

Casualty Simulation Techniques



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Figure 1. Casualty in properly staged situation

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The the image above shows a properly staged scenario and is from a U.S. Army casualty simulation manual dated 1964. From the collection of the National Museum of Health and Medicine, Armed Forces Institute of Pathology; the image is a work of the U.S. Government and is in the public domain.

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Why I wrote this

When I began casualty simulation I found that the materials I was supplied with were difficult to use and often didn't work the way I wanted. The materials varied greatly in quality and many seemed to have been selected primarily on price. Given the vast array of professional products available, it took a bit of experimentation to determine which ones gave the best results. I visited makeup and special effects suppliers and talked with working makeup artists to research products useful in casualty simulation. My ethos is to freely share information for the common good and it is in that spirit that I created this document.

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Casualty Simulation

Unlike film and television where visual "look" of the scene is important, the primary goal of casualty simulation is the realistic depiction of wounds in a practise setting. Care must be taken not to create a gory wound just for shock value; every wound created must be based on a detailed knowledge of anatomy, physiology and a sound understanding of the underlying physics. Simulated injuries should always make sense in light of the mechanism of injury and other factors (e.g. body armour, eye protection)

Remember the saying *"We do not rise to the level of our expectations. We fall to the level of our training."* Medics and first responders need realistic simulations to learn how to properly assess and treat casualties before they enter the field environment. Quite often a minor wound will appear horrendous and a life threatening wound will appear minor. Detailed, realistic simulations help increase the level of confidence and competence during training. Simulated wounds help the medic or first responder to keep everything sorted out while treating the casualty.

Another aspect, often overlooked, is the element of time in casualty simulation. In the real world the casualty's condition will change over time; in casualty simulation makeup is unchanged. Burns turn from dry to oozing, shock deepens, the area over broken bones swells and darkens. The casualty has some limited ability to change his/her actions (if a conscious casualty) over time. Wounds should be appropriate for the amount of time which has passed since the injury was incurred. All wounds caused by the same mechanism of injury should have an appearance consistent with one another for the given time line.

Study articles on trauma and talk with medics and first responders to find out how wounds actually appear in the field. If you have the opportunity, talk with makeup and special effects professionals to discover how they would handle the problem. Always be on the lookout for new techniques to make your work better, faster or easier. Ask the people running the scenario for suggestions or criticism. Keep a notebook to record successful techniques you have used. Share the information with others. You can also join in discussions at makeup and special effects forums.

Film and High Definition Television

Makeup and special effects artists for film and television share many of the problems of casualty simulation. The makeup must be applied quickly, it must be durable and it must be believable. High definition television has led to several new techniques in the makeup industry; older, less detailed makeup techniques look fake with the extreme detail inherent in HDTV. Among these techniques are the use of gelatin and silicon appliances, airbrush application of materials and the use of alcohol activated paints.

There are, of course, many differences. Makeup artists working in film and television have much more latitude in their work; they are not fettered by reality in the same way that casualty simulators are. The effects they produce do not have to work in real time. A bullet strike, for example, can be created by a squib placed behind an appliance. From a distance, the exploding squib creates a realistic bullet strike. For the close-up shot of the resulting wound, the makeup artist might create a more detailed realistic wound. When the film is edited, the effect appears seamless. This is why some techniques used in film and television are not directly applicable to casualty simulation.

Professionalism

Work out your makeup and effects ahead of time, on paper if possible. Tell the organizers of the simulation how much time you'll need and any resources (personnel and supplies) required for the simulation. Quite often those running the exercise don't understand what it takes to do proper casualty simulation in terms of time and resources. Make sure your casualties are kept warm and comfortable. Instruct casualties on how to act for realism. Be available to touch up your work if it becomes damaged. Do not eat, drink or smoke while applying makeup. Before using any product read the manufacturer's directions and have a thorough understanding of the properties of the product. Before applying any products ask your casualties about allergies they might have to the products you'll be using. You are responsible for removing any makeup or other products you have applied to the casualties. Wash fake blood/tissue/fluids from any items that are disposable so that others will not mistake any of the discarded items for biohazardous waste. Dispose of sharps in a properly labelled container. Work in a well lighted area with access to clean, warm water. Have proper makeup removal and cleaning supplies available for the products you are using. Check your kit beforehand for outdated supplies and other deficiencies. Keep yourself, your team and your kit sorted out.

Makeup Sanitation

It is your job as a casualty simulator to use proper sanitation techniques. Understanding the characteristics of pathogens (infectious agents), the proper terminology, how they are spread and how they reproduce is important for the casualty simulator. According to a study by Dr. Elizabeth Brooks, a biological sciences professor, makeup can harbour staph, strep and E. coli bacteria (source: "[Handle those store makeup testers with care](#)", by Alene Dawson, L.A. Times, April 18, 2010).

- **Bacteria:** Bacteria are single-celled microorganisms. Most bacteria do not harm humans, some are beneficial to humans and some are harmful to humans. Transmission of bacteria can be through contaminated food and water, by direct contact and by sneezing and coughing. Bacteria reproduce by asexually by binary fission (cell division). Colonies of bacteria can form physical bonds between both individual bacteria and surfaces creating a biofilm. Biofilms can make efficient surface disinfection difficult. Examples of common bacterial infections are tuberculosis and salmonella.
- **Viruses:** A virus is an infectious agent made of genetic material (DNA or RNA) inside a protein coat. Transmission of the virus can be through bodily fluids (blood, saliva), through contaminated water or by sneezing and coughing. Viruses require a host cell to create copies of the original virus, they cannot reproduce on their own. Examples of common viral infections are influenza and herpes.
- **Fungi:** Some of the species in this kingdom, such as yeasts and moulds, are microorganisms which can cause infections in humans. Fungi can reproduce both sexually and asexually. Of special concern to the makeup artist are the dermatophytes; fungi which cause infections of the hair, skin and nails. This can be spread by infected exfoliated skin adhering to makeup tools. Like bacteria, some fungi can form biofilms. Examples of common fungal infections are tinea pedis (Athlete's foot) and vaginitis.
- **Microorganism:** A small single-celled or multi-celled organism. Examples include bacteria, fungi, algae and some tiny animals such as mites. Viruses are sometimes included in this category although they are not cells or living organisms.
- **Disinfectant:** Destroys microorganisms on non-living objects. An example of a common disinfectant is a 5.25% solution of sodium hypochlorite (household bleach).
- **Antiseptic:** Destroys microorganisms on living tissue. An example of a common antiseptic is 70% isopropyl alcohol solution used to prepare the skin during aseptic procedures such as an injection.

Clean hands: *Always wash your hands before working with a client*, preferably with soap and water. To wash your hands, first place three clean, dry paper towels near the sink. Turn on the water. Make a lather with hand soap and lather your hands for at least 20 seconds. Dry with paper towels, using the third towel to turn off the faucet so you don't contaminate your hands. Aside from clean hands you should keep your nails clean, trimmed and filed.

If you don't have access to a sink use disposable hand wipes. These wipes remove dirt and usually contain a mild antiseptic such as benzalkonium chloride. Hand sanitizer should be considered a distant 3rd choice since regular hand sanitizer just moves dirt around rather than removing it as soap and water or hand wipes do.

Gloves: Some artists like to apply makeup directly to clients using their fingers; this is a personal preference. Your skin is constantly shedding cells and working hands get nicked, cut and scratched. Gloves are a barrier that prevents cross-contamination between client(s) and the makeup artist. Gloves are NOT a substitute for clean hands. My gloves of choice are vinyl examination gloves. These are thin, translucent and cheap. Vinyl is a better choice than latex which has allergy issues or nitrile which only comes in colours (usually purple or blue) that can bias your colour sense. Gloves let you move rapidly between clients by quickly changing gloves and shows your client that you are indeed a clean and sanitary makeup artist. You can use the back of the glove as a convenient palette to mix creme colours.

After working with a client, consider the outside of the glove contaminated and the inside of the glove, next to your skin, clean. To remove gloves, grasp the outside cuff of one glove between your thumb and index finger (contaminated to contaminated). Pull off glove turning it inside out as you pull it off. Using your un-gloved hand, curl your fingers inside the cuff of the remaining glove (clean to clean) and pull off, turning the glove inside out with the first glove inside the second. Dispose of the soiled gloves in the garbage.

Set up your work area for cleanliness. Use a fresh white cotton towel with a disposable towel on top to layout your clean tools. The disposable towel can be replaced as necessary to keep the area clean. The cotton towel provides additional absorption when drying brushes and for accidental spills. Use disposable cleaning pads and makeup sponges when possible. Make sure you have a waste bin close by before you start so you don't end up with a pile of dirty, used disposables next to your work area.

Sometimes you'll have to use the same set of brushes on several clients. Always clean and sanitize your brushes before using on a new client. Use a brush cleaner intended for makeup brushes and follow the directions on the product. Stainless steel makeup spatulas and other tools can be cleaned with an alcohol wipe between clients or whenever you suspect contamination. Alcohol is most effective when diluted with water which facilitates diffusion through the cell membrane of the bacterium. Proper disinfection requires a concentration of at least 60% alcohol; most alcohol wipes are 70% alcohol.

Between makeup sessions I like to clean the brushes used for creme and liquid products with a brush soap and warm water. This ensures that all of the makeup is removed from the brush so there is nothing for microorganisms to grow on during storage and it conditions the brush as well. Follow the manufacturer's directions on the brush soap container.

- **Creme products:** Scoop creme products out with a makeup spatula and place on a clean palette. Place the scooped product beside previous scoops (not on top of) to prevent cross-contamination via the spatula. If you use your spatula to mix, clean with an alcohol wipe before scooping more product.
- **Liquid products:** Dispense liquid products onto a clean palette or fresh applicator with a dropper, pump or brush. Setting liquids and sealers applied using a pump sprayer will eliminate cross-contamination. Rigid collodion must be applied directly from the bottle since it dries quickly. The solvent content in the collodion will prevent cross-contamination between casualties.
- **Pencils:** Keep clean pencils capped to prevent breakage and soiling. Sharpen pencils between clients and wipe with an alcohol wipe (70% alcohol). Air dry the pencil and replace cap.
- **Dry powders:** Dry powders, loose or pressed, in general do not provide an hospitable environment for microorganisms to breed. Dry powders are difficult to scoop out with a makeup spatula so it is best to work directly from the pan and use a makeup sanitizing spray on the powders between clients. I use Beauty So Clean spray. Setting powders can be dispensed in small amounts into a shallow dish for more control when loading the powder brush.
- **Cake products (water or alcohol activated):** You can work with alcohol activated paints directly from the cake to the client's skin. Microorganisms on the client's skin will be killed by the alcohol. With water activated cake there are two ways of working. If you don't use very much of the product, use a small, flat synthetic brush to mix and hold the product. Work from that brush as you would a palette. For products such as cake foundation, work directly from the cake and sanitize between clients. In some cases, small amounts of cake foundation can be scrapped off the cake with a make-up spatula and mixed on the palette. This is convenient when you want to mix a custom colour.

Product Selection, Safety and Application

There are many professional make-up products on the market. Select the ones that you want to use based on local availability and price. In general you should purchase professional grade products from reputable suppliers. Although you'll pay more for professional products you'll get more coverage and have better working characteristics. In the end you'll save yourself time, money and frustration.



The most versatile and useful products I've found are the burn, bruise and injury wheels available from various manufacturers. The wheel on the left is a Kryolan® Burn & Injury Wheel, the wheel on the right is a Ben Nye® Monster Wheel (excellent for frostbite and cold injury). These wheels group together commonly used colours needed to create the effects suggested by the name. You can use neutral set powder between layers of creme colour and makeup sealer to coat the finished effect. In many cases, all that is needed is a wheel, a brush, neutral set powder and a spray bottle of makeup sealer to create a realistic, long-lasting wound effect.

When using any product on the body be sure that it is appropriate. Anything applied directly to the body should be restricted to cosmetics only; do not use poster paint, glue or other materials directly on the body. The Art & Creative Materials Institute, Inc. (ACMI) is a non-profit association of manufacturers of art, craft and other creative materials which has developed standards for art material safety. The ACMI approved product (AP) label: *" . . . identifies art materials that are safe and that are certified in a toxicological evaluation by a medical expert to contain no materials in sufficient quantities to be toxic or injurious to humans, including children, or to cause acute or chronic health problems."* (from the ACMI website, <http://www.acminet.org/>). Note, however, that the ACMI on their website also states: *"Never use products for skin painting or food preparation unless indicated that the product is meant to be used in this way."* Although a product may be non-toxic, it may stain or irritate the skin if not used for its intended purpose. Some non-toxic pigments may be abrasive and cause injury to the eyes.

In most cases, products in this document that are not cosmetics are used in such a way as to be isolated from the skin. Objects may be sealed using a make-up sealer. Adhesives like Pros-Aide® form a barrier between the body and the object.

Inappropriate materials used as makeup can have dire consequences. Actor Buddy Ebsen (1908-2003) became seriously ill after inhaling aluminum powder used on his skin to create the Tin Man character for the 1939 film *The Wizard of Oz*. He had to be hospitalized with respiratory problems and was eventually replaced in the film by actor Jack Haley. The silver makeup used on Mr. Haley was reformulated as a creme base.

Grease paint sticks should be avoided. These tend to be difficult to apply and blend. Grease paint sticks smear and transfer easily to clothing. I also find grease paint sticks present a problem in maintaining a professional level of sanitation at my make-up station. Use creme colours or alcohol activated colours instead.

One of the primary skin cleansers I use is witch hazel, an astringent made from the leaves and bark of the *Hamamelis virginiana*, a shrub native to North America. It has a long history of safe use and is available from most pharmacies at a low cost and works well. You can also use isopropyl alcohol to clean the skin. Alcohol is especially good at removing grease and oils but may dry the skin if used repeatedly on the same area.

Glycerin is a hygroscopic liquid used to keep some effects such as thick blood wet looking. Mixed with water in a 1:1 ratio it can be sprayed on the skin as a non-drying perspiration. Add a one or two drops of green food colouring per 100ml to make the glycerin/water perspiration stand out against the skin. In some situations a water-based lubricant such as Muko® can be used instead of glycerin. These water-based lubricants have a higher viscosity than the glycerin/water mixture and are less inclined to be absorbed by makeup.

Liquid latex used in casualty simulation should always be the cosmetic grade. Store liquid latex at a temperature above 10°C (50°F); below this temperature the latex can freeze, congeal and become useless. Be careful when using liquid latex around the eyes since the ammonia used in the latex can irritate the eyes. Water-Melon™ (by Michael Davy <http://www.michaeldavy.com/>) is a substitute for liquid latex. If you or any of the people you work with have latex allergies, you might consider using this product in place of latex.

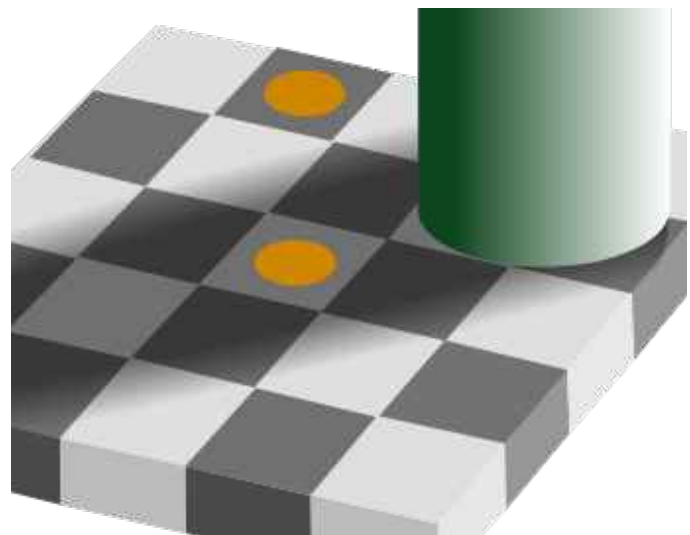
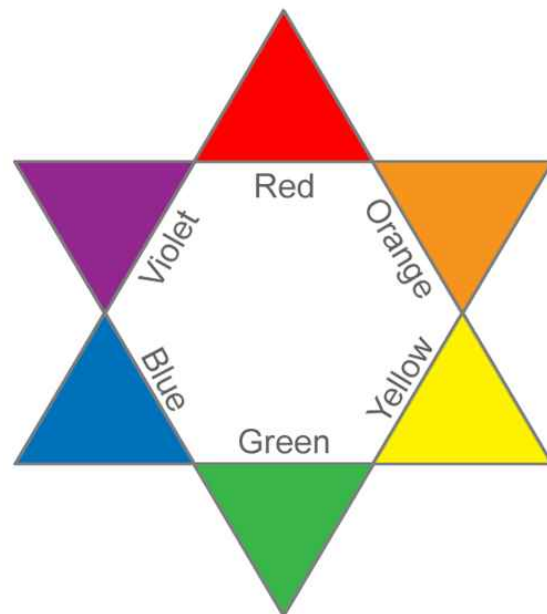
You'll often find a flesh coloured wax in casualty simulation kits. Although the wax (sometimes called nose & scar wax) is easy to shape and apply to the casualty, it does have shortcomings. Water-based colours will not stick to the wax. In cold climates, the wax becomes brittle and will fall off. It is difficult to apply to areas of the body that flex. The wax also deforms if a pressure bandage is applied over the wound, something which is common in casualty simulation. In most cases, I avoid using wax except for small effects over bony areas. It is good for creating deformations in limbs resulting from closed fractures. Wax can be made more durable by an application of Pros-Aide® or spirit gum on the skin before you apply the wax. Daub a cotton ball into the adhesive so the cotton fibres stick to the area. This provides additional grab for the wax to hold. Coating the wax with liquid latex improves the durability as well as the ability to accept certain kinds of makeup. Use a makeup sponge to apply a couple of thin layers of latex then seal with a castor sealer when dry, prior to applying any makeup. The sealer prevents the latex from absorbing the makeup and affecting the colour.

A prosthetic appliance (usually just appliance) in makeup and special effects, is a prosthetic made from silicone, latex, gelatin, wax or other material which is attached to the skin. The appliance modifies the shape and texture of the actor's features.

Colour

The pigments used in makeup modify light by absorbing or reflecting particular wavelengths of light which we perceive as colours. Different pigments absorb/reflect different wavelengths and appear as different colours. The *simplified* painter's colour wheel on the right shows how the primary colours can be mixed to make secondary colours. Mix blue and yellow to get green, red and blue to get violet and so on. Colours opposite each other will neutralize each other and become a grey colour. Mix red and green pigments and you'll get a grey tone. This is useful in modifying skin tones for conditions such as shock where a lack of blood (red) can be achieved by neutralizing the red with a light green or light blue makeup. Reds are often used to cover tattoos done with blue inks.

Not all colours can be made by mixing just two of the primary colours. Brown, for example, is a tertiary colour made from a mixture of three primary colours. Tertiary colours have a neutral component and can be made by mixing a secondary colour and black. If you look at the example to the right (a modified version of the original checker shadow image by Edward H. Adelson; this image may be reproduced and distributed freely) you'll see what appears to be an orange and a brown. These two values are the same colour, one appears darker because of the surrounding tones. The sensation of colour and tone is not absolute but is relative to the surround.



Skin

In casualty simulation practically all of the effects are applied to the skin. Understanding how the skin looks and functions is critical to realistic casualty simulation.

Skin colour a function the of melanin in the epidermis and underlying layers, the dermis and hypodermis. Melanin comes in two types pheomelanin (red) and eumelanin (brown-black). All humans have some pheomelanin in their skin; women have more pheomelanin than men and, in general, have a more reddish skin tone. Pheomelanin is responsible for the pink hue in the lips, nipples and vaginal lining. The amount of eumelanin varies in human populations, the higher the concentration of eumelanin the darker the skin.

The dermis is the second layer of skin which contains the blood vessels, hair follicles and nerves. Some of the colour of the skin is the result of blood in the dermis. When someone is in shock, the lack of blood causes loss of colour in the skin.

Underneath the skin is the hypodermis or subcutaneous tissue. It contains a layer of fat, thicker in women than in men. The older a person is, the more yellow the subcutaneous fat.

As we age the skin becomes damaged from environmental sources. Sunlight can cause uneven skin pigmentation and can permanently dilate capillaries. Dark spots in the skin, solar lentigines (commonly known as liver or age spots) can be caused by excessive exposure to the sun. Sunlight can also damage the collagen and elastin fibers leading to wrinkles and loose, sagging skin. Nicotine from smoked or smokeless tobacco can prematurely age the skin by vasoconstriction reducing the skin's blood supply.

The structure of the skin, combined with ageing and damage from everyday living, gives the skin its colour. You can see minor skin colour variations in the photographs on the right (both female, mid-20s).

Skin moves in different ways depending upon how it is attached to the underlying structures. In the face, the muscles insert into the skin, giving humans a wide range of facial expressions. The scalp is relatively immobile, attached to the fascia covering the skull. On the palms, the skin is bound in places to the fascia giving the distinctive lines of the palm. The loose skin of the eyelids and foreskin permit fluid movement of those parts.

Blood

Adult humans, depending on size, have a total blood volume of 5-6 litres. Hypovolemic (reduced blood volume) shock may only become apparent after blood loss of up to 40% of the total blood volume. Each break in the pelvis will, on average, cause an internal blood loss of 500ml. Each femur fracture represents a loss of about 1.5 litres of blood. Oxygenated arterial blood is bright red in colour; deoxygenated blood returning to the heart through the veins is a darker colour. Human blood is only slightly more viscous than water. It is also translucent, not transparent, since it contains cellular material (red blood cells) which give it colour.

The amount of blood you will use around a casualty during a simulation will vary based on the type of scenario and the surround. On pavement, blood remains pooled on the surface; even a small amount looks like a large quantity. In contrast, dry sand or gravel will absorb a considerable quantity of blood. You can see this for yourself by pouring water on a sandy area and on a paved area.



Note: In the remainder of this section the references to blood will be to fake blood used in casualty simulation and not to real human blood.

Stage blood is often darker, transparent and stickier than real blood; the basic ingredients in many brands are corn syrup and colouring. Usually this is advantageous since it sticks to the wound and the dark colour adds depth. Some products, often labelled mouth blood, may have flavouring added. For more realistic splatter effects add a bit of yellow food colouring to the blood and thin it slightly. I sometimes add a very small amount of cheap, water-based makeup foundation (from the dollar store) to give the blood a realistic translucency. You can modify stage blood by adding other products to it. K-Y® Jelly or a similar water-based lubricant (suggested by MedFX at [The FX Lab](#)) can be added to stage blood to make it more slimy (let the blood-jelly mix sit overnight to thicken); use glycerin for a less sticky consistency.

You can make your own blood quite cheaply in quantity. I use the following recipe:

- 3.8 l of water
- 35 g methylcellulose (Monster Makers)
- 250 ml glycerin
- 20 ml red body paint (Kryolan)
- 10 ml #40 red food colour powder (Monster Makers)
- blue food colour liquid

Stir the methylcellulose into the water (cool) and let stand overnight. When the methylcellulose has fully absorbed the water, stir to break up the lumps. Add glycerin and stir. Mix the paint and food colour with 100 ml of cool water and add to the methylcellulose mixture. Stir until uniform. Add blue food colouring drop-by-drop to adjust the colour. This recipe will give you a thick blood which can be easily poured. It can be thinned with water for spraying. Do not thin too much or the red paint pigment will settle to the bottom of the container.

Thick blood is a gel type of product which can be applied to wounds with a makeup spatula for dimensional effects. Old or scab blood is like thick blood but with a brownish tint. Concentrated blood is available from several sources; my own experience has been with [Laerdal](#) Concentrated blood. This product is useful when you need large quantities of blood for arterial bleeds and similar situations.

Alcohol activated paints in blood colours can be used to create durable “bleeds”. Paint the bleed on the skin with appropriate colours then add water-based lubricant to the area for dimensionality and shine. Give the casualty a packet of lubricant to renew the bleed as necessary.

If you're concerned about staining try mixing red flocking with a water-based lubricant (KY Jelly) or methylcellulose/water to make a non-staining fake blood. Adjust the colour with small amounts of blue or black flocking. This mixture was used in the movie “Water for Elephants” (2011) to make up the elephants (elephant skin stains easily). Add glycerin/water to modify the viscosity of this fake blood.

For a non-pyro (no squib) blood hit effect from a bullet or fragment, try this simple effect used by Tom Savini in the movie “Dawn of the Dead” (1978). Take a condom and make a cut in it. Tape the cut closed then fill with blood and attach to the actor. Run a fishing line from the tape. For the effect, tug sharply on the fishing line to tear off the tape and cause a blood splatter. (see the Tom Savini interview in “Fantastic Flesh: The Art of Make-Up EFX” DVD, directed by Kevin Vanhook, Starz Entertainment LLC, 2008).

Brushes, Sponges and other Tools

Brushes, sponges and other tools are essential yet often overlooked items of your makeup kit. To perform your duties properly you must have the proper type and sufficient quantities of these items AND keep them clean and serviceable.

The brushes you'll use will be a mixture of synthetic and natural bristles. I like soft, natural bristles for anytime I'm working directly on someone's skin; applying pigments or powder. Natural bristles tend to be softer and a bit more controllable. On the downside, natural bristles have longer drying times when used with wet media and the fibres are sometimes dyed which can wash out. When you're doing casualty simulation being able to clean and reuse your brushes quickly is a major consideration. Synthetic bristles (nylon, Taklon) are good for applying adhesives and blending appliances. The synthetic bristles tend not to absorb liquids as readily as natural bristles. Most brushes consist of a handle (wood or plastic), a ferrule (metal or plastic) and the bristles.



Brush sizes may be given in metric (millimetres), US/Imperial measure (inches), type/use (i.e. powder) or in the case of artists' brushes, by a numbering system. Artists' brushes are sized by a numbering system from smallest to largest: 10/0, 7/0, 6/0, 5/0, 4/0, 000, 00, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 20, 22, 24, 25, 26, 28, 30. This numbering system is not an absolute measure and sizes will vary between manufacturers. The size is often embossed on the handle (see photograph)

Brushes come in many different types. The most common types you'll run into in casualty simulation are:

- **Round:** Long bristles which come together in a point. Used for precise application of colour.
- **Flat:** Long bristles in a flat end. A good choice for applying adhesives.
- **Bright:** Similar to a flat but with shorter bristles. Use where you need more control than offered by a flat such as painting and blending.
- **Angle:** Similar to a bright but with an angled end. I use a synthetic angled brush to blend gelatin appliances; the angled tip gives a fast, sharp cut through the flashing and the flat portion gives good control for blending.
- **Chip:** A cheap, disposable flat brush, 2-3cm in width. Used to apply adhesives, cleaning fluids and paint.
- **Fan:** A wide fan shaped brush. Used primarily for blending makeup or colours.
- **Powder:** Large, soft brush used to apply powder.
- **Contour:** A soft brush similar to but smaller than a powder brush. This brush has angled bristles.

When cleaning your brushes between casualties, use a commercially available spray brush cleaner/sanitizer. These spray cleaners are good for your dry brushes (powder, contour) and work quickly and effectively. Spray then wipe off any makeup with a tissue. For other brushes, wash in water or other suitable solvent (i.e. alcohol). Do NOT leave your brushes sitting on the bristles soaking in water; this will distort the bristles and ruin your brush. Use an artist's brush washer which has a holder which keeps the bristles off the bottom of the washing container. Don't soak your brushes; water can swell wooden brush handles and weaken adhesives holding the bristles and the ferrule. When storing round and bright brushes, work a bit of artist's brush soap into the bristles, shape with your fingers and dry. This will help to retain the shape of the bristles over the lifetime of the brush. Wash out the soap just before using the brush.

You'll use several different types of sponges for different tasks. The triangular makeup sponge is the most versatile item in your casualty simulation kit. You can use it to apply creme or alcohol-activated colours, stipple on liquid latex and to blend colours. Cheap, disposable makeup sponges are often made of latex. If you're casualty is not sensitive to latex and you're not using silicone then latex is an acceptable choice. Otherwise use polyurethane sponges available from a professional makeup supplier. The polyurethane sponges are more expensive but can be used with silicone (the sulphur compounds in latex inhibit curing in platinum cured silicone). Latex sponges are cheap and should be thrown away after use. Polyurethane sponges can be carefully cleaned and dried after use. Always be sure to have enough sponges available. NEVER use the same sponge on more than one person unless it has been properly washed and dried between uses.

When applying colours, either creme or alcohol-activated, pick or tear away parts of the sponge to give it an uneven shape. This will make your application more natural than using the square end of the sponge.

Other sponges you may wish to try are the black nylon stipple sponge and the orange rubber sponge. The black nylon stipple is used for creating realistic looking scrapes by stippling on thick blood or colour. You can also use it to create a broken capillary effect for windburn (heat/cold injury). The orange rubber sponge is excellent as

a texture sponge for colour blending appliances and some types of burn injuries. Both of these sponges are usually sold as a large sponge which should be cut into smaller pieces prior to use. These sponges can be washed, dried and reused several times.

Cotton cosmetic pads are good for cleaning the skin. Purchase good quality woven pads; cheap pads tend to disintegrate and leave fibres on the skin. I keep a few cotton balls (absorbent puffs) in my kit to add fibres to Pros-Aide® to aid in the adhesion of wax.

You should also have several small, steel makeup spatulas. Spatulas are very useful in transferring small quantities of makeup from containers to your palette (to prevent cross-contamination from double dipping). You can apply items such as thick blood to wounds using a makeup spatula. Always clean and sanitize the spatula before using it on another casualty to prevent the transfer of germs. Wood tongue depressors are excellent for mixing and working silicones, effects gels and cabo (thickened Pros-Aide®). When sculpting with silicone or cabo on the skin, dip the tongue depressor in 99% alcohol before using to help reduce sticking.

For cutting I like to use bandage scissors. These have an angled handle and a blunt end so it is easy and safe to use near the skin. The surgical stainless steel is highly polished and easy to clean and sanitize.

Paints

Paints are used in casualty simulation to colour skin and appliances. Paints may contain:

- pigment/dye – gives the paint its colour. A pigment is a finely divided material which is insoluble in the vehicle used in the paint. A dye is a colourant which is soluble in the vehicle.
- vehicle or binder – the substance or body of the paint that binds the pigment or is coloured by the dye. Examples: gum arabic (watercolours, gouache), linseed oil (oil paint), acrylic, wax (encaustic).
- solvent – the liquid used thin the paint. Examples: water (watercolours, gouache, acrylic), alcohol (alcohol activated paints), mineral spirits, turpentine (oil paints).
- additive/modifier – an additive/modifier changes the characteristics of the paint. Examples: thickeners, dryers (speeds drying), retarders (slows drying), opacifiers (make the paint opaque), matting agents (reduce surface shine)

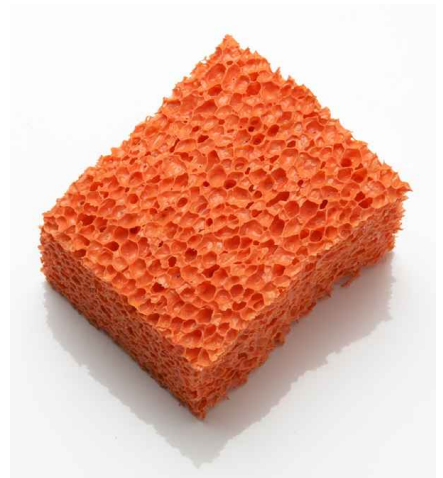
Danger! The components listed above are only examples and are not necessarily safe for use on humans. Use only approved cosmetic products on people.

Many **professional** artist's paints contain materials which are harmful to humans if not handled properly. For example, Flake White oil paint is made with the pigment lead carbonate. Other paints may contain compounds of cobalt or cadmium. Read all labels carefully. Do not use these paints/pigments in makeup or appliances.

Stippling is the application of a paint or ink with a quick up/down motion at right angles to the surface rather than a brushing motion across the surface. Foundations are usually applied in a stippling motion using a sponge. Scumbling is the application of a paint or ink to a surface in a broken, irregular pattern. In makeup, scumbling is often used to recreate the slightly irregular texture of human skin. A torn makeup sponge can be used for scumbling. A wash is a diluted or thinly applied layer of paint, usually translucent or transparent.

Alcohol Activated Paints

Alcohol activated paints and inks are durable, waterproof makeup products that use 99% isopropyl alcohol as a solvent. Available in both cake and liquid, these paints/inks are concentrated colours with high coverage intended for professional use. I've found that cake colours in a palette are the easiest to work with and can be replenished by adding liquid paint (same make and colour) to the palette and allowing it to dry.



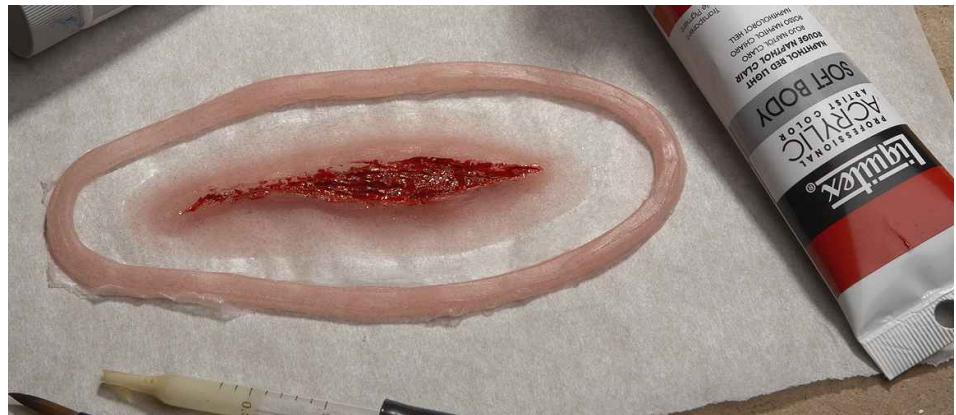
A quick way to blend appliances to the skin colour with alcohol activated paints is to use a stiff brush to splatter paint in a random pattern in the area you wish to blend. Use a chip brush with the bristles cut short (1cm) or a toothbrush. Load the brush with thinned paint and splatter by drawing a piece of stiff metal or plastic across the bristles. With a bit of practise you'll find this technique is fast and effective for blending.

PAX Paint

PAX paint is a mixture of acrylic paint and Pros-Aide® in a 1:1 ratio. This paint is the standard paint used by makeup and special effects artists for painting appliances. I use Liquitex® acrylic paints to make my paints. PAX paint can be thinned with up to 25% water. If you need additional thinning for greater translucency add more Pros-Aide®. Use PAX ONLY for colouring appliances; DO NOT USE PAX DIRECTLY ON SKIN. For maximum durability allow PAX paints to cure for 3 days (keep the appliance in a plastic bag in a cool area). A basic skin tone to start with is a mixture of 30 parts White, 10 parts Raw Sienna, 5 parts Burnt Umber and 2 parts Red Oxide. The amounts given are only approximate; you will need to adjust this to match your casualty's skin tone. This mix is a little bit reddish so you may want to use some blue or green as an adjuster to match olive skin tones. Darken basic mix this by adding more Raw Sienna and/or Burnt Umber. Parchment colour is a good starting point for bone and fascia. Subcutaneous fat can be coloured with a mix of Parchment and Yellow Oxide; remember that subcutaneous fat becomes more yellowish with increasing age. Naphthol Red Light is a good match for bright arterial blood, mix with Red Oxide for a darker scab congealed blood colour for wound edges.

I usually use a Cobalt Blue Hue in the deepest areas of the wound and under torn and avulsed skin to enhance the depth and to provide contrast and detail. Some texts say to use pure black to paint the deeper parts of the wound but I recommend against using black as black paint flattens the wound instead of making it appear truly three dimensional. Experienced fine art painters rarely use pure black except as a key in small areas. If you look at the work of Rembrandt and Jean Siméon Chardin you'll notice the shadows are dark, not black, and contain detail even in the deep shadows. By colouring the wound slightly lighter than pure black you'll make it appear realistic. Vary the shading to add depth and detail; use the darkest, coolest blue at the deepest part of the wound and warm the blue with a touch of light red as you move toward the shallow areas. Highlight the upper parts of a bloody wound with small amounts of bright red mixed with deep yellow. Add transparent washes of your blood colours over the blue underpainting; the blue modulates the red.

The image is a gelatin appliance in the process of being painted with PAX paint. It is on silicone parchment and the gelatin is intrinsically coloured with flocking.



Pros-Aide® and Thickened Pros-Aide®

Pros-Aide® is the industry standard adhesive for applying non-silicone prosthetics to the skin. To use, coat a thin layer on the prosthetic and allow to dry; it will remain tacky. Apply to clean skin.

For blending the edges of latex appliances or building up effects on the skin, Pros-Aide® adhesive can be thickened to a toothpaste-like consistency by adding Cab-o-sil®, an inert fumed silica thickening agent. This mixture is sometimes called bondo (**NOT** to be confused with the Bondo® used for auto body repair) or cabo. Although it is inert from a chemical standpoint, inhalation of the dry Cab-o-sil® powder can cause pulmonary inflammation. The dry powder is also a mild skin irritant. Always wear a recommended respirator (use an N95 for nuisance levels of dust, see the product data sheet for more information) when using Cab-o-sil® in a dry powder state. Cab-o-sil® is approved by the U.S. FDA for use in food and cosmetics. This mixture can be tinted with coloured flocking and if a bit of care is used, painted with alcohol based paints. Use a wet makeup sponge for blending to get a smooth surface.

When using adhesives and makeup sealers try to avoid building up the products layer upon layer unless necessary. Doing so can cause problems in removal since one product may prevent remover from reaching a lower layer. Always have the proper remover for the adhesives/sealers you're using and enough to finish all of your casualties.

Thickened Pros-Aide® can be moulded into appliances using silicone moulds but this technique is beyond the scope of this article. If you wish to find out more about this technique, I highly recommend the book *"Special Makeup Effects for Stage and Screen: Making and Applying Prosthetics"* by Todd DeBreceni. The technique of moulding Pros-Aide® into appliances was pioneered by makeup artist Christien Tinsley while working on the Mel Gibson film *"The Passion of the Christ"* (2004). Mr. Tinsley won an Academy Award (2007) in Technical Achievement " . . . for the creation of the transfer techniques for creating and applying 2D and 3D makeup known as *"Tinsley Transfers."*" (preceding quote from <http://www.oscars.org/>). moulded Pros-Aide® appliances (forehead and under the eyes) were used to age actor Brad Pitt in the 2008 film *"The Curious Case of Benjamin Button"*. Makeup artist Greg Cannom won an Academy Award, Achievement in Makeup, for his work on *Benjamin Button*.

Using Flesh Effects Gel

Flesh Effects Gel is a gelatin-based product made by Ben Nye®; similar products are available from other manufacturers. Scar Effects Gel is a similar product only with colouring added to simulate flesh colour. Heat the container in a cup of hot water until it turns to a thick liquid. You can use a metal makeup spatula and wooden sculpting tools to shape the gel before it sets. Use this product to create small effects like lacerations, bullet and fragment wounds, blisters, pustules and lesions. Be sure you test the gel BEFORE you apply it to the casualty to make absolutely sure it is not too hot. For more durability apply Pros-Aide® to the skin before applying the effects gel and seal the finished effect with another thin layer of Pros-Aide® before colouring.

You can also make your own effects gel using the following formula. It can be adjusted to the materials you're using and to your personal preference.

- ➡ 14g Gelatin (food grade, 2 × 7gm packets)
- ➡ 10ml Liquid foundation (dollar store, 20ml for \$1)
- ➡ 30ml Glycerin
- ➡ 10ml Water

Mix components in a microwavable container. Heat in the microwave for 9 seconds and stir. Repeat until the gelatin is dissolved. Pour into individual containers and allow to set. Use the same way as the commercially made product.

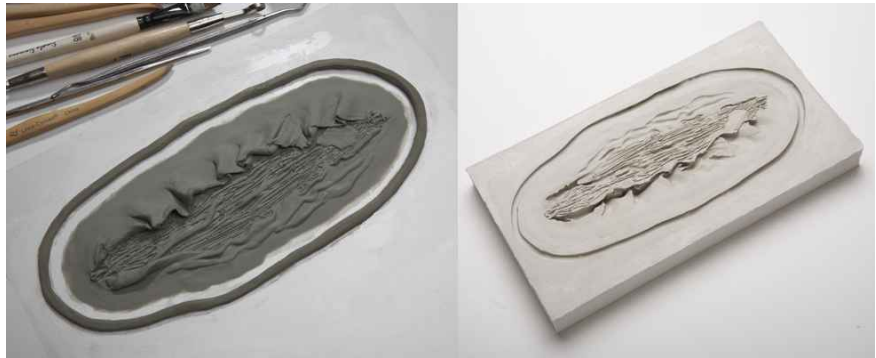
You can make a clear effects gel by substituting 5ml of water for the liquid foundation (14g gelatin + 30ml glycerin + 15ml water). Mix and heat as described. You can add a *small* amount of red flocking (an inert coloured textile fibre) to this mixture to mimic capillaries. For more about flocking see the section "Making Gelatin Appliances."

Sculpting Appliances and Making Moulds

To make appliances you'll need a mould. You can create your own moulds or purchase ready-to-use plastic moulds online. In most casualty simulation work you'll be using plate moulds (also called flat moulds) to create generic appliances that can be used on anyone. To make your own mould, lay a piece of clear plastic on a flat surface and tape down along the edges. I use Dura-Lar™ clear polyester 0.005" sheets to keep the surface of my moulds smooth; other brands of polyester sheeting should work just as well. Using a non-sulphur professional plasteline (I use clay by Chavant, a brand popular with many professionals), sculpt your wounds on this surface. Using a non-sulphur plasteline makes your moulds silicone friendly (sulphur inhibits curing of most silicones) giving you more options with respect to materials. You can smooth the plasteline with a soft brush dipped in mineral spirits. Purchase sculpting tools from an art store or make your own from wood and metal. If you're new to sculpting, use items you have around the house as sculpting tools to help you decide on what types of tools you need. Tool selection and use varies considerably among artists. Silicone coated parchment paper, used in baking, can be used as a non-stick surface to roll and form parts of your sculpture on before you add them to your sculpture. Gently taper the edges of your sculpture to help with blending the appliance to the skin. For large appliances surround with an overflow for easier handling. Keep the moulds small for easy handling and quick production. The edges of the sculpture should be irregular for easy blending (straight edges

stand out). Keep the appliance thin, 5mm or under, you can make the wound appear deeper by applying colour and shading later. A thin appliance uses less gelatin, is easier to shape to the body and is easier to blend. Since gelatin, latex and silicone are flexible you can make wounds that are *slightly* undercut. The photographs show the original sculpture with overflow on the left and the finished Ultracal® mould on the right.

When you're finished, surround the wound sculptures with a cardboard or foamcore dam about 2cm high. Stick it to the Dura-Lar™ with a hot glue gun. Spray the sculpture with a *thin* coat of Krylon® Crystal Clear Acrylic spray to seal the sculpture. Let the Crystal Clear dry for 8 hours or longer then spray the sculpture with a *thin* coat of Krylon® Dulling spray to give the sculpture a bit of tooth so the plaster will stick and help prevent bubbles from forming. Allow the dulling spray to dry



for at least one hour. Over use of these sprays can cause loss of detail in your final appliance since the spray solvents can soften the plasteline. These sprays are available at many art/craft stores. You may be able to substitute other products; others have reported success in using [Pledge®](#) spray instead of the dulling spray but I have not tried this yet.

For most of your moulds use Ultracal® 30 gypsum cement, a product developed specifically for making detailed moulds. This material, if properly used, give you a mould which is much harder and more durable than one made from regular plaster.

Fill the mould with Ultracal® 30 gypsum cement. Mix the cement in a ratio of 38 parts cool water to 100 parts Ultracal® 30 *by weight*. You can measure the water by volume since 1ml (1ml $\approx$ 1cm³) of water is about 1 gram. The ratio is 2.63g of dry cement for each 1ml of water; round up to the nearest 10g after calculating the amount of dry cement needed. The final volume of your cement mix will be roughly 2 times the volume of water you start with. Measure your box and calculate the volume required (height $\times$ width $\times$ depth).

Example: The inner measurements of my box are 24cm $\times$ 12cm $\times$ 2cm = 576cm³ or 576ml. The volume of water required is half of this amount or 288ml. The dry cement required is 288 $\times$ 2.63 = 757.44g rounded up to 760g of dry Ultracal® 30 gypsum cement.

Mix the cement in a flexible plastic bowl. Add the dry cement to the water and mix thoroughly. Let stand for about 5 minutes so the cement can fully absorb the water then mix again. When mixing do not whip the mixture; whipping the mix will add air bubbles which you do not want. Do not wash leftover cement down the drain as it will settle in the trap, set and plug your drain. Let any leftover cement harden in the bowl, then flex the bowl to break it up and dispose of the cement pieces in the garbage.

Use a very soft brush (I use a 1" chip brush) to apply the first layer of cement mix to the sculptures; this helps prevent air pockets, then carefully pour in the remainder. Gently tap the mould to help remove any remaining air bubbles. As the cement sets it will become quite warm to the touch. Allow to fully set and cool, then peel off the plastic and remove the plasteline carefully. You can use a soft brush and mineral spirits if needed to remove small bits of plasteline. Small defects can be filled in or carved away with a sharp knife. If you need to patch a small defect, carefully scrape the area, soak with water for several minutes then apply freshly mixed Ultracal® 30 as needed.

Let the mould dry for 3 or 4 days then warm the mould (no more than 49°C/120°F or you'll risk surface calcination of the mould). *For slush moulding latex or Water-Melon™, do not seal or release the mould;* the mould absorbs water from the latex to form a skin on the inside of the mould. If you're using gelatin, coat the mould with a release agent such as Mann Ease Release™ 2831 (a wax based release). You can use a *very light* coating of petroleum jelly as a release agent instead. Heat the mould gently (keep below 49°C/120°F) before using so the gelatin mixture will remain liquid for a little while and flow into all areas and pick up detail.

Making Gelatin Appliances

In special effects makeup, a prosthetic appliance is a piece of shaped material applied to the face or body with adhesive. Various materials including wax, latex and silicone have been used to create appliances for the stage, television and motion picture. Gelatin is gaining in popularity since it is low cost, easy to work with, well tolerated by most individuals, flexible, tough, translucent and holds fine detail. Health care workers are at risk for latex allergies (see the NIOSH Latex Alert at <http://www.cdc.gov/niosh/latexalt.html>); using gelatin instead of latex in casualty simulations may help reduce allergy risk. Gelatin appliance mix can be purchased ready to mould from special effects suppliers or you can make it yourself.

The gelatin used in makeup appliances is a high Bloom (usually 250-300 Bloom) type used specifically for make-up and available from special effects suppliers. Bloom is the measure of the rigidity or toughness of the gelatin; the higher the Bloom, the tougher the gelatin. The 70% (by weight) sorbitol solution is usually available from the same source as the gelatin. Both the glycerin and the sorbitol are plasticizers which increase the flexibility of the gelatin appliance. Sorbitol adds toughness to the finished appliance and also acts as an indirect plasticizer by incorporating water into the gel. I add a small amount of water and use slightly less sorbitol than other formulations to improve the blending and flexibility of the appliance. Glycerin interacts directly with the gelatin as a plasticizer and does not need additional water. You can purchase glycerin from your local pharmacy. The ingredients you use may vary in quality and consistency from source to source and even from batch to batch. You may have to make slight adjustments to the following formula.

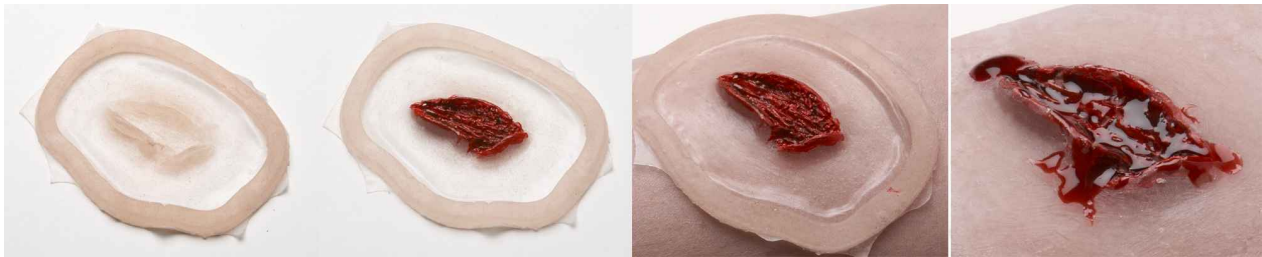
→Gelatin (250-300 Bloom)	20g
→Glycerin	45ml
→Sorbitol 70% solution	40ml
→Water	5ml

Mix the above ingredients thoroughly in a microwavable container. Allow the mix to sit for one hour. Place in the microwave and heat for 9 seconds on high. Stir. Repeat until the mixture is heated through and the gelatin is dissolved. You should not see any granules of gelatin in the mix when it is fully dissolved. DO NOT allow the mixture to boil. You can now stir in flocking in red and/or flesh colour if desired. Flocking is short pieces of thread. It mimics the tiny capillaries in the skin and gives the appliance a realistic colour. Use flocking to approximate the skin colour and reduce the amount of time you spend in blending the colour to match the casualty's skin tone. Flocking incorporated into a translucent or transparent medium like gelatin is called intrinsic colouring because the colour is distributed throughout the medium rather than just painted on the surface. You don't need very much flocking; too much flocking will make it difficult to obtain a smooth surface. **Note:** Any colouring you use in the appliance should be approved for cosmetic use. Let the mixture set, peel out of the container and store in a sealed plastic bag in a refrigerator until you need it.

To make an appliance, place the gelatin mix in a microwavable container. Heat for 9 seconds on high. Stir. Repeat until the gelatin is liquid. DO NOT allow the mixture to boil. Carefully pour the mixture into a mould and scrap the top flat with a tongue depressor or plastic scraper. Don't use a metal scraper; I've found that metal conducts heat away from the gelatin mixture quickly causing a build-up on the metal and an uneven flashing on the appliance. Allow the gelatin to cool, then strip the appliance out of the mould. Powder with cornstarch baby powder and store in a plastic bag in the refrigerator if the appliance will not be used immediately.

To use a gelatin appliance, clean with 99% alcohol or with acetone (ensure proper ventilation) to remove powder and grease/release from the surface. Coat the flat side (to be adhered to the skin) with two light coats of Kryolan® sealer or Green Marble SeLr™ allowing each coat to dry. The application of the sealer protects the gelatin appliance from perspiration. You can paint the wound with PAX paint, see section on PAX for details. Do not paint the rest of the appliance; you'll need to leave the gelatin edges unsealed and unpainted so you can blend it during application. To adhere to the skin, coat the flat side which has been sealed, with Pros-Aide® and allow to dry until tacky. You don't need a thick layer of Pros-Aide®, a thin layer dries quickly and is easier to blend. Clean the skin with witch hazel then apply Telesis™ Top Guard® Skin Barrier to the skin. Place the appliance on the skin and gently press into place. If you're using a large appliance, leave on the overflow (thick) edge to help in handling and keep the flashing from flopping around and sticking to itself. Use a soft brush or sponge dipped in warm (40° C) witch hazel to blend (dissolve/melt) the edges of the appliance into the skin. Pull off the overflow as you blend. Now you can paint the entire appliance with a thin layer of plain, uncoloured Pros-Aide®. Extend this coating of Pros-Aide® onto the surrounding skin and allow to dry. Blend to the skin colour

with thin washes of alcohol activated colour; you can spray with Green Marble SeLr™ to keep the alcohol from affecting the Pros-Aide® layer. Use a makeup sponge roughly torn in half to stipple the diluted colour on the appliance and skin. Splattering the appliance with alcohol activated paints is another quick way to blend. You can also use creme colours to blend the appliance to the skin. Fix with neutral set powder if desired.



The photos show a small gelatin appliance. At the far left is the powdered appliance after removal from the mould. The next image is the appliance after cleaning with alcohol and painting with PAX paints. The third image is the appliance being applied to the skin (you can see the transparency of the gelatin and how the closely the intrinsic colouring matches the skin colour). The far right is the appliance after blending with witch hazel and a small amount of stage blood applied. No colour was applied to blend to the skin, only neutral set powder was used to reduce the tack of the Pros-Aide®. You can use makeup sealer to reduce the tack of the Pros-Aide®.

Silicone for Special Effects Makeup

Silicone is often used in special effects for television and motion picture. It is available in a variety of densities, is hypoallergenic, skin safe, clear, is not affected by moisture or heat and can be intrinsically coloured. Silicone can be cast in moulds or modelled directly on the skin. There are, however, some technical points which should be understood before you work with silicone.

The hardness/softness of silicone is indicated by the shore scale. Shore hardness is given in one of twelve scales (A, B, C, D, DO, E, M, O, OO, OOO, OOO-S, R), with a value between 0 and 100; the higher the number the harder the material. For the most commonly used types of silicone the A and the OO scales are used. The scales overlap but the A is used for harder materials (mould making silicones). A rubber band has a shore hardness of 30 on the A scale, chewing gum a shore hardness of 20 on the OO scale (much softer). The shore scale is most often used with silicones intended for mould making and casting.

Silicone changes from a liquid/gel to a solid by curing. The type of silicone used in special effects makeup is often referred to as Room Temperature Vulcanization (RTV) since it cures at room temperature without the application of heat. Single component RTV silicone, used in products such as caulking, cures when in contact with water (either liquid or vapour). Single component RTVs liberate acetic acid during curing, may take from 7-10 days to fully cure and should not be used directly on the skin. Two-part tin cured silicones release water and alcohol during curing and should not be used directly on the skin. Skin safe silicones are usually two-part platinum cured types. Platinum cured silicones can be heat accelerated and will fully cure in a matter of minutes. Always check with the product manufacturer beforehand to be sure that the product you have selected can be safely used for your application.

Pot life is the amount of time you have to mix and apply the silicone. Total cure time is the time it takes for the silicone to fully cure. Cure time may be affected by factors such as temperature and how thick a layer of silicone is applied. This is especially true of single component RTVs and tin cured silicones.

Materials containing sulphides or amine in contact with the silicone may inhibit proper curing (these compounds bind to the platinum catalyst and inhibit it). Don't use latex sponges or gloves when handling silicone and, if you're making clay originals, use non-sulphur clays like Chavant NSP. Materials suspected of containing sulphur can be sealed with a thin coat of Krylon® Crystal Clear prior to moulding.

As mentioned, some silicones can be applied directly to the skin to create wounds and other effects. Before you apply silicone to the skin make sure that it is skin safe and follow the manufacturer's instructions. I've had experience with two silicone products that can be used on the skin; 3rd Degree by Alcone and Skin Tite™ by Smooth-On.

3rd Degree is a two-part (A and B) platinum cure silicone that comes in a thick gel. It is easy to mix (you can eyeball the amounts of gel) in a 1:1 ratio, has a pot life of approximately 3 minutes and a cure time of 5 minutes.

It takes alcohol based paints such as Skin Illustrator®. You can add a small amount of flocking while mixing for intrinsic colouring. When using 3rd Degree use separate tools to scoop out A and B gels; if you don't, cross-contamination between the two parts will make small lumps of silicone in your mix. Likewise, keep the lids labelled and on the proper containers. I have been able to use 3rd Degree with a dry latex "skin" for texture in wounds without any apparent problems (see previous caution regarding latex and silicone). If you wish to try this, experiment with small amount of latex "skin" and 3rd Degree to verify that this will work with your materials.

Skin Tite™ is a two-part (A and B) platinum cure silicone which is somewhat thinner than 3rd Degree. It is mixed by volume in a 1:1 ratio. You should measure it accurately according to the manufacturer's directions. Pot life is slightly longer than 3rd Degree, about 4 minutes, and the cure time is about 6 minutes. One of the things I like about Skin Tite™ is the ability to control the thickness/viscosity of the product by adding a thixotropic agent (Thi-Vex™). Thi-Vex™ is added to Part A in amounts between 0.5% and 2% of Part A; the more Thi-Vex™ you use the thicker the mix. Use a regular 1ml syringe or an insulin syringe to measure tiny amounts; the marking on the insulin syringe are usually in "units" of insulin (U-100 insulin). 1 unit of insulin is 1/100th of 1ml, 100 units = 1ml, 1 unit = 1% of 1ml. Don't use too much Thi-Vex™, as it is oily and the excess will migrate to the surface of the silicone and keep paints from adhering. Intrinsic colouring, such as flocking, can be added after mixing both parts. Like 3rd Degree silicone, Skin Tite™ works well with alcohol based paints. Skin Tite™ can also be cast in a mould to create appliances although Dragon Skin Pro FX is probably a better choice for casting. Skin Tite™ can also be used as an adhesive to adhere silicone appliances to the skin. Label the lids of Skin Tite™ containers to prevent mix-ups and cross contamination. You can clean up mixing utensils containing unmixed parts A and B and Thi-Vex™ using mineral spirits.

Both of the above products can be smoothed and blended with a brush, wooden stick or urethane sponge and 99% isopropyl alcohol prior to curing. Remove by peeling off the skin; use baby oil or isopropyl alcohol as needed to help remove the appliance.

Casting Silicone Appliances

In many ways casting appliances in silicone is simpler than casting in gelatin. You do have to pay attention when measuring out the components but all steps in the casting are done at room temperature, unlike gelatin, no heating is required. I use Dragon Skin Pro FX by Smooth-On but there are several other similar products available from other manufacturers. Whichever product you choose, be sure that it is safe for the skin and follow the directions.

Make the mould from Ultracal 30 just like you would for a gelatin appliance but be very careful that no sulphur containing substances come in contact with your original sculpt or your mould. Seal/release the mould with Mann Ease Release™ 2831. I like to heat the mould so the release penetrates the stone and leaves a smooth surface. Allow the mould to cool to room temperature before casting. If you use a warm mould it will accelerate the curing of the silicone and the silicone may not flow into some of the detail areas of the mould.

Mix your A and B parts of the silicone. In the case of Dragon Skin Pro FX you use a 1:1 ratio by volume. After mixing thoroughly I add Smooth-On Slacker (a silicone deadener which makes the appliance a bit softer and less rubbery, more like real flesh) and flocking to intrinsically colour the appliance. You can also add very tiny amounts of Silc Pig® silicone colour pigments to colour the appliance. An amount of 20% to 50% Slacker by volume of your A/B mix seems to work well. Mix these additional components thoroughly with your A/B mix. Pour into your mould. Use a toothpick or paper clip to remove large air bubbles and help the silicone flow into all areas of the mould. Scrape the top of the mould with a straightedge or the side of a tongue depressor to remove excess silicone and create thin blending edges. Allow the silicone to cure. Powder the back of the appliance with talc and then strip the appliance out of the mould. Powder the front of the appliance with talc. The talc keeps the thin edges of the appliance from sticking together. You only need to treat the mould once with the release since not very much transfers to the silicone. You can paint the finished appliances with alcohol activated paints. Store the finished appliances on a flat surface so they won't become misshapen or distorted.

To apply the silicone prosthetic mix a small amount of Skin Tite™ but don't add any Thi-Vex™. Wipe off the talc from the back of the appliance with a pad dampened with 99% alcohol. Apply the Skin Tite™ to the skin then press the prosthetic into place. Smooth down and blend the edges with a tongue depressor dipped in 99% alcohol. After the Skin Tite™ has cured, wipe the appliance with a pad dampened with 99% alcohol. Blend with alcohol activated paints as necessary.

The slickness of the silicone may create problems with causing blood and makeup to adhere properly. Use thick blood on the silicone wound as a base for stage blood. You can apply a water-based lubricant to give water

based blood something to cling to. A small amount of skin safe liquid hand soap applied to the silicone surface will help fake blood to stick. In some cases, alcohol activated paints will lift off when dampened with stage blood and then topped with a pressure dressing. If you anticipate rough treatment try stippling a thin layer of Skin Tite™ over the painted wound to help seal in your paint. You can use creme makeup of the appropriate colour to blend the silicone to the casualty or for additional effects such as bruising.

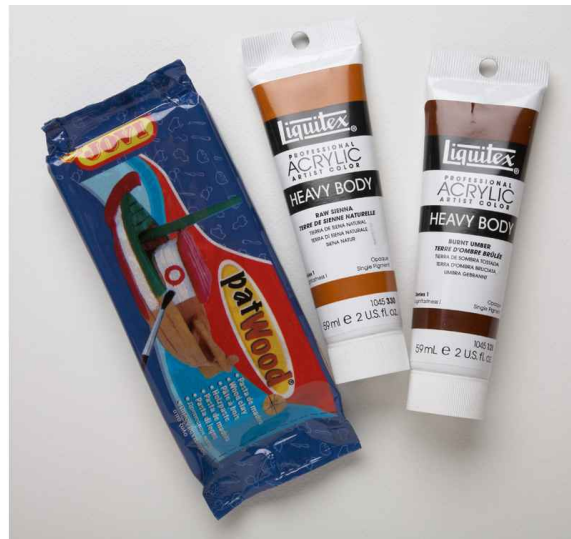
Creating Fragments and Embedded Objects

In real life, fragments may be from a conventional munition such as an artillery shell, grenade or land mine. Two examples are the notched wire inside the M-67 grenade which breaks into small diamond shaped pieces and the steel shot embedded in a plastic matrix in the M18A1 Claymore Antipersonnel Mine. Nails, bolts, scrap metal and just about anything else that can be easily obtained are also used in fragmentation devices, especially in the case of an improvised explosive device (IED). In addition to fragments from the device itself, materials surrounding the blast site such as glass, concrete, dirt, rocks and vegetation may be picked up and propelled by the blast.

When creating a fragment for casualty simulation you should try to keep it as lightweight as possible since it will be glued to the skin. It must also be non-toxic and without sharp edges.

Small fragments can be created from expanded polystyrene cups and packaging materials. Break the expanded polystyrene into suitable sizes. Use a brush to fully coat each piece with silver acrylic paint (I use Liquitex® Heavy Body Iridescent Rich Silver). Allow to dry. This acrylic coat prevents spray paints from dissolving the expanded polystyrene.

Use spray paints in various colours to give the fragments an authentic look. Flat black gives a burned look; red iron oxide primers and camouflage green are good choices for fragments produced by military ordinance. Apply the spray paint lightly and randomly for the most convincing effect.



For larger pieces resembling parts of military hardware use plastic poly plumbing connectors and nylon nuts and bolts (following photo left, see your local big box building store for a selection). Cut into interesting shapes with a hacksaw. Sand any rough edges with 220 grit wet/dry sandpaper. You can use a propane torch (outside, away from combustible materials; be careful of hot melted plastic!) to create realistic melted and distorted edges. Paint with spray paints, including aluminum for a metallic look.

To create natural materials such as small rocks, model from a lightweight synthetic modelling material; I've used Jovi PatWood® wood clay. Colour with matte acrylic paints in natural brown or grey shades (photo previous right, try Burnt Umber and Raw Sienna). Use flat black spray paint to give a burned or distressed look.

For embedded glass, use polycarbonate plastic sheeting at least 3mm thick to prevent injury. Cut into jagged shapes. Sand the edges with 320 grit sandpaper to remove any sharp edges. Colour the edges with a green marker such as Prismacolor® Emerald for a more glass-like appearance and better visibility in the wound.

You can use rubber glass (sometimes called rubber ice), a clear silicone rubber, to simulate broken glass fragments such as the broken glass in an automobile accident. It looks like real broken glass but is soft and pliable. Available from motion picture special effects suppliers.

Note: When dry the materials described will generally not cause any adverse reactions when stuck to human skin. If you are concerned about skin reactions with the materials, seal the items with a makeup sealer. The photograph shows finished fragments and glass made from safe, lightweight materials.



Creating Fragment Hits

Most fragments are aerodynamically unstable and cause irregular wounds. The fragment may bury itself fully in the casualty's body, it may be partially buried or it may bounce off the casualty causing only a small amount of damage. Large, heavy pieces can travel a considerable distance. The famous WW2 "pineapple" grenade, the Mk 2, had a published lethal radius of under 10m. The fill plug of the Mk 2, which did not break up, was much heavier than the other fragments and was lethal at a distance of over 100m. Fragmentation injuries are secondary blast injuries; the blast propels the fragments. If the casualty is close enough to the blast to sustain many hits there will be other injuries as well; primary blast injuries caused by overpressure (tension pneumothorax and other barotrauma) and tertiary blast injuries such as broken bones caused by collision with other objects, including the ground, if the casualty is thrown by the blast. For a more complete description of blast injuries and treatment see "*Blast Injuries*", Ralph G. DePalma et al, N Engl J Med 2005;352:1335-42.

To create hits, first determine how large the area will be. Clean the skin with witch hazel or 99% isopropyl alcohol. For small hits use Kryolan® Rigid Collodion, a solution of [pyroxylin](#) in ether and alcohol. This product dries quickly and you must work directly from the bottle. The alcohol in the solution will prevent cross contamination. You can also apply a thin layer of Pros-Aide® to the skin before applying the Rigid Collodion to help protect the skin. Stretch the skin with your fingers and apply a thin layer of collodion solution in the shape of the hit, usually a jagged shape. Allow to dry (usually about a minute) then quickly apply another thin layer over the top of the first and allow it to dry also. As the collodion solution dries, it contracts, pulls the skin and dimples the wound slightly for a dimensional effect. If the fragment is entirely embedded colour the centre of the hit with paint in a dark blue using alcohol activated colour; gently and quickly stipple the colour with a small brush for a realistic texture. Keep the brush fairly dry; too much alcohol may weaken the collodion. You can spray on a light coat of makeup sealer now if you wish. Apply a layer Ben Nye® Thick Blood, the blue base will make the centre of the hit darker and enhance the depth of the hit. To keep the hit from drying out coat with a thin layer of glycerin or water-based clear lubricant.

Using collodion solution on the skin repeatedly in the same place can cause irritation. If you're using the same person as a casualty for several scenarios, use different areas for the hits to avoid skin irritation. The collodion solution tends to work best on the face, arms and legs. It doesn't work as well on the abdomen. Do not use collodion near the eyes.

For medium size hits use scar effects gel, silicone or thickened Pros-Aide®. A spatula is used to shape the wound. Colour with blue paint and thick blood. Large hits can be made using gelatin appliances.

If the fragment is partially buried, use medical adhesive or Pros-Aide® (depends on the size of the fragment and what you're familiar with) to glue the fragment to the wound. Apply a thin layer of thick blood to the wound and work up slightly around the base of the fragment.

For bounce hits use Ben Nye® Fresh Scab or create a small bruise (use a Kryolan® Six Color Burn & Injury wheel, Art.#1307 or a similar product). I'm assuming that bounce hits will only result in slight bleeding which will dry quickly, hence the use of fresh scab (brownish and scabby) rather than thick blood.

Impaled Objects

For small impaled objects, create the wound like you would for a fragment hit. For larger objects, an appliance (silicone or gelatin) can be used. Use objects that are lightweight. Attach a thin base to the object then apply the appliance around it. Attach to the casualty using Pros-Aide® adhesive.

Gunshot Wounds

Gunshot wounds (usually abbreviated as GSW) are caused by the transfer of kinetic energy from the projectile to the body. Bullets have a wide range of masses from a .22 cal. (2.6g) to a .50 cal. (59g) and speeds (330m/s for .22 cal. to 928m/s for .50 cal.)

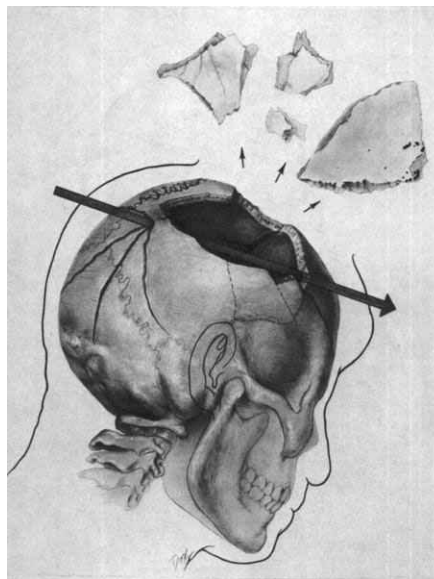
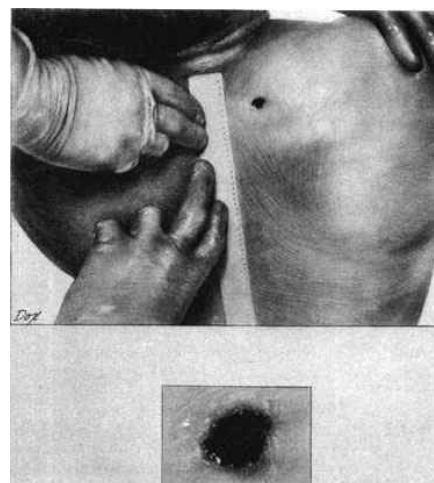
Bullets transfer kinetic energy to the body, inflicting damage, in several ways. The bullet may strike a bone, damaging the bone and altering the trajectory of the bullet. After striking a bone the bullet may also become deformed, break-up or begin tumbling resulting in more damage. In soft tissue, inertial cavitation causes considerable damage when the energy from the bullet creates a cavity which collapses, producing a shock wave. Entrance wounds, in general, will be smaller and more sharply defined than exit wounds.

The two images on the right from the Kennedy assassination show how the same type of bullet can cause dramatically different wounds. In the first illustration the bullet entering the President's back caused only a small entrance wound approximately 6mm by 4mm. It continued through the body, damaging the trachea and exiting from the neck. This exit wound was obliterated by an emergency tracheotomy.

The second illustration shows the path of a bullet through the head of President Kennedy. Skull fragments are not to scale. At the widest point the wound in the skull is approximately 13cm across. Illustrations are by medical illustrator Ida G. Dox, and published as (back wound) Figure 4 on page 85 of volume 7 and (head wound) Figure 29 on page 125 of volume 7 (Medical and Firearms Evidence) of the *Appendix to Hearings Before the Select Committee on Assassinations of the U.S. House of Representatives* (1979). Both are works of the U.S. Government and are in the public domain.

Gunshot wounds can be made with rigid collodion, effects gel, silicone, thickened Pros-Aide® or an appliance, depending upon the size and shape of the entrance or exit wound. See directions for fragment hits.

If the muzzle of the weapon is close to the casualty, residue from the cartridge can cause tattooing of the skin around the entrance wound. The hot gases will burn, bruise and discolour the skin in a mottled red.



Scraps and Abrasions

Use a piece of stipple sponge to apply blood colour alcohol based paint to the area. Apply using a stippling technique. Next stipple fresh scab over the paint for a dimensional effect. You can use a stiff nylon brush with the paint and fresh scab to make linear abrasions. Use glycerin or a water based lubricant to soften the fresh scab if necessary. Drag the brush through the fresh scab. Pros-aide® adhesive can be used to add cosmetic dirt to the wound. Seal with a makeup sealer if necessary for added durability. Apply stage blood at scene for oozing abrasions.

Bruising

Bruising occurs in many types of trauma and can point to the mechanism of injury. In an automobile accident, bruising on the chest, along with appropriate symptoms, may indicate broken ribs or a flail chest. Quite often the bruises will have the pattern of the object which created them such as the steering wheel. Use a torn makeup sponge and a Bruise wheel to create different types of bruises. Seal with a makeup sealer if desired.

Scars

Although a scar is a healed wound, it may give medical personnel valuable clues. For example, old scars on the wrists might indicate past suicide attempts, a surgical scar may help to fill in past medical history. You can make a scar by drawing it on clean skin with rigid collodion. When the solution dries it will contract and produce the scar. Raised scars (a hypertrophic scar or a keloid scar) can be made with thickened Pros-Aide®, silicone or with Flesh Effects Gel. For a recent scar or for a more pronounced effect, colour the scar a light rose (the colour should be a little blotchy). Seal with make-up sealer.

Shock

Shock is the lack of perfusion, the supply of oxygenated blood, to the tissue. Shock may be the result of pump failure (cardiogenic shock), vasodilation (vasogenic or high space shock), fluid loss (hypovolemic shock) or lack of oxygen (hypoxic shock). A myocardial infarction will result in cardiogenic shock. Uncontrolled internal or external bleeding, fluid loss from burns or severe dehydration can cause hypovolemic shock. Anaphylactic shock is caused by an abnormal reaction to a protein causing blood vessels dilate and bronchioles to constrict. Septic shock is caused by a toxin which dilates blood vessels and causes increased capillary permeability. Both anaphylactic and septic shock are types of vasogenic shock. In the first stage of shock, compensatory shock, the body tries to compensate for the shock by shunting blood to the vital organs. The face and extremities become pale due to lack of blood. Untreated, shock progresses to decompensated shock when the body can no longer compensate for the shock. The face takes on a sunken look, the skin becomes diaphoretic and the lips cyanotic. Cyanosis usually occurs when the oxygen saturation drops below 90%. Unlike other types of shock, a casualty with shock from a spinal cord injury, a type of vasogenic shock, will have warm, dry extremities

Apply Ben Nye® Color Cake Foundation in Blue Spirit (PC-82), Death Flesh (PC-840) and Sallow Green (PC-83). Shades should be mixed to adjust for skin colour and effect desired. Green and blue tones in the foundation reduce the redness in the skin (from the blood) and give a better shock effect than pure white does. Pure white appears artificial and clown-like. The foundation mentioned is a water activated foundation. For maximum durability, use Ben Nye® LiquiSet to activate the foundation. If you need to blend the foundation, activate with plain water. Apply lightly and evenly, stippling the colour on using a damp make-up sponge. The sponge should be quite damp but not dripping wet. You can blend the colours with a damp makeup sponge unless you're using LiquiSet. When working around the eyes and mouth, pull the skin tight so any small wrinkles in the skin are coloured evenly. Apply shock makeup to the arms and hands as well. This product is a theatrical foundation and is a bit heavier than other foundations but I've found it easy to blend and get good results. To create a sunken effect use gray creme colour under the eyes, the mentolabial furrow beneath the lower lip and in the nasolabial folds. Blend and seal with Final Seal or similar product. Lips should be coloured with a very light application of blue (I use Ben Nye® Creme Color Sky Blue CL-22). For a longer lasting blue use an alcohol activated colour instead of the creme colour. Apply in thin washes.

A mixture of glycerin and water (50% glycerin) can be applied to the face with a sprayer to mimic diaphoresis. Additional makeup sealer may need to be applied to prevent absorption of the glycerin spray. Water-based gel lubricants such as Muko® (the kind used for airway insertion) can also be used instead of the glycerin-water mix. Apply the gel to the skin drop by drop using a fine brush.

Shock casualties may also be nauseous and vomiting. Use the plastic "puke" from novelty/joke shops beside the casualty to indicate vomiting. This works well visually and is fast, cheap and more sanitary than using food products to make vomitus.

Lacerations

Langer's lines (after Austrian anatomist Karl Langer (1819-1887)) also known as stress or cleavage lines, are lines of stress in the resting body. Wounds parallel to Langer's lines will tend to remain closed and heal with less scarring. Wounds which cut at right angles to the lines will present as more open as the stresses pull the wound open and the wound will heal with more scarring. You can find Langer's line charts online and in medical texts. In living, active individuals stresses in the skin caused by the position of the body (extension or flexion) can sometimes work counter to Langer's lines. When creating lacerations be aware of how the wound would actually present in an actual casualty. Lacerations are classified as linear (smooth edges), usually caused by a knife or other sharp object. Stellate lacerations have jagged edges and are caused by blunt objects which tear rather than cut the skin.

For tiny lacerations use fresh scab directly on the skin; you can also use collodion solution as described in fragment hits to add depth and texture to the laceration. For small lacerations, use flesh effects gel and a spatula. Spread on a thin, smooth layer of gel on the skin. Make the laceration with a wooden modelling tool or make-up spatula after the gel has set enough to become workable. Fold the gel back on itself and allow to fully set. Another technique is to brush one ply of a facial tissue with cosmetic grade liquid latex and apply to the skin. This method is good for stellate lacerations since the tissue can be pushed into position to give the effect of skin subjected to a tearing force. Before applying the tissue tear it in a shape with a ragged edge to make it easier to blend. Brush some more liquid latex on top to blend. Allow it to dry slightly then create the laceration as described for the flesh effects gel. You can also use Pros-Aide® thickened with Cab-O-Sil® to build the laceration or use silicone. Whichever method you use don't build up too much thickness; it makes blending more difficult and increases drying time for the medium. Colour the deepest parts of the laceration blue using an alcohol activated paint then use thick blood to colour and texture the wound (the red and blue give the illusion of depth, see the section on PAX paints for more about this technique). Colour the area as needed to match the surrounding skin. When the casualty is in position, add liquid blood. For large lacerations, use gelatin or silicone appliances.

Avulsions

An avulsion is the tearing away of a part or structure of the body. In many cases it refers to a wound with flap of loose skin. A limb, eye or tooth may also be avulsed. Skin avulsions are often caused by a force that is at an oblique angle to the surface of the skin. Hair may be caught in a rotating shaft and part of the scalp torn off. Degloving injuries are a type of avulsion in which the skin is pulled off an extremity such as a finger, hand or foot. Begin by making a variety of latex skin flaps well ahead of time. On a clean piece of glass, use a soft brush or makeup sponge to create the skin flap by brushing/stippling on a thin layer of latex. When dry add more layers on the free edge to increase thickness. The edges that are to be bonded to the skin should be as thin as possible. When finished, peel off the glass (if you're storing the latex skin powder it first). Apply Pros-aide® to the edges of the flap that are to be bonded to the skin. Allow to dry, position and press into place. Colour to blend with the surrounding skin then add thick blood under the flap.

Burns

First degree (superficial) burns involve only the epidermis, the outermost layer of skin. This type of burn will be pink or red without any blistering. The skin will be dry and possibly slightly swollen. Apply red from a burn wheel evenly over the area using a wide, soft brush or a makeup sponge. A first degree burn caused by a sudden burst of heat is called a flash burn and will have sharply delineated borders.

Second degree (partial thickness) burns involve both the epidermis and the dermis. Damage to the blood vessels in this layer of skin will cause blistering. Depending upon the burn site, the individual and the heat source a second degree burn may range from white to bright red, be moist, mottled and blistered. Clean the area with witch hazel and apply Telesis™ Top Guard® Skin Barrier. Create the blisters using beads of transparent effects gel. Position your casualty so the area you're applying the effects gel is level to keep the gel from forming drip shaped blisters. Let the gel set and coat with liquid latex applied with a makeup sponge. Apply a white/tan colour to the blistered area and blend with the darker surrounding area. Where the second degree burn blends into a third degree burn (see following paragraph) carefully pull up the edges of the latex film with a wooden tool and tear to rough and random borders. Seal the latex with castor sealer then use the burn wheel to colour the area.

Third degree (full thickness) burns involve the subcutaneous tissue and can extend into the fat and muscle of the body. The destroyed skin layers form a tough, dry layer called eschar. The burn may range in colour from white to red or brown. Portions of the burn may be carbonized, sooty or dirty. Fresh third degree burns are

usually dry. Begin by applying colour from the burn wheel to the area of the burn. Then apply a very *light* coating of petroleum jelly in random spots to the skin where you want the 3rd degree burns. Using a makeup sponge, stipple on one or two layers of liquid latex (depends upon the consistency the latex you're using) beyond the area where you've applied the petroleum jelly. Use neutral set powder on the wet latex. The petroleum jelly prevents the latex from sticking to the skin and the powder dries and weakens the latex slightly. Now use the edge of a tongue depressor to *carefully* scrape and lift the latex eschar you've created away from the skin and break it into rough sections. If you use Water-Melon™ (by Michael Davy <http://www.michaeldavy.com/>) instead of latex you can weaken the eschar with a bit of 99% alcohol before using the tongue depressor. Thick eschar for deep burns can be made using a single ply of facial tissue and latex.

Instead of the direct on skin method described above, you can create latex eschar "skins" ahead of time. Use a makeup sponge to daub a thin layer of liquid latex on piece of clean glass. Let dry. Make small holes in the dried latex sheet by scraping the surface with a small, sharp stick. Apply a second thin layer of liquid latex. Build up a thin skin, peel from the glass, and powder with cornstarch baby powder. These skins can be stored. Before use, pull the latex skin with your fingers to create rents. You can also use scissors to make larger openings in the latex skin. To use, clean the eschar skin with alcohol and apply to the skin with Pros-Aide®

Whichever method you use to create the burns, seal with castor sealer and apply appropriate colour from a burn and injury wheel. Fix with neutral set transparent powder. If the burn is bleeding add old/scab blood or thick blood (spread and soften using a brush loaded with glycerin or a water-based lubricant to prevent the blood from drying out) in the exposed areas. Use cosmetic charcoal powder (a black powder made from cosmetic grade pigments, specifically produced and sold for cosmetic use) to mimic charred areas.

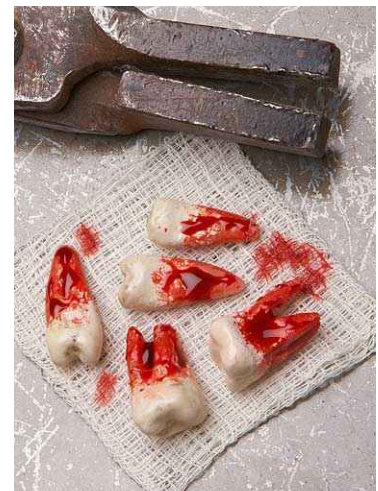
Burn casualties often have inhalation injuries. Simulate these injuries by using cosmetic charcoal powder under the nose and around the nostrils. Apply the cosmetic charcoal powder by picking it up with a moist makeup sponge. Be very careful not to get any of this powder in the eyes. Have your casualty close their eyes and hold their breath while you fix the powder in place by spraying with makeup sealer. You can spray a small amount of liquid smoke, available from grocery stores, on the casualty's clothing to give a burned odour.

Mouth

Injuries to the mouth are often bruising and bleeding. Use the bruise wheel and fresh scab applied with a small makeup spatula OUTSIDE the mouth. Lost teeth can be painted out with black tooth paint which is available from a number of suppliers. BEFORE using tooth paint ask the casualty if he/she has dental veneers or cosmetic bonding. If the casualty does have veneers or bonding, then DO NOT use tooth paint on that casualty. Dry the tooth with a piece of clean gauze before applying the paint. Alcohol activated inks such as Skin Illustrator® and OCC can be used to paint out the teeth; follow the same rules as for black tooth paint. You can purchase synthetic teeth as a stand-in for the missing teeth. Look for teeth from a typodont, a model of the oral cavity used by dental students for training. Alternatively you can make teeth from a modelling material like Sculpey. Synthetic teeth should **NOT** be placed in the mouth since they might be swallowed by accident. The casualty should hold them in a piece of blood stained gauze instead. Use stage blood, sometimes listed as "mouth blood" and made with food grade materials, in and around the mouth.

Prosthetic teeth can be molded from real human teeth. Extracted teeth obtained from a dental clinic (cleaned and autoclaved) were sprayed with two coats of Krylon® Crystal Clear. The two-part mold was made from Mold Max 30 by Smooth-On. I partially embedded the teeth in non-sulphur plastiline to hold the teeth in position during the molding process. I also added keys to the plastiline to help in aligning the two parts of the mold later. The teeth were cast using dental polymer/monomer from Monster Makers. This product is very forgiving with respect to proportions of the polymer/monomer. I found that a ratio that gave a thick syrup consistency worked well. The mixed product sets very quickly.

After casting, remove the prosthetic teeth from the mold and remove any flashing with sharp knife or fine sandpaper. Small voids can be filled with thick dental polymer/monomer. Finish with acrylic paints. You can also seal with Krylon Crystal Clear. The finished teeth in the image at the right have been daubed with Ben Nye Stage Blood.



Eye Injuries

Eye injuries are serious and must be treated promptly. As many as 28% of blast casualties may have eye injuries(source: *"Maxillofacial injuries caused by terrorist bomb attack in Nairobi, Kenya"*, Odhiambo WA et al, Int J Oral Maxillofac Surg 2002;31:374-7). The adult human eye is approximately 25mm in diameter. You can purchase fake eyes of this diameter from various suppliers (the eyes in the photograph are Real Eyes Brand Doll Eyes by the Secrist Doll Company, 24mm and a 26mm diameter at the far right). Frayed red threads can be added to the fake eyes (NEVER your casualty's real eyes!) to give realistic blood vessels.



When working around the eyes be aware that the skin is more delicate than the skin on the rest of the face. Avoid using strong adhesives on the area just under the eye and the eyelid. Appliances should extend from the cheek to the eyebrow. You can seal the eyebrows with Gafquat® (see next section **Head and Scalp Injuries**).

Head and Scalp Injuries

The scalp is a highly vascular area and even a small laceration will bleed profusely. To protect the hair use Gafquat® (the trademark name, owned by International Specialty Products, for Polyquaternium-11), a thick, water-soluble solution which is used in many hair products. Use Gafquat® to hold down, seal and protect the hair in the area you're going to build the wound. Build the wound on top of the Gafquat®.

Two external signs of basilar skull fracture are raccoon sign (sometimes raccoon eyes) and Battle sign (also Battle's sign, after William Henry Battle (1855-1936), an English surgeon). Raccoon sign is bruising which blackens the eyes. Battle sign is a sign of basilar skull fracture at the posterior portion of the skull and appears as bruising over the mastoid process, behind the ear. Both are late signs of fracture since it takes blood time to accumulate and the bruising to appear.

Deformations and lacerations of the head are indicators of possible brain injuries. Deformations can be created with a wax/latex build. You may be able to cover the build by combing over hair. You can also create a laceration in the deformation and bloody up the area eliminating the need for hair on the wound. The hair in this case would be covered and matted by the blood.

One easy and effective trick you can use with a head injury or skull fracture is to create a nosebleed on demand. I've seen this trick in a number of texts including "Special Makeup Effects" by Todd DeBreceni. Cut a piece of a sea sponge small enough to easily fit in the nostril of your casualty. Make a similar size piece for the other nostril from a makeup sponge. Dip the sea sponge in liquid stage blood and gently insert in the nostril you want to bleed. Insert the makeup sponge in the other nostril. Have the casualty breath through their mouth until a bleed is needed. To bleed the casualty forces air out through their nose. A couple of cautions. Don't use too large a piece of sponge, it can damage the delicate interior of the nostril if too large and tight. Try cutting the sponge to the shape of the nostril. This effect should be prepared just before it is required since breathing through the mouth can become uncomfortable quite quickly. You should coat the interior of the nostrils with a thin coating of petroleum jelly to prevent irritation and injury.

Heat Injury

Heatstroke is a serious medical condition that occurs when the body can no longer handle the stress imposed by a hot environment. Sweating stops and the core temperature of the body rises out of control. Unless treated immediately, death will result. Characteristics of heatstroke include: dry red (flushed) skin with a rapid pulse and difficulty breathing. Neurological signs include confusion, agitation, seizures and coma.

When creating a heat injury casualty the makeup should give the first responder appropriate clues. If the casualty has been exposed to a hot environment, he/she may have sunburn and be dehydrated. Use the Burn and Injury wheel to make a first degree sunburn in the appropriate areas. Powder the face with a neutral set powder to dry the skin. Apply a thin latex skin with Pros-Aide® on stretched lips. When the lips return to normal they will wrinkle. You can pull up parts of the latex to show peeling lips. Colour the lips as appropriate with a burn and injury wheel.

Cold Injury

Frostbite is damage to the skin and underlying tissue caused by extreme cold. Areas of greatest risk for frostbite are the hands, feet, ears and nose. Risk factors include exposure to extreme cold, prior cold injury, moisture in the skin, wind, altitude, medical conditions such as diabetes which involve poor circulation, and tobacco use. Nicotine is a vasoconstrictor which reduces blood flow to the extremities.

The frostbitten area becomes hard, pale, and waxy white. Well-defined grey or yellowish blisters may form even in the early stages of frostbite. When thawed, frostbite becomes red sometimes progressing to blistering with shades of white, dark red, grayish blue and black. Frostbite can be approximated by using a Ben Nye® Monster Wheel, mixing and blending the colours to give a pale, waxy effect. The creme colour can be mixed with a small amount of Smashbox Artificial Light or a similar product to give a more realistic waxy appearance. Apply a small amount of Ben Nye® Sparklers Glitter Opal Ice MD-1 on top of the colour with a soft brush to mimic tiny ice crystals then seal with a matte sealer. Create the blisters with flesh effects gel and colour with the monster wheel. These blisters often form at the border between the frostbitten and non-frostbitten areas as a result of freeze/thaw cycles. Colour lips with a burn and injury wheel (purple, red, black), apply thin latex to simulate peeling skin on the lips. When applying the latex to the lips ask the casualty to tighten his/her lips; this will create a more natural wrinkled appearance when the lips are relaxed. For windburn apply the red from a burn wheel in a fine stipple with a stipple sponge.

For ice effects, mix a small amount of Ben Nye® Sparklers Glitter Opal Ice MD-1 with a water-based lubricant such as Muko. Apply to face and hair but keep away from the eyes. You can thicken this mixture with a bit of Cab-O-Sil® if needed. There are kits available for ice effects from motion picture and special effects shops.

When working in a cold environment, you don't want to expose your casualty to the cold. Make latex sheets by pouring latex out on a flat surface and letting it dry. Build your wound on the latex. Leave a wide border (10cm or more) around the wound. Cut or tear an opening in the casualty's outermost layer of clothing where the wound is located and position your wound below/inside this. It can sit on top of the casualty's skin or on top of inner layers of clothing. If you're careful you can reuse these wounds several times.

Closed Fracture

Clean the area where the swelling/deformation caused by the fracture will be with witch hazel or alcohol then coat with a thin layer of Pros-Aide® or spirit gum. Daub the adhesive with a cotton ball so that fibres adhere to the adhesive base. These fibres will help bond the wax to the skin. Build up the area with wax (nose and scar wax). The wax should be smooth and blend into the skin. Coat with a thin layer of latex and allow to dry. Seal latex with Green Marble® or castor sealer (the sealer prevents makeup from changing colour due to absorption by the latex). Colour with the Burn and Injury wheel then seal makeup sealer. You can also use RMGP instead of the sealer/creme makeup combination (see **Eviscerations** for more detail).

Open Fracture

You should have a selection of previously created broken bones made with Sculpey or a similar modeling material. Sculpey is a synthetic, non-toxic modelling clay available in a wide variety of colours that can be cured in your kitchen oven at 130°F/275°F for 15-45 minutes (time depends on thickness of sculpture). Clean the area of the break and attach the bone with a suitable adhesive. Cover the area where the bone exits the body with a latex skin flap attached with Pros-Aide®. Colour the open wound area with alcohol activated blue paint to give depth then apply thick blood with a makeup spatula. Blend the skin flap as necessary. Create additional damage as necessary depending upon the bone broken and the mechanism of injury. Seal with makeup sealer. A silicone or gelatin appliance can also be used for an open fracture.

Amputations

When creating amputations always consider the mechanism of injury. For example, an amputation caused by a sharp object such as a machete or industrial machine may be quite clean. The limb may be mangled by construction or farm equipment. In the case of a blast injury from a land mine or IED, the stump may be torn and burned. Traumatic amputations in civilians (without protective gear) resulting from blast injuries have a high fatality rate (see *“Medical Consequences of Terrorism: The Conventional Weapon Threat”*, Michael Stein, Asher Hirshberg, Surg Clin North Am, 1999 Dec; 79(6):1537-52). The end of the bone may or may not be showing. Muscles may retract leaving loose skin and fascia hanging from the stump.

To create a simulated amputation *gently* fold the arm or leg back to create the “stump”. Secure the limb in position with a wide triangular bandage if necessary. Clothing may be cut, the folded limb inserted and safety pins used to hold the cut clothing together. If you can, build your amputation in such a way, using flexible materials, so that your casualty can straighten his/her limb when not role playing (this helps to prevent discomfort). You can use a variety of materials for the stump. Latex “skins” held on with Pros-Aide® are good for a start then colour with alcohol based paints and add thick blood. Other methods you can use are gelatin or silicone appliances or wax (follow directions in "Closed Fracture" for using wax). For fingers or thumb, bend the finger/thumb under and *gently* secure with tape. Build up the stump with either wax or effects gel, colour with blue ink and thick blood. A Sculpey bone can be used (you'll have to plan this ahead of time). Amputated parts such as an arm or leg can be created with boots, gloves, bits of clothing and some silicone or latex.

Open Pneumothorax

An open pneumothorax is a opening between the chest and the chest cavity (pleural space) often caused by a penetrating chest wound (bullet, fragment, stabbing). This is a serious medical condition which, if not treated, will result in death. As the casualty breathes, the chest cavity (pleural space) fills with air and fluid compressing the lung. An open pneumothorax, also called a sucking chest wound, is easily recognizable with a mixture of blood and other fluids bubbling out of the wound as the casualty breathes. Proper treatment involves the application of an Ascherman Chest Seal (a one-way valve) or something similar to drain the chest of air and fluids and keep the lung from collapsing. In some cases, a needle decompression may need to be performed. The diagrams of open (sucking chest wound) and tension pneumothorax are taken from a U.S. Army publication (MEDICAL DEPARTMENT, UNITED STATES ARMY, *SURGERY IN WORLD WAR II*, THORACIC SURGERY, Volume II, Prepared and published under the direction of Lieutenant General LEONARD D. HEATON, *The Surgeon General, United States Army, 1965*, Figures 2 and 42). As works of the U.S. Government these illustrations are in the public domain.

Creating a realistic open pneumothorax makes use of a specially created gelatin or silicone appliance (see silicone or gelatin appliances section) with a 14g IV catheter embedded in it (just the plastic part, NOT the steel needle) with the opening hidden in the wound and the luer portion available. You'll also need a fluid administration set, a 20ml or larger syringe, an 18g or 20g needle and a soft rubber ear bulb syringe (usually about 30ml or 1 oz.)

MacGyver the ear syringe to the tubing to form an air tight seal. What I've done is to cut off the plastic spike on the drip chamber and drill out the opening to fit the ear syringe. When drilling hold the drip chamber above the drill so the plastic particles fall away from the drip chamber and don't end up inside the chamber and tubing. Use medical tape to hold the ear syringe in place. If you're using a gelatin appliance, place on a flat surface and *carefully* push the IV catheter through the gelatin so the tip is in the “wound” then withdraw and properly dispose of the sharp, leaving the Teflon® catheter in place. Keep your fingers behind the sharp end of the needle. A bit of petroleum jelly on the catheter will make it easier to push through the gelatin. For a silicone appliance embed the catheter when you're moulding the appliance. Position the appliance in the proper area using and apply. Seal the gelatin appliances thoroughly to prevent the blood solution from destroying the appliance. Blend the appliance with makeup to match the skin and apply thick blood as required

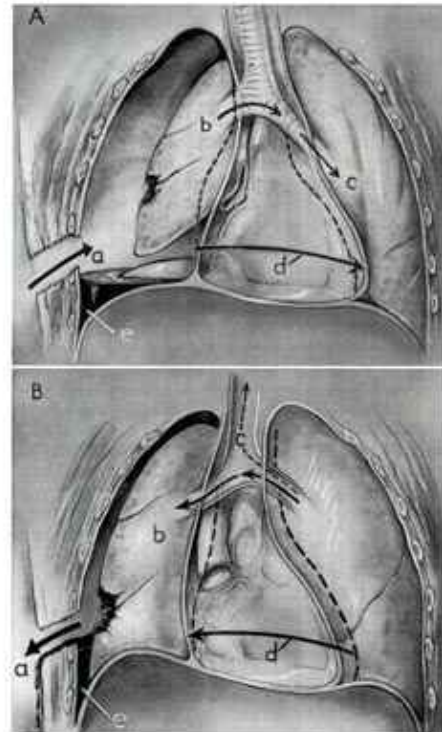


FIGURE 2.—Schematic showing of pathologic physiology of sucking chest wound. A. Entrance of air into chest on inspiration through wound in chest wall (a), the amount of air being directly proportional to the size of the opening as compared with the surface area of the open glottis. Collapse of lung on affected side (b), with passage of air out of affected bronchus. Entrance into bronchus of some air from collapsed lung (c), with passage to intact lung. Shift of mediastinum toward uninvolved side (d), hemothorax (e). B. Escape of air on expiration through sucking wound of chest wall (a). Expansion of collapsed lung (b). Passage of air from uninvolved side to lung on involved side, thence out trachea (c), producing the so-called pendular breathing. Shift of mediastinum to involved side (d). Hemothorax (e).



taking care not to block the end of the 14g catheter embedded in the appliance. Using the luer lock on the catheter, attach the fluid administration set. With medical tape or Tegaderm™ secure the tubing of the fluid administration set to the casualty running it in a 360° loop with a 5cm radius.

Fill the 20ml syringe with stage blood, thinned with water and with a drop of liquid dish washing detergent added (mix well before filling the syringe). Attach the needle to the 20ml syringe and insert the needle in the lower injection port on the fluid administration set. Squeeze the ear syringe bulb and release while injecting some of the blood solution into the port. The ear syringe will draw the mix into the loop. Withdraw the needle and dispose of properly or store safely.

You can now create bubbling, frothy blood by compressing the bulb of the ear syringe. The ear syringe will force the "blood", along with air, out of the wound. For the best effect have the casualty squeeze the bulb at the same rate as his/her breathing. Inject more "blood" into the line as necessary.

Tension Pneumothorax

A tension or closed pneumothorax is caused by air leaking from the lungs into the pleural space causing the lung(s) to collapse. If not treated promptly the casualty will die. A violent blow to the chest, such as the impact of the chest against the steering wheel in an automobile accident, can cause a tension pneumothorax. The shock wave from an explosion can cause a tension pneumothorax by spalling; as the blast wave travels through the body it moves from the tissue into the less dense, air filled, alveolar spaces. Bits of tissue are blown off the surface creating defects which allow the air to enter the pleural space. Protective equipment such as body armour can potentiate primary blast effects increasing the severity of the injuries. Overpressure from the blast, especially in enclosed spaces such as a vehicle, will cause small tears in the lung parenchyma resulting in a tension pneumothorax and noncardiogenic pulmonary edema. Proper treatment for tension pneumothorax is needle decompression at the scene with rapid transport to a medical facility.

For a blow to the chest, create appropriate bruising using creme makeup and sealer. A tension pneumothorax caused by a blast may not have any obvious injury to the chest (external) but should be apparent by mechanism of injury and other injuries. Coach the casualty to cough and wheeze, and to have trouble answering questions in more than one or two words. Pulmonary edema can be simulated with mouth blood; casualties usually have a pink froth at the mouth.

Bleeding

An arterial bleed is usually considered a serious condition which the first responder must take care of quickly. When creating a casualty with an arterial bleed consider which artery is affected. Most arteries are deep and run along bones, usually on the flexor aspect, which offers protection for the artery. An arterial bleed can be made with concentrated blood colour (used to make fake blood by mixing with water), a 500ml or 1litre IV bag of 0.9% normal saline and a fluid administration set. You can use out-of-date IV solution since it is not being injected. Cut the luer lock off the end of the fluid administration set. Puncture the IV bag with the spike on the top of the drip chamber then *carefully* withdraw it (it is plastic but it is still sharp). Use an eye dropper or catheter syringe to add concentrated blood colour to the IV bag then reinsert the spike. Shake to mix. Embed the end of the fluid administration set tube in your wound. Squeeze the IV bag to squirt blood from the wound.

Eviscerations

Most abdominal organs are well anchored internally and will not be eviscerated except in extremely violent situations and, in those cases, the casualty will be dead. An exception is the small intestine, which can extrude through an opening into the skin or through an internal opening to another area of the body (a hernia).

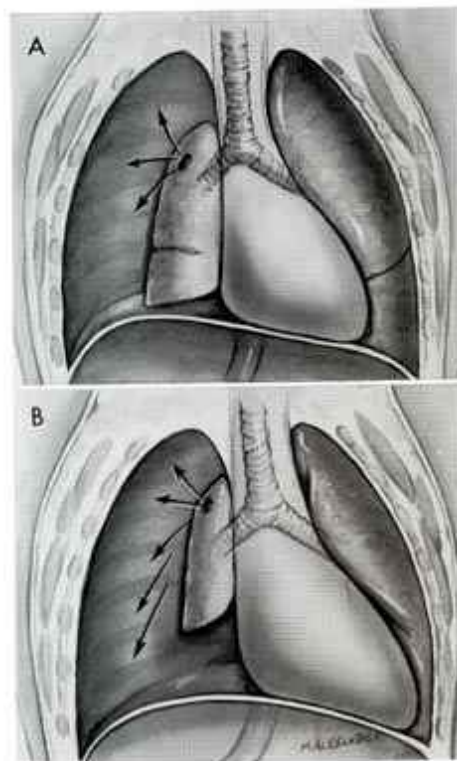
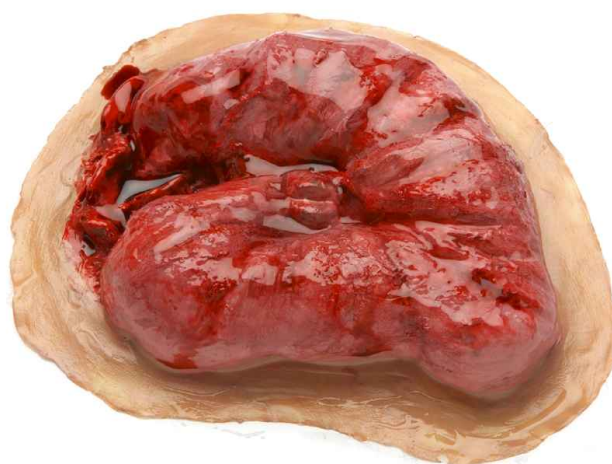


FIGURE 42.—Pathologic physiology of tension pneumothorax. A. Pneumothorax of moderate extent. As air escapes into the pleural cavity, the affected lung collapses, and there is moderate mediastinal shift to the unaffected side. B. Tension pneumothorax. The uninvolved lung, as well as the involved lung, is now collapsed, as the result of mediastinal shift to the uninvolved side. Shock increases as the result of collapse of the superior and inferior vena cava, and because of the decreased venous return to the heart associated with the marked mediastinal shift.

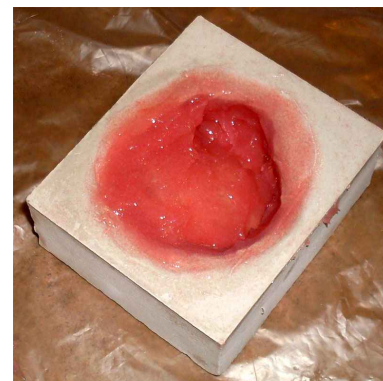
Sculpt eviscerations in professional grade plasticine. Your sculpture should have a flashing of about 1cm all the way around. Create a negative stone (gypsum) mould from the sculpture using Ultracal® 30. I use the Ultracal® 30 out of convenience; plain Plaster of Paris works more quickly but is softer and can become easily damaged. Dry the mould thoroughly in an oven. DO NOT RELEASE THE MOULD. Make the evisceration by slush moulding liquid latex. An alternative to latex is Water-Melon™ (follow product directions if slush moulding with this product). This process is similar to slip casting in clay. Take the dry mould, fill it with water then empty it immediately. This helps to reduce air bubbles in the casting by replacing air near the surface of the mould with water. Set the mould on a level surface and fill with liquid latex. Allow the latex to sit for 15 to 30 minutes (you'll need to experiment a bit), then pour it out. The mould will have absorbed some of the water, resulting in a latex coating on the sides of the mould. Let the latex dry, powder the interior with talc to prevent sticking and remove from the mould. If portions of the latex appliance are too thin, reinforce on the inside with a piece of gauze dipped in liquid latex. Paint the appliance with PAX paint. Add fine blood vessels as needed by dipping coloured thread or yarn in clear acrylic gel medium and applying to the surface.

The following image, left, shows a sculpt of an evisceration in NSP clay ready to be cast. It has been sprayed with Crystal Clear and Dulling spray. At the right is the finished latex evisceration; in use the brown edge of the latex is coloured to match the skin of the casualty.



To use, clean the skin with witch hazel and apply Telesis™ Top Guard® Skin Barrier to help protect against skin irritation from latex sensitivity. Attach the appliance to the casualty with Pros-Aide®. Blend the flashing to the casualty's skin colour with Rubber Mask Grease Paint (usually abbreviated RMGP) or PAX paint (use PAX paint only on the latex, never on the skin). RMGP contains a castor sealer to prevent the paint from changing colour when applied to the latex. I've found that applying a setting powder to the RMGP gives a more robust colour and helps prevent smearing (I use Kryolan® RMGP and Derma Color Waterproof Setting Powder). You can also seal the latex with castor sealer and use creme-based makeup. Use a water-based lubricant or stage blood to give the evisceration a wet look. With care these appliances can be used several times.

If you would like to avoid latex, you can make eviscerations from silicone. I use Dragon Skin Pro FX silicone by Smooth-On thickened with Thi-Vex™ to give me a uniform layer inside the mold. Make your sculpt from professional grade plasticine and cast in Ultracal® 30. **Release the mold. Please note that you cannot use molds previously used for casting latex since the sulphur from the latex will inhibit the curing of the silicone.** Colour the silicone with flocking or with silicone pigments. Put the thickened silicone in the mold and use a tongue depressor or chip brush to coat the inside of the mold in an even thickness with the silicone. You may need to force the thickened silicone into some of the detailed areas. Use a tongue depressor dipped in 99% alcohol to scrape the top of the mold so the base of the silicone appliance will be flat and have a nice blending edge. The image to the right shows the mold coated with thickened silicone and the top scraped flat.



Paint your silicone evisceration with a suitable paint. Adhere the silicone evisceration to clean skin with Skin-Tite™ or other skin safe silicone adhesive. Blend the edges to skin colour with Skin Illustrator® alcohol-activated paints. The image to the right shows the powdered silicone appliance removed from the mold prior to painting. Note the blending edge.



Bioterrorism

The most likely scenarios, based on the availability of suitable toxins and dispersal methods, are:

- anthrax
- botulism
- plague
- smallpox

See *Bioterrorism Preparedness Training and Assessment Exercises for Local Public Health Agencies*, by David J. Dausey, Nicole Lurie et al, prepared for the Department of Health and Human Services by RAND Health, a unit of the RAND Corporation, Santa Monica, CA, U.S.A., 2005 <http://www.rand.org/>

Anthrax is caused by the bacterium *Bacillus anthracis* and has two variants, cutaneous and inhaled. Cutaneous anthrax starts as a boil-like skin lesion eventually forming a painless necrotic ulcer with a shiny black eschar. Approximately 20% of cutaneous anthrax cases result in death.

Inhaled anthrax results in flu-like symptoms for several days followed by respiratory collapse. If treated early mortality for this form of anthrax is approximately 45%.

Cutaneous anthrax images are from the CDC upper image by James H. Steele, 1962, lower image dated 1953 creator unknown. As a work created by an agency of the U.S. Federal Government it is in the public domain.

In the anthrax attacks of September 2001 in which the spores were delivered in the mail, 11 cases were inhaled anthrax and 11 cases were cutaneous anthrax. For more about anthrax as a weapon see "Anthrax as a Biological Weapon, 2002, Updated Recommendations for Management", JAMA. 2002;287:2236-2252, <http://jama.ama-assn.org/cgi/content/full/287/17/2236>

Cutaneous anthrax lesions may be simulated by a number of materials including latex and facial tissue. Take a single ply of facial tissue the approximate size and shape of the lesion you wish to make and saturate with cosmetic grade latex. Apply to clean skin. Shape with a makeup spatula and brush handle to approximate the shape of the lesion. Allow to dry and colour with creme or alcohol activated paint. For the shine of the eschar, coat with glossy makeup sealer or a very thin coat of baby oil gel. You can also create lesions with cabo (thickened Pros-Aide®) or silicone. Colour and blend with alcohol activated paints.



Botulism is caused by the neurotoxin botulin, produced under anaerobic conditions by the bacteria *Clostridium botulinum*. Signs of botulism include drooping of both eyelids and loss of facial expression. The [muscles controlling facial expression](#) are inserted into the face and controlled by the cranial nerves which are affected by the toxin. If untreated respiratory failure can follow leading to coma and death. Death from botulism is approximately 2% when treated, 60% if left untreated.

The drooping of the eyelids and facial paralysis can be simulated by using adhesive medical dressing like Steri-Strips™ to tension parts of the face. Apply the strips to clean skin. You can use cabo to blend the edges of the strips. Colour blend with alcohol activated paints. Be very careful when placing adhesive strips near the eyes since the skin in this area tends to be thin, delicate and easily injured.



Plague (pneumonic plague) is a bacterial infection caused by *Yersinia pestis* which affects the lungs. Unlike bubonic plague which is caused by the same bacterium, pneumonic plague can be spread by an initial aerosol attack and then from person to person by coughing or sneezing. Signs and symptoms include fever, weakness, and rapidly developing pneumonia with shortness of breath, chest pain, and cough. Sometimes a watery or bloody sputum is present. Simulate bloody sputum with a fake blood product designed for use in the mouth. Without treatment respiratory failure, shock and death follow. For more information about plague as a weapon see Plague Information at the Centers for Disease Control and Prevention at <http://www.bt.cdc.gov/agent/plague/>.

Smallpox is caused by the variola virus and comes in two forms, variola major and variola minor. Most cases, approximately 90%, of smallpox are of the ordinary variola major type which has a fatality rate of about 30%.

After exposure to the virus there is an incubation period lasting 7 to 17 days. During this time no signs or symptoms are present. The Prodrome phase follows the incubation period and lasts from 2 to 4 days. Symptoms are fever, malaise, body aches and sometimes vomiting.

The next phase is an early rash starting with small red spots on the tongue and mouth. It is during this phase, the seven days following the onset of the rash, in which the person is most contagious. They will remain contagious until the end of the resolution phase. The spots develop into sores that break open spreading large amounts of the smallpox virus into the mouth. At the same time a rash spreads over the entire body usually within 24 hours and the fever goes down. By the third day the early rash forms raised bumps. On the fourth day these bumps fill with a thick opaque fluid and may have a depressed centre. This is a distinguishing characteristic of smallpox. At this point the fever may rise. Smallpox photos at right from the CDC, upper by Dr. John Noble Jr. 1968, lower by Dr. Robinson, 1962.



During the next 5 days the raised bumps become pustules, sharply raised and firm to the touch. At the end of this time the pustules form a crust and then scab over. This phase lasts about 5 days also, then a resolution phase lasting about 6 days begins during which the scabs begin to fall off. The person remains contagious until all the scabs have fallen off. For more information about smallpox as a weapon see Smallpox Information at the Centers for Disease Control and Prevention at <http://emergency.cdc.gov/agent/smallpox/>

Smallpox can be simulated using the latex/tissue method (see cutaneous anthrax description for this method), cabo or silicone. Colour using appropriate materials.

Resources

Makeup Manufacturers

[Graftobian Makeup Company](http://www.graftobian.com/) <http://www.graftobian.com/>
[Ben Nye®](http://www.bennye.com/) <http://www.bennye.com/>
[Temptu Cosmetics](http://www.temptu.com/) <http://www.temptu.com/>
[Kryolan® Professional Make-Up](http://www.kryolan.com/) <http://www.kryolan.com/>
[Reel Creations](http://www.reelcreations.com/) <http://www.reelcreations.com/>
[Pros-Aide®, a division of ADM Tronics Unlimited, Inc.](http://www.pros-aide.com/) <http://www.pros-aide.com/>
[Obsessive Compulsive Cosmetics](http://www.occmakeup.com/) <http://www.occmakeup.com/>
[Kett Cosmetics](http://www.kettcosmetics.com/) <http://www.kettcosmetics.com/>
[Michael Davy Film & TV Makeup](http://www.michaeldavy.com/) <http://www.michaeldavy.com/>
[Premiere Products - Makeup Products](http://www.ppi.cc/makeup_sp_efx.htm) http://www.ppi.cc/makeup_sp_efx.htm

Art and Specialty Supplies

[Liquitex® Artist Acrylic Paints](http://www.liquitex.com/) <http://www.liquitex.com/>
[Trengove Studios \(special effects\)](http://www.trengovestudios.com/) <http://www.trengovestudios.com/>
[Sculpey](http://www.sculpey.com/) <http://www.sculpey.com/>
[Burman Industries](http://www.burmanfoam.com/) <http://www.burmanfoam.com/>
[Kilgore International Inc. \(typodont\)](http://www.kilgoreinternational.com/) <http://www.kilgoreinternational.com/>
[Jovi Corporation, Patwood](http://www.joviusa.com/) <http://www.joviusa.com/>
[Make-Up Magazine \(publication\)](http://www.makeupmag.com/) <http://www.makeupmag.com/>
[Ice Fx Makeup](http://www.icefxmakeup.com/) <http://www.icefxmakeup.com/>
[3M Tegaderm™ Dressings](http://solutions.3m.com/wps/portal/3M/en_US/SH/SkinHealth/brands/tegaderm/) http://solutions.3m.com/wps/portal/3M/en_US/SH/SkinHealth/brands/tegaderm/
[Chavant non-drying clay](http://www.chavant.com/) <http://www.chavant.com/>
[Crown Brush \(Cosmetic Brushes\)](http://www.crownbrush.biz/) <http://www.crownbrush.biz/>
[Smooth-On Liquid Rubbers and Plastics \(silicone molding supplies\)](http://www.smooth-on.com/) <http://www.smooth-on.com/>
[Krylon Spray Paints \(Crystal Clear and Dulling Sprays\)](http://www.krylon.com/) <http://www.krylon.com/>
[Industrial Products Division of United States Gypsum Company \(Ultracal® 30\)](http://gypsumsolutions.com/) <http://gypsumsolutions.com/>
[Mann Mold Release Agents](http://www.mann-release.com/) <http://www.mann-release.com/>
[Chef's Select Parchment Paper \(silicone coated\)](http://www.chefsselect.com/) <http://www.chefsselect.com/>
[Alcone 3rd Degree Silicone](http://www.alconeco.com/products/3rd_degree) http://www.alconeco.com/products/3rd_degree
[PlatSil® Gel-10 Silicone](http://www.polytek.com/products/PlatSilGel10-new.pdf) <http://www.polytek.com/products/PlatSilGel10-new.pdf>
[Monster Makers](http://www.monstermakers.com/) <http://www.monstermakers.com/>

Makeup Safety and Regulation

[Cosmetic Information & Safety](http://www.cosmeticsinfo.org/) <http://www.cosmeticsinfo.org/>
[Cosmetics, U.S. Food and Drug Administration \(FDA\)](http://www.cfsan.fda.gov/~dms/cos-toc.html) <http://www.cfsan.fda.gov/~dms/cos-toc.html>

Special Effects and Makeup Forums

[The Effects Lab](http://www.theeffectslab.com/) <http://www.theeffectslab.com/>
[Make-Up Artist Board](http://www.make-upboard.com/) <http://www.make-upboard.com/>
[Indy Mogul - DIY Filmmaking](http://www.indymogul.com/) <http://www.indymogul.com/>

Researching Trauma and Medical Conditions

[PubMed, a service of the U.S. National Library of Medicine,](http://www.pubmed.gov/) <http://www.pubmed.gov/>
[Trauma.org - Trauma care,](http://www.trauma.org/) <http://www.trauma.org/>
[Mass Casualty Event Preparedness and Response, CDC,](http://www.bt.cdc.gov/masscasualties/) <http://www.bt.cdc.gov/masscasualties/>
[Instructor's Guide for Casualty Simulation, U.S. Army, 1964,](http://www.archive.org/details/CasSimKit) <http://www.archive.org/details/CasSimKit>
[Forensic Pathology Index, University of Utah,](http://library.med.utah.edu/WebPath/FORHTML/FORIDX.html) <http://library.med.utah.edu/WebPath/FORHTML/FORIDX.html>

Books

Special Makeup Effects for Stage and Screen: Making and Applying Prosthetics by Todd Debrececi, Focal Press, Burlington, MA, 2009

The best introduction I've seen to special effects makeup. Everything from simple to advanced techniques explained in enough detail that you can try it out for yourself. Covers intermediate and advanced work in gelatin, silicone, foam latex and other materials. Clearly written and well illustrated, showing the latest techniques in special makeup effects. Every casualty simulator should have a copy of this book. Well worth the modest price.

A Complete Guide to Special Effects Makeup: Conceptual Creations by Japanese Makeup Artists by Tokyo SFX Makeup Workshop, Graphic-sha Publishing Co. Ltd., Tokyo, Japan, 2008

This book is a good choice for the beginner with a couple of caveats. First, the book seems to be targeted at cosplay enthusiasts which somewhat limits its usefulness in casualty simulation. Secondly, the book shows many techniques but does not provide, in my opinion, sufficient detail to easily recreate the effects. Otherwise this book is a good source of inspiration for the casualty simulator. Well illustrated with colour photos.

Grande Illusions a learn-by-example guide to the art and technique of special make-up effects by Tom Savini, Imagine Inc., Pittsburgh, PA, 1994

Grande Illusions Book II by Tom Savini, Morris Costumes, Charlotte, NC, 1996

Although these books are now somewhat dated (Grande Illusions was first published in 1983) both are an excellent introduction to the type of thinking and skills necessary to create convincing special make-up effects. Well illustrated with photos and drawings showing the techniques in detail. Easy to read and very entertaining.

DVD

Fantastic Flesh: The Art of Make-Up EFX, directed by Kevin Vanhook, produced by Andrea Kaufman, Starz Entertainment LLC, 2008

Interviews with directors, actors and make-up artists about special effects make-up in motion pictures. Includes excerpts from well-known films such as "Dawn of the Dead", "Planet of the Apes", "Death Proof" and many others. Although this is not an instructional video, you will find some useful tips and you'll be introduced to the way that working make-up artists think and solve problems. 58 minutes.

Casualty Simulation Basic Kit

The quantity will vary according to the number and type of simulations you're doing. Using the materials in this list takes a moderate amount of technical skill. This list includes materials necessary for prosthetics application and removal but not the prosthetics (make these yourself or purchase). For clarity I've included examples in the product column (greyed out) where applicable; choose products based on performance, availability and price. Print out the list, fill it in (# = quantity, Product/Size) and take it to your local supplier. Keep your kit clean and organized. Check the contents on a regular basis for leaks and changes in colour or consistency. Some materials, such as silicone, have a limited shelf life.

#	Product/Size	Description
		Blood, stage
		Blood, thick
		Blood, old/scab
	Laerdal® Concentrated Blood	Blood, concentrated
	Kryolan® Burn & Injury Wheel and Bruise Wheel	Burn/Bruise Wheel
	Ben Nye® Monster Wheel	Creature Effects Wheel
	Green Marble SeLr™ or Ben Nye® Final Seal	Sealer, makeup spray
	Ben Nye® Neutral Set Powder	Powder, translucent set
		Powder, charcoal/black makeup
		Powder, dirt makeup
	Ben Nye® Color Cake Foundation	Foundation, theatrical, pale colours
	Ben Nye® creme Color Sky Blue	Creme base, light blue makeup
	alternative to latex: Water-Melon™ by Michael Davy	Latex, cosmetic grade liquid
	Seals latex when using creme makeup	Castor Sealer
	Kroylan® Dermacolor Camouflage Cream	Creme Foundation Palette, fair to dark
		Wax, nose and scar
		Effects Gel, transparent
		Pros-Aide® adhesive
		Rigid Collodion
		Cabo, premixed Pros-Aide® + Cab-o-sil®
		Gafquat®
	3 rd Degree or Skin Tite™ and Thi-Vex™	Silicone, skin safe prosthetic grade
		Flocking, red
		Flocking, beige
		Flocking, brown

#	Product/Size	Description
		Flocking, black
		Flocking, green
		Flocking, yellow
		Mixing cups, disposable
	Skin Illustrator® FX Palette	Paint, alcohol-activated, wound effects
		Witch Hazel
		Alcohol, isopropyl 99%
		Glycerin
	K-Y® Jelly or Muko®	Lubricant, water-based
		Mineral oil
	Collodacolor™ remover or acetone (cosmetic grade)	Collodion remover
	Telesis™ Super Solv®	Makeup remover
	Telesis™ Top Guard®	Barrier, skin
		Cotton tipped swabs
		Cotton balls
		Pads, quilted cotton
		Sponges, makeup
		Sponges, stipple
		Tongue depressors, wood
		Brush, powder
		Brush, round sable fine point
		Brush, angle, 1cm
		Brush, flat, various widths
		Brush, chip, 2.5cm
		Spatula, stainless steel, makeup
		Palette, stainless steel, makeup
		Eye droppers
		Scissors, bandage

My email address is below as an image to fool spambots
bmr@barrymrobinson.com

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