UPDATED CHEST INJURY CRITERION FOR THE THOR DUMMY

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ABSTRACT

Anthropomorphic crash test dummies are designed to predict the risks of injury in automotive crash conditions. These dummies must therefore measure parameters that make it possible to calculate a metric related to injury mechanisms. This metric must evaluate the risk of injury whatever the solicitation, in a range covering all the solicitations arising in a crash. More specifically for a frontal impact, the risk of chest injury associated with this criterion must be the same, whatever the contributions of the belt or the airbag load paths. The objective of this paper is to develop such a criterion for the chest.

Several thoracic criteria were proposed by Poplin in 2017 for the THOR dummy, based on the measurement of the 4 3D deflections of the thorax. Unfortunately, for the sample studied, these criteria did not predict the risk of rib fractures better than the central deflection measured on an Hybrid III. The in-depth analysis of the sample showed that the sample configurations were too similar and that the deflection range was too small. Additional tests were added to the Poplin sample, which diversified the types of restraint systems and increased the extent of deflections. A new analysis was performed on this sample.

A new criterion was proposed. This criterion is a linear combination of the maximum value of the 4 chest resultant deflections and the absolute value of the difference of the upper right and left deflections. A risk curve was then constructed based on this criterion and age.

The consistency of the results of the new tests performed with the THOR dummy was assessed against the identical tests performed on the Hybrid III dummy. Similarly, the consistency of the injury assessments between the new tests and those of the initial sample was carefully studied. The results of these analyses confirmed the relevance of the added data. If the statistical methods used have shown the best performance of the new criterion, it has been optimized on the sample used and must be validated on external data. This could be verified on some data from the bibliography and further tests are planned to confirm it.

The use of an expanded test sample allowed to successfully develop a new thoracic criterion for the THOR dummy. It better predicts the risk of rib fractures, while being more consistent with crash investigation findings related to the age effect and the balance between the seat belt and the airbag. This paper brings new experimental data and analysis to improve the ability of the THOR to better predict the risk of rib fractures as a function of age.

INTRODUCTION

Petitjean et al. [1] showed that the deflection measured on the Hybrid III dummy was not sufficient to differentiate between the risks from the belt and the airbag. Her conclusions were the same for THOR. Moreover, Mertz et al. [2] proposed different risk curves for different loads. Petitjean et al. [1] proposed a criterion based on deflection and upper shoulder belt force. But the introduction of a measurement external to the dummy (the belt force) was a limiting factor for the acceptance of this criterion.

Davidsson et al. [3] proposed a criterion combining the maximum deflection along the X-axis with the low and high differential deflections. This criterion made it possible to better take into account the effects of the belt and airbag, but it introduced threshold values defined empirically.

In 2017, Poplin et al. [4] proposed a criterion based on a PCA (Principal Component Analysis). The dependent variable was the total number of fractured ribs, including cartilage fractures (NFR). The explanatory variables were the maximum of the sum of the upper resultant deflections (UPtot), the maximum of the sum of the lower resultant deflections (LOWtot), the maximum of the difference of the upper deflections (UPdif) and the maximum of the difference of the lower deflections (LOWdif). Unfortunately, based on the experimental sample used, this criterion was not better at predicting the injury risk than the resultant maximum deflection (Rmax), and above all, the prediction made with THOR was not better than with HIII (Dmax). An analysis of the sample showed that the THOR data set was highly correlated with the HIII data set (Figure 1) and that, except for a configuration without a shoulder harness, the variables used in the analysis by Poplin et al. [4] were highly correlated with each other (e.g. UPdif versus Rmax in Figure 2).

It then seemed appropriate to enlarge the sample by introducing other tests duplicated with THOR of the same definition as Poplin's (Mod-kit with SD-3).

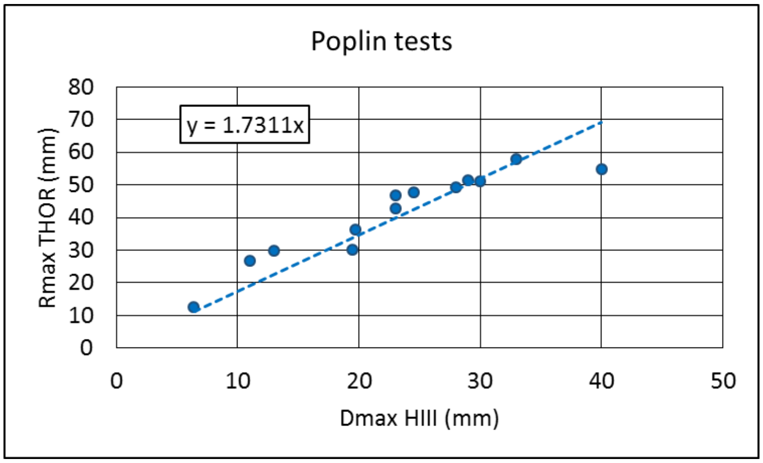

Figure 1. THOR versus HIII deflections for paired tests of Poplin et al. [4]

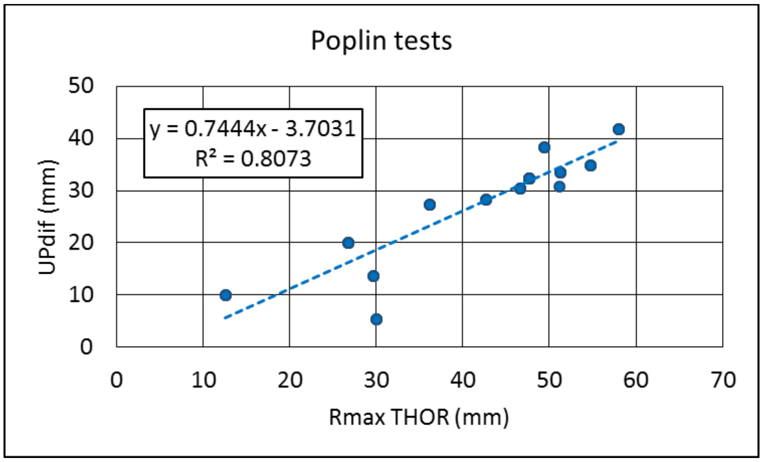

Figure 2. Upper chest deflection difference (UPdif) as a function of maximum resultant deflection (Rmax) for THOR tests of Poplin et al. [4]

METHODS

The first step was to collect PMHS data and check the consistency between data sources. Next, the corresponding THOR and HIII tests had to be found, and then the relationships between the explanatory variables and the number of rib fractures had to be investigated, in order to identify the most relevant criterion. Finally, the injury risk curves had to be constructed.

Experimental dataset

The data from Poplin et al. [4] were used as the starting point and the results of the corresponding HIII tests were collected from the NHTSA database. PMHS sled tests data published in Luet et al. [5], Uriot et al. [6] and Uriot et al. [7] were then collected to expand the range of deflections. In addition, data from Lebarbe et al. [8], Trosseille et al. [9], as well as new data with an airbag loading were added to diversify the types of restraints and increase airbag-type loading. All these tests were duplicated with HIII and THOR Mod-kit with SD-3.

The number of fractured ribs (NFR) included the costal cartilage fractures, as indicated in the definition of the 2008 version of the Abbreviated Injury Scale (AIS) cited by Poplin et al. [4]. In addition, the number of separated fractured ribs (NSFR) was collected when available. This variable was considered by Trosseille et al. [9] to be more representative of the clinical count of rib fractures, since non separated rib fractures cannot be detected on X-Rays.

The chest deflections selected were, as for Poplin et al. [4], the four resultant deflections measured on the THOR dummy.

Poplin sled tests: These are sled tests, in a "Gold Standard" configuration or on a 2004 Ford Taurus seat. The restraints were mainly 3-point belts only (35/45). The remaining restraints were 3-point belts with airbags (7/45) or lap belts with airbags (3/45).

LAB sled tests: These tests were carried out as part of submarining studies: Luet et al. [5] on rigid seat, Uriot et al. [6] on real seat and Uriot et al. [7] on semi-rigid seat. The restraint consisted of a 3-point belt or separated lap and shoulder belts. There were no airbags or knee bolsters in these tests.

LAB airbag tests: The Lebarbe et al. [8] and Trosseille et al. [9] tests consisted of the deployment of unfolded airbags, carried out in such a way as to generate only a membrane effect close to the loading of a subject in a crash test. Additional tests in similar configurations, but with a cold gas generator (CGS) were added too. The test setup was the same as in Trosseille et al. [9], but the power of the generator and the distance between the chest and the airbag were different. The volume of the airbag was 60 liters, except in the SEB 210 test where the airbag was only 45 liters.

LAB sled tests and LAB airbag tests will be defined as "LAB tests" in the rest of the document.

Statistical analysis

Linear regressions were performed between several explanatory variables and the number of fractured ribs (NFR) or the number of separated fractured ribs (NSFR), in order to define the most relevant metric to explain the injuries.

The data were then corrected with respect to the linear regression results corresponding to the selected metrics, and survival analyses were performed to obtain injury risk curves.

RESULTS

Experiments

The analysis of the data from Poplin et al. [4] showed that there was no very clear relationship between the number of fractured ribs and the maximum deflection, although the introduction of morphometric parameters such as the subject mass and size improved the regression. The best correlation coefficient obtained was $R^2=0.36$, the age being not significant, which is problematic according to the bibliography (Kent et al. [10]).

The addition of the sled tests of Luet et al. [5], Uriot et al. [6] et Uriot et al. [7] did not significantly changed the relationship between the deflection measured on the Hybrid III and the THOR dummies (Figure 3). Same observation with the addition of the airbag tests of Trosseille et al. [8], even if they deviate slightly from the regression curve (Figure 4).

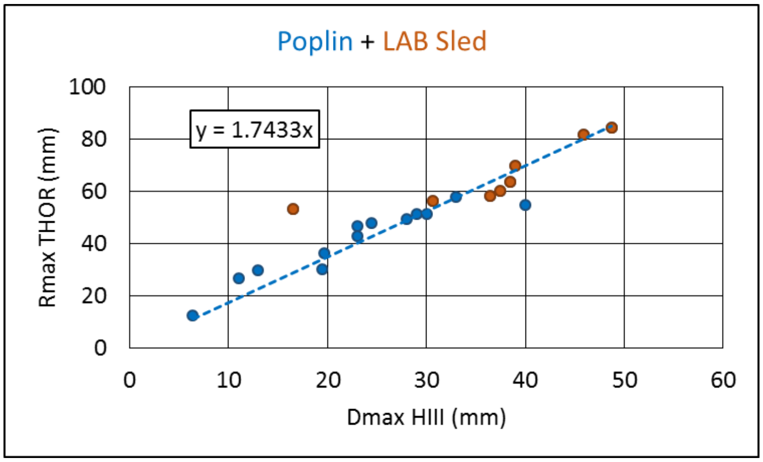

Figure 3. THOR versus HIII deflections for paired tests of Poplin et al. [4], Luet et al. [5] and Uriot et al. [6, 7]

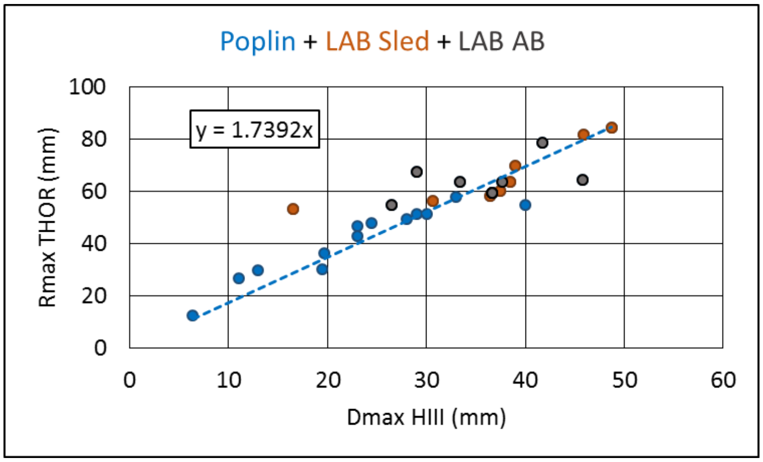

Figure 4. THOR versus HIII deflections for paired tests of Poplin et al. [4], Luet et al. [5], Uriot et al. [6, 7], Lebarbé et al. [8] and Trosseille et al. [9]

With regard to the relationship between the upper differential deflection (UPdif) and the maximum deflection (Rmax), the added sled tests remain in the same trend as the tests of Poplin et al. [4], while the airbag tests deviate from them (Figure 5).

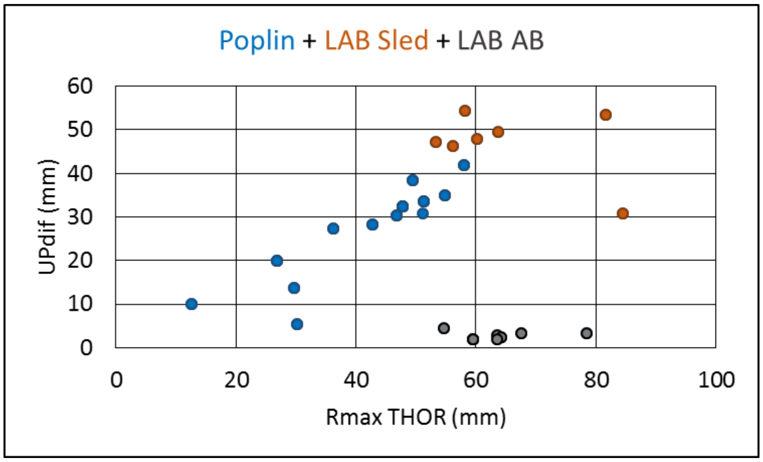

Figure 5. Upper chest deflection difference (UPdif) as a function of maximum deflection (Rmax) for THOR tests of Poplin et al. [4], Luet et al. [5], Uriot et al. [6, 7], Lebarbé et al. [8] and Trosseille et al. [9]

Statistics

A linear regression between the number of fractured ribs (NFR) and the explanatory variables showed that Rmax, the upper differential deflection (UPdif), the age and size of the subjects were all significant factors at 5%. The correlation coefficient was $R^2 = 0.588$, while the best correlation obtained with Rmax was $R^2 = 0.43$ where only the age had a significant effect. The relationship was as follows:

$$NFR = 12.79 + 0.117\ Rmax + 0.194\ UpDif + 0.138\ Age - 0.146\ Height \qquad \text{(Equation 1)}$$

$$NFR(45\ y/o\ ;\ 175\ cm) = -6.5 + 0.117\ Rmax + 0.194\ UpDif \qquad \text{(Equation 2)}$$

The other explanatory variables were not significant.

The same exercise was done with the number of separated fractured ribs (NSFR). The result was as follows:

$$NSFR = -19.17 + 0.0744\ Rmax + 0.227\ UpDif + 0.213\ Age, \text{ with } R^2 = 0.61 \qquad \text{(Equation 3)}$$

Injury risk curves

The risk curves are binomial. There is therefore a significant loss of information for censored data, as the notion of the number of fractures disappears in favor of a binomial variable. It is therefore irrelevant to introduce the variables whose effects were defined by linear regressions (age or height) into these binomial regressions. Similarly, it is not relevant to introduce the two variables Rmax and UPdif separately. Instead, it was decided to calculate a new criterion (TIC for Thoracic Injury Criterion) for each subject, correct it for a given age and size, and then calculate the risk curves associated with that age and size. The new criterion was defined as follows:

$$TIC\_NFR = Rmax + 1.66\ UpDif \qquad \text{(Equation 4)}$$

$$TIC\_NSFR = Rmax + 3\ UpDif \qquad \text{(Equation 5)}$$

For a 50th male subject M50 (size 175 cm) of Y years old, the TIC should be corrected by the following formulas:

$$\text{TIC\_NFR(M50@Y y/o)} = \text{TIC\_NFR(subject)} - 1.25 * (\text{Height}-175) + 1.18 * (\text{Age-Y}) \qquad \text{(Equation 6)}$$

$$\text{TIC\_NSFR(M50@Y y/o)} = \text{TIC\_NSFR(subject)} + 2.86 * (\text{Age-Y}) \qquad \text{(Equation 7)}$$

Risk curves were then constructed for several ages and injury levels. Figure 6 shows the risk curves for 3+ and 7+ fractured ribs (NFR3+ and NFR7+), for 45 and 65 years.

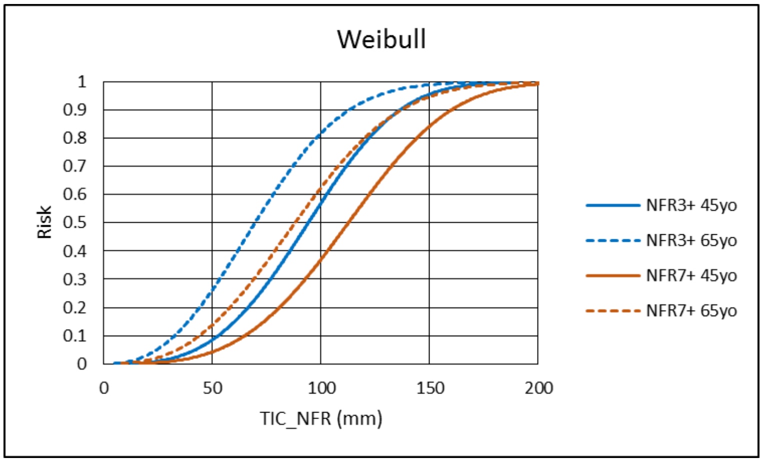

Figure 6. Injury Risk Curves for the total number of fractured ribs (NFR)

Figure 7 shows the risk curves for 3+ displaced fractured ribs (NSFR3+), for 45 and 65 years.

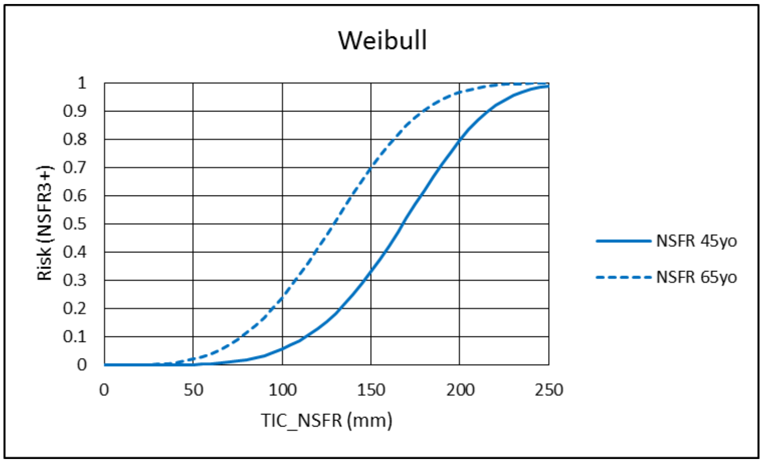

Figure 7. Injury Risk Curves for the number of separated fractured ribs (NSFR)

DISCUSSION

Consistency of THOR/HIII sled tests

The ratios between the maximum deflections measured on the THOR and the Hybrid III in the additional sled tests and in the Poplin et al. [4] sled tests are identical. Since most of the restraint in all these tests is carried out by the belt, this is not surprising. On the other hand, this indicates that the THOR responses in the LAB tests and in the tests of

Poplin et al. [4] are similar. They correspond to the definition of the 2013 mod-kit dummy with SD-3. The test results are therefore consistent and can be aggregated.

Consistency of THOR/HIII airbag tests

If the results of the airbag tests of the LAB remain on the same line as the sled tests on a graph Rmax(THOR) versus Dmax(HIII), the trend is however less clear, the deflections of the THOR seem to be on a plateau. The varying parameters in these tests were further investigated. Only tests performed with the same airbag volume were considered for this purpose.

For the THOR, Dmax is a function of the maximum force and distance between the airbag and the chest (dist):

$$\text{Rmax} = 30.2 + 4.1\ \text{Fmax (kN)} - 0.078\ \text{dist (mm) with } R^2 = 0.94 \qquad \text{(Equation 8)}$$

For the HIII, Dmax is a function only of the maximum force, regardless of the distance whose effect is not significant:

$$\text{Rmax} = 8 + 2.8\ \text{Fmax (kN) with } R^2 = 0.85 \qquad \text{(Equation 9)}$$

It is therefore consistent that there is no linear relationship between the HIII and THOR measurements. These tests were performed with the same THOR as in the sled tests. There is therefore no reason to question the results. This only means that the THOR is more sensitive than the Hybrid III to the application surface of the airbag forces.

Definition AIS3 threshold using NSFR

Should the number of fractured ribs be targeted at 3, as in the AIS3 definition, or 7 to take into account the difference between the number of fractures detected on a living subject and a PMHS? Or should the number of fractured ribs displaced be used, so that only the fractures detectable during a clinical examination are counted?

The number of separated fractured ribs (NSFR) is strongly correlated to the total number of fractured ribs found at autopsy (NFR), as shown in Figure 8. According to the regression, a total of 9 fractures are required to observe 3 separated fractures.

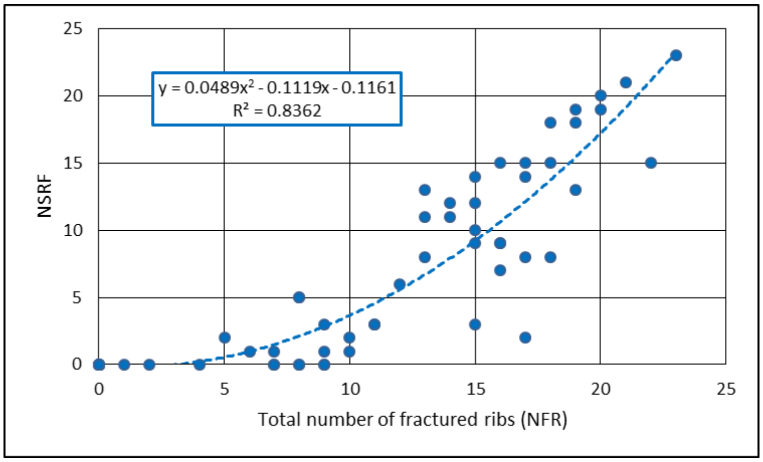

Figure 8. Number of separated fractured ribs (NSFR) as a function of the total number of fractured ribs (NFR)

Crandall et al. [11] compared the number of fractures detected at the autopsy and on X-rays. He found that 44% of fractures were detected on X-Rays for predominantly belt restraints and 24% for AB restraints. Comparing the number of fractures detected on X-Rays with the total number of fractures detected at autopsy (Figure 9), gives almost the same relationship as with the number of separated fractured ribs detected at autopsy.

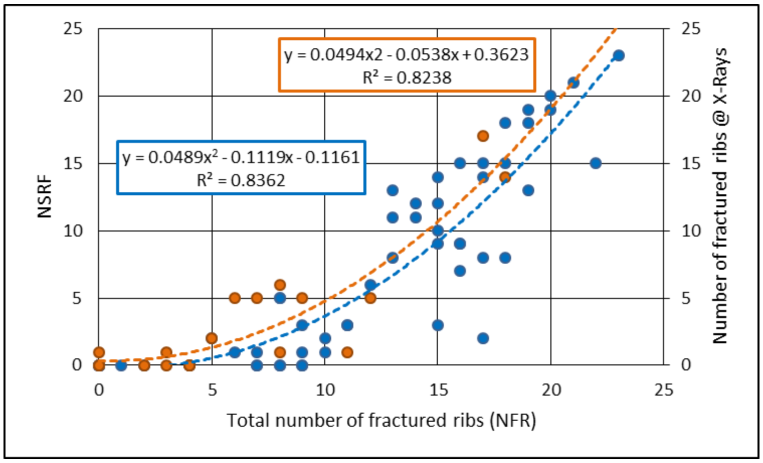

Figure 9. Number of fractured ribs detected on medical imaging as a function of total number of fractured ribs (NFR)

This therefore justifies using the number of separated fractures detected at autopsy to determine the level of AIS, which is clinically determined by the observation of medical imaging. Nota: the direct comparison of the number of fractures detected on X-Rays and the number of separated fractured ribs detected at autopsy could not be performed because there are too few subjects for whom both information are available.

Risk comparison by metrics

For all the dummy tests, the risks calculated from Rmax with the risk curve from Poplin et al. [4] were compared to the risks calculated from TIC_NFR for 3 fractured ribs (Figure 10). The risk calculated from the TIC_NFR and the risk calculated from Rmax for the sled tests (in blue) are similar. On the other hand, the risk calculated from TIC_NFR is much lower than the risk calculated from Rmax for airbag tests.

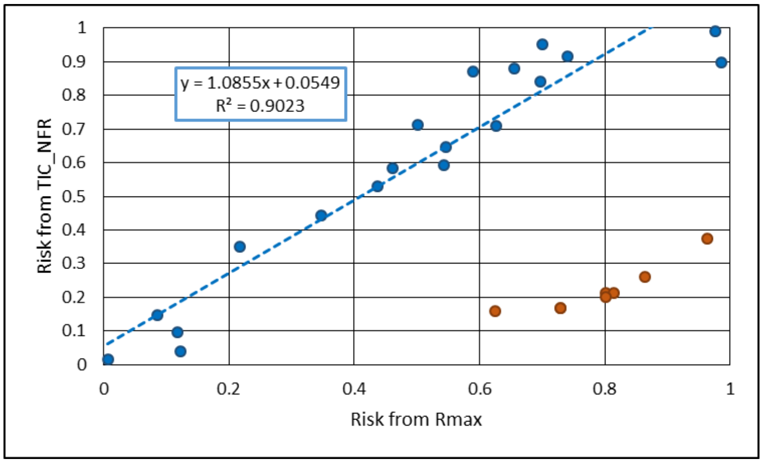

Figure 10. Comparison of risks calculated from Rmax and TIC_NFR for 3 fractured ribs

Perspectives

Simple statistics were used to define the best regression models. Linear regressions may be questionable for count data and other distributions will be investigated to account for the non-normal distribution of the sample. Large differences were also found between airbag like and belt-like restraints, which could bias the statistics. Intermediate restraints would be necessary to fill the gap between the two kinds of restraints and secure the analysis.

Sled tests in configurations with various ratio of belt force to airbag force were undertaken to validate the criterion. They include one configuration where the restraint consisted of a belt with a 3.5kN force limiter with an airbag and one configuration where the restraint consisted of a belt with a 5kN force limiter and a less inflated airbag. Different combinations of Rmax and TIC values are expected, which will allow for the discrimination between the criteria.

SUMMARY AND CONCLUSIONS

The use of an expanded test sample allowed to successfully develop a new thoracic criterion for the THOR dummy. It is better able to predict the risk of rib fractures, while being more consistent with crash investigation findings related to the age effect and the balance between the seat belt and the airbag.

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APPENDIX

Ref. #	Ref.	Test#	Cad ID#	Age	Sex	Height	Mass	BMI	NFR	NSFR	NFR X-Ray	UL	UR	LL	LR	Rmax	UP dif	LOW dif	HIII Defl
10	Lopez-Valdes 2010	1397	393	59	F	167	80	28.7	0	0	NA	3.6	12.6	3	6.6	12.6	10	4.8	6.4
		1404	422	60	M	191	81	22.2	0	0	NA	3.6	12.6	3	6.6	12.6	10	4.8	6.4
		1401	462	69	M	178	84	26.5	0	0	NA	3.6	12.6	3	6.6	12.6	10	4.8	6.4
11	Lopez-Valdes 2010	1398	393	59	F	167	80	28.7	11	NA	NA	14	49.4	12.8	31	49.4	38.3	28.5	28
		1405	422	60	M	191	81	22.2	5	NA	NA	14	49.4	12.8	31	49.4	38.3	28.5	28
		1402	462	69	M	178	84	26.5	13	NA	NA	14	49.4	12.8	31	49.4	38.3	28.5	28
8	Shaw 2009	1295	403	47	M	177	68	21.7	17	8	17	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
		1294	411	76	M	178	70	22.1	6	1	5	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
		1358	425	54	M	177	79	25.2	10	NA	NA	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
		1359	426	49	M	184	76	22.4	8	NA	NA	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
		1360	428	57	M	175	64	20.9	5	NA	NA	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
		1379	433	40	M	179	88	27.5	8	0	6	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
		1380	441	37	M	180	78	24.1	2	0	0	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
		1378	443	72	M	184	81	23.9	8	5	1	47.7	16.1	47.4	14.7	47.7	32.3	35.6	24.5
13	NA	S0029	492	66	M	179	70	21.8	0	0	NA	26.8	13.4	19.4	14.7	26.8	20	13.9	11
		S0028	494	59	M	178	68	21.5	0	0	NA	26.8	13.4	19.4	14.7	26.8	20	13.9	11
		S0302	674	67	M	178	72	22.6	4	0	0	26.8	13.4	19.4	14.7	26.8	20	13.9	11
		S0303	736	67	M	170	70	24.2	7	1	5	26.8	13.4	19.4	14.7	26.8	20	13.9	11
		S0304	695	74	M	178	73	22.9	0	0	NA	26.8	13.4	19.4	14.7	26.8	20	13.9	11
14	NA	S0313	362	69	M	173	69	23.1	7	0	NA	35.8	9.4	36.2	17.5	36.2	27.3	19.3	19.7
		S0314	750	66	M	172	76	25.8	5	2	2	35.8	9.4	36.2	17.5	36.2	27.3	19.3	19.7
		S0315	767	67	M	177	64	20.5	0	0	NA	35.8	9.4	36.2	17.5	36.2	27.3	19.3	19.7
2	Kent 2001	580	105	57	M	177	57	18.2	0	0	NA	51.3	23.9	39.4	13.5	51.3	33.5	36.8	29
		579	106	72	F	156	59	24.3	11	NA	1	51.3	23.9	39.4	13.5	51.3	33.5	36.8	29
		578	107	69	F	155	53	21.7	4	NA	0	51.3	23.9	39.4	13.5	51.3	33.5	36.8	29
		577	111	57	M	174	70	23.1	0	0	0	51.3	23.9	39.4	13.5	51.3	33.5	36.8	29

Ref. #	Ref.	Test#	Cad ID#	Age	Sex	Height	Mass	BMI	NFR	NSFR	NFR X-Ray	UL	UR	LL	LR	Rmax	UP dif	LOW dif	HIII Defl
3	NA	652	118	46	M	175	74	24.1	0	0	1	27.2	30.1	19	16.9	30.1	5.4	7.2	19.5
		651	121	70	M	176	70	22.6	0	0	0	27.2	30.1	19	16.9	30.1	5.4	7.2	19.5
		650	124	40	M	150	47	20.9	4	NA	0	27.2	30.1	19	16.9	30.1	5.4	7.2	19.5
4	Kent 2001	665	112	55	M	176	85	27.5	3	NA	0	54.8	22.7	45.7	20	54.8	34.9	37.2	40
		666	115	69	M	176	84	27.1	3	NA	1	54.8	22.7	45.7	20	54.8	34.9	37.2	40
		667	120	59	F	161	79	30.5	12	NA	5	54.8	22.7	45.7	20	54.8	34.9	37.2	40
5	Forman 2006	1094	322	49	M	178	58	18.3	0	0	NA	42.7	15.9	36.2	17.1	42.7	28.2	28.1	23
		1095	323	44	M	172	77	26.1	0	0	NA	42.7	15.9	36.2	17.1	42.7	28.2	28.1	23
		1096	327	39	M	184	79	23.5	0	0	NA	42.7	15.9	36.2	17.1	42.7	28.2	28.1	23
6	Forman 2006	1110	323	44	M	172	77	26.1	0	0	NA	51.2	21.7	46.6	17.7	51.2	30.7	36.8	30
7	Forman 2009	1262	362	51	M	175	55	17.9	9	0	5	58	28.3	43	14.5	58	41.8	40.7	33
		1264	367	57	M	179	59	18.4	9	0	NA	58	28.3	43	14.5	58	41.8	40.7	33
		1263	394	57	F	165	109	40	18	8	14	58	28.3	43	14.5	58	41.8	40.7	33
9	Forman 2009	1386	429	67	M	175	71	23.2	8	NA	NA	46.7	29	35.2	13.8	46.7	30.3	32.3	23
		1387	444	69	M	171	60	20.5	1	NA	NA	46.7	29	35.2	13.8	46.7	30.3	32.3	23
		1389	457	72	M	175	73	23.8	10	NA	NA	46.7	29	35.2	13.8	46.7	30.3	32.3	23
12	Kent 2011	1428	461	69	M	175	69	22.7	0	0		25.4	29.7	20.8	13.6	29.7	13.6	11.5	13
		1427	481	72	M	173	88	29.2	7	NA	NA	25.4	29.7	20.8	13.6	29.7	13.6	11.5	13
		1429	482	40	M	186	83	24	2	NA	NA	25.4	29.7	20.8	13.6	29.7	13.6	11.5	13
LAB1	Uriot 2015 [7]	SubBIO22	683	55	M	177	92	29.4	16	15	NA	32.2	81.7	36.2	52.1	81.7	53.3	30	45.9
		SubBIO23	679	86	M	168	67	23.7	17	15	NA	32.2	81.7	36.2	52.1	81.7	53.3	30	45.9
		SubBIO24	681	87	M	175	77	25.1	15	12	NA	32.2	81.7	36.2	52.1	81.7	53.3	30	45.9
		SubBIO25	682	87	M	171	64	21.9	17	14	NA	32.2	81.7	36.2	52.1	81.7	53.3	30	45.9
LAB2	Uriot 2015 [7]	SubBIO26	678	85	M	165	79	29.0	20	19	NA	33.7	63.9	30.5	84.5	84.5	30.9	58.01	48.7
		SubBIO27	677	84	M	170	57	19.7	13	8	NA	33.7	63.9	30.5	84.5	84.5	30.9	58.01	48.7
		SubBIO28	676	84	M	170	64	22.1	13	11	NA	33.7	63.9	30.5	84.5	84.5	30.9	58.01	48.7
		SubBIO29	680	89	M	175	77	25.1	18	18	NA	33.7	63.9	30.5	84.5	84.5	30.9	58.01	48.7

Ref. #	Ref.	Test#	Cad ID#	Age	Sex	Height	Mass	BMI	NFR	NSFR	NFR X-Ray	UL	UR	LL	LR	Rmax	UP dif	LOW dif	HIII Defl
LAB3	Luet 2012 [5]	IRIS09	631	67	M	171	59.5	20.3	15	3	NA	25.5	53.2	14.7	51.9	53.2	47.2	38.3	16.5
		IRIS10	632	85	M	167	69.5	24.9	23	23	NA	25.5	53.2	14.7	51.9	53.2	47.2	38.3	16.5
		IRIS11	633	76	M	163	54	20.3	10	2	NA	25.5	53.2	14.7	51.9	53.2	47.2	38.3	16.5
LAB4	Luet 2012 [5]	IRIS12	636	77	M	171	61.5	21.0	15	9	NA	26.8	63.7	NA	55.8	63.7	49.5	NA	38.5
		IRIS13	635	56	F	161	57	22.0	19	13	NA	26.8	63.7	NA	56.8	63.7	50.5	NA	39.5
		IRIS14	634	68	M	170	79	27.3	15	10	NA	26.8	63.7	NA	57.8	63.7	51.5	NA	40.5
LAB5	Luet 2012 [5]	IRIS15	639	90	M	162	71	27.1	21	21	NA	29.9	56.1	21.9	48.6	56.1	46.3	41.9	30.7
		IRIS16	638	67	M	170	58	20.1	16	9	NA	29.9	56.1	21.9	48.6	56.1	46.3	41.9	30.7
		IRIS17	637	79	M	161	57	22.0	22	15	NA	29.9	56.1	21.9	48.6	56.1	46.3	41.9	30.7
LAB6	Uriot 2015 [6]	IRIS39	659	70	M	167	54	19.4	12	6	NA	NA	69.7	17.4	54.2	69.7	NA	41.4	38.9
		IRIS40	657	88	M	178	90.5	28.6	14	12	NA	NA	69.7	17.4	54.2	69.7	NA	41.4	38.9
		IRIS41	658	64	M	179	69	21.5	14	11	NA	NA	69.7	17.4	54.2	69.7	NA	41.4	38.9
LAB7	Uriot 2015 [6]	IRIS29	653	75	M	168	57.5	20.4	19	18	NA	20.0	58.2	41.2	47.7	58.2	54.4	39.3	36.4
		IRIS30	652	63	M	180	70	21.6	19	19	NA	20.0	58.2	41.2	47.7	58.2	54.4	39.3	36.4
		IRIS31	651	68	M	176	80.5	26.0	20	20	NA	20.0	58.2	41.2	47.7	58.2	54.4	39.3	36.4
LAB8	Uriot 2015 [6]	IRIS32	649	80	M	178	81.5	25.7	15	14	NA	31.5	60.2	27.9	55.9	60.2	47.9	31.8	37.4
		IRIS33	650	60	M	176	68.5	22.1	11	3	NA	31.5	60.2	27.9	55.9	60.2	47.9	31.8	37.4
		IRIS34	648	76	M	174	73	24.1	13	13	NA	31.5	60.2	27.9	55.9	60.2	47.9	31.8	37.4
LAB9	New data	SEB206	656	83	M	174	76	25.1	9	1	NA	54.5	55.9	78.5	68.6	78.5	3.21	10.9	41.7
		SEB207	660	89	M	164	65	24.2	1	0	NA	45.2	44.8	67.6	60.6	67.6	3.31	10.6	29
		SEB210	672	83	M	167	67	24.0	7	0	NA	39.6	37.4	54.7	52.8	54.7	4.35	6.36	26.5
		SEB220	674	81	M	165	79	29.0	8	5	NA	44.7	42.5	63.5	56.6	63.5	2.85	8.22	37.7
		SEB221	675	91	M	150	54	24.0	16	9	NA	49.7	50.2	64.3	61.8	64.3	2.41	3.77	45.8
LAB10	Trosseille 2008 [9]	SEB144	594	78	M	169	65	22.8	8	0	NA	37.0	37.1	59	59.6	59.6	1.93	5.43	36.6
	Lebarbe 2005 [8]	PCH1624	559	73	M	174	67	22.1	11	3	NA	37.0	37.1	59	59.6	59.6	1.93	5.43	36.6
		PCH1658	561	72	M	173	83	27.7	0	0	NA	37.0	37.1	59	59.6	59.6	1.93	5.43	36.6
LAB11	New data	SEB159	607	84	M	175	56	18.3	18	15	NA	34.7	35.3	63.5	60.0	63.5	2.00	4.70	33.4