

Stages of Thermal Damage to the Head

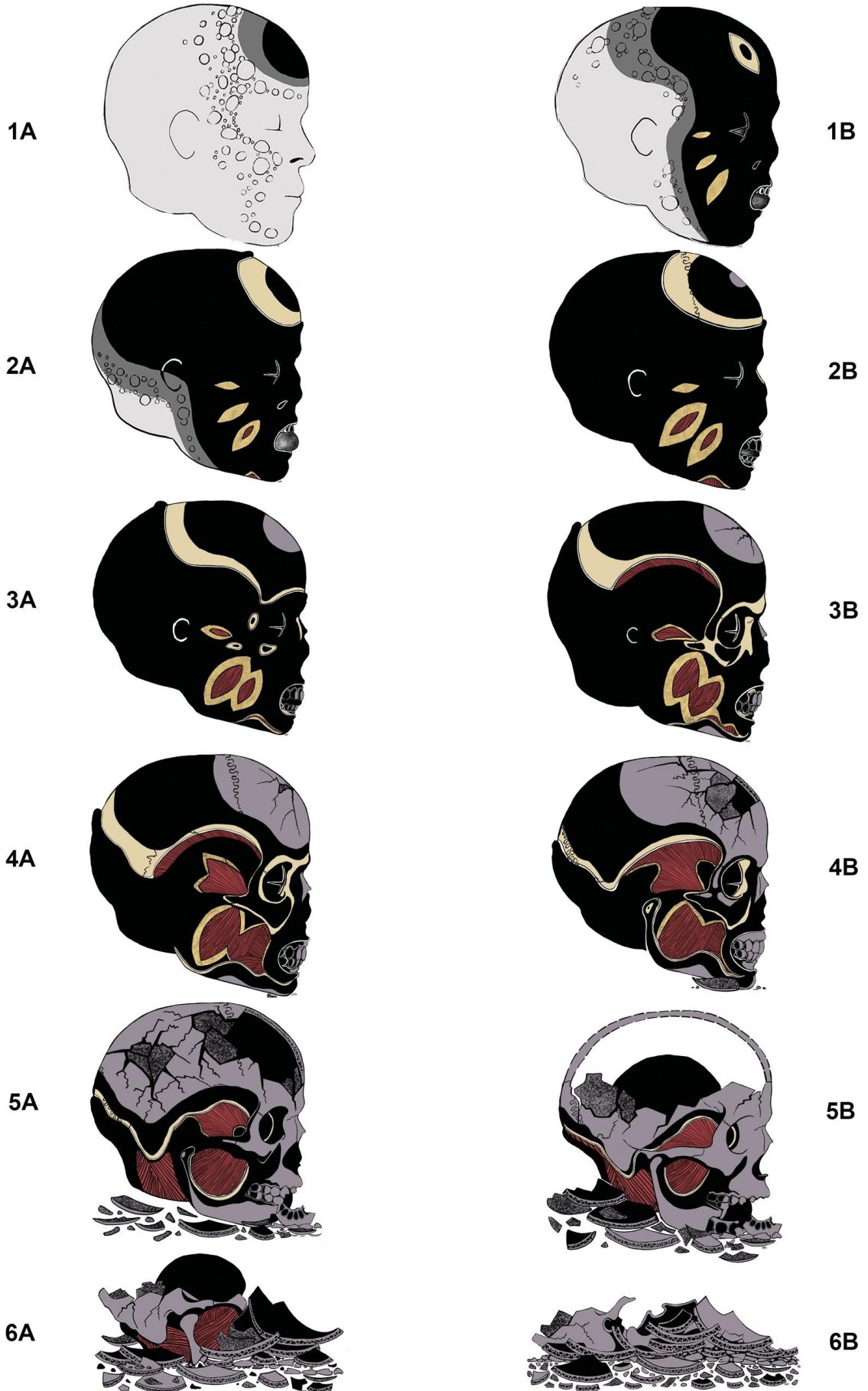


FIG. 3—Illustrations of fire damage to the head for stages 1 to 6, demonstrating early and advanced phases for each stage.

STAGE	DESCRIPTION OF HEAD (FIGURE 3)
1	Superficially scorched skin and singed hair
A	<ul style="list-style-type: none"> • Burned and unburned skin • Scorched hair and skin • Bands of discolored skin (red, tan, brown to charred black depending on skin pigmentation) • Large and small blisters border discolored skin • Eyes, nose, and ears somewhat shrunken and deformed
B	<ul style="list-style-type: none"> • Skin darker brown to charred black • Blisters follow skin color changes • Skin splits closest to heat expose underlying subcutaneous fat, oily surfaces, rendered grease, possibly exposed cranial bone under scalp splits • Temporary shrinking/opening of eyelids, shrunken nose, and ears, lip retraction, swollen and protruding tongue • Anterior dentition exposed and possibly charred
2	Deformed facial features and anterior cranial vault exposure
A	<ul style="list-style-type: none"> • Charred, shrunken skin with multiple skin splits • Remnants of blisters • Exposed subcutaneous fat and rendered grease • Facial skeletal muscles exposed • Lower facial bones protected by subcutaneous fat and muscle • Facial features that are charred are unrecognizable • Anterior maxillary incisors charred labially • Exposed vault bone, usually frontal, with discoloration bands
B	<ul style="list-style-type: none"> • Charred and calcined bone, on the anterior cranial vault • Exposed charred anterior dentition and shrunken tongue • Nasal bones exposed
3	Expansion of charring and calcination of vault and face
A	<ul style="list-style-type: none"> • Scalp retraction exposes approximately one-fourth of vault (frontal, anterior parietals) • Charred surfaces of upper facial bones (nasal, maxilla, zygomatics) and inferior mandible • Calcined cranial bone with heat fractures • Neck extended • Anterior dentition (incisors) enamel charred and calcined and can have heat fractures with exposed dentine
B	<ul style="list-style-type: none"> • Skin splits expand on lower face • Cranial vault half exposed as charred and calcined bone • Heat fractures develop in external table with early delamination • Charred bone extends into upper face, around orbits, and inferior mandibular body • Calcination expands on the cranial vault and may appear on nasals, inferior mandibular body, and dentition
4	Significant loss of tissue, especially on superior aspect
A	<ul style="list-style-type: none"> • Charred and calcined bone on half of the head, including cranial vault and upper face • Eyes shrink into orbits • Delamination of outer table in calcined cranial bone • Heavily charred skin and skeletal muscles: masseter (cheeks), temporalis (sides of the head), and nuchal (neck) • Remaining scalp dense and shrunken mass above nuchal line • Dental charring/calcination extends to canines and premolars
B	<ul style="list-style-type: none"> • Increased calcination of cranial vault and face • Delamination includes external table flaking, deformation, and detachment • Delaminated fragments partially attached or separated in fire debris • Full-thickness cranial fractures present • Inferior mandible charred/calcined contour follows masseter muscle • Mandibular condylar process possibly visible • Incisors to premolars often calcined with fragmented enamel • Dentine/root sections in situ or separated in fire debris
5	Incomplete cremation
A	<ul style="list-style-type: none"> • Charred soft tissues on posterior head and neck (remnants of masseter, temporalis, and nuchal muscles) • Over three-fourths of vault and/or face charred and calcined • Skull remains either intact with heat fractures or fragmented • Delamination and full-thickness fractures into inner table • Dental charring and calcination to premolars and molars • Possible anterior dentition loss, including roots
B	<ul style="list-style-type: none"> • Increased cranial, facial, and dental heat fractures • Vault either appears intact or fragmented • Shrunken and charred brain mass in cranial base • Charred and carbonized muscles present under zygomatic arch and around cranial base
6	Highly fragmented calcined bones
A	<ul style="list-style-type: none"> • Cranium either “intact,” though fractured, or calcined fragments Carbonized tissues (cranial base muscles and brain)
B	<ul style="list-style-type: none"> • Complete cremation with skeletonized fragments or partially intact cranium with calcined fragments in fire debris

Stages of Thermal Damage to the Torso

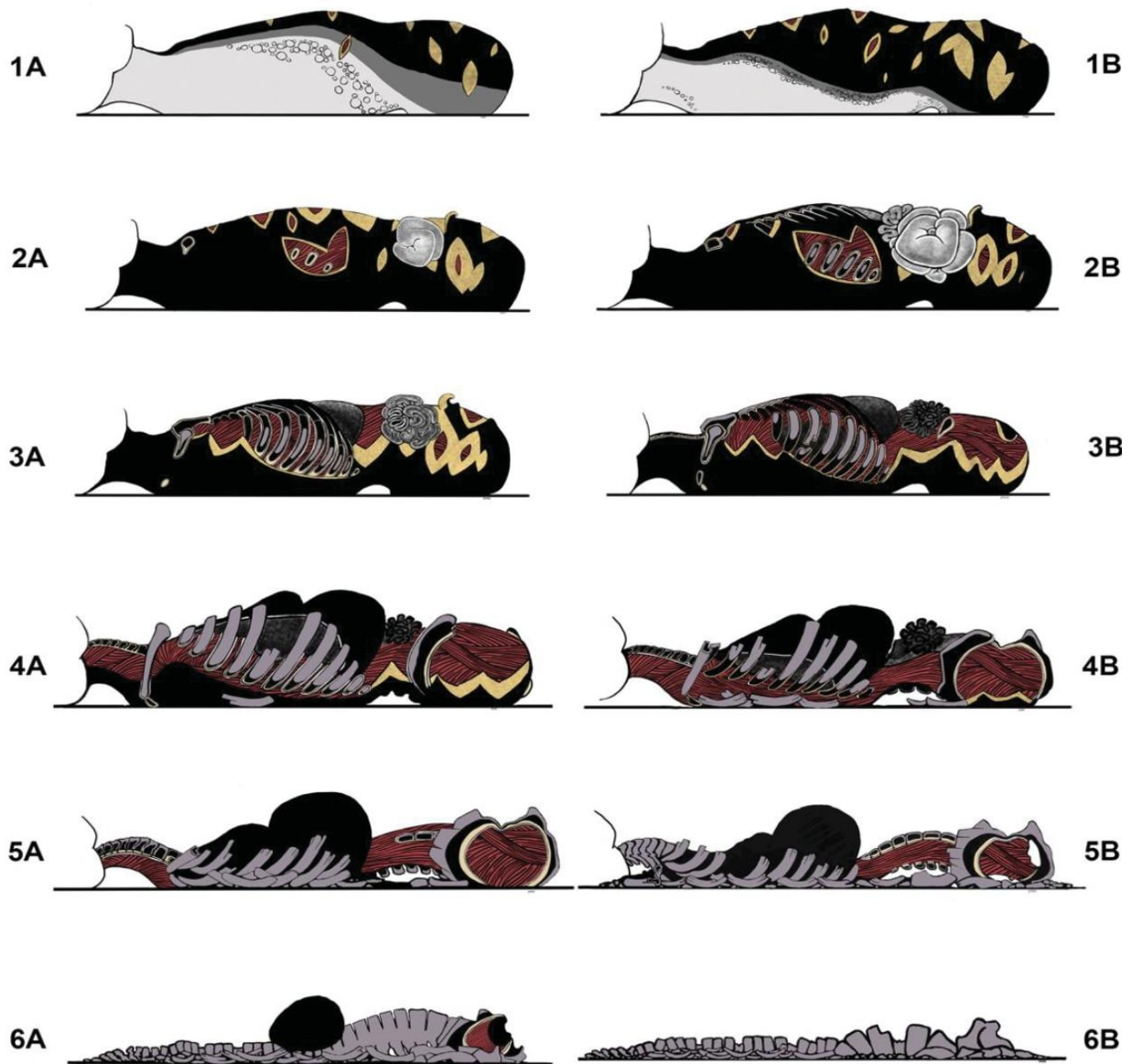


FIG. 4—Illustrations of fire damage to the torso for stages 1 to 6, demonstrating early and advanced phases for each stage.

TABLE 2—Description of changes to the Torso.

STAGE	DESCRIPTION OF TORSO (FIGURE 4)
1	Superficial burning with skin discoloration, blistering, and skin splits
A	<ul style="list-style-type: none"> • Unburned and burned skin with scorched hair and skin • Bands of discolored skin (unburned, red, tan, brown, and black, depending on normal pigmentation) • Shrunken and tightened skin • Bands of small and large blisters • Skin splits with exposed subcutaneous fat layers
B	<ul style="list-style-type: none"> • Larger skin splits closest to heat exposure • Skin discoloration and blistering expanded • Exposed and rendered subcutaneous fat and charred muscles with oily surfaces
2	Charred skin surfaces, bony chest exposure, and abdominal organ protrusion
A	<ul style="list-style-type: none"> • Larger skin splits prevalent closest to heat • Exposed and rendered subcutaneous fat • Charred chest skeletal muscle with delineated costal cartilage • Early exposure of lower abdominal organs protrude outside of torso, appear as burned and unburned intestinal loops • Anterior or lateral rib surfaces exposed

STAGE	DESCRIPTION OF TORSO (FIGURE 4)
-------	---------------------------------

B	<ul style="list-style-type: none">Exposed upper chest skeletal musclesDelineated and charred costal cartilage with anterior rib pattern visibleSurfaces of anterior/lateral ribs, medial clavicle, sternum, and manubrium charred and calcinedInternal organs protrude through lower abdomenFor larger individuals, fat rolls/sheets peel from abdomenEarly neck extension
3	Chest wall isolation with burning/shrinkage of abdominal musculature
A	<ul style="list-style-type: none">Sternum, costal cartilage, and medial clavicles charred with calcined surfacesExposed charred and calcined anterior/lateral ribsHeart, lungs, and liver charred and shrunken, partially visible through ribsProtruding abdominal organs charred and shrunkenNeck extends, moving head away from torso, and back extended slightly
B	<ul style="list-style-type: none">Chest wall exposedCostal cartilage dehydrated, partially consumedRibs calcined laterally and anteriorlyRibcage is “isolated” with space between ribs and interior chest interiorInternal thoracic organs visibleAnterior cervical vertebrae exposed and charredExposed liver, intestines, and stomach partially charredCharred anterior iliac crest
4	Reduction of the anterior ribcage
A	<ul style="list-style-type: none">Ribs calcined with heat fractures and charred close to musculatureSternal rib ends irregularly fragmentedCostal cartilage consumedCalcined sternum and medial clavicles in chest/fire debrisDistal clavicles point downward into chestLateral scapulae exposed and charredThoracic and abdominal organs (lungs, heart, liver, stomach, intestines) charred and shrunkenCervical vertebrae centra exposed and charred on extended neckIliac crest and anterior pubic surface charredLumbar spine extended, exposing charred spinous processes
B	<ul style="list-style-type: none">Charred muscles and organs (heart, liver, and abdominal organs)Charred and calcined bones of lateral/posterior ribcage, anterior cervical spine, shoulders (lateral scapulae), iliac alae, and pubic bonesRibs fragmented and calcined except near spinal musclesHeart and liver large black masses within lower ribcage
5	Reduction to blackened spine and pelvis
A	<ul style="list-style-type: none">Partially skeletonized extended neckThoracic bodies protected by charred organsLumbar bodies protected by skeletal musclesCarbonized posterior sacral surfacesSmall calcined rib segments protrude from spineHeart and liver are black massesPelvic cavity contains shrunken muscles and internal organsCalcination and fragmentation extend to ilial alae and pubic surfacesHip muscles charred masses
B	<ul style="list-style-type: none">Spine partially skeletonized, charred, and calcined with fragmented ribs, charred internal organs, and minimal charred musclesCharred heart and liver massesPelvic area retains skeletal muscle and some internal organsPelvis exposed, charred, calcined, and often fragmentedPossible curved heat fractures on ilia
6	Incomplete to complete cremation
A	<ul style="list-style-type: none">Spine devoid of soft tissue except for lower back and pelvisBlackened mass liver mass possibly presentCharred soft tissues around inner pelvisPelvic ring integrity lostVertebral bodies relatively intact while larger bones are fragmented
B	<ul style="list-style-type: none">Disarticulated, calcined bone and bone fragments, in rough anatomical position in fire debris

Stages of Thermal Damage to the Upper Limb

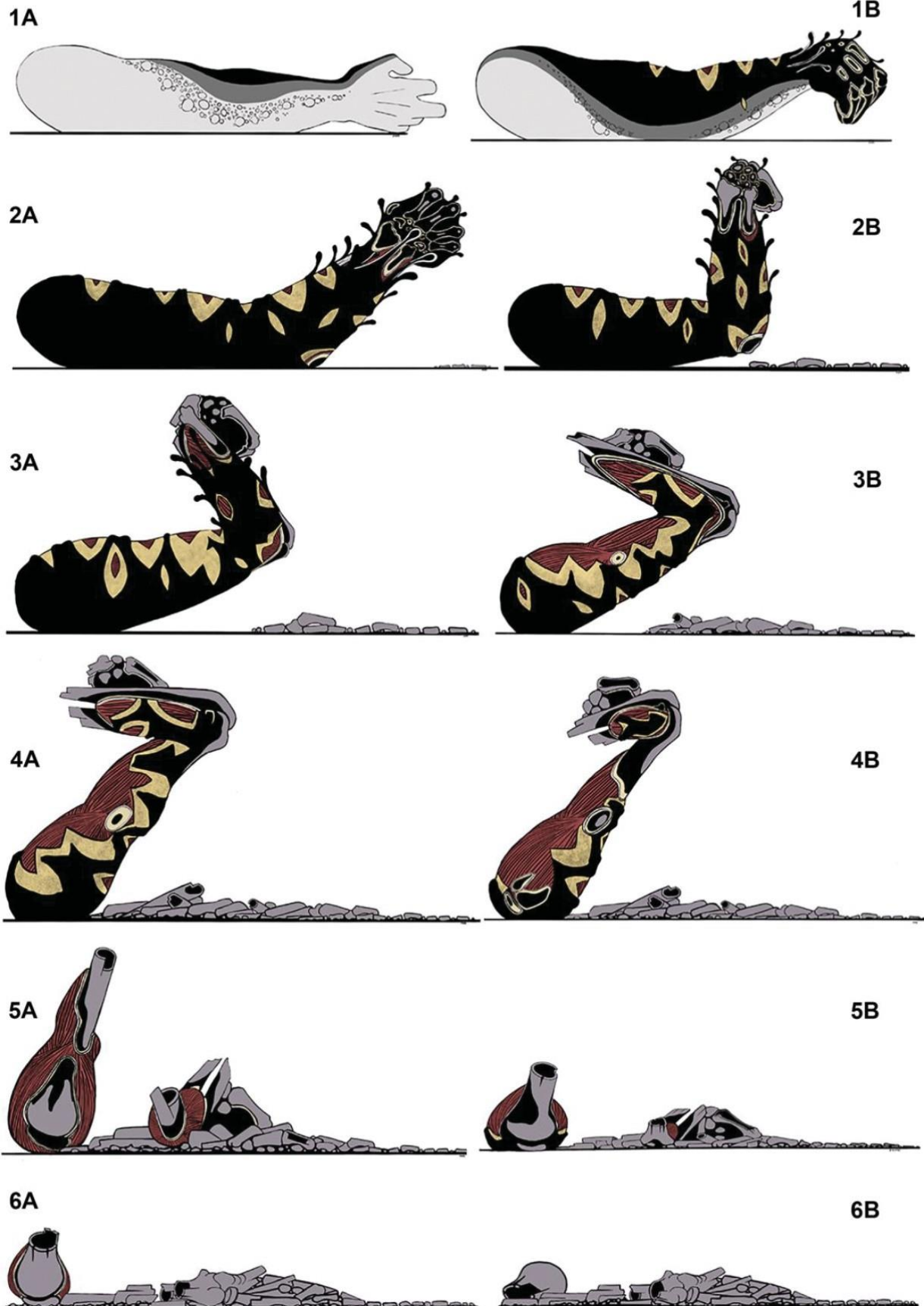


FIG. 5—Illustrations of fire damage to the upper limb for stages 1 to 6, demonstrating early and advanced phases for each stage.

TABLE 3—Description of changes to the upper limb.

STAGE	DESCRIPTION OF UPPER LIMB (FIGURE 5)
1	Superficial burning with skin discoloration, blistering, and skin splits
A	<ul style="list-style-type: none"> • Unburned and burned/discolored areas of skin • Scorched arm hair and skin • Small and large blisters • Skin splits usually confined to partially flexed finger joints and dorsal hand • Fingers splay and flex at interphalangeal joints • Wrists flex with palms medial
B	<ul style="list-style-type: none"> • Skin dark brown to charred black, shrunken and tightened • Blisters follow discolored skin • Skin splits expose subcutaneous fat • Rendered fat with oily surfaces • Fingers, hand flex • Elbow flexion raises lower arm above substrate • Superficial burning on dorsal hands with exposed skeletal muscles and charred bone • Phalanges at flexed joints, dorsal hand/wrist possibly exposed and charred with shrunken and detached extensor tendons • Exposed bone discolored and charred
2	Arm movement with expansion of skin splits
A	<ul style="list-style-type: none"> • Greasy charred skin with skin splits and blisters • Fingers, hand, wrist, and elbow are flexed, with forearm elevated from elbow • Exposed and charred skeletal muscles • Charred, shrunken, and detached extensor tendons on forearm • Charring with small, calcined surfaces on flexed fingers, dorsal hand, and wrist, distal radius and ulna, and proximal ulna (olecranon process)
B	<ul style="list-style-type: none"> • Skin splits on most of arm, charred skeletal muscle, ligaments, tendons, and charred/calcined bone • Bone exposure expanded to distal radius/ulna and proximal ulna • Elbow flexion more pronounced • Contracture of shoulder muscles lifts elbow off substrate (or beside torso) • Heat fractures on charred and calcined fingers, hand, wrist, distal radius, and ulna
3	Distal forearm reduction, upper arm movement, and detachment of hand/wrist
A	<ul style="list-style-type: none"> • Skin splits, rendered subcutaneous fat, charred skeletal muscle and tendons, exposed bone, and shrunken extensor tendons • Charred/calcined bone includes elbow (proximal ulna and distal humerus), distal forearm, wrists and hands • Heat fractures through distal radius and ulna separate hand and wrist from forearm • Arm raised around/above chest from early shoulder flexion
B	<ul style="list-style-type: none"> • Hand and wrist detached from heat fractures through distal radius/ulna or along natural wrist joint • Distal radius and ulna, wrist, hand and retained in shrunken skeletal muscles, pulling hand toward mid-forearm • Exposure of lateral ulnar midshaft • Deltoid tuberosity of humerus charred • Arms positioned around/above chest from shoulder flexion and internal rotation • Heat fractures in calcined bone with fragmentation
4	Further reduction of forearm, elbow, hand, and wrist
A	<ul style="list-style-type: none"> • Partial skeletonization from fingers to elbow • Widespread charred skin and muscles and rendered fat • Upper arm fully raised above floor and above/around chest • Detached hand positioned closer to mid-forearm • Calcined hand, wrist, and forearm bones fragmented • Humerus charred and calcined distally and charred at deltoid tuberosity • Calcined bone heat fractured and fragmented
B	<ul style="list-style-type: none"> • Charred musculature concentrated around flexed elbow and shoulder • Detached hand/wrist positioned within mid-forearm musculature charred • Upper arm raised above body at shoulder • Humerus charred, calcined, and heat fractured above elbow • Lateral aspect of proximal humerus and scapula charred
5	Loss of upper arm, except around shoulder
A	<ul style="list-style-type: none"> • Heat fracture through distal humerus (above elbow) separates elbow, lower arm, wrist, and hand from body • Charred skeletal muscle in upper arm and shoulder • Proximal humerus attached and anteriorly flexed • Charred and calcined humeral midshaft extends from shoulder

STAGE	DESCRIPTION OF UPPER LIMB (FIGURE 5)
B	<ul style="list-style-type: none"> • Distal humerus calcined and fragmented below midshaft with heat fractures, shrinkage, and warping • Proximal humerus in shoulder muscles with charred lateral surfaces
6	Incomplete to complete cremation
A	<ul style="list-style-type: none"> • Smaller charred shoulder muscles • Proximal humeral portion raised at shoulder
B	<ul style="list-style-type: none"> • Full skeletonization and cremation with charred and calcined fragments in debris

Stages of Thermal Damage to the Lower Limb

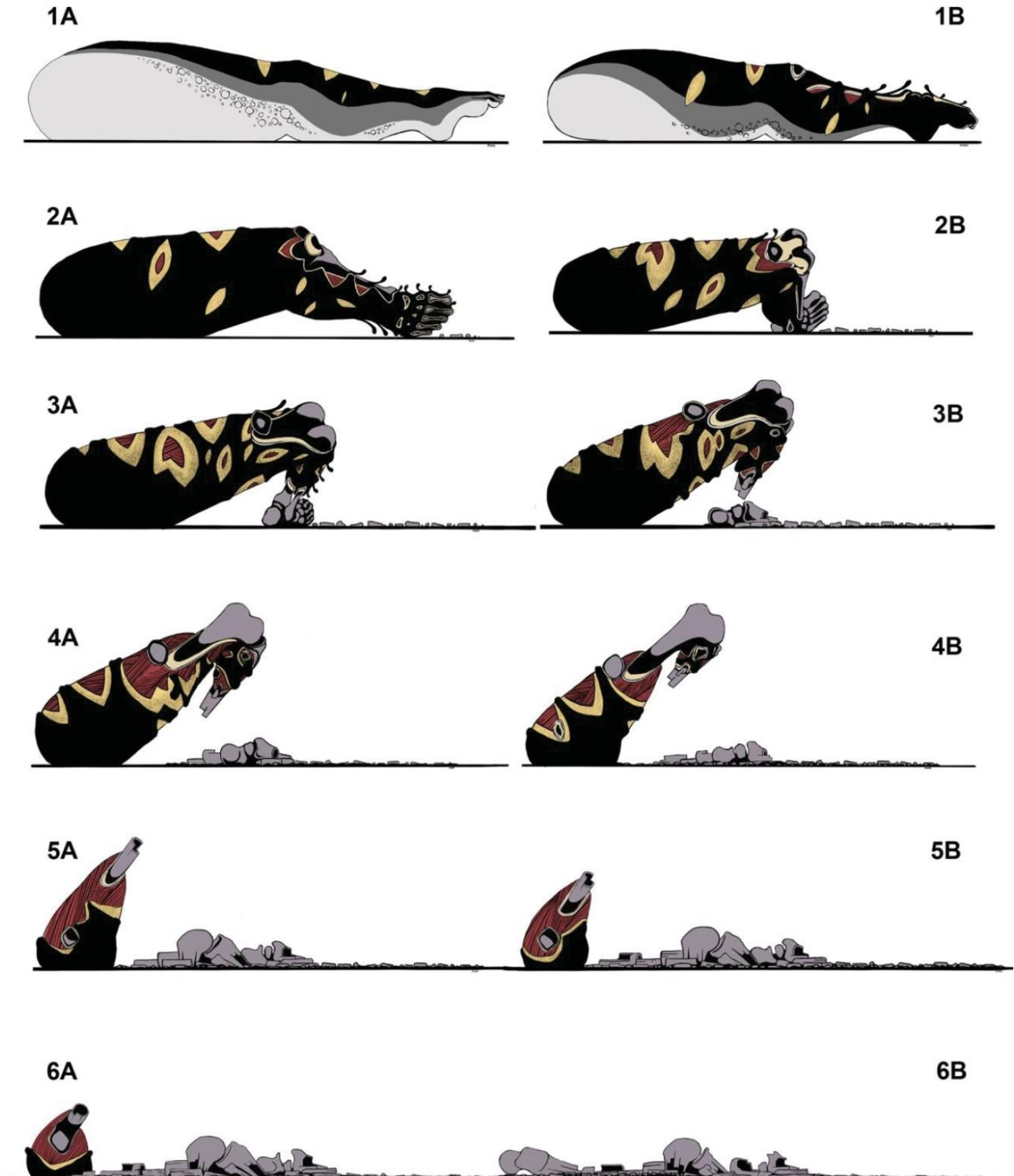


FIG. 6—Illustrations of fire damage to the lower limb for stages 1 to 6, demonstrating early and advanced phases for each stage.

TABLE 4—Description of changes to the lower limb.

STAGE	DESCRIPTION OF LOWER LIMB (FIGURE 6)
1	Superficial burning with skin discoloration, blistering, and skin splits
A	<ul style="list-style-type: none"> • Unburned and burned areas of skin • Scorched hair and skin • Skin shrunken, tightened, blistered, and discolored • Possible skin sloughing on sole • Toes splayed and joints flexed • Foot slightly flexed and pointed downward • Skin splits and possible bone exposure over flexed toe joints close to surface unless protected by footwear
B	<ul style="list-style-type: none"> • Skin darker brown to charred black, shrunken and tight with oily surfaces • Small and large blisters, skin splits, and exposure of subcutaneous fat • Flexed toes, with flexed foot inversion • Ankle extension with flexed foot pointing downward • Skin splits over toe joints, dorsal metatarsals, tarsals, and distal/anterior tibia • Exposed bones are discolored and charred
2	Leg movement expansion with charred superficial soft tissue
A	<ul style="list-style-type: none"> • Legs spread apart from knee flexion • Knees point laterally, flexed foot points downward, heels near midline • Skin charred with greasy/oily surfaces, skin splits, and blisters • Exposed musculature on lower leg and foot • Charring and calcination on anterior tibia • Bone exposure on toes, dorsal foot, ankle, anterior distal tibia, and around knee
B	<ul style="list-style-type: none"> • Flexed knees raised above ground/floor substrate • Thighs spread apart • Feet drawn toward torso midline • Skin charred and oily with skin splits • Exposed and rendered subcutaneous fat • Skeletal muscles, ligaments, tendons, and bone charred • Noticeable loss of body mass on lower leg, ankle, and foot • Charred and calcined bone extends to patella and distal femur
3	Reduction of foot, ankle, and lower leg
A	<ul style="list-style-type: none"> • Lower legs and thighs raised above substrate • Thighs charred with skin splits, rendered fat, charred muscles, tendons, and ligaments • Exposure, charred, calcined, and heat-fractured bone extends from toes to distal femur • Charred and calcined patella detached but retained in thigh muscles • Foot and ankle possibly detached by heat fracture through distal tibia/fibula or ankle joint
B	<ul style="list-style-type: none"> • Large thigh muscles present around femur and exposure of the knee • Knees flexed • Thighs spread wide apart and raised above substrate • Lower legs and heels closer to midline • Foot and ankle detached from heat fracture through distal tibia/fibula or ankle joint
4	Heat fractures with fragmentation of tibia, fibula, and portions of distal femur
A	<ul style="list-style-type: none"> • Widespread charring of thigh muscles with rendered fat • Charred calf muscle masses on posterior proximal tibia and fibula • Lower leg bones calcined with heat fractures • Thigh flexed at hip, tightly flexed at knee, and upper legs positioned outward
B	<ul style="list-style-type: none"> • Thigh mass reduced • Carbonized muscles around back of flexed knee • Exposure and charring of greater trochanter • Tibia/fibula shafts mostly charred and calcined bone fragments
5	Mostly fragmentation at mid-thigh
A	<ul style="list-style-type: none"> • Distal femur, knee, and lower leg detached from femoral midshaft and body as fragments in fire debris • Proximal femur protected in charred thigh muscles with charred greater trochanter • Charred and calcined femoral shaft extended at flexed hip
B	<ul style="list-style-type: none"> • Femoral midshaft, charred and calcined bone fragments are separated from body and with heat fractures, shrinkage, and warping
6	Incomplete to complete cremation.
A	<ul style="list-style-type: none"> • Skeletonized with carbonized tissues around hip and upper thigh • Proximal femur attached to torso
B	<ul style="list-style-type: none"> • Lower limbs skeletonized, calcined, and fragmented in fire debris

INVESTIGATOR: _____ DATE: _____

CASE NO: _____ AGENCY: _____

TORSO STAGE _____

NOTES:

HEAD STAGE _____

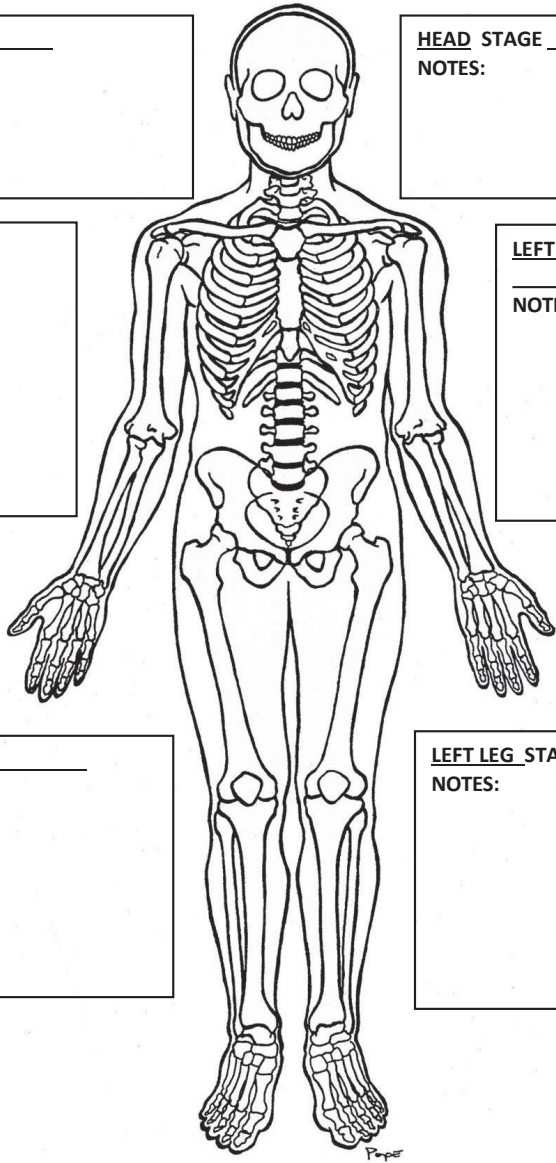
NOTES:

RIGHT ARM STAGE

NOTES:

LEFT ARM STAGE

NOTES:



RIGHT LEG STAGE _____

NOTES:

LEFT LEG STAGE _____

NOTES:

OVERALL STAGE AND NOTES:

INVESTIGATOR: _____ DATE: _____

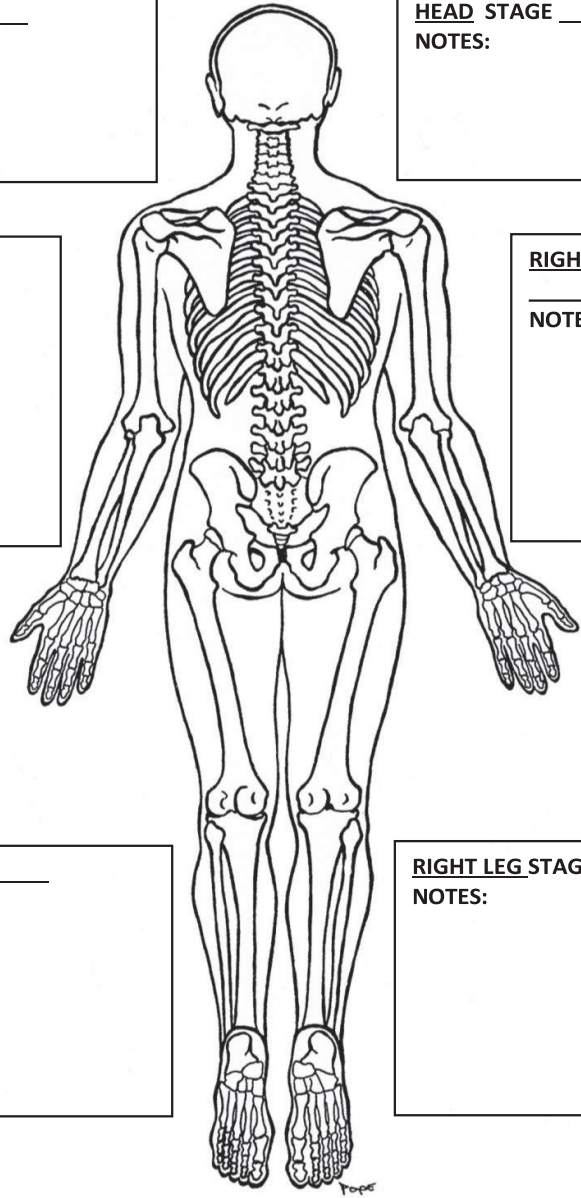
CASE NO: _____ AGENCY: _____

TORSO STAGE _____
NOTES:

HEAD STAGE _____
NOTES:

LEFT ARM STAGE _____
NOTES:

RIGHT ARM STAGE _____
NOTES:



LEFT LEG STAGE _____
NOTES:

RIGHT LEG STAGE _____
NOTES:

OVERALL STAGE AND NOTES: