

Report on Research Commissioned
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Rider Jacket Evaluation Test

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Rider Jacket Evaluation Test

1. Outline of the Present Study

The present study was conducted to evaluate the performances of jackets developed for rider protection. The items of evaluation were: (a) the rider protection performance of the jacket against impact and (b) the time required for the airbag housed inside the jacket to fully inflate. A biofidelic dummy was employed, and impacts were applied to the dummy by a 23.4 kg-mass impactor.

2. Impact Test on Rider Jackets

2.1 Impact Test Conditions

Figure 1 shows the photographs of the dummy's jacket clothing condition with impact to be applied to the back of the dummy. The test conditions employed with regard to the rider jacket were: a) the dummy without any jacket on, b) the dummy clothed in a jacket but the airbag not inflated, and c) the dummy clothed in a jacket and the airbag inflated.



Fig. 1 Jacket clothing conditions in back impact test

2.2 The Dummy

The present study was conducted using a front crash Hybrid-III dummy with or without a rider jacket on (Fig.2). The dummy had stature of an average U.S. male adult (height 175 cm, weight 78 kg) and characteristics resembling the human body in structure, shape, weight, and the motion ranges of the joints.

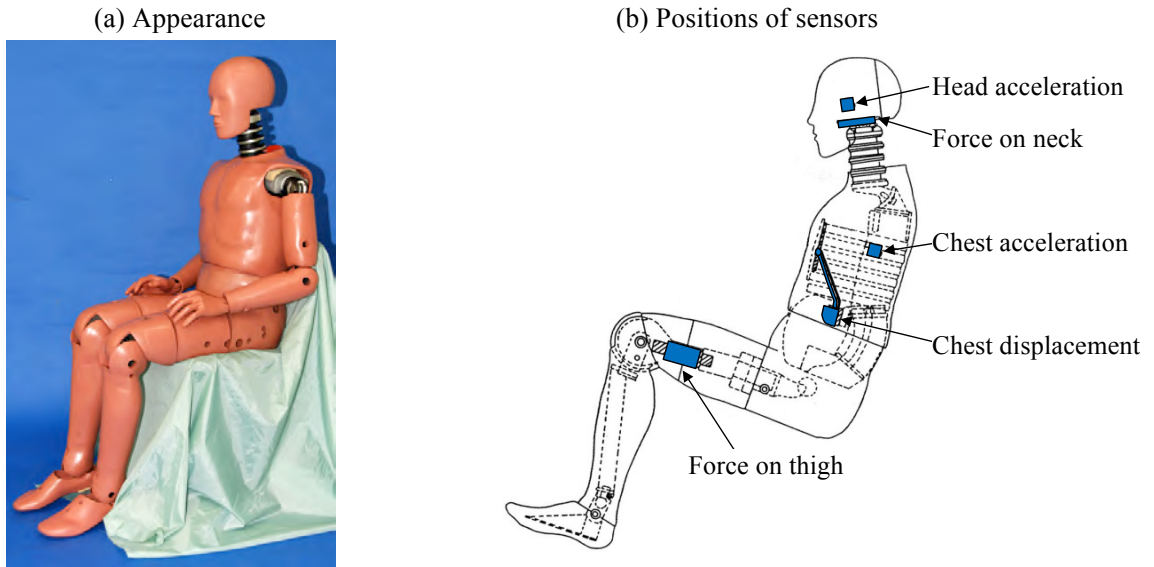


Fig. 2 Appearance and sensor positions of

2.3 Measurement Items

The present study involved application of an impact to the back of the dummy by an impactor having an impact face diameter of 152.4 mm and a mass of 23.4 kg moving at a speed of 4.2 m/s. In the back impact test, the acceleration of the impactor and the resultant acceleration generated in the dummy's chest were measured. In addition, the impact scenes were photographed by a high-speed video camera (500 frames/s) to visually determine the detailed outcomes of each impact and airbag inflation. Table 1 lists the instruments used in the present study.

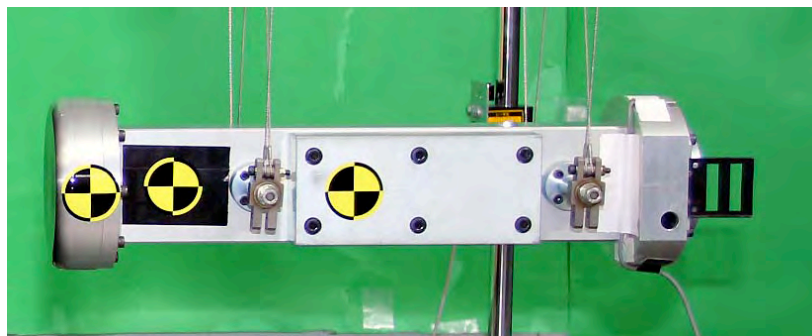


Fig. 3 Appearance of the impactor

Table 1 List of instruments used

Instrument	Model name	Manufacturer
Dummy	Hybrid-III AM50	Denton
Data recorder	DIS-2000	Kyowa Electronic Instruments
High-speed video camera	GX-1	Nac Image Technology
Neck load cell	1716	Denton
Chest displacement sensor	Pot	FTSS
Chest accelerometer	7264B	Endevco Corp.

2.4 Test Results

The dummy was set face to face with a fixed wall structure so that the impact of the impactor would be delivered to the back of the dummy. To evaluate the effects of the airbag in relation to back locations, two impact positions were tested: a) a point in alignment with the spine on the dummy's back and b) a point 65 mm to the left of the spine on the dummy's back. In both cases the impact point was 420 mm above the surface of the seat as measured from the center of the impactor's impact face.

Table 2 shows the results of the back impact test regarding the fore-and-aft acceleration (G) generated in the chest. Where impact was delivered on the spine, the highest chest acceleration (209.1G) was recorded in Test No.00 in which the dummy had no jacket on. The lowest chest acceleration (40.2G or an 81% reduction from the highest chest acceleration) was obtained in Test No.04 in which the dummy was clothed in a jacket, thus indicating the best protection performance of the rider jacket.

Where impact was delivered on the left side the back, the highest chest acceleration (187.0G) was recorded in Test No.000 with the dummy having no jacket on. The lowest chest acceleration (42.1G or a 78% reduction from the highest chest acceleration) was obtained in Test No.03 with the dummy clothed in a jacket, indicating the best protection performance of the rider jacket.

Table 2 Results of back impact test

Test No.	Impact speed (m/s)	Impact position	Impactor acceleration (G)	Chest fore-and-aft acceleration (G)
00	4.28	On dummy spine	117.0	209.1
000	4.28	Left side of the back	103.7	187.0
Test-01	4.28	On dummy spine	107.2	186.0
Test-02	4.29	On dummy spine	54.9	69.3
Test-03	4.29	Left side of the back	39.4	42.1
Test-04	4.28	On dummy spine	39.2	40.2

Note*) Because the biofidelity of Hybrid-III's back is considered to be lower than those of other body parts, the chest fore-and-aft acceleration values are given in the above table merely as reference data.

3. Test on Rider Jacket Inflation Time

3.1 Outline of the Jacket Inflation Test

The rider jacket used in the present study was equipped with an automated system of injecting air into the airbag inside the jacket upon detection by sensors of the rider's separation from the motorcycle body. Therefore, another test was undertaken to measure the airbag inflation time from the activation of the air injection system to the inflation of the whole part of the rider jacket including the neck part. The inflation time was measured from the photo images of the dummy taken by the high-speed video camera. Figure 4 shows a typical scene of how the air injection system was activated in this inflation time test.



Fig. 4 Jacket inflation time test

3.2 Test Results

The jacket inflation time test was undertaken using only one type of rider jacket. Table 3 shows the measured time required for the inflation of the neck part and the whole part of the jacket. The inflation time proved to be 80 msec for the neck part and 180 msec for the whole part of the jacket.

Table 3 Results of jacket inflation time test

Test No	Inflation time for neck part (msec)	Inflation time for whole part (msec)
1	80	180

4. Conclusions

To evaluate the protection performances of rider jackets, a back impact test and an inflation time test were conducted. The test results are summarized as follows:

(1) Back protection performance

From the results of the back impact test, the following findings were obtained:

- In the test with impact delivered on the spine of the dummy, the clothing of the rider jacket reduced the fore-and-aft acceleration of the chest by 81% as compared to the acceleration in Test No.00 where the dummy had no rider jacket on.
- In the test with impact delivered on the left side of the dummy's back, the clothing of a rider jacket reduced the fore-and-aft acceleration of the chest by 78% as compared to the acceleration in Test No.000 where the dummy had no rider jacket on.

(2) Inflation time test

The time required to fully inflate a rider jacket proved to be 180 msec.

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Test No.01



Test No.04

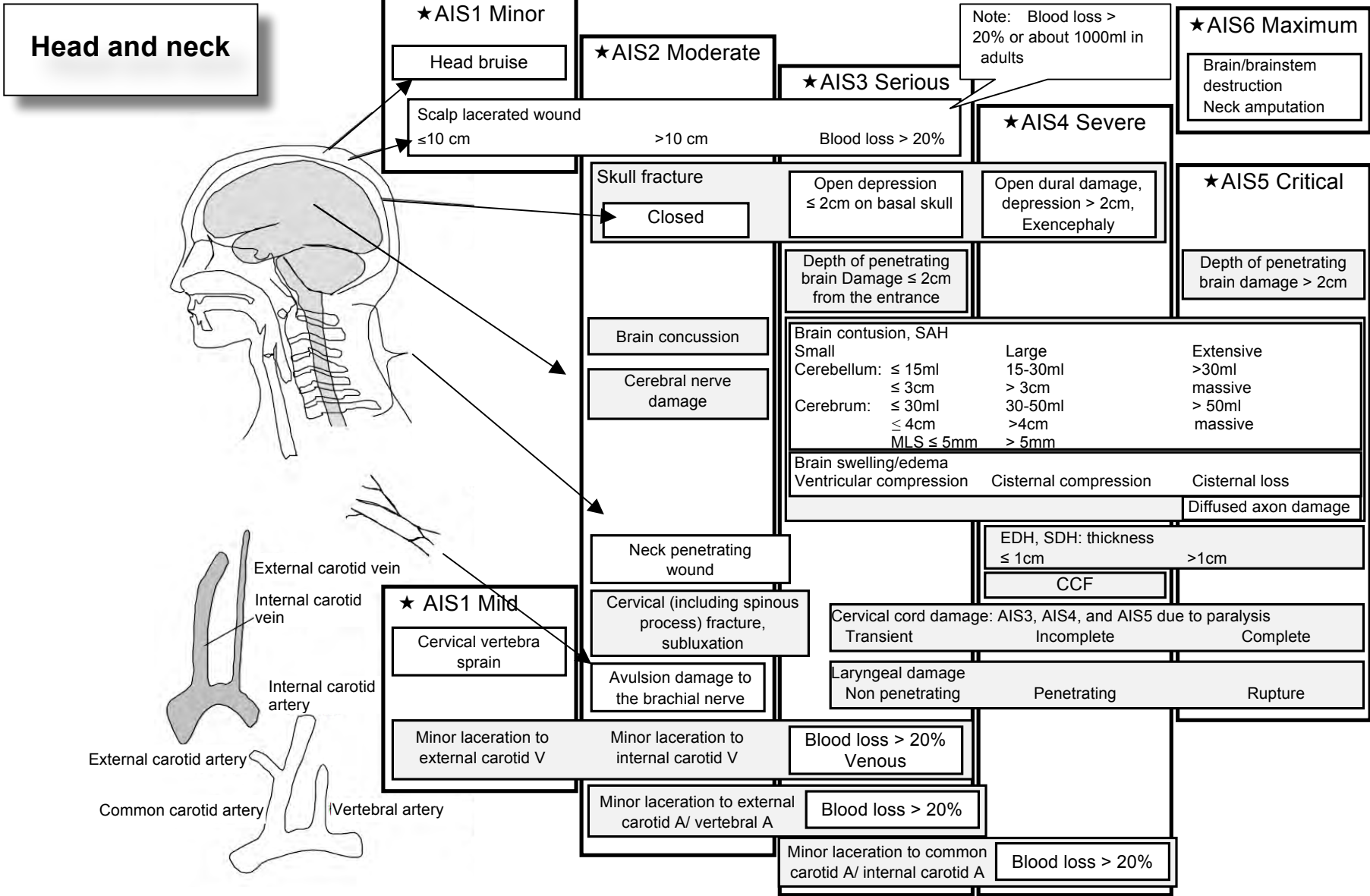


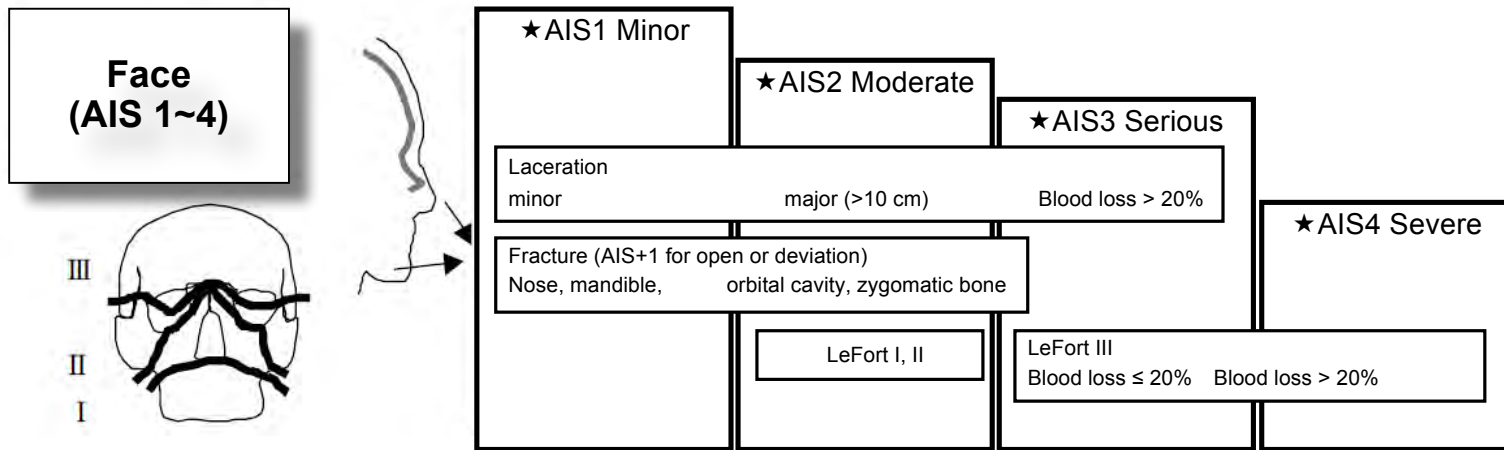
Appendix 1: Serial photographs of back impact test

Test No.01



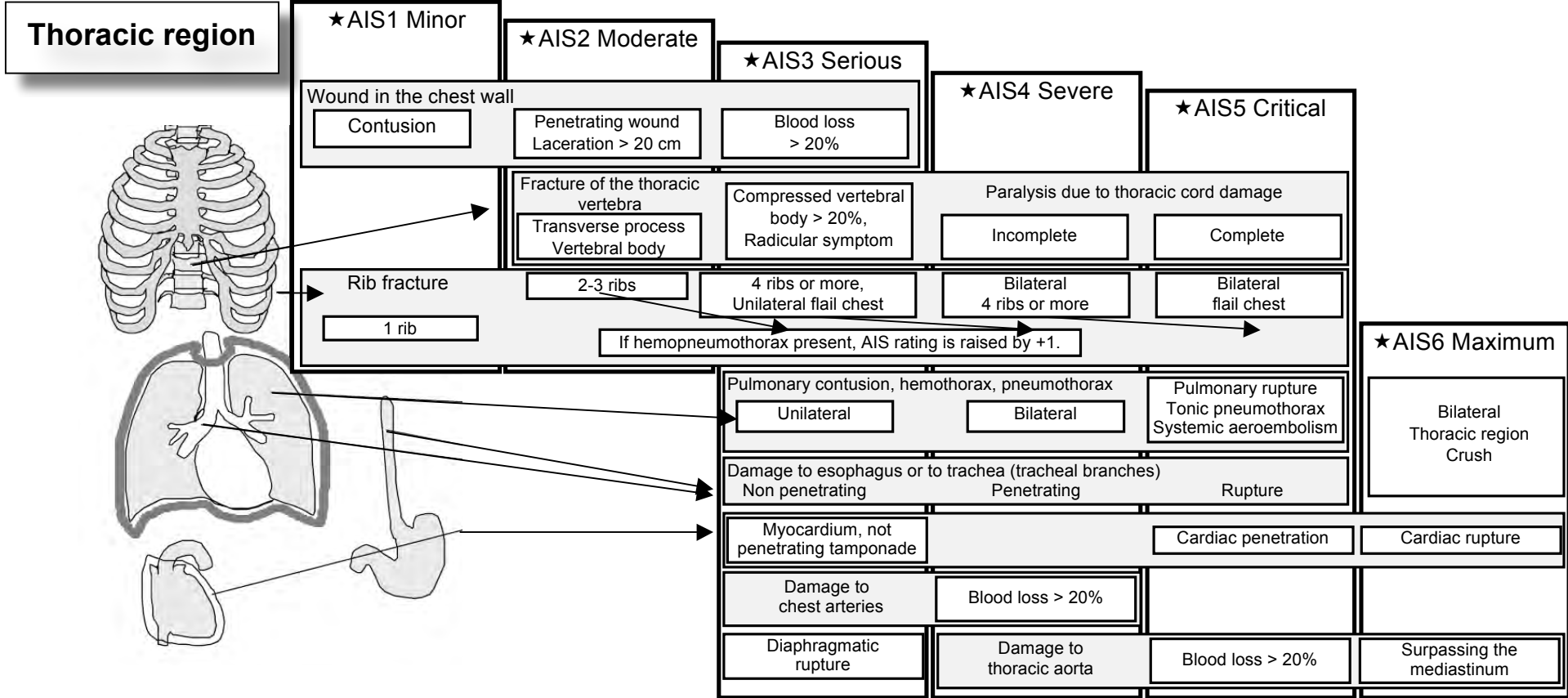
Appendix 2: Serial photographs of jacket inflation time test





Appendix 3 Trauma by AIS rating (head, neck, face)

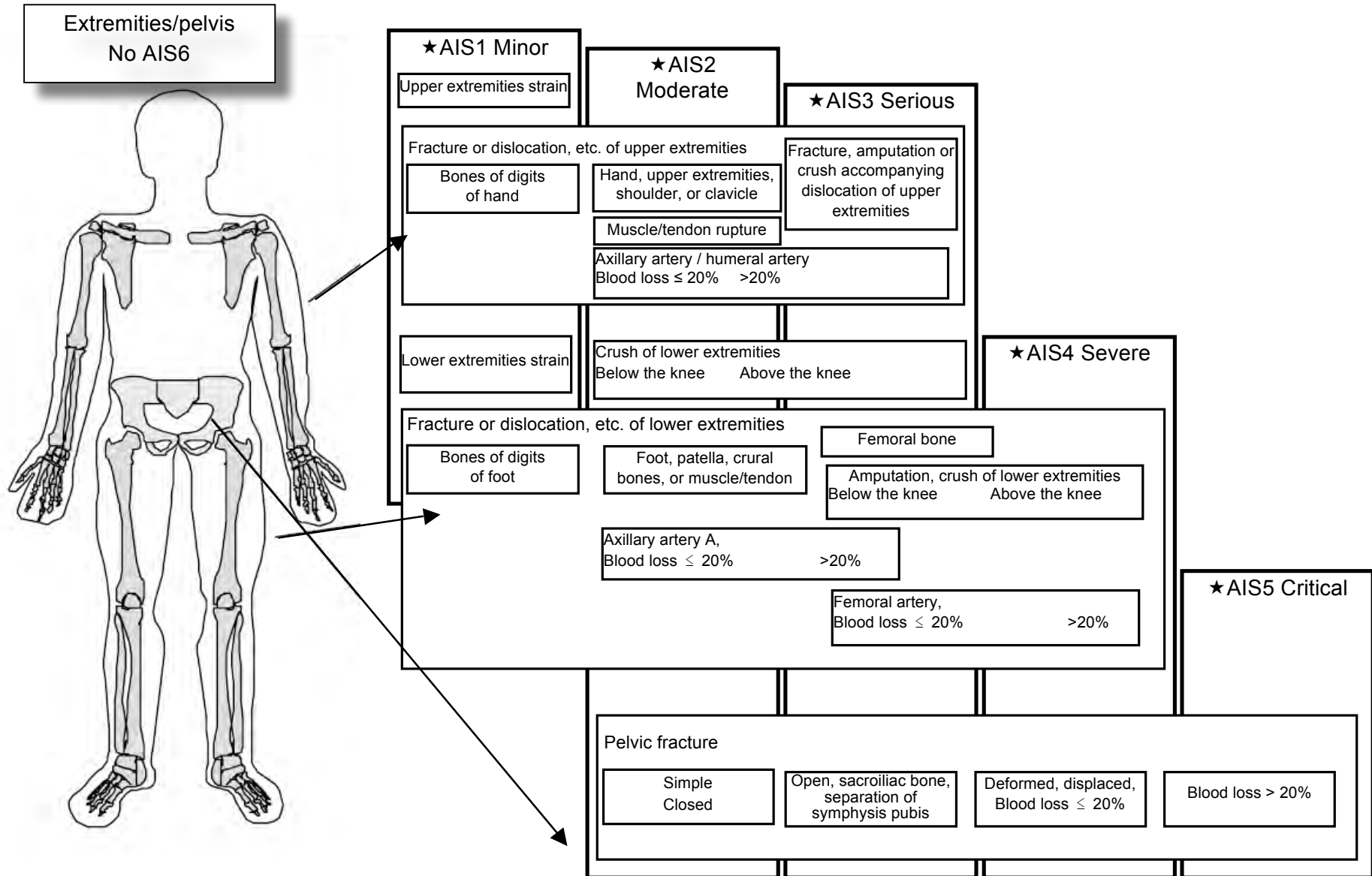
Quoted from the check table composed by Funabashi Municipal Medical Center, Department of Neurosurgery

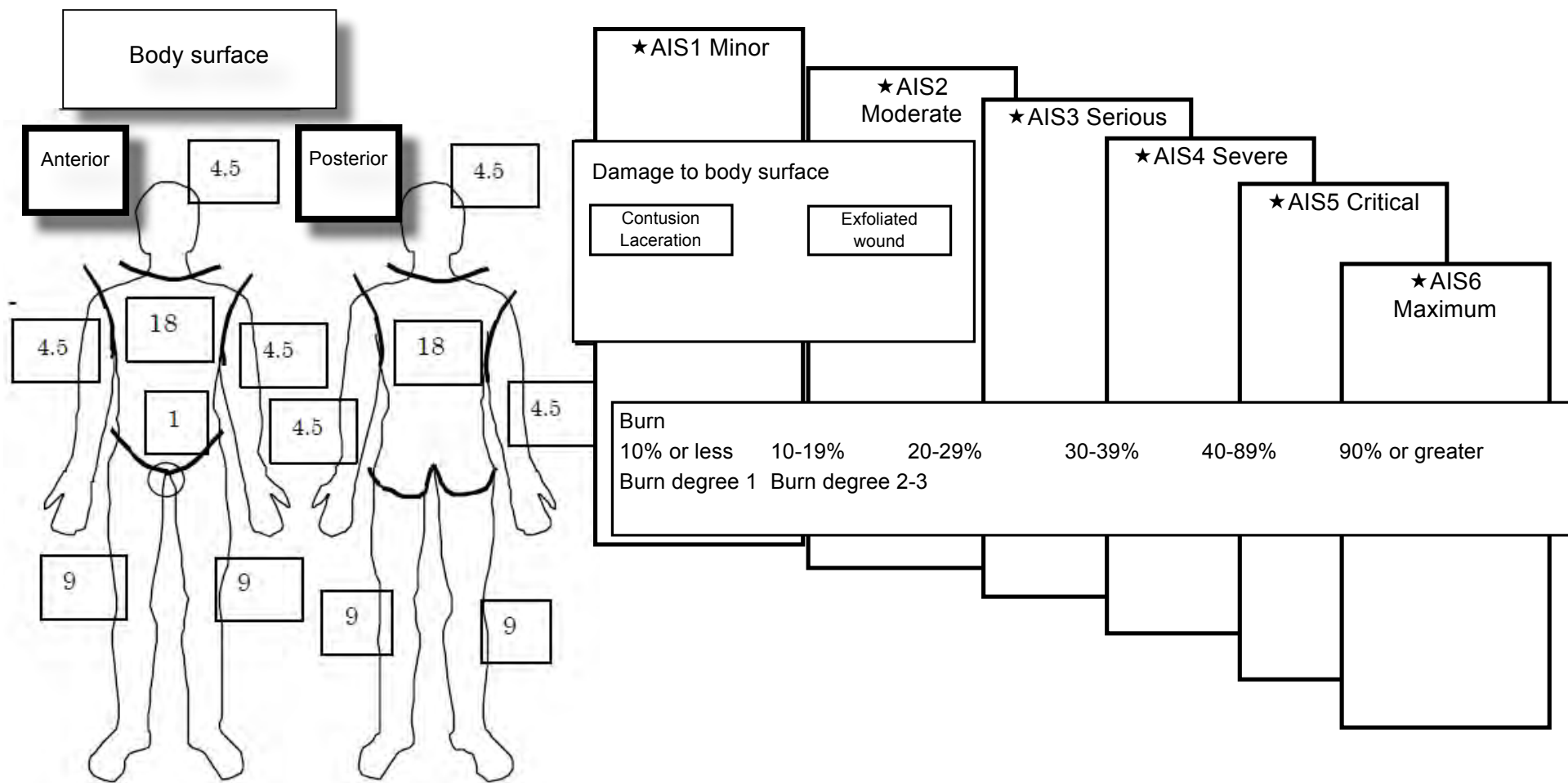


Abdominal region	★AIS1 Minor	★AIS2 Moderate	★AIS3 Serious	★AIS4 Severe	★AIS5 Critical	★AIS6 Maximum
	Contusion/lacerated wound, or bite wound, superficial	Lacerated wound > 20 cm, up to subcutaneous tissue	Blood loss > 20%			
Lumber vertebra sprain	Fracture of spinous process, transverse process or vertebral body	Lumber vertebral fracture, Radicular symptom	Lumbar cord damage, Incomplete paralysis	Lumbar cord damage, Complete paralysis		
	Superficial contusion of kidney, Contusion of bladder, Ureter: non penetrating	Subcapsular Partial laceration, Penetrating	Penetration from cortex to renal pelvis	Renal destruction		
	Hepatic contusion: ≤ 10cm >10cm		Hepatic exfoliation			
	Hepatic laceration: blood loss ≤ 20% >20%		Parenchymal destruction: ≤ 75% >75%			
	Splenic contusion: ≤ 5cm >5cm					
	Splenic laceration: depth ≤ 3cm >3cm		Segmental	Splenic destruction		
	Mild pancreatic contusion/laceration	Major blood vessel/vessel	Ampulla	Pancreatic destruction		
	Stomach, small intestine, large intestine, not penetrating	Penetrating	Rupture			
	Rectum non penetrating	Full thickness	Up to perineum	Fecal contamination		
	Mesenterium: blood loss ≤ 20% >20%		Rupture			
	A/V in the abdominal cavity: blood loss ≤ 20% >20%					
	Retroperitoneal hematoma	Abdominal Ao/peritoneal A: blood loss ≤ 20% >20%				

Appendix 4 Trauma by AIS rating (thoracic and abdominal regions)

Quoted from the check table composed by Funabashi Municipal Medical Center, Department of Neurosurgery





Appendix 5 Trauma by AIS rating (extremities, body surface)

Quoted from the check table composed by Funabashi Municipal Medical Center, Department of Neurosurgery