UNEMBALMED CADAVER TRAUMA STUDY [1]

by

L.M.Patrick Wayne State University

SUMMARY

A program in which unembalmed cadavers were exposed to collision environments with a three point restraint system has shown that the results are remarkably life like. The unembalmed cadaver gives much better results than the embalmed cadavers since the latter do not have realistic soft tissue response. Also, it is necessary to "limber" the unembalmed cadaver by working the joints. The exact mechanism of the loosening is not known but examination of soft tissue indicates that there is a tearing of the tissue and consequently a deviation from the original structure. It is difficult to limber the unembalmed cadaver so that the joints react the same as the living human. For example, limbering the cadaver requires extreme care in the area of the back or the movement will occur over a few vertebra rather than over the entire spine

The use of unembalmed cadavers provides a remarkably life life reaction as far as the dynamics of the human are concerned. This was observed when comparing the results of human volunteers with those of an unembalmed cadaver when exposed to identical acceleration environments. While the comparison has not been made exhasutively, the visual comparison of high speed films from the volunteers and the unembalmed cadavers shows great similarity.

Contusions and abrasions of the soft tissue are similar to those observed in human volunteers and in accidental exposures. While the bruises are similar in area and location they do not spread as they do in the living human. This is probably due to the lack of blood pressure to force the blood through the ruptures to the small vessels.

The organ similarity is notable with the internal organs having the same appearance, feel and apparently the same injury potential. Further work should be done to establish whether the organs can be made even more life like by pressurization or other treatment.

The injury patterns observed in the experimental data are similar to those found in accident cases. Rib fractures are the most prevalent type of injury with the three point harness as they are in accident cases. Injuries to the neck occur only under very severe conditions and appear to be more prevalent than those observed in the accident population probably due to lack of muscle tone.

Perhaps the greatest dissimilarity between cadavers and the living population exposed to automobile accidents is in the age group. Most cadavers were rather old at time of death and consequently do not represent the general population age. Also, it is suspected that the predeath history will be important in the results from unembalmed cadavers. There is some evidence that if the individual was con-

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fined to bed for a long period prior to death that the strength of bones and perhaps other tissues are adversely affected.

If the use of unembalmed cadavers is to achieve maximum benefit, it is desirable to have a uniform method of preparing and examining them before and after exposure with the same instrumentation utilized by the different organizations. Standardization will permit comparison of the results from different organizations, and thus provide a large data bank obtained under similar conditions. Otherwise the use of the cadavers will have limited value since the number available does not permit any single organization to obtain statistically significant data under a large variety of exposure conditions.

PROTOCOL

A protocol should be established to serve as a guide for investigators using unembalmed cadavers. These should include the following recommendations.

1. The cadaver should be used as soon after death as possible providing the rigor mortis is not present. It is preferable to use the cadavers within ten days after death. They have been used up to thirty days with apparently satisfactorily results, but additional work will have to be done before this can be verified. The cadaver should be maintained at a temperature just above freezing (3 to 5°C) to minimize changes in tissues.

2. It is important to obtain a predeath history. This should include any previous trauma that might have an effect on the experimental exposure and the length of time, if any, that the individual was confined to bed prior to death.

3. Preparation of the cadaver is important to provide a common base for the data. Pressurization of the vascular system increases the realism of the experiment. It also provides pressure in the vessels that will represent the hydraulic action present in the living human. In addition to the vascular system, consideration should be given to pressurizing the lungs and other organs with liquid or gas depending upon the normal contents of the organ.

4. In the unembalmed condition after rigor mortis the cadaver is very limber. When using the cadaver in collision simulations it is necessary to stiffen the neck to some degree. One recommendation is to stiffen it to the so called one G level. This has been accomplished by wrapping the neck with an ace bandage until the one G stiffness is obtained as evidenced by the droop or bending of the neck when the head is unsupported in a horizontal attitude.

5. Standardization of instrumentation is extremely important to permit the analysis of the results to follow along uniform lines. The instrumentation should include accelerometers mounted on the head, instrumentation to measure the moment or torque at the base of the skull, instrumentation for the acceleration and/or deflection of the chest, methods of measuring the forces or pressures in the abdomen, a means of establishing the forces on the limbs, and other instrumentation to permit analysis of potential injury.

6. A post exposure examination should include: visual examination and photographs of the external tissue, palpation, and x-rays to compare with the preexposure x-rays for fracture and other bone anomalies.

7. A complete autopsy to deliniate the injuries is essential. A standard protocol for the autopsy should be established to avoid missing some of the important data that can be obtained from the autopsy.

Data Analysis

A standard method of data analysis is desirable to permit comparison with results from other investigators. Normalization of the data by comparing the bone strength and size of some agreed upon bone in the body is an important part of the analysis. A vertebra or femur might be used for this purpose. A standard method of testing the specimen for normalization is desirable. Injuries should be described according to a standardized format with diagrams to locate the injury site. Reporting the injury(s) by detailed description should be accompanied by an Abbreviated Injury Scale (AIS) rating to permit a gross comparison with similar data from accident investigation programs.

Calculation of the established injury criteria such as the Head Injury Criterion, the Gadd Severity Index, the 60 G/3ms Chest Acceleration Criterion, the Femur Criterion and other pertinent injury criterion should be undertaken on a basis that will permit accurate comparison of results between investigators. The channel class for each transducer system is important and should be standardized to insure accurate results and to permit comparison of data from different organizations.

CONCLUSIONS

The following conclusions are based upon a limited number (10) of experiments with unembalmed cadavers in a simulated collision environment with a restraint system.

1. The unembalmed cadaver appears to have great promise in establishing injury mechanisms and injury levels under prescribed conditions.

2. Soft tissue damage is similar to that found in volunteer experiments and from accident investigation programs.

3. Bone damage is very similar to that obtained in the accident data with rib fractures being the most prevalent injury observed from the cadaver studies and also from the accident data.

4. There is a preliminary indication that soft tissue damage to the abdominal area might be greater in the cadaver than in the accident population. This may be due to a more severe exposure, a difference between cadavers and human response, and/or a difference between age and preexposure health conditions.

5. There is a wide variation from individual to individual used in the cadaver study just as there is in living humans.

6. Cadavers provide a useful method of establishing injury mechanisms, but are not suitable for evaluating small changes in vehicle components. Variation from cadaver to cadaver is so great that a minor change in performance of a vehicle component could be less than that observed between cadavers.