONSENT

- The possibility of two persons having the exact same bite marks is 1- 2.5 of billion which indicates that it is practically impossible.

Classification of Bite Marks:

A. Cameron and SIMS Classification:

- This is based on the type of agent producing the bite mark and material exhibiting it.

1. Agents:

- a) Human
- b) Animal

2. Materials:

- a) Skin, body tissue
- b) Food stuff
- c) Other materials

B. Mac Donald's Classification:

a) **Tooth Pressure Marks:** Marks produced on tissues as a result of *direct application of pressure by teeth*. These are generally produced by the incisal or occlusal surfaces of teeth.

b) **Tongue Pressure Marks:** When sufficient amount of tissue is taken into mouth, the tongue presses it against rigid areas.

c) **Tooth Scrape Marks:** These are caused due to *scraping of teeth across the bitten material*. They are usually caused by anterior teeth and present as scratches or superficial abrasions.

C. Webster’s–foodstuff- theft/robbery

- Type 1- food item fractures readily-limited tooth penetration eg- hard chocolate
- Type 2- considerable food penetration eg- apple & other firm fruits
- Type 3- complete penetration of food item with slide marks-eg cheese

Mechanism of Bite Marks

- Three predominant mechanisms associated with production of bite marks are; tooth pressure, tongue pressure and tooth scrape.
- Tooth pressure marks are caused by direct pressure application by incisal edges of anterior teeth/occlusal edges of posterior teeth.
- Severity of bite mark depends upon duration, degree of force applied and degree of movement between tooth and tissue.

- Clinical presentation of tooth pressure indicates pale areas representing incise edges and bruising that represent incisal margins.
- Tongue pressure is caused when the material taken into mouth is pressed by tongue against teeth/ palatal rugae and distinctive marks are present due to tongue sucking/ thrusting.
- Tooth scrape is caused by teeth scraping against tooth surface commonly involving the anterior teeth. Clinical presentation can be in the form of scratches and abrasions. Scratches and abrasions that indicate irregularity and peculiarity of incisal edges are useful in identification.

Identifying injury as a bite mark

- **Gross features:**
  - circular/elliptical mark - upper & lower arch
  - central area ecchymosis - sucking action
- **Class features:** differentiate b/n tooth type
  - incisors - rectangular
  - canines - triangular
  - premolars + molars – spherical/point shaped
  - Depends on attrition
- **Individual features:** fractures/rotations/spacing

Sites of bite marks

- Females are usually bitten - breasts, abdomen, thighs, buttocks and pubis, while.
- Men are usually bitten - back, arms, shoulders, chest and genital areas.
- In cases of self-defense the victim can bite on the hands and arms of an assailant.

Characteristic

Class characteristics:

- A feature, trait, or pattern that distinguishes a bite amrk from other patterned injuries.
- For ex: finding of four approximating linear or rectangular contusions is a class characteristics of human incisors.
- Their dimensions vary in size depending upon what inflicted the injury: maxillary or mandibular teeth and whether primary or permanent teeth.
- Bite-mark class characteristics identifies the group from which it originates

Individual characteristics

- A feature, trait, or pattern that represents an individual variation rather than an expected finding within a defined group.
- There are two types:
- Arch characteristics: a pattern that represents tooth arrangements within a bite mark.
- For eg: a combination of rotated teeth, buccal or lingual version, mesio-distal drifting and horizontal alignment contribute to differentiation between individuals.

Cont….

- The number, specificity and accurate reproduction of these arch characteristics contribute to overall assessment in determining the degree of confidence that a particular suspect made the bite mark.
- Dental characteristics: it is a feature or trait within a bite mark that represents an individual tooth variation. The number, specificity and accurate reproduction of these dental characteristics in combination with the arch characteristics contribute to overall assessment in determining the degree of confidence that a particular suspect made the bite mark.

Bite Marks Patterns

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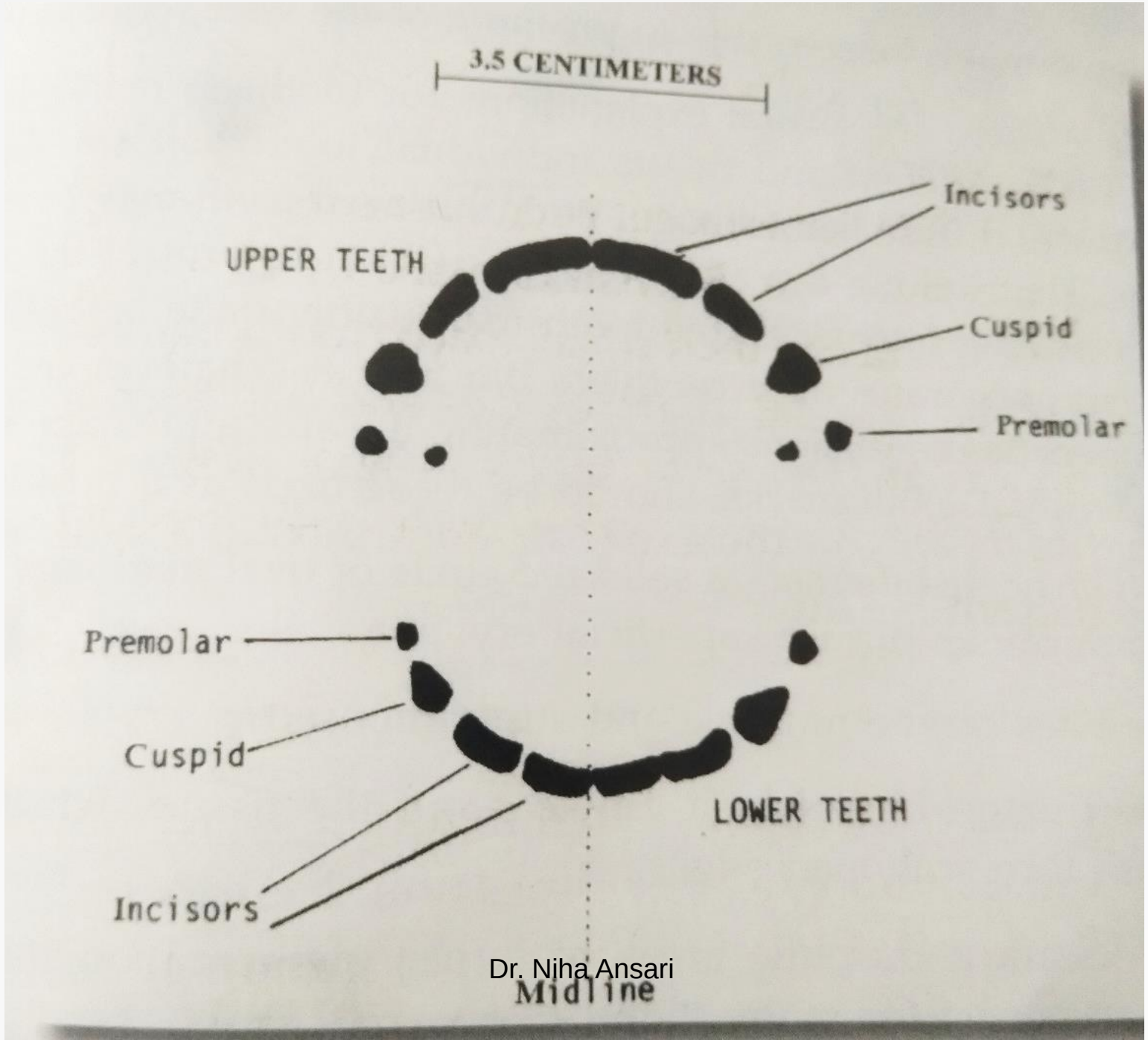
- Prototypical bite marks
- Sunburst Pattern
- One sided/ single arched bites
- Central Contusion
- Toothless bite marks
- Solid bite marks
- Multiple Bites
- Avulsive bites
- Healed Bite marks

Prototypical bite marks

- Also known as textbook bite mark
- Appears as a circular or oval injury measuring from 3-5 cm in widest diameter.
- In case of children, the diameter is < 3.5 cms
- Has two separate, curved arches facing one another
- Each arch is composed of a row of contusions, abrasions, lacerations and depressions
- Marks may consist of 16 individual tooth marks (8 in each arch), in some cases 6 and 12 individual tooth marks may also be seen

- Upper and lower jaw appears distingtive
- Lower jaw markings are well defined as compare to upper jaw as lower jaw hold the skin more securely
- Incisor teeth apperas as rectangular / linear markings
- Canines/ Cuspid teeth as circles / triangles


3.5 CENTIMETERS
Incisors
UPPER TEETH
Cuspid
Premolar
Premolar
Cuspid
LOWER TEETH
Incisors
Midline

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Sunburst Pattern

- Radiating abrasions near the periphery of the marks
- Marks may be radiating outwards or towards the center
- The drag marks indicates the area where teeth has scraped along the skin before and after they took hold of the skin
- Appear as linear red streaks

One sided/ single arched bites

- Only one arch is seen
- Can due to biting force, curvature or absence of teeth, clothing etc

Central Contusion

- also known as suck marks
- Suggestive of sexual or sadistic nature of bite
- Ecchymosis (blood bleeds under the skin from capillary) in the center of the bite mark is seen
- Also can results due to suction or tongue thrusting or due to pinching of skin between teeth

Toothless bitemarks

- May be found on soft skin or skin overlaying fat.
- As fat is resilient (strong) and can resist tooth pressure.
- Though bite marks are formed due to collective pressure and results in diffuse hemorrhage (spread bleeding) due to clothing presence
- Healing process of bite-marks may give these appearance

Solid bite marks

- A solid red circle or oval markings because of early inflammation causes diffuse superficial erythema (superficial reddening)

- Multiple Bites: superimposed bite marks / multiple

Fig. 2 Multiple, overlapping bite marks on

- Avulsive bites: where tearing of tissues is seen and an ovoid gaping laceration with torn scalloped edges is seen

- Healed Bite marks: presence of scars and areas of hyper pigmentation are seen

Factors influencing the bite marks:

- **Type of tissue:**
  - loose or with excessive fat - bruising leading to poor definition.
  - Fibrous tissue or with high muscle content - bruise less, definition is good.
- ***Age:*** *Infants and old individuals bruise more than other age groups.*
- **Sex*:*** Females tend to bruise more than males. Once produced bitemarks will be evident for longer period of time in females compared to males.
- **Medical status:** bleeding disturbances, under anticoagulant therapy, skin diseases → bruise more.
- **Time:** Depression produced in the skin due to bitemarks will recover within 10-20 minutes leaving swelling and discoloration.
- After death skin tends to contract, harden and decomposedent for longer period of time in females compared to males.

Guidelines for the analysis of bite marks

- To standardize the analysis of bite marks the American Board of Forensic Odontostomatology (ABFO) established the following guidelines in 1986:

- 1) History – Obtain history of any dental treatment subsequent to, or in proximity to, the date of the bite mark.

- 2) Photography – Extra-oral photo-graphs including full face and profile views, intraoral should include frontal views, two lateral views and an occlusal view of each arch.
- Often it's useful to include a photograph of maximal mouth opening. If inanimate materials, such as food stuffs, are used for test bites the results should be preserved photographically.
- Place a scale beside the bite mark and make a note of distance at which photograph was taken. UV light photographs can see the damage deeper into the tissue and can capture the spacing, size and shape of teeth.
- A blood group determination is possible in bite marks in human tissue as well as in food stuffs on account of saliva left in bite mark.

- 3) Extra-oral examination – It include observation and recording of soft and hard tissue factor that may influence biting dynamics. Measurements of maximal opening and any deviations on opening or closing should be made. The presence of facial scars or evidence of surgery should be noted, as well as the presence of facial hair.
- 4) Intra-oral examination – Salivary swabs should be taken. The tongue should be examined to assess size and function. The periodontal status should be noted with particular reference to mobility. Prepare a dental chart if possible.

- 5) Impressions – Take two impressions of each arch using material that meet the American Dental Association specifications. The occlusal relationship should be recorded.
- 6) Sample bites – Whenever possible, sample bites should be made into an appropriate material, simulating the type of bite under study.
- 7) Study casts – Casts should be prepared using Type II stone according to manufacturer's specifications, using accepted dental techniques. Additional casts should be made by duplicating the master casts.

FORENSIC EXAMINATION

Dr. Niha Ansari

Bite mark cases have to be dealt step by step in the following way:

1. Description of bite marks.
2. Collection of evidence from the victim.
3. Collection of evidence from the suspect.
4. Bite marks comparison.

1. Description of bite marks:

- Both in the living and deceased victims the following vital information should be recorded.
- ***Demographics:***
- Name, age, sex, race, case number, date of examination, and name of the examiners should be recorded.
- ***Location of the bite mark:***
- Anatomic location, contour - flat, curved or irregular and state the tissue characters
- Skin - fixed or mobile.
- Underlying tissue - bone, cartilage, muscle or fat.

- **Shape of the bite marks:**
- round, ovoid, crescent or irregular in shape.
- **Color of the mark:**
- **Size of the mark:**
- Both vertical and horizontal dimensions should be recorded in metric system.
- **Type of injury:**
- Petechial hemorrhage, Contusion, Abrasion, Laceration, Incision, Avulsion.

2. Collection of evidence from the victim

A. Visual Examination- Type of injury, Contour & texture, Physical appearance (color and size), location

- If the victim is dead, visual examination must be done before an autopsy.

B. Photographs of the bite marks should be made immediately.

1. Orientation photographs
2. Close-up photographs

C. Salivary swabbing:

- Saliva deposited on skin may have WBCs and sloughed epithelial cells which may be a source of DNA, enabling direct link to the suspect

D. Impression of bite marks

3. Collection of evidence from the suspect.

- History of dental treatments after or just before the bite mark has to be noted.

Photographs:

- Full face, frontal, occlusal and lateral views of the dental arches should be taken.
- Special attention should be given to the arrangement of dentition.

Saliva swabbing should be performed

Upper and lower dental models using dental stone should be prepared.

4. Bite marks comparison

- While evaluating the bite mark first the cause of the mark has to be determined, since bite marks may be caused by nonhumans or humans.

Preservation of Bite marks

1. **Bite mark site:** First determine whether washing, contamination, lividity, embalming, decomposition, change of position etc. have affected the bite mark.
2. **Saliva Swabs:** Use double swabbing method to collect swab of bite mark. One swab moistened with sterile distilled water with medium pressure to wash dried saliva from the surface over a period of 7-10 seconds. Then apply a second dry swab with light pressure to collect the moisture left on the surface. Further can be used for examination.
3. **Photography:** Orientation and close-up photography is done. Use scale on the same plane and adjacent to the bite mark.

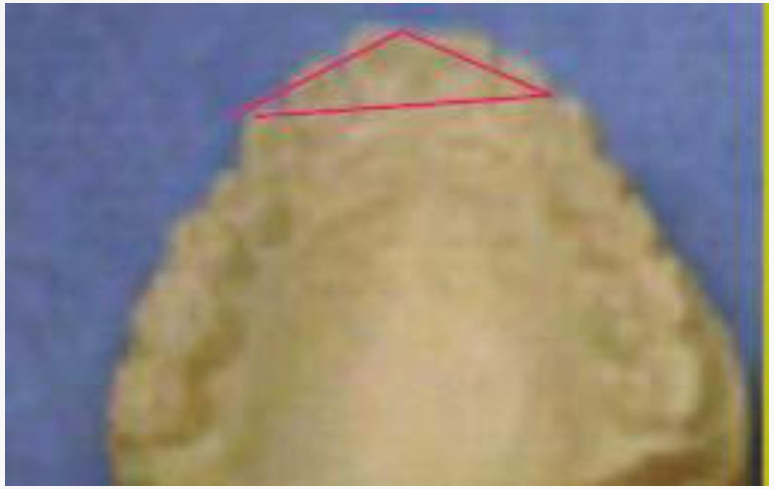
HISTOPATHOLOGICAL CHANGES IN BITE MARKS

- Stage 1 –0 to 18 hrs – Scab formation
- Stage 2 –30 to 70 hrs- Epithelial regeneration
- Stage 3 –5 to 12 days - Subepidermal granulation
- Stage 4 –after 12 days – Regression

METHODS OF BITE MARKS ANALYSIS:

Odontometric triangle method:

- A triangle is made on the tracing of bite marks and teeth models by marking three points, two on the outer most convex point of canines and one in the centre of the upper central incisors.
- Three angles measured and compared



Pattern Association

Bite mark photograph from victim

Direct method- suspects model are placed directly over the bite mark photograph

Indirect method- incisal and occlusal edge of the suspect's teeth may be traced on to clear acetate and superimposed on life-size bite mark photographs.

Image perception software procedure

- A photograph of a bite mark is opened with the image perception software, and a region of interest is then selected.
- After such selection, colours can be added to different grey scale areas of the image. The assigning of selected colours to levels of grey values enables the forensic odontologist to select regions with similar grey values or to enhance subtle differences of grey values in the picture.
- The human eye can only distinguish about 40 shades of grey in a monochrome image, but can distinguish hundreds of different colours.

- This will make it easier to establish which regions of pixel intensity is part of the bitemark and which are not.
- By omitting certain areas of pixel intensity, it is possible to isolate the region of the image which shows the bite mark. A detailed image of the bite mark is produced.
- The coloured image of the bite mark is now layered over the original bite mark photograph using Photoshop of Adobe Systems

Selected region of interest from original photograph

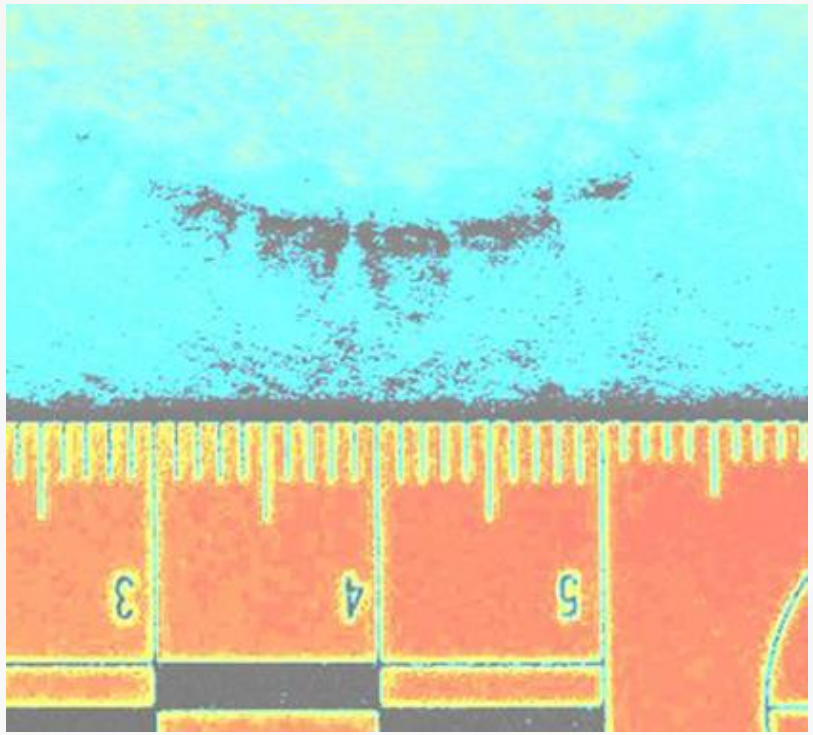
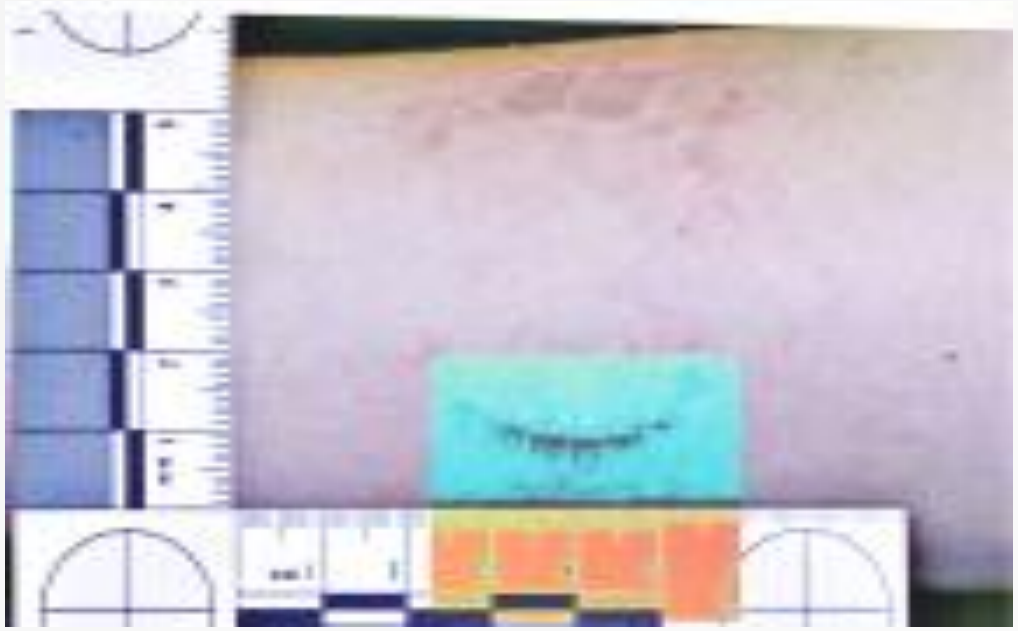


Image artificially coloured with image perception technology software



Coloured image with visible incisal detail layered over original photograph

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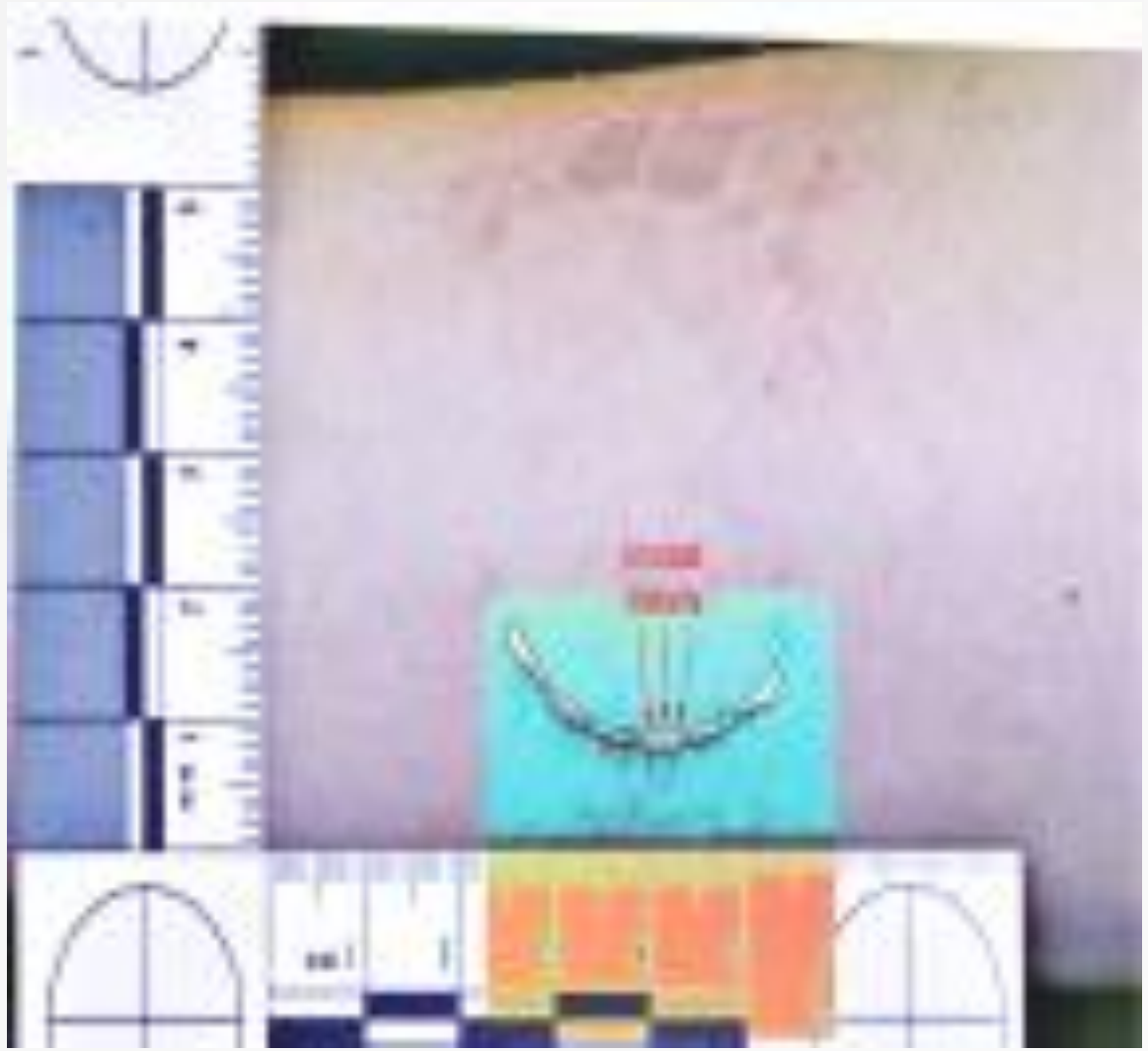

Overlay comparison

Difficulties in bite mark analysis:

- **Accuracy of the bite imprint:** The impression may not be accurate due to irregularity of the bitten areas on the human skin and the poor quality of the material and time duration between infliction of the bite mark and creation of the model.
- **Permanency:** Unlike fingerprints, which are reasonably constant over the course of an individual's life, the dentition is capable of major changes in configuration, with and without professional intervention. Various restorative materials can change the character of the bitten surfaces or actual position of the individual's teeth. Disease process e.g. caries or periodontal diseases can change the configuration.
- **Uniqueness:** Singular nature of an individual dentition is often assumed, but it has not been definitely established.


Thank
you