Aseptic technique

Adapted from: Essentials for animal research: A primer for research personnel, 2nd Edition, Chapter 5 - Principles of Aseptic Technique, John C. Schofield, B.V.Sc., M.R.C.V.S.

Terminology

- **Antimicrobial** - An agent or action that kills or inhibits the growth of micro-organisms.
- **Antiseptic** - A chemical agent that is applied topically to inhibit the growth of micro-organisms.
- **Asepsis** - Prevention of microbial contamination of living tissues or sterile materials by excluding, removing or killing micro-organisms.
- **Autoclave** - A steam sterilizer consisting of a metal chamber constructed to withstand the pressure that is required to raise the temperature of steam to the level required for sterilization.

Terminology

- **Bactericide** - A chemical or physical agent that kills vegetative (non-spore forming) bacteria.
- **Bacteriostat** - An agent that prevents multiplication of bacteria.
- **Commensals** - Non-pathogenic micro-organisms that are living and reproducing as human or animal parasites.
- **Contamination** - Introduction of micro-organisms to sterile articles, materials or tissues.

Terminology

- **Disinfectant** - An agent that is intended to kill or remove pathogenic micro-organisms, with the exception of bacterial spores.
- **Pasteurization** - A process that kills nonspore-forming micro-organisms by hot water or steam at 65-100^{o}C.
- **Pathogenic** - A species that is capable of causing disease micro-organism in a susceptible host.
- **Sanitization** - A process that reduces microbial contamination to a low level by the use of cleaning solutions, hot water or chemical disinfectants.

Terminology

- **Sterilant** - An agent that kills all types of micro-organisms.
- **Sterile** - Free from micro-organisms.
- **Sterilization** - The complete destruction of micro-organisms.

Facilities

- "Functional areas for aseptic surgery should include a separate support area, a preparation area, the operating room or rooms and an area for intensive care and supportive treatment of animals. The interior surfaces of this facility should be constructed of materials that are impervious to moisture and easily cleaned. The surgical support area should be designed for storing instruments and supplies for washing and sterilizing instruments. Items that are used on a regular basis, such as anesthetic machines and suture materials, can be stored in the operating room. There should be a separate surgical preparation area for animals. An area equipped with surgical sinks should be close to, but apart from, the operating room. A dressing area should be provided for personnel to change into surgical attire.“*
- * *Guide for the Care and Use of Laboratory Animals*

Facilities

- The surgical facility should be located outside normal facility traffic patterns. This can help to minimize the potential for surgical suite contamination by the movement of personnel and equipment. Personnel access to these areas should be restricted to essential surgical support staff.

Facilities

- Ideally, the operating room ventilation system should provide a net positive pressure with respect to the surrounding facilities. The system should be regularly monitored. Ventilation filters should be inspected and cleaned or replaced at regular intervals.
- Dedicated surgical facilities should be used for aseptic surgeries and the storage of essential surgical equipment, not as general storage space.

Equipment

- The equipment in areas used for aseptic surgery should be easy to clean and portable to simplify sanitization of the area. The operating table should be constructed with a durable surface material impervious to moisture which can be readily cleaned. Other useful table design features which assist patient positioning include height and tilt adjustments, V-trough configuration and restraint strap cleats.
- Hypothermia can be corrected by the routine use of a heating pad placed under the surgical patient. Inexpensive short-term alternatives include hot water bottles or heat lamps. Any heat source should be used with caution to prevent patient burns.

Equipment

- Instrument tables provide the surgeon ready access to the surgical instruments and minimize the risk of sterilized instrument contamination by contact with non-sterile fields. Any tray arrangement may be used for this purpose. The unit should be easy to clean and simple to operate.
- The drapes in an instrument pack frequently include impervious table covers which can minimize instrument contamination and allow the surgeon to reposition the table without breaking aseptic technique during the procedure.

Equipment

- Adequate lighting is essential for performing surgical procedures. A variety of fixtures can be used to provide sufficient light. The commercially available surgical light fixtures may be ceiling or wall-mounted or free standing. Surgical lights are often positioned above the operative area and should be regularly wiped with a moist towel prior to use to minimize potential contamination of the sterile field below.
- Light fixtures designed with detachable sterilizable handles allow the surgeon to adjust the beam during surgery. Wheeled, height-adjustable intravenous drip stands should be available when conducting major surgery.

Equipment

- Ancillary equipment such as suction units, respirators, electrosurgical units and ECG monitors should be portable and included with the light fixtures in a routine equipment cleaning schedule. Specific details on such devices could be obtained from an institutional veterinarian or surgical supervisor.

Equipment

- Surgical instrumentation and pack preparation will vary with the type and complexity of surgery to be performed. Consultation with an institutional veterinarian or surgical supervisor could be helpful when selecting the appropriate surgical instruments necessary to perform a proposed procedure .
- Instrument packs should be double wrapped. Various commercial materials are available for this purpose. As many sterilizable items as possible should be included.

Personnel

- Aseptic technique requires careful attention to a series of steps which begins with patient and instrument preparation and ends at final wound closure. Aseptic technique designs all actions and motions to protect the sterile field from contamination.
- Personnel should receive instruction on the indications for aseptic technique, the sources of potential contamination, patient, instrument and equipment preparation, sterilization systems, gowning and gloving techniques, and intraoperative aseptic management.

Sterilization

- Sterilization is the process that is intended to kill or remove all types of micro-organisms. There are two principal sterilization methods:
  - Physical (dry heat or saturated steam)
  - Chemical
- Factors which determine the method to be used are the type of micro-organisms involved, the nature of the article to be sterilized and the time available for sterilization.

Physical methods (steam)

- Steam sterilization depends on the use of steam above 100^{o}C. Temperatures ranging from 121-134^{o}C at pressure s of 15-30 psi are generally recommended. Minimum holding times for the sterilization of medical equipment are 15 minutes at 121^{o}C, 10 minutes at 126^{o}C, and 3 minutes at 134^{o}C. The steam is then removed and instrument packs are allowed to dry or liquids cool. The drying stage may be adjusted to suit the load.

Physical methods (steam)

- The color change on a chemical dye impregnated indicator strip placed within the pack can provide a convenient and rapid visual check that the appropriate sterilization conditions were reached.
- Function should also be monitored on a regular basis using commercially available biological indicators. Spore strips of *Bacillus stearothermophilus* are placed within the wrapped article prior to sterilization. After sterilization the strip is incubated at 57ºC for 48 hours. The absence of growth indicates effective sporicidal autoclave action.

Chemical method (liquid)

- The use of chemical solutions as a sterilization technique for surgical equipment is frequently employed, but it should be stressed that most solutions only disinfect and do not guarantee sterility. When the necessity for maintaining sterility is a critical factor, as in the implantation of prosthetic devices , indwelling catheters or vascular access ports, disinfection in chemical solutions is not recommended. Such prostheses should be thoroughly sterilized by either gas or steam. Chemical solutions, however, offer the advantages of safety for delicate and thermolabile plastics.

Chemical method (liquid)

- Other limitations of chemical solutions should also be appreciated. Equipment must be thoroughly cleaned before immersion, as chemical action is ineffective in the presence of proteins or fats. There are currently no indicators commercially available to monitor the effectiveness of this sterilization method.
- Alcohols are neither sporicidal nor viricidal. They are not stable and lose effectiveness through evaporation. Alcohols cannot be used for instruments that have plastic or cemented parts.

Preparation of the animal

- The animals should be prepared in an area separate from where surgery will be performed. Preparation is facilitated by first inducing anesthesia. The stomach, rectum and urinary bladder can then be evacuated as required at this stage. Hair is then removed from the surgical site using electric clippers equipped with a fine blade. A liberal area is clipped to anticipate any enlargement of the initial surgical incision and minimize wound contamination from adjacent unclipped areas.
- In rodents, the need to minimize the loss of heat during surgery and recovery must be balanced against the need to provide an adequate aseptic field when clipping the animal.

Preparation of the animal

- Initial skin cleaning can be done prior to moving the animal to the operating area. When the animal is moved to the operating area, it should be positioned on a heating pad on the surgical table.
- To avoid burns heating pads should be wrapped to prevent direct contact with the animal. Inclined positioning with a tilt table is indicated for some procedures and some species.

Preparation of the animal

- The surgical approach will dictate actual animal position; however, some guidelines to consider are:
  - The animal's respiratory function should not be compromised by overextension of forelegs stretched towards the head, or by excessive body tilt which causes pressure from the abdominal organs on the diaphragm.
  - Limbs should not be extended beyond their normal range of motion and restraint straps should be padded as needed to prevent impaired venous return in extremities.

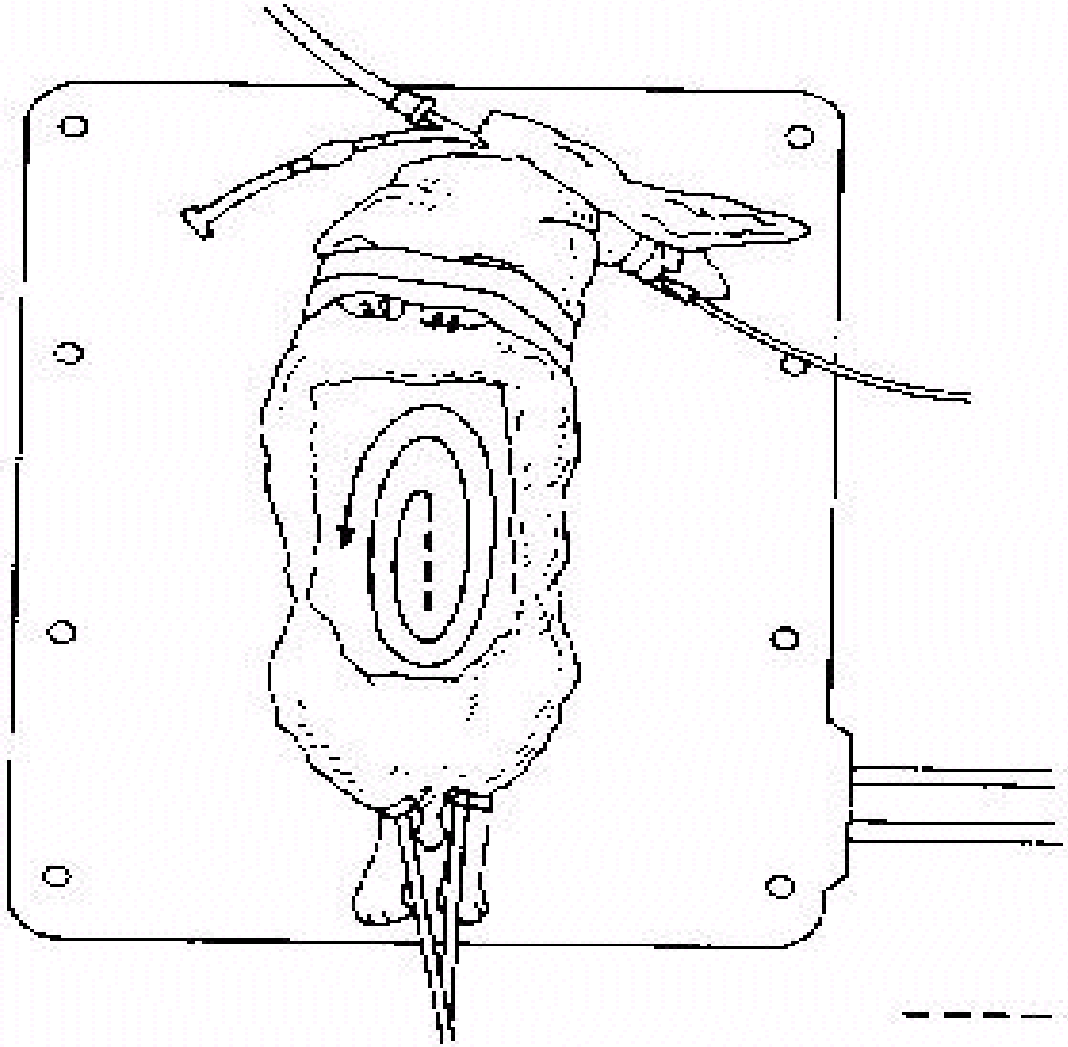
Preparation of the animal

- After the animal has been secured, any monitoring devices such as ECG electrodes and esophageal stethoscopes should be placed and their function tested.
- Ruminants are frequently positioned on a slight incline with the head dependent, to minimize the potential for aspiration of rumen fluids. After intubation with a cuffed endotracheal tube, a large bore stomach tube is also frequently placed down the esophagus to remove rumen fluids and gas.

Preparation of the animal

- The animal is now ready for final preparation of the surgical site. Personnel who perform the presurgical skin preparation should wear a cap and mask when preparing the surgical scrub supplies and when opening pre-sterilized sponge and drape packs. Skin preparation solutions may be applied with a sterile sponge held by a pair of sterile forceps or by a hand wearing a sterile glove.
- A sterile surgical glove is put on one hand, while the other hand is used to hold and manipulate non-sterile bottles of surgical scrub solution. A sterile sponge held in the gloved hand is saturated with surgical scrub solution and the surgical area is scrubbed beginning with the central incision site and working progressively in a circular fashion to the margins of the shaved area. The sponge is then discarded and the process repeated, working from the center to the outside to minimize contamination of the surgical site.

GENERAL PATH OF ASEPTIC SKIN PREP



---- Incision

——— Path of aseptic skin prep

Fig. 1

Preparation of the animal

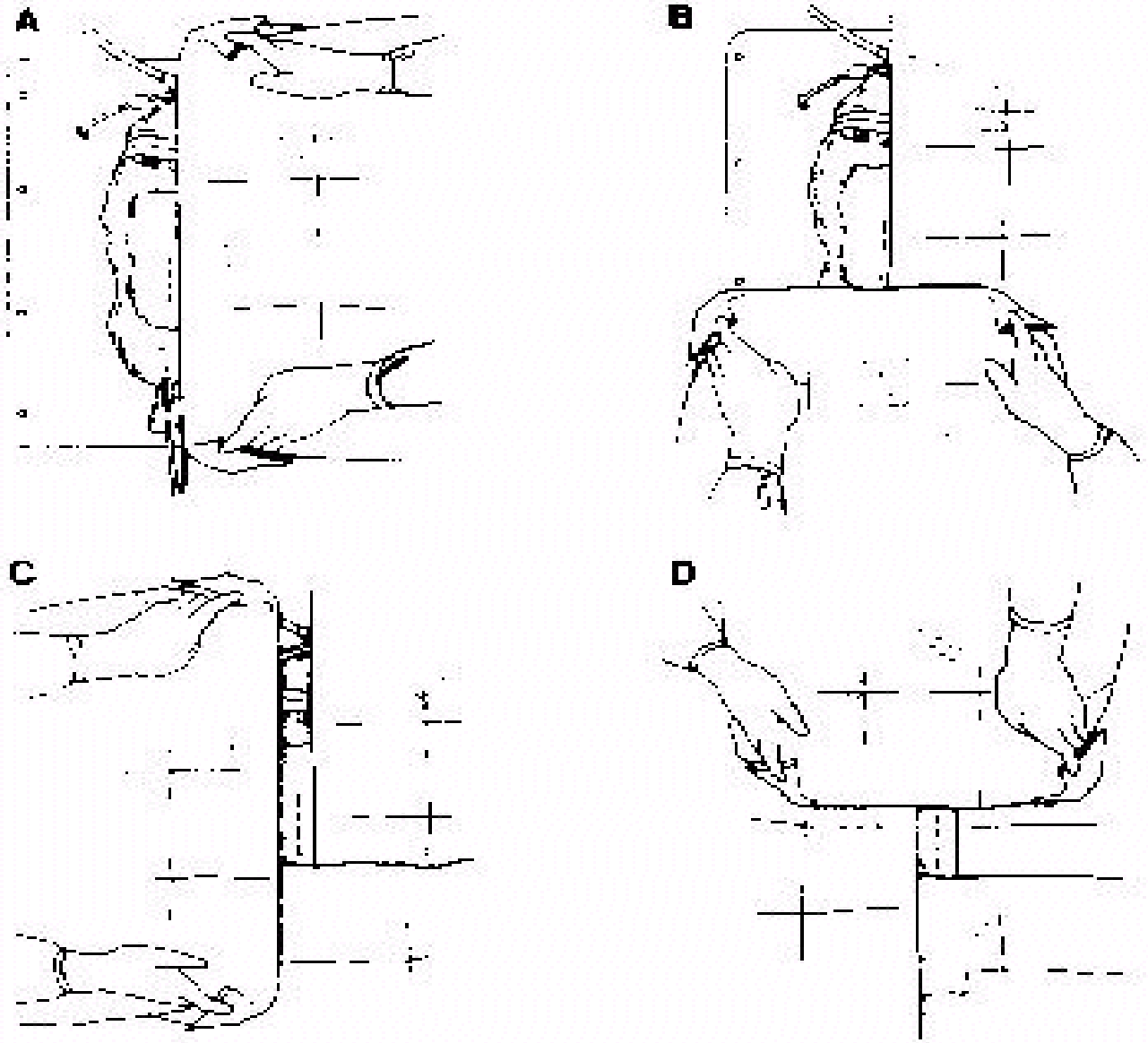
- Some of the most frequently used chemical solutions for preoperative surgical skin preparation are: chlorhexidine, iodophors and povidone-iodine surgical scrubs. Recommended contact times vary from 2 to 4 minutes.
- Following removal of the scrub solution with a 70 percent alcohol solution using the same technique, an iodine skin solution is painted on the site using the above technique and left to dry.

Preparation of the animal

- Drapes serve to isolate the surgical site and minimize wound contamination. Drapes should be positioned without the fabric dragging across a non-sterile surface. There are two basic types of drape systems used: fenestrated and four corner.
- Fenestrated drapes have a hole in them which is placed over the surgical site. Frequently used for smaller species, these drapes are utilized for routine elective procedures. The fenestration should be just slightly larger than the intended incision.

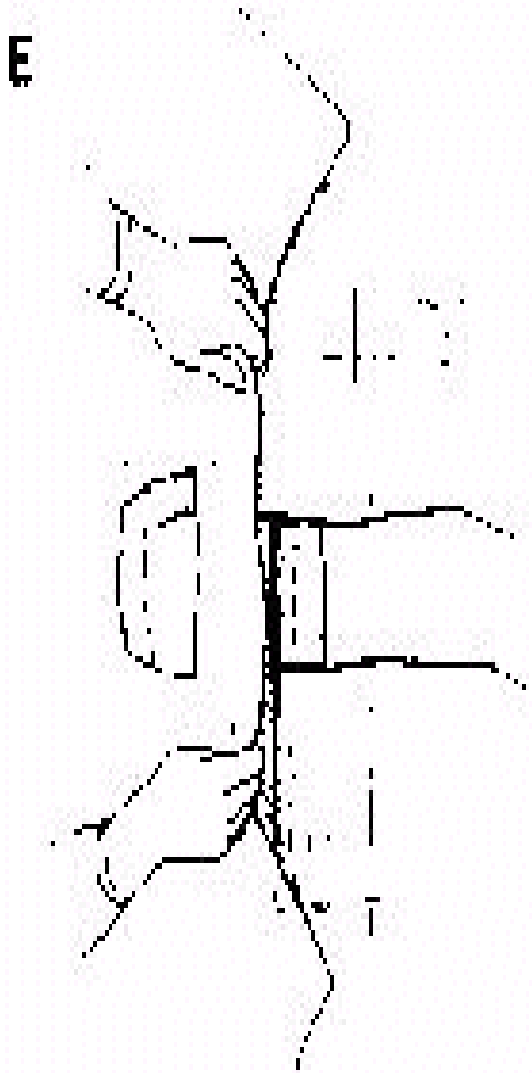
Preparation of the animal

- The four corner drape system: a drape is placed at each of the four margins of the surgical site. Four corner drapes are applied one by one in a clockwise or counterclockwise direction. Each drape should be carefully positioned with a 6 to 8 inch edge folded underneath at the incision site. Small adjustments in position can then be made without contaminating the underside of the drape. Drapes can be secured in place with towel clamps at the four corners or aerosol adhesive applied to the margins of the surgical site prior to draping.

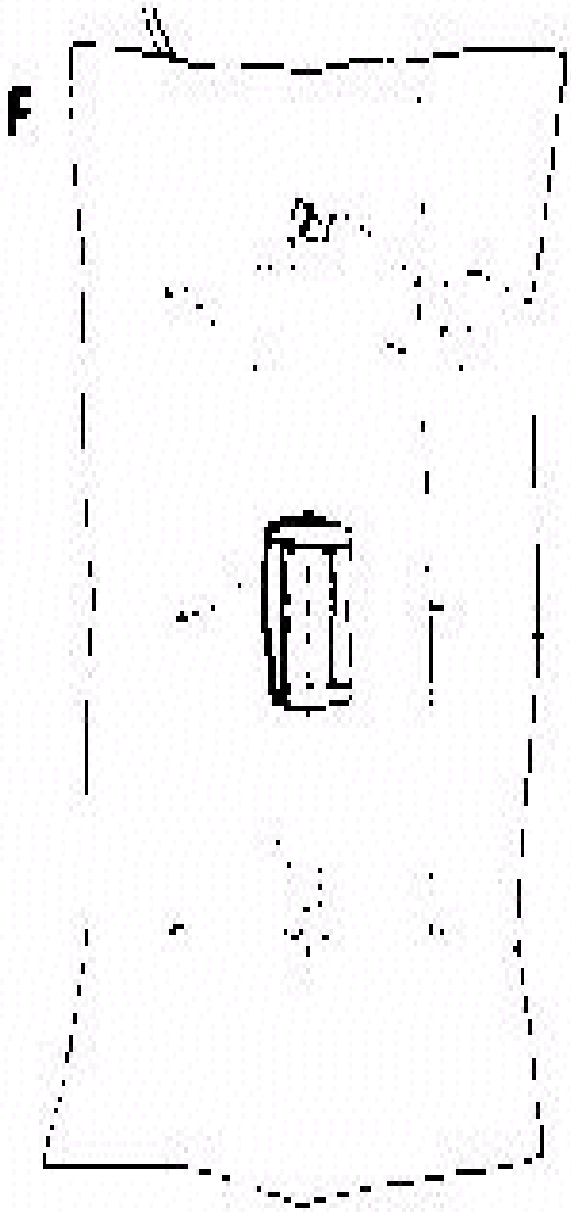

A
B
C
D

Preparation of the animal

- Some surgeons prefer to secure four corner drapes, then apply a fenestrated drape as a second layer of protection. Ideally, the patient and entire surgical table should be draped, and the drape extended to the instrument table. The need to monitor the draped patient should always be considered.



Four corner



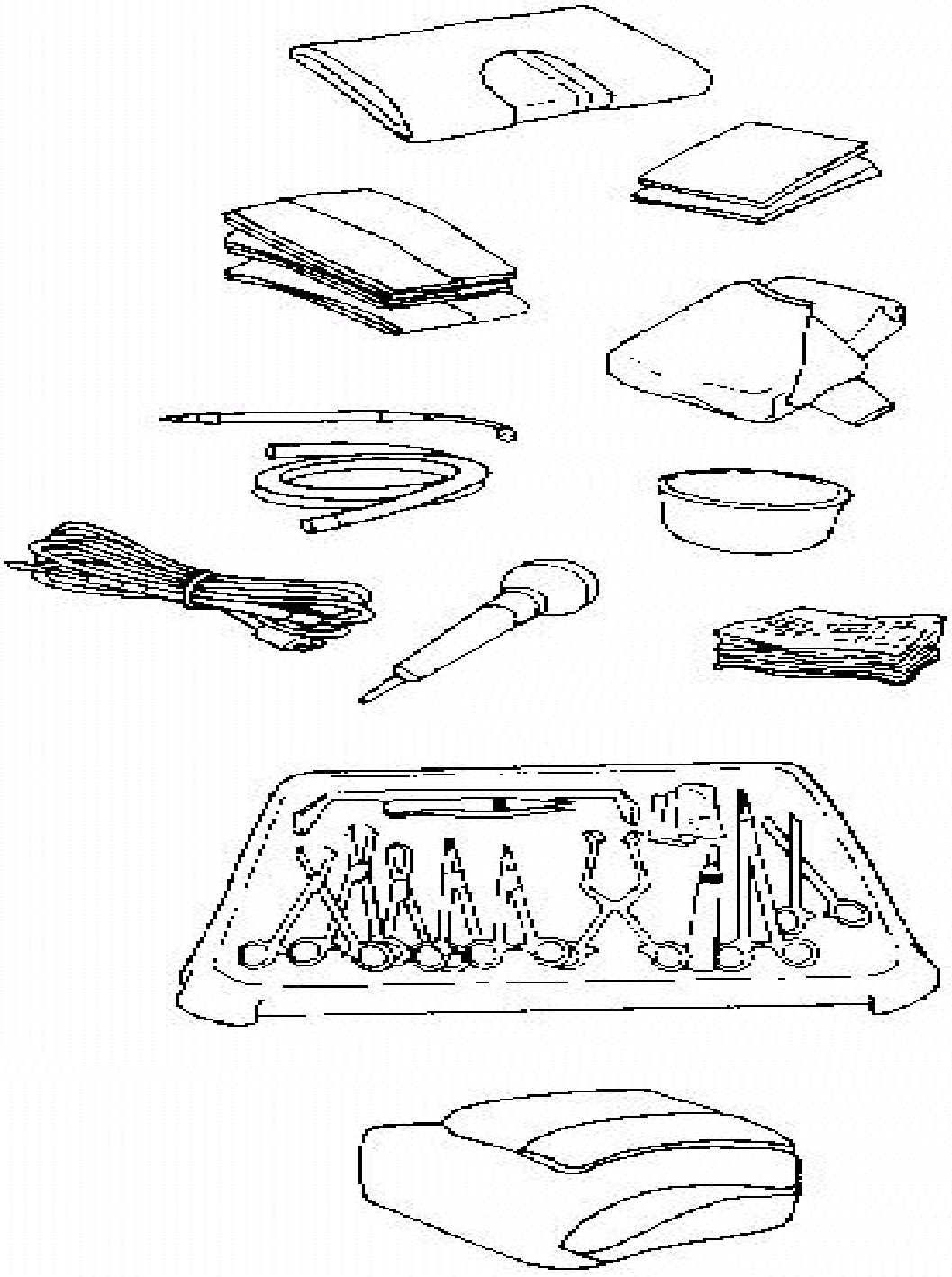
Fenestrated

Preparation of surgical pack

- Each instrument should be inspected to ensure that all debris has been removed. Items should be assembled on a tray and arranged in a consistent order. Materials should be placed in sequential order so that items used first are placed on top. Packs should not be too densely packed in the autoclave to allow for adequate steam or gas penetration. Indicator test strips can be placed deep within the pack. Packs should be double wrapped, and the outer wrap should be secured with adhesive indicator tape on which is recorded the date of sterilization.

Preparation of surgical pack

When opening a sterilized surgical pack the sterilization date should be checked. The shelf life of wrapped instruments is up to 6 months. The adhesive indicator tape should be noted for the appropriate color change. Packs should be placed on a dry instrument tray and the outer wrapping carefully unfolded by touching only the corners of the outside drape surface. The operator should avoid reaching over the pack. The packs should not be opened too early. Any other sterilized supplies which can be opened onto a sterile field should be made ready at this time.



Preparation of the surgeon

- In a laboratory setting, the extent of surgeon preparation will depend on the facilities and the need for strict attention to aseptic technique. Well-equipped surgical facilities, in which sophisticated survival procedures are performed, generally require surgeons to wear appropriate surgical clothing and to scrub, gown and glove. Instruction in such procedures should be done on a one-to-one or small group basis in appropriately designed scrub rooms.

Preparation of the surgeon

- The surgeon should change into surgical scrubs and shoes or wear shoe covers. Head covers and face masks should cover all facial hair. Remove all rings, jewelry and wrist watches before scrubbing. Finger-nails should be trimmed short and cleaned with a disposable nail cleaner. Scrub sinks equipped with leg or foot-operated faucets are ideal. Regular faucets must be turned on, adjusted and not touched again. The hands and forearms are washed for 30 to 60 seconds with a surgical scrub soap. Then a sterile brush is used to methodically scrub all surfaces of the hands, fingers and forearms down to the elbows. Both arms are rinsed and the process repeated starting with fingertips working down to the elbows. The definition of a "complete surgical scrub" is controversial. However, contact times of 3 to 15 minutes and/or 5 to 20 strokes per surface are frequently recommended.

Preparation of the surgeon

- After rinsing, the hands are held together high and rinse water allowed to drip from the elbows. The surgeon should avoid touching anything at this stage except to dry the hands with a sterile towel. Next the sterile gown is carefully removed from the pack to avoid touching the outside of the gown. It is held away from the body and shaken out. The sleeve hole is located and each arm inserted in turn. Correct gowning requires an assistant to tie the back of the gown at the neck and waist (being careful to touch only the inner gown surface).

Preparation of the surgeon

- Sterile surgical gloves are packaged with the cuff of each glove turned down. One glove is picked up by the turned-down cuff and pulled onto the hand with the cuff left turned down. Using the gloved hand, pick up the remaining glove by inserting the fingers into the cuff and pulling it onto the opposite hand. Then the glove cuff is lifted over and onto the gown cuff and the process repeated on the other hand. This technique is known as "open gloving." Remove the powder on the outer glove surface by wiping the gloved hands with a damp sterile gauze. Arms and hands should be held above the waist at all times. Aseptic technique is maintained when the gowned and gloved surgical team only touches sterilized equipment within the sterile field.

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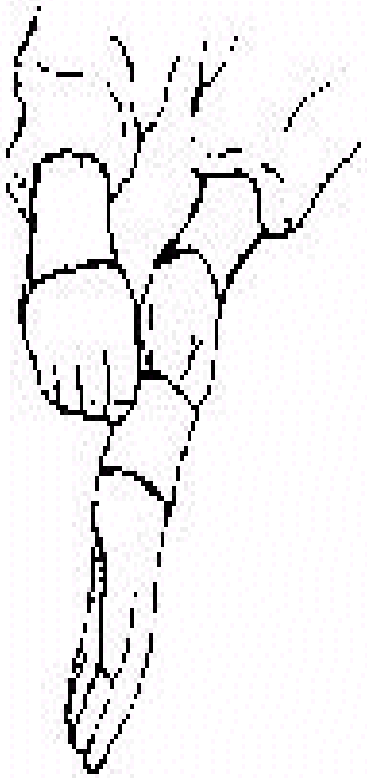

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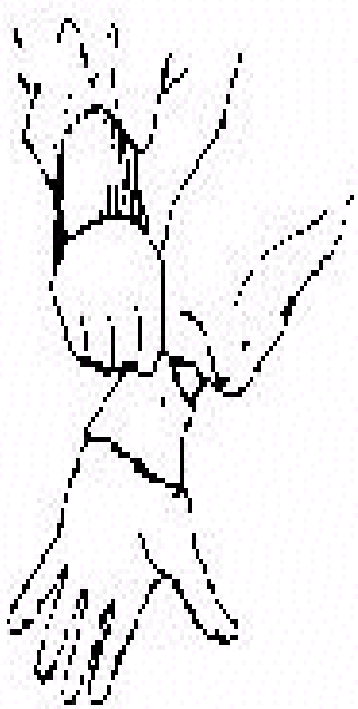

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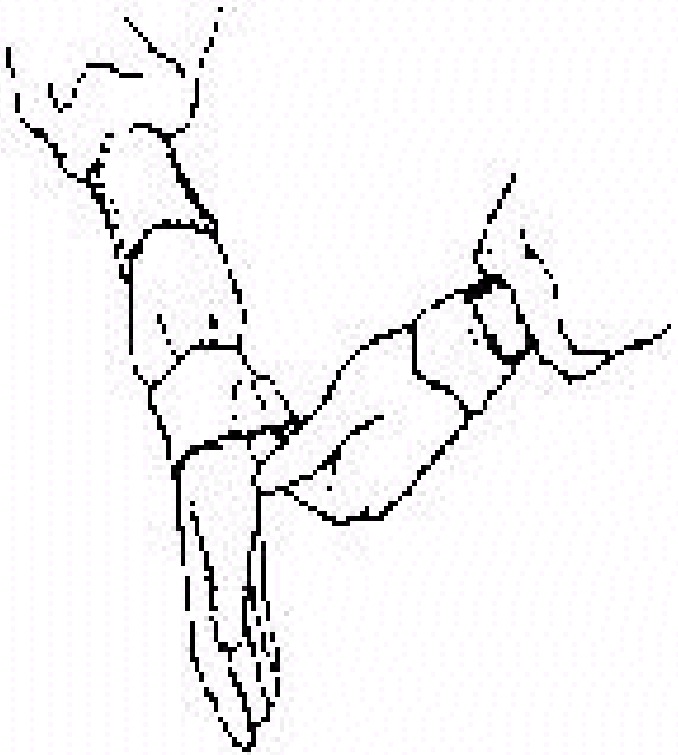

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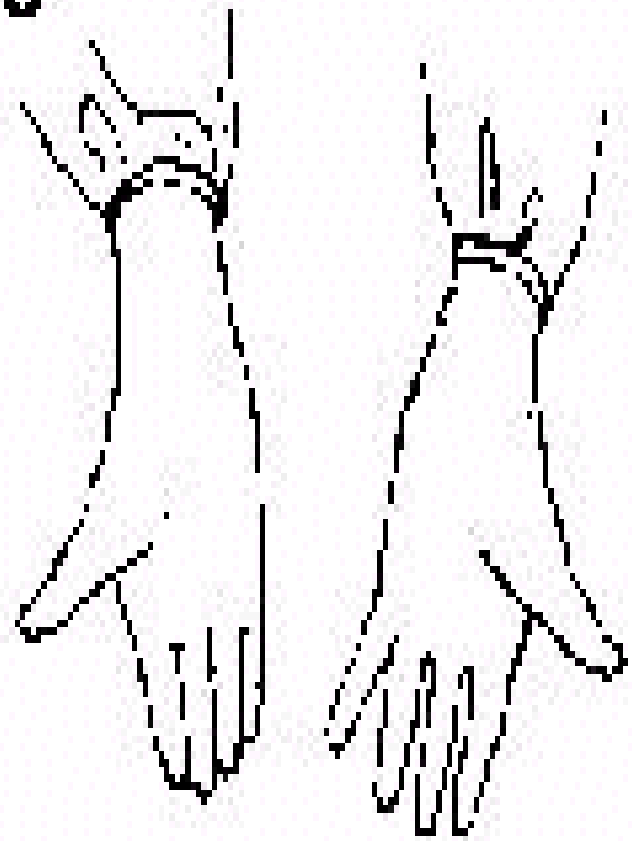

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