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INTRODUCTION

Factors Predisposing to Injury

- Risk to personnel in intraoperative consultation (IOC) room is greater than risk to pathology personnel in general due to multiple factors
 - **Time constraints**
 - Activities (e.g., examining specimens, cutting sections) need to be performed quickly
 - **Multiple people from different departments use IOC room**
 - Pathology personnel, surgeons, operating room nurses, and researchers may be present
 - Not all people may be familiar with best practices for room and specimens
 - **Multiple people may be involved in examining single specimen**
 - Each person must be responsible for appropriate and careful handling and disposal of sharps
 - **Unfamiliarity with room &/or equipment**
 - Some personnel may only use room intermittently
 - Safety equipment may not always be used appropriately
 - Materials may not be replaced or replenished appropriately
 - Room may be used at night and on weekends when personnel familiar with room are not present
 - **Less experienced personnel may perform tasks at irregular intervals**
 - May only use cryostat during IOCs
 - **Patients undergoing surgery may have undiagnosed infectious disease**
 - Pathology personnel who are immunocompromised or with compromised skin (dermatitis, weeping skin lesions, or wounds) may have increased vulnerability
- It is important to have protocols and personnel in place to ensure safety
 - One person should be designated as being in charge of IOC room
 - Ensures room is properly equipped and maintained

- Provides training to new personnel
- Supervises daily use of room
- New pathology personnel should be trained in appropriate procedures during IOC
 - Training should occur annually or when new procedure is introduced

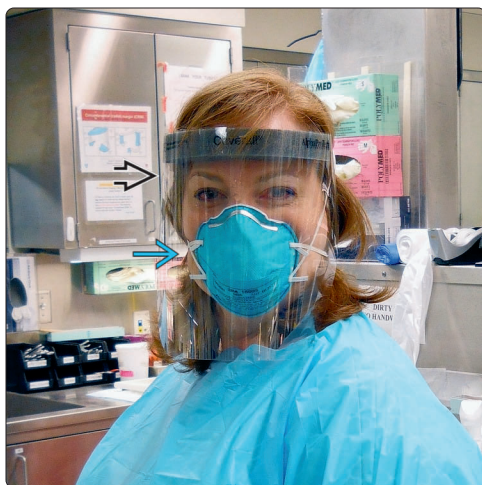
TRAUMATIC INJURIES

Sources

- Razor blades
 - Should have single blade and always be used with protective sheath
- Cryostat blades
 - Blades should never be cleaned with hands
 - Large swab (e.g., gauze wrapped around applicator) is safer method to brush shavings away from blade
 - Injuries from cryostat blades are particularly problematic as exposure to multiple specimens is possible
 - If chuck or block needs to be manipulated, this should be done outside of cryostat
 - Removal of excess embedding material
 - Removal of staples from tissue
- Scalpels
 - Blades must be removed with caution using hemostat or forceps
 - Common source of injuries is during removal of blade when it is contaminated
- Large cutting blades
 - Disposable blades are preferred
 - Can be disposed rather than cleaned
 - Do not require sharpening
- Syringe needles
 - Use of needles is rarely indicated and should be avoided due to risk of penetrating injuries
 - If used, needle should be directly discarded into sharps container and not recapped
 - Needles should not be used to mark site of lesion for later evaluation

Face Protection: Splashes

(Left) When there is a risk of splashing (e.g., opening large cystic masses), a full face shield provides the best protection. A face mask provides additional protection for the lower face and mouth. (Courtesy K. Gill, PA.) (Right) Special masks designed to protect against chemical fumes may be worn when performing tasks such as changing solutions on a staining rack. (Courtesy V. Chan, BS.)



Face Protection: Chemical Exposure



- Large paperclips can be threaded through tissue to mark lesions (e.g., site where radio seed was removed)

Types of Injuries

- Most common type of injury is laceration from blade
- Nondominant hand injuries most common but also occur to dominant hand
- Injuries can potentially convey infectious agents

Prevention

- All blades must be discarded by person using blade
 - Common source of injury is from blades hidden by surgical drapes, paper towels, or tissue
 - Blades should be discarded rather than left on work space after use
- The hand holding the specimen should be well away from the hand holding the blade
 - Hard specimens that require increased force to section are particularly hazardous
 - Specimen can be held with gauze, which provides firmer grip and helps keep nondominant hand away from blade
- Kevlar gloves or metal mesh gloves are available
 - In actual practice, these gloves are unwieldy and difficult to use
- Use of needles and other piercing instruments should be avoided
- Frozen embedding medium should not be removed from chuck using blade
 - Common source of injury
 - Chuck can be kept at room temperature until block is melted or chuck and block can be briefly dipped into formalin container to speed melting
- Cytologic preparations should be used rather than frozen sections when infection is suspected

INHALATION

Sources

- Tissue from patients with infectious disease
- Chemicals (stains, fixatives)
 - Formaldehyde and xylene are of most concern

Mechanism of Injury

- Infection
 - Only reported when aerosolized coolants have been used to freeze blocks with tissue containing *Mycobacterium tuberculosis*
 - Coolants should not be sprayed directly onto tissue
 - If used to cool block, resulting aerosol should be contained within cryostat and not inhaled
 - Better alternative methods for cooling blocks rapidly are available
 - Specimens are unlikely to pose threat under other conditions
- Chemical inhalation
 - Unlikely to occur unless chemicals are not stored properly or unless there is large spill

Prevention

- Infection
 - Masks designed to protect from aerosolized bacteria are available

- Specific masks for protection from *M. tuberculosis* should be used when specimens from patients with known infections are examined

- Chemical inhalation
 - Appropriate ventilation of IOC room is essential
 - Chemicals must be tightly capped and stored
 - Staining racks should be kept covered when not in use to prevent evaporation as well as air contamination
 - Spill kit and protocol must be available

MUCOCUTANEOUS EXPOSURE

Sources

- Bloody specimens
- Cysts with fluid under pressure

Types of Injuries

- Splash injury into eyes or mouth
- Cutaneous exposure into breaks in skin

Prevention

- Personal protective equipment must always be worn
 - Protective goggles or face masks must be worn when handling specimens that are likely to pose risk of splashing
 - Double gloves should be worn when handling particularly bloody specimens or specimens of known or suspected infectious risk
- Extreme care should be exercised when cutting into hard, intact mass that could be cystic
 - Piercing cyst can result in forceful ejection of fluid several feet
 - Waterproof barrier may be kept over site of incision until it is determined if fluid is present or not
 - Cysts should be opened near sink to aid in disposal of fluid cyst contents
- Eating, drinking, smoking, and application of cosmetics or lip balm are not allowed in IOC room
 - Food cannot be stored in room or refrigerators and must not be discarded in waste containers
- Material that will leave IOC room must be clean to protect personnel outside room from exposures
 - Outer specimen container is kept clean
 - All paperwork is kept clean
 - If contamination occurs, paperwork can be placed inside protective plastic sleeve or information copied onto clean form

INFECTIOUS AGENTS

General Guidelines

- Freezing does not inactivate infectious agents
- Formalin inactivates many infectious agents but may require many hours to do so
 - Prions remain infective after routine fixation
- IOCs should only be performed when absolutely necessary on specimens suspected to harbor infectious agent
- However, majority of infectious agents do not pose risks to immunocompetent individuals

Tuberculosis

- 3 cases of conversion to positive skin tests have been reported during performance of frozen section

- All involved use of aerosolized coolant and inhalation
- Aerosols should be avoided
- Yearly tuberculous (TB) tests are recommended for all hospital personnel

Creutzfeldt-Jakob Disease

- 3 cases have been reported in 2 histotechnologists and 1 pathologist
 - Exposure was to fixed tissues
 - No cases have been reported during performance of IOC
- Special techniques are necessary to inactivate prion proteins
 - Formalin fixation for 24 hours
 - 95% formic acid for 1 hour
 - Formalin fixation for another 24 hours
- Symptoms suggestive of Creutzfeldt-Jakob disease (CJD) include
 - Rapidly progressive dementia
 - Myoclonus
 - Nonspecific neurologic findings
- Tissue handling
 - Specimens from patients with suspected CJD should not be examined by IOC
 - Tissue should be fixed immediately following suggested protocols and stored in secure location
 - Clinical necessity of tissue processing should be considered carefully before placing personnel at risk

HIV

- No cases have been reported during performance of IOC
 - 1 reported case of pathologist infected after scalpel injury to hand during performance of autopsy
- ~ 0.3% risk of infection after penetrating injury
- Postexposure prophylaxis includes 4-week treatment with 2 drugs

Hepatitis B Virus

- No cases have been reported during performance of IOC
- 30% risk of infection after percutaneous penetrating injury
 - Likely also high risk after mucocutaneous exposure
- Infectious hepatitis B virus (HBV) can exist in dried blood for at least 1 week
- Pathology personnel should be vaccinated for hepatitis B
- If nonvaccinated person is exposed, postexposure prophylaxis includes vaccination for HBV
 - Hepatitis B immune globulin can also be used

Hepatitis C Virus

- No cases have been reported during performance of IOC
- ~ 1.8% risk of exposure after penetrating injury
 - Risk after mucocutaneous exposure is likely low
- Hepatitis C virus (HCV) degrades rapidly in environment
- Personnel should be monitored for infection after exposure
 - Postexposure prophylaxis has not been shown to be effective

TUMORS

Risk After Exposure

- Single case report of sarcoma transferred to physician

- Surgeon suffered injury to hand during excision of sarcoma
- Sarcoma developed at site of injury
- Genetic analysis showed that tumor was derived from patient
- Physician remained well 2 years later
- Rare reports of injected tumor cell lines growing in recipient
- Procedures to avoid exposure to infectious agents also prevent exposure to tumors
 - Risk of transferring tumor to another person is extremely low

RADIATION

Specimens

- Radioactive agents are sometimes used intraoperatively
 - Sentinel lymph node identification
 - Radioactive seeds for localization of breast lesions
 - Octreotide to localize neuroendocrine lesions
- Dose used is generally too low to result in significant exposure to pathology personnel
 - Special procedures are generally not required to limit exposure
 - Standard gloves are adequate for protection
 - Radioactive seeds contain iodine-125 that emits low energy gamma rays of 20-30 keV
 - Titanium capsule surrounds internal core filament containing iodine-125
 - If internal core filament is damaged, area must be treated as radioactive spill
 - Damaging seed should be avoided by not using scissors and very carefully sectioning specimen with scalpel under guidance with gamma probe
- Adequate storage area required for retrieved radioactive material
 - Radioactive seeds can be safely stored in metal container
 - Seed must be stored in closed container listing corresponding surgical pathology number
 - Log book is required to document specific seed, when retrieved from specimen and when released to Radiation Safety Department

Prevention

- If radioactive agents used during surgery, risk to pathology personnel should be considered
- If radioactive materials need to be retrieved (e.g., radioactive seeds), procedures for doing so must be instituted
- Pathologists must have necessary equipment (e.g., Geiger counter, gamma probe) to monitor radioactive material and to detect radioactive medical devices

PERSONAL PROTECTIVE EQUIPMENT

General Guidelines

- Personal protective equipment (PPE) is defined as equipment designed to prevent exposure of skin or clothing to blood or other infectious materials
 - Worn to minimize exposure to hazards that cause serious workplace injuries and illnesses

- Includes chemical, radiological, physical, electrical, mechanical, or other workplace hazards
- Must be provided by institution to employees
- Must be discarded appropriately when contaminated and when leaving IOC room

Hands

- Gloves must always be worn when handling tissues
 - Rings with sharp surfaces should be removed as they can increase likelihood of puncture
- 2 pairs of gloves are recommended if infectious agent suspected
- Latex gloves protect against biohazards but not chemicals
 - Latex is permeable to chemicals and can rapidly degrade when exposed to some types
- Nitrile and neoprene gloves protect against biohazards and exposure to fixatives
 - Personnel with latex allergy may use nitrile gloves
- Metal mesh and Kevlar cloth gloves are available if puncture injuries are possible
 - Latex or nitrile gloves are worn beneath and over gloves
- Soiled gloves should be discarded and replaced when touching other objects in room
 - Gloves should also be changed between specimens to avoid any chance of contamination
- Hands must always be washed after handling specimens and when leaving IOC room
 - Small, inapparent breaks in gloves are common
 - If 2 gloves are worn and blood is present between gloves, gloves should immediately be removed to determine source of blood
 - If hand injury is identified, first aid and evaluation of infection exposure is required

Head and Face

- Eye protection should be worn if splash injuries are possible
 - Safety glasses or goggles
 - Full face mask
 - Face protection should include side shields
- Special respiratory masks protect against aerosolized TB
 - N-95 masks filter at least 95% of particulates that are 3 µm or larger
 - Requires each person to be individually fitted for mask
 - In practice, these masks are uncomfortable and not often used
- Surgical masks
 - Designed to protect patients from exhalations of person wearing mask
 - Inadequate to protect pathology personnel from aerosolized infectious agents
 - Can provide protection of mouth and lower face from splashes

Body

- Scrub suits may be worn when exposure is probable
 - These clothes can be easily exchanged for clean replacements if exposure occurs
- Aprons are used over clothes or scrub suits to protect torso
 - Sleeve protectors or aprons with sleeves are preferable when numerous specimens are handled
- Disposable jumpsuits offer complete coverage of body

- Lab coats should not be used for protection if also worn outside of IOC room

EQUIPMENT AND ROOM

Cryostat

- Ideally, 1 cryostat should be designated for known or possible infectious cases
 - Cases requiring decontamination include known or suspected HIV, HBV, HCV, SARS-related coronavirus, prion disease, myobacterial disease, or systemic fungal disease
 - After cryostat is used for such cases, it must be marked and not used again until after decontamination
- All cryostats must be decontaminated at defined intervals
 - Cryostat is defrosted
 - Tuberculocidal disinfectant is used to clean interior
 - Trimmings and sections of tissues must be removed
- More frequent decontamination is necessary if known infectious cases have been processed

Room

- "Clean" areas should be designated where gloves must not be worn
 - Typically microscopes, telephones, door knobs
 - Most common items used by personnel not directly involved in processing specimens
 - Only clean hands without gloves are allowed to handle material in these areas
 - Avoids possible contamination with biohazardous material that has touched gloves
- All soiled disposable material should be immediately placed in appropriate biohazard containers
- Exposed surfaces are cleaned and disinfected with diluted bleach or other appropriate sterilants

Specimens

- Fix in adequate amount of formalin as soon as possible
- Container must be leakproof and securely sealed
- Specimens that may be infected with CJD must be specifically labeled as biohazard and stored separately
 - These specimens require additional handling to inactivate prions

Chemicals

- Fixatives and stains are associated with health risks if inhaled, ingested, or if exposure to mucous membranes
 - Formalin: Acute effects
 - Strong eye and throat irritation
 - Coughing, wheezing, chest tightness
 - Bronchitis, laryngitis
 - Corneal clouding, loss of vision
 - Xylene: Acute effects
 - Strong irritant of eyes, nose, throat, mucous membranes, skin
 - At high concentrations, can cause headache, dizziness, nausea
 - Aerosol freezing agent: Acute effects
 - Usually use carbon dioxide and propellant
 - Effects are dependent on specific formulation
- Material safety data sheets must be available in room

- Includes information on hazardous ingredients, physical/chemical characteristics, fire and explosion data, reactivity data, information on health hazards, precautions for safe handling and use of chemicals, response to spills, storage and safe disposal methods, and effect on environment
- Flammable chemicals must be kept in metal cabinet
 - Fire extinguisher suitable for chemical fires must be available
- Containers should be kept sealed when not in use and staining racks should be kept covered
- When chemicals are handled, protective gloves must be worn
- Spill kit must be available for small amounts of chemical
 - Absorbent material is poured around spill for containment
 - Absorbent material is then poured over chemical
 - Material can then be swept or brushed into appropriate hazardous waste container
- If large spill cannot be contained, additional help must be requested
 - Room should be evacuated and doors kept closed

Safety Equipment

- Removal of scalpel handles
 - Injuries may occur when removing blade from handle
 - Blades should not be removed using hands
 - Forceps or hemostats can be used
 - Handle is held firmly
 - Blade is pointed away from prosector and other people
 - Blade and blade lock must be facing upward with slanted edge of blade facing toward prosector
 - Base of blade is grasped with forceps or hemostat and pulled outward away from handle until blade lock hole lifts off lock
 - Blade is then carefully moved forward (toward tip) to remove
 - Blade is then placed in sharps container
 - Special devices can also be used to remove handles
- Sharps containers
 - Used to dispose of all blades and needles
 - Must be red &/or marked with biohazard sign
 - Leakproof
 - Should be emptied frequently so that sharps can be dropped into container
 - Sharps should never be pushed into container

Waste Disposal

- Materials contaminated or possibly contaminated with blood or infectious agents
 - All PPE and other materials in contact with specimens and blood must be disposed into specific containers

POST INJURY OR EXPOSURE TREATMENT

Immediate Care

- Administer first aid as necessary
- Wash penetrating injuries with soap and water
 - Allow bleeding injuries to continue to bleed liberally
- Eye and mucous membrane injuries are flushed with water

- Copious amounts of water should be used and eyelids should be held open
- There should be access to eyewash fountain
- Record name and other identifiers of patient whose specimen was involved in exposure
 - Occupational Safety and Health Administration (OSHA) requires maintaining logs of occupational exposure and sharps injuries

Subsequent Care

- Consult institutional healthcare team
 - Each institution should have policies for treatment after injury or exposure
 - Incident reports are important to identify repeated problems
 - For some exposures, prophylactic treatment is indicated
 - National Clinicians' Postexposure Prophylaxis Hotline (888) 448-4911

RESOURCES

OSHA

- Refer to OSHA website, Bloodborne pathogens, standard 1910.1030 (see references)
 - Includes regulations for PPE, labeling and disposing of hazardous waste, record keeping (sharps injury log, occupational exposure log, training log) as well as many others
- Refer to OSHA website, Respiratory protection, standard 1910.134 (see references)
 - Primarily issues related to protection from particulates and toxic fumes
- Refer to OSHA website, Personal protective equipment

Clinical and Laboratory Standard Institute (CLSI)

- Protection of laboratory workers from occupationally acquired infection guidelines

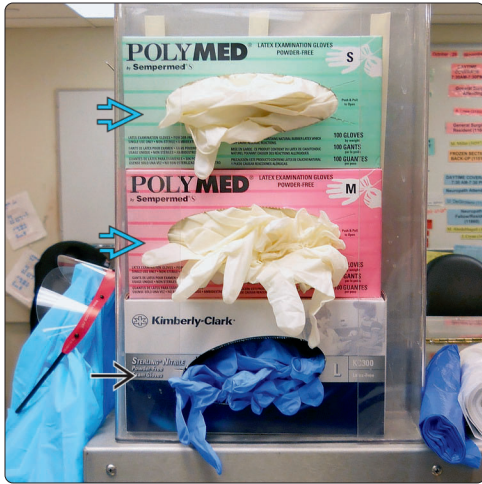
College of American Pathologists

- Laboratory Accreditation Program Manual
 - Requirements related to pathology personnel safety include
 - All solutions and stains are properly labeled and changed on defined schedule
 - Cryostats are decontaminated at defined intervals and record is kept of this procedure

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Types of Gloves



Cut-Resistant Gloves



(Left) Latex gloves protect against biological materials but are not protective against chemicals. Some people have latex allergies and need to avoid this type of glove. Nitrile gloves or neoprene gloves protect against both biological materials and chemicals such as formalin. (Right) Gloves designed with metal mesh or synthetic fibers such as Kevlar can be used in addition to latex gloves when there is a danger of laceration. However, these gloves may reduce dexterity and are not commonly used. (Courtesy L. Cheney, PA.)

Blades

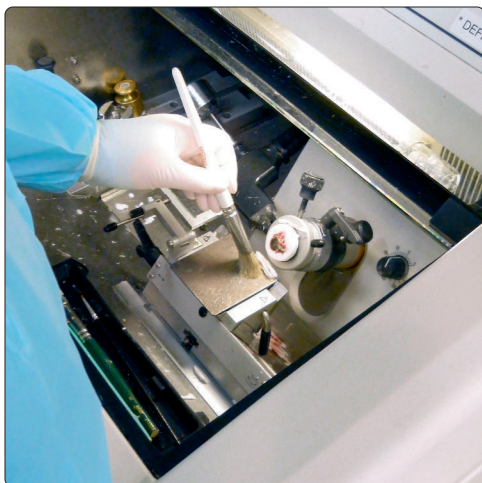


Most Common Hand Injuries



(Left) The majority of injuries incurred during intraoperative consults are lacerations due to razor blades, scalpels, knives, or cryostat blades. The need for rapid diagnosis must not override safe practices. Blades should be used with the correct handles and discarded appropriately immediately after use. (Right) The nondominant hand is more susceptible to injury, as it is often used to hold specimens while sectioning. The dots on the glove indicate the most frequent sites of injury.

Clearing Cryostat Blade With Brush






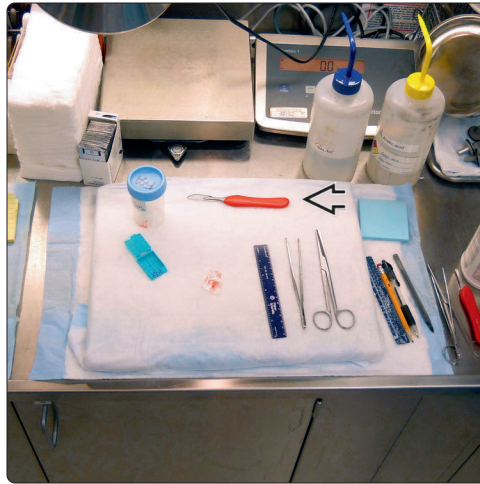
Glove Perforation



(Left) The cryostat blade is cleaned of shavings before cutting a new block, or when shavings accumulate when facing a block. A large brush or swab should be used for this purpose. This should never be done with a hand because of the danger of laceration from the cryostat blade. (Right) If 2 gloves are used and blood is seen between the gloves, there has been a perforation in the outer glove or in both gloves. The gloves should be immediately removed and the hand examined for possible injuries.

Clean Work Space

(Left) The work space must be kept clean and free of clutter. Blades  should be kept at the far side of the area (with the blade pointed away from the prosector) when not in use. (Right) Cluttered work spaces greatly increase the likelihood of injury and errors. Blades  may not be seen if left intermingled in paper towels and discarded gloves. A common source of injury is a laceration due to a hidden blade when cleaning a workspace. Blood  and tissue contamination also should be avoided.



Cluttered Work Space

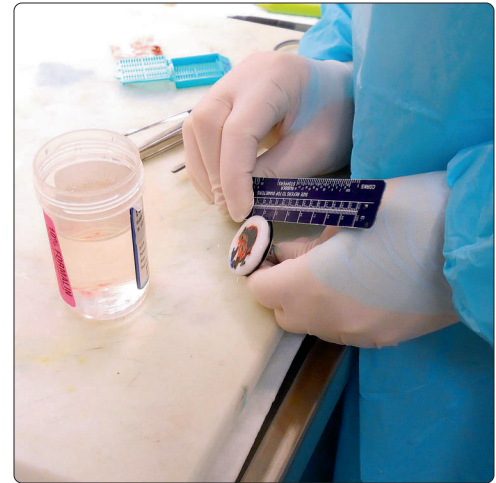


Removing Block From Chuck



(Left) A frozen block must be removed from the chuck to process the tissue. This should never be done with a blade, as the force required can result in deep injuries to the hand. The block can be allowed to partially melt at room temperature or will melt more quickly if dipped into formalin. A softened block is easily removed with a finger. (Right) After a block is slightly softened, it can be removed safely from the chuck with a finger or a ruler. The remnant is wrapped in lens paper and placed in formalin.



Removing Block From Chuck



Soiled Paperwork

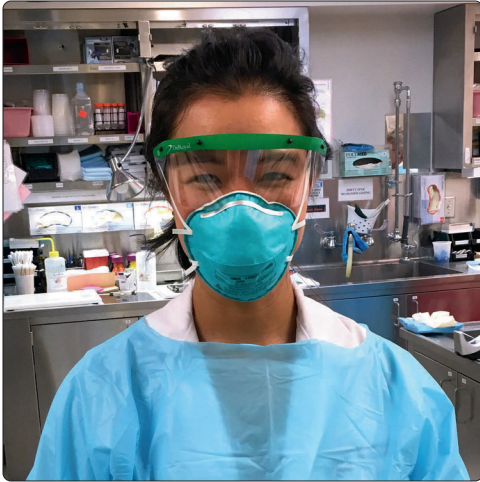
(Left) Materials, such as paperwork, that are transferred to other locations cannot be contaminated . Paperwork will be handled by transcriptionists and other personnel who do not use personal protective equipment. If contamination occurs, protective sleeves can be used for soiled paperwork. (Right) All blades, needles, and unused glass slides must be disposed into appropriate containers designed for safe disposal. This container is not safe because sharp objects  are protruding from the top and pose a hazard.



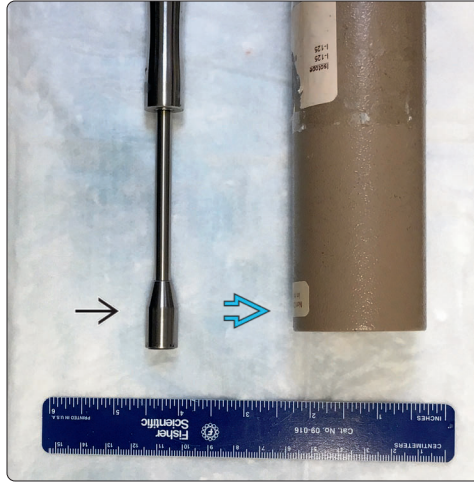
Unsafe Sharps Container



N-95 Mask



Radiation Sensors



(Left) Specially designed masks are required to protect against infectious agents such as *M. tuberculosis*. This is an N-95 mask. It is important that the correct size be used for maximum protection. (Courtesy V. Chan, BS.) (Right) Geiger counters have a broad sensor and are helpful for detecting a variety of types of radiation that can be encountered in medicine. Gamma detectors are used to identify radioactive seeds used to mark breast lesions. A narrower tip is necessary to localize the small seed in the specimen.

Radioactive Material: Storage



Locked Storage



(Left) After radioactive material is retrieved, a shielded container is required to store the material until it can be safely discarded. This is an envelope lined with lead. (Right) A locked storage area must be available for storage of radioactive materials. The area must be marked with appropriate signage.

Chemical Cabinet



Spill Kit



(Left) Each intraoperative consultation room must have a fireproof cabinet to store the flammable chemicals used for fixation of tissue and staining tissue sections. (Right) A spill kit contains the materials required to absorb chemicals for disposal and protective wear to keep personnel safe (e.g., face masks). If the spill is too large to be safely contained by such a kit, the room should be evacuated and closed, and the institutional hazardous waste team should be called.