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Impact Biomechanics Cadaveric Facility Design Considerations

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Biomechanics has been in existence for over 50 years and has come a long way as a discipline in the nearly 20 years that I have been involved. We have progressed from the relatively unsophisticated dummies, to embalmed cadavers and on to the use of unembalmed cadavers in a continual search for truer, more lifelike, realistic research results. Some of the cadaveric research findings have helped to produce generations of progressively more sophisticated dummies such as are now in use.

The use of unembalmed cadavers has created the need for health and sanitation considerations as never before, which have in turn, brought about the need to plan such a cadaveric facility as an integral part of such a research institution. Here are some basics.

- 1] LOCATION. A location as close to the major test site as possible should be chosen, and before any equipment is installed, some basic requirements should be considered:
- 2] SPACE. The work area should be of sufficient size to allow movement of people and specimens without danger of exposure

to accidental contamination.

- 3] WATER AND SEWER. Adequate water and sewer at various points must be available to insure proper sanitation and working conditions. Sinks should be stainless steel and the drains noncorrosive. There should be water and sewerage in the storage, prep-autopsy, x-ray, darkroom and scrub station.
- 4] LIGHTING. Proper lighting is important to create a good working environment which leads to better results with less fatigue. Lights should be of an ample foot-candle power as befits the work area along with an additional surgical overhead light in the prep-autopsy room.
- 5] VENTILATION. A suitable working atmosphere would be difficult to establish without air conditioning. The normal air changes movement should be supplemented by an exhaust system in the prep-autopsy room to handle any noxious odors.
- 6] ELECTRICAL OUTLETS. A more than normal amount of electric outlets of various voltages [110-240] should be installed, perhaps 110 volts at about 4 to 5 foot intervals, to preclude the use of extensions. Extensions complicate sanitization.

Some of the electrical equipment that might be used are bone saws, saw vacuum accessories, drills, hair clippers and other small appliances. These can be operated on standard 110 voltage from circuit outlets.

Cordless tools are very useful, eliminating electric cords being contaminated by the work.

Refrigerators/freezers and X-ray must each be operated on separate circuits of the appropriate voltage.

- 7] COMPRESSED AIR. Not recommended. Mentioned only as an aid to experiments and tests. Definitly not as a cleaning aid.
- 8] TELEPHONES. Telephone extentions in every area, office, storage, prep-autopsy and X-ray/darkroom are a valued aid to contamination prevention. Being able to respond to calls without leaving the area where work is taking place adds to efficiency and eases sanitary procedures. Now, with the advent of speaker telephones, calls can be answered on speaker extensions in the work areas without touching the equipment.
- 9] CHEMICAL STORAGE. A separated area or a storage locker should be set aside for any bulk chemicals or solutions that may be used such as formaline, acetone, alcohol and bleach.
- 10] DOORS. Doors should be easy to operate and sanitize. Full swing of the door is important. Four foot wide doors or double doors should be considered. Doors ought to be fitted with gurney bumpers to assist passing through. Doors operated by electric eye or tread mats would ease passage and sanitation problems.

11] FLOORS. Floors should be impervious to spills, have as few seams and joints as possible to minimize points of hidden contamination, and for ease of cleaning and sanitizing.

12] FLOOR DRAINS. Floor drains are convenient and useful but are also a source of odors and a breeding place for *Drosophila*. These problems can be controled easily with bleach.

Having considered some of the building needs it becomes a matter of scope and volume as to further planning. This is not to presume or assume any definate configuration or that some modification or combining to fit the circumstances could not be used in establishing the working environment and sanitation.

An Anatomical-Cadaveric facility can be broken down into three areas, the reception-storage area, the prep-autopsy area, and the X-ray area.

These areas will be further explained under separate headings. All equipment should be of stainless steel construction for ease of cleaning.

All the equipment and the entire area used or passed through should be sanitized after each use.

1] STORAGE AREA. This is the area into which the anatomic materials are received and preliminary preparation takes place, such as weight, height, frankfurt plane markers and hair removal etc. Anthropometric measurements can also be taken here.

It is best that all anatomical materials be blood

tested before they reach this point but if that is not practical then handling, even with appropriate safe-guards, clothing etc., should be minimal until such tests can be performed.

This area should be equipped with refrigerator-freezers of appropriate size and design or perhaps a refrigerated walk-in unit would be more suitable. Each refrigerator/freezer, as stated above, should be on a separate electrical circuit, to prevent loss of all refrigeration should there be an electrical failure in one unit. An alarm system, preferably to some central point or to security is very desirable, if a refrigeration failure should occur. A "through the wall" design between the prep/post area and the storage area will aid to minimize handling and sanitation processes.

Any storage refrigerator/freezer that is multi-tiered, such as a three body cooler or freezer, should be equipped with some sort of lifting devise or hoist that can reach all doors.

The wrapping of anatomical materials in plastic sheets is useful for handling and to prevent dehydration and freezer burn. Wrapped specimens are more easily inventoried and identified and present a more aesthetic appearance along with aiding in keeping a more sanitary work area.

Also some sort of an area delineation should be made, within the storage area, to sanitize equipment and tools entering and

leaving to and from test-sites etc.

[2] PREP-AUTOPSY AREA. This has really two parts. The work area and the scrub-change area.

WORK AREA. All the equipment, work surfaces and storage units should be stainless steel and of an off-the-floor design so that floors have no inaccessible area that can't be sanitized.

This room should be large enough to accommodate the largest specimen that will be used and have ample room for people to move around in and avoid personal contamination.

It should have access to cooler-freezers, possibly by means of the "through the wall" configuration mentioned in the storage equipment.

There should be ample water and sewers, particularly in this area. There might also be an auxiliary drain catch basin connected directly into the sewer at a suitable height above the floor to drain body fluids directly from pans. There are sinks and pans that are designed to couple together for this purpose. Such a sink requires a separate sink for tools and instruments, etc., in order to avoid working in a sink contaminated from draining body fluids.

Stainless steel gurneys that are equipped with locking wheels and brakes along with stainless steel pans equipped with drains are more convenient and flexible than a fixed location surgical table as they eliminate they need to transfer anatomical materials on and off the table and can go anywhere. There is a type of gurney that positions similar to an operating table and

can be moved about the prep-autopsy room but are somewhat limited for transport because they have castors, not wheels.

It would be very convenient if a suitable sink facility were opposite the "through-the wall" refrigerator/freezer doors. With this configuration, body pans of anatomical materials on gurneys can be worked on in the center of the room or connected to the sink or drain catch basin for flushing with running water.

There should be sufficient surgical and common tools, equipment, replacement rubber gloves and protective clothing and supplies in this room to forestall exiting in a contaminated state.

Lighting as mentioned above in this area is very important. An overhead surgical type light would be very helpful in the autopsy area in addition to abundant work area foot-candle lighting or luminaires.

As a safety precaution an eyewash station should be in the prep area in case of accidents. This is not to say that eye wash stations could not be installed in other areas. In addition there should be a first aid point accessible to all areas where sharp instruments are used.

Another useful item to have is a mopbucket of bleach or germicide and water with a mop and ringer standing by to use in case of spills. This mop-bucket solution should be changed frequently (at least daily). This equipment can be used for general floor maintenance also.

THE SCRUB AREA: This should be divided into three zones. First

there should be booths where street clothes can be removed and scrubs put on. Protective clothing of every sort, coats, coveralls, masks, headcovers, latex gloves, apron, eye protection and shoecovers or footwear should be available here. From this point personnel can enter the contaminated work area. On exiting the contaminated work area there should also be a zone where contaminated protective clothing can be removed and disposed of. Next there should be a zone with knee operated scrub sinks so people can sanitize themselves. Then back to the first zone to remove scrubs and put street clothes back on.

A knee operated scrub sink is preferable to a floor pedal operated sink because of the problem of cleaning the floor under and around the pipes and pedals. Sanitary conditions are difficult to maintain if in-sink taps are used.

[3] THE X-RAY AREA. The X-ray area should be of lead lined construction, with a lead protected control booth, a leaded glass window within the X-ray booth, so the X-ray table can be seen. The lead lined construction also provides protection for people working in adjacent areas.

There should be running water and sewer within the X-ray area to provide persons placing or moving anatomical materials on the X-ray table somewhere to clean up. Rubber gloves and protective clothing should be available here for the purpose of changing.

THE DARKROOM. The darkroom should be adjoining the X-ray

room and be lead protected on the walls common with X-ray. It should have a film pass box, running water and sewer and, as previously stated, suitable electrical outlets should be available to operate the various equipment, film processing, enlargers, etc.

DISCUSSION

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SPEAKER: John Ryan, Wayne State University

QUESTION: Guy Nusholtz, Chrysler

First thing I'd like to do is thank you, it's something that we don't talk about enough is the problems associated with the sanitary preparation of cadavers and I think that was an excellent presentation. I have a couple of comments-one is, I personally don't like the idea of having telephones in the autopsy rooms or in areas where cadavers are prepared because they are hard to clean up. My other comment is that it's always good to make sure you can flood the area because you don't know what might have dropped on the floor and just by flooding it and letting it down the drain and then be processing the drain with bleach, you can generally keep the area pretty clean. And one question is how much ventilation do you recommend?

A: I recommend an air-conditioned room with an exhaust fan above the area where the preparation and autopsies of the cadavers take place. So that if there are any obnoxious odors, they can vented immediately. Its hard to keep any kind of air movement without air conditioning, which I think is very essential.

Q: One of the things I've discovered is you not only need a vent above the subject, it would be better to have it below because when you lean over the subject to do your autopsy, the odors come up past your face and then up to the ceiling. Somehow when you can suck it down, you don't quite have that problem. The other thing that I found was that to maintain a good seal, I generally have to put a drape around it to make sure that the fresh air comes up from below and goes past the cadaver.

A: These are good suggestions.

Q: Richard Morgan, NHTSA

John, I'd like to know your opinion for inoculation or shots for the personnel. What shots do you recommend?

A: All our people have hepatitis shots and if they so desire, they can have blood tests too (the hepatitis shots require blood tests) for other things, of course, because there always is a contamination possibility from HIV, which we have to live with. All our material is tested prior to acceptance for HIV and hepatitis; so we've minimized that risk to begin with.

Q: John, at what temperature do you freeze yours subjects?

A: 20° below C.

Q: If you have a sprinkler system for fires, what's your opinion on that? If you have the subjects out and the whole system floods with water, would the drains remove any blood or body fluids?

A: That's why you have the floor drains, yes. As far as, I don't know how fast you'd have to operate in case of an emergency, of course, but there's always the possibility of covering it with either a critter pan cover or a plastic sheet.

Q: Jeff Crandal, University of VA

You mentioned that you use bleach for disinfectant; Are there any other chemicals you use for disinfectant? We found bleach to be very corrosive; we found that we lost the paint of the floor, things like that.

A: We use Broad Spec (256) but we found that bleach is just as effective, much cheaper, a little harder to handle because of its corrosive nature. That's why I say the floor should be sealed.

Q: We tried an epoxy compound, we haven't tested it yet. Is that what you're leaning towards?

A: Most of our floors have a minimum of seams, we use linoleum rather than tile which I would like to see covered with epoxy so there is no seam. It should be impervious to spills, though.