

WORKSHOP ON HUMAN SUBJECTS FOR BIOMECHANICAL
RESEARCH - MINUTES OF SEVENTH ANNUAL
MEETING AND TECHNICAL SESSION

The meeting was convened by Dr. Albert King, Wayne State University, at 9:25 AM on October 16, 1979 at the Del Coronado Hotel In Coronado, California. Fifty-four persons were in attendance.

Dr. Albert King opened the meeting with a presentation of "Procedures for Compliance with ethical requirements in Cadaver Utilization". He discussed the paperwork involved in meeting the new NHTSA contract requirements in accordance with the guidelines outlined in NHTSA order 700-4.

He detailed the variety of procedures and actions required in preparation of the (1) benefit assessment, (2) criteria for Cadaver Selection, (3) Statement of Ethical Practices on Cadaver Useage, (4) Handling unembalmed cadavers and (5) legal requirements. Several questions and statements came from the floor as follows:

Dr. Vostal - G.M. NHTSA should be congratulated. much has been achieved since last year. NHTSA has now adopted guidelines. One possible problem - 90% bodies come from willed programs. Should we use only anatomical gift bodies and no unclaimed bodies because of many conflicting local laws. Dr. Levine,

Wayne University responded that laws vary with the area. That unclaimed bodies are often of younger people, and that if kept frozen could be usable -

Dr. Vostal continued to consider it an important point and that guidelines might be needed for restrictions on such use. A 7-8 day limitation on the use of fresh cadavers would not permit such use of unclaimed bodies. Freezing can modify mechanical properties of body tissues. G. M. would require next of kin consent before use of bodies. Stanley Backaitis, NHTSA, asked whether there was any difference in laws governing the use of child and adult cadavers. Responder Unnamed stated that child cadavers are virtually unobtainable in the U. S. but that there are no legal prohibitions, to his knowledge. Medical schools will preempt should any become available. State determines the disposal of unclaimed bodies. A thirty day wait is minimum for next of kin search. There is no maximum. Dr. Randal Smith, UCSD stated that in his opinion the fewer restrictive guidelines the better. He would oppose the exclusion of unclaimed bodies since there may be excellent uses for them in the future. Dr. Levine suggested that a frozen 30 day old cadaver might be quite suitable for certain types of research, for example, bone injury.

TECHNICAL SESSION

Discussion completed, Dr. King moved into the technical session. Seven brief informal presentations were made dealing with instrumentation, biomechanical modeling, and experimental procedures. This section of the minutes includes a brief description of each presentation.

1. Additional Data on 9 Accelerometer Method for Measuring Angular Motion", Paul Bergeman, Wayne State University - Dr. Bergeman used the nine accelerometer scheme for obtaining "3D" rigid body accelerations and checked results against film analysis - The methods show good agreement. Several approaches to the data analysis were presented. Errors and difficulties described. The 9 accelerometer method works even with large g loads and displacements, but is sensitive to offset errors. There were no questions.
2. "Status Report on Microminature 9 Accelerometers/Transmitter System, Mark Haffner, NHTSA, Mr. Haffner presented a report on the current status of the "Boxer Program" which is aimed at the determination of human concussive threshold and inertial response of the head. The accelerometer/transmitter system will be fitted into a boxers mouthpiece and the head motions monitored at ringside during a bout. Currently these are three organizations working on the program under NHTSA sponsorship: - Konigsberg Instruments, who have designed and developed the instrument and housing, National Bureau of Standards who are preparing and conducting calibration procedures and evaluating

the system, Science Applications of L. A. who are conducting a feasibility study on the interface between the device and the boxer, and setting up protocol for actual field tests. A description of the instrumentation and packaging was presented along with a status report on the activities of the three supporting organizations. The hope is that the device will be utilized in actual ringside tests by mid-1981.

Mr. Richard Lamb - TRRL - asked about instrument package availability for other labs. Mr. Haffner stated that after we learn how to calibrate them and set up the procedures for doing so, they can be manufactured to a specification and distributed. In response to a question on probable cost, Mr. Haffner quoted Konigsberg as about \$200.00/channel.

3. "Thoracic Side Impact Injury Prediction and Application to Side Impact Dummy." Dr. John Melvin, HSRI. Dr. Melvin reviewed the status of a program which had for its objectives 1) Quantification of rib cage impact response, 2) Prediction of performance specifications for rib cage surrogates, 3) Compilation of predictive functions relating mechanical parameters to injury.

In essence, the aim is to effect a modification of the 572 dummy for appropriate response to lateral impact. Experimental procedures and protocol were described. Innovative dummy designs were tested and responses are quite promising. A new dummy based on the reported results is under construction. If performance is up to expectations, it will be tested at other

laboratories.

D. R. Stalnaker - Can a 20 ms. pulse input be analyzed? Dr. R. Eppinger - The model is equally good for 5-10-15-20 ms. pulses. Dr. R. Stalmaker - In tests, some impacts result in point loads and others in distributed loading. Are the ribs able to detect this?

Dr. Eppinger - The system is very flexible so that ribs can be distorted. Point loading has not yet been studied but it is expected that the response will be good.

4. "Simulation of Thoracic Impact Experiments using THORAX V Computer Model."

Dr. Sanford B. Roberts, U.C.L.A. - Dr. Roberts described his finite element model for simulation of thorax and how well it will simulate results from frontal and side impact tests on cadavers. Data was taken from Melvins' 12 accelerometer channels. It was necessary to estimate the spatial and temporal distribution of the pressure application. Two frontal and one side impact test were reported. In general, for both frontal and side, the sternum response predicted well. This review illustrated the difficulty of predicting an individual test result using a generalized model.

Dr. Prasad - Were any non-linear codes used? Dr. Robert - Not yet, geometrical non-linearity is not considered too important at this point. Other parameters, especially connections and temporal/spatial ones, are more important than rib

displacement. We haven't looked at strains - we've only been interested in accelerations so far. S. Backaitis - Any velocities and displacements?

Roberts - There were calculations which were not shown. Displacements and velocities were not recorded in experiments, however model displacements are consistent with physical realities. We have checked velocity and it is consistent at the impact point. R. Eppinger - was mass distribution and

damping in model? Roberts - No damping yet, just linear response, masses assigned to modal points. Bud Mertz - How do you handle internal organs?

Roberts: We don't handle them, except as part of the mass distributions.

5. "Correlation of Certain Brain Stresses and Injury" By Dr. Guy Nusholtz, HSRI

Study is a comparison of experimental data and predictions from a finite element brain model developed by Dr. C. Ward. Pressures in certain regions of the primate brain were measured in the living and cadaver during impact by HSRI cannon. Pressures measured differed in the living and Cadaver. The model was adjusted to account for the live and post mortem states. Model predictions seemed very good.

Dr. Vostal - would pressurization of the brain in the cadaver animals bring the results closer to those observed in the living? Nusholtz - I don't know.

6. Comparison of Human Skull and Spherical Shell Vibrations - Implication for Head Injury Model - D. Viano G. M. Computed head response to impact, using model and compared with measures from dry skull under tap tests, found that human skull has different resonance model patterns from closed spherical shell. Model predicts 50% higher for Ω value. Only an "effective" Young's Modulus could be used to bring model and experiment closer together. Shell is inherently stronger than real skull. Matching dynamic response is a good approach.

Dr. J. Melvin - For large contact areas, f_x is remote from impact site, how do you model that? Viano - There is weak dependence on contact area - theory predicts strong link, experiment did not show that.

7. Progress in Interpretation of Cadaver Injuries. A Fayon -
Laboratoire de Physiologie et de Biomecanique de L'Association Peugeot-Renault.

Problem attacked is the relationship between cadaver test results and accident victim's injury. Researchers used a factorial analysis of principal components which factors most affect response. Main results seem to indicate that in frontal impacts there is a resistance threshold age (between 40-50 years may be indicated). Females may be more vulnerable and size is probably a second order effect. More cadaver tests are needed to further examine this promising approach.

Since there were no questions, several announcements were made. The next meeting will take place on October 14, 1980, the day before the 24th Stapp Conference in Detroit. It is important to notify either Albert King or Arthur Hirsch, regarding presentations, by the end of July 1980 to permit appropriate scheduling. However, the program will be flexible to accommodate last-minute material. Meeting was adjourned by Dr. King at 1:30 PM.

David R. Foust, General Motors

A. E. Hirsch, Chi Associates