

JAMA Round Robin Tests
Using the Flex-GTR-prototype (SN03)

Back Grounds

- JAMA had a task from the Flex-TEG to conduct round robin test among the JAMA members using Flex-GTR-prototype (SN03).
- JAMA member company therefore started the round robin test form April 2009 when it was available to use the Flex-GTR-prototype (SN03) on this purpose.
- JAMA member companies are going to evaluated the repeatability, durability and usability of the impactor during the round robin test.
- Three JAMA member companies have already conducted the round robin tests up to know.
- The round robin tests are going to be continued by the end of July 2009.
- In this report, we present the JAMA round robin test results up to now.

Test Schedule

2009								
April		May		June		July		
JAMA Apr.09-A	JAMA Apr.09-B	JAMA May.09-A	JAMA May.09-B	JAMA Jun.09-A	JAMA Jun.09-B	JAMA Jun.09-A	JAMA Jun.09-B	
	Finished							
Car Tests (n=3)	Car Tests (n=3)	Car Tests (n=3)	Car Tests (n=3)	Car Tests (n=3)	Car Tests (n=3)	Car Tests (n=3)	Car Tests (n=3)	Car Tests (n=3)
PT1	PT2	PT3	PT4	PT5	PT6	PT7	PT8	PT9

PT: Pendulum Test at JARI

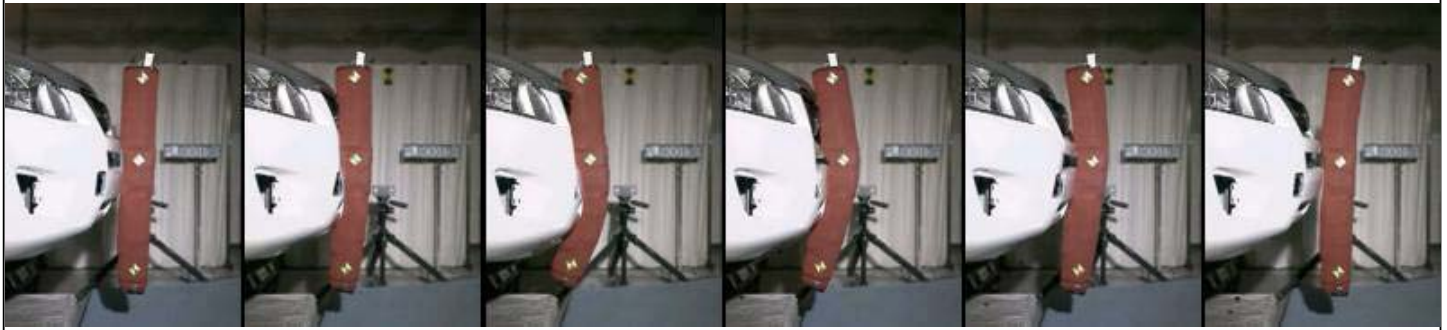
Flex-GTR-prototype JAMA Round Robbing Test Results
(JAMA-Apr.09-A1, A2, A3)

Flex-GTR-prototype JAMA Round Robbing Test Results Kinematics (JAMA-Apr.09-A1, A2, A3)

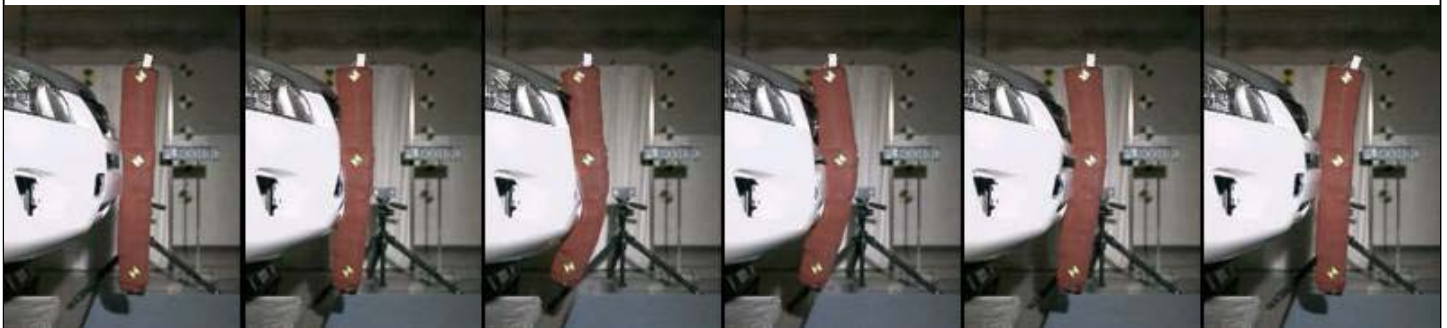
JAMA-Apr.09-A1



JAMA-Apr.09-A2



JAMA-Apr.09-A3



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10 ms

20 ms

30 ms

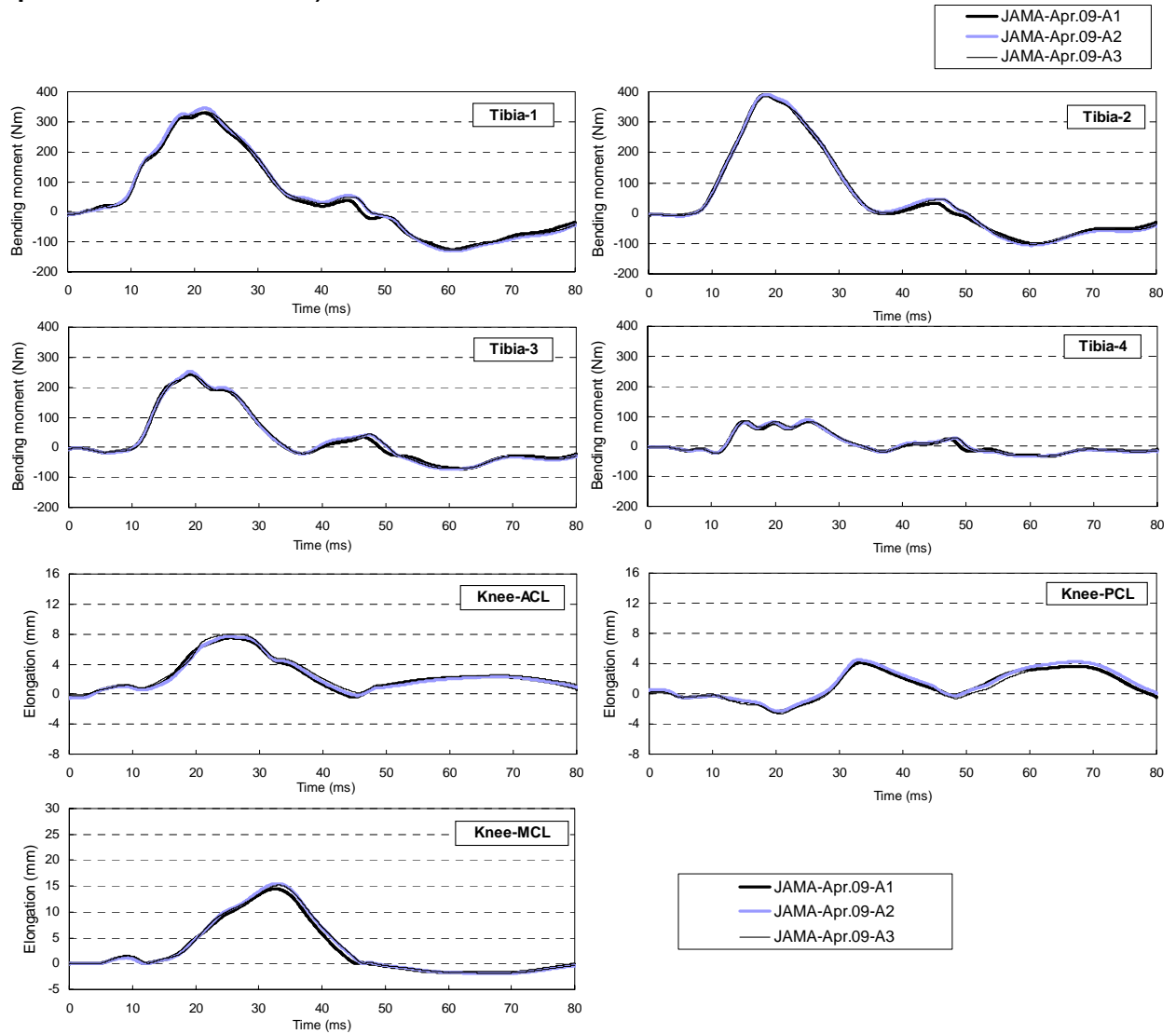
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Flex-GTR-prototype JAMA Round Robbing Test Results

Waveforms (JAMA-Apr.09-A1, A2, A3)

- Tibia-1
- Tibia-2
- Tibia-3
- Tibia-4



- Knee-ACL
- Knee-PCL
- Knee-MCL

Flex-GTR-prototype JAMA Round Robbing Test Results

Maximum Values (JAMA-Apr.09-A1, A2, A3)

Repeatability Check for GTR-prototype

Impactor: Flex-GTR-prototype (SN03)
 Test Method: Subsystem (Free freight)
 Test Rig: Car

	Max. values						
	Tibia-1 (Nm)	Tibia-2 (Nm)	Tibia-3 (Nm)	Tibia-4 (Nm)	Knee-ACL (mm)	Knee-PCL (mm)	Knee-MCL (mm)
JAMA-Apr.09-A1	329.1	391.7	244.1	83.1	7.50	4.11	14.4
JAMA-Apr.09-A2	345.3	390.6	253.0	88.0	7.67	4.52	15.5
JAMA-Apr.09-A3	332.0	384.2	241.5	86.3	8.01	4.04	15.1
Avg.	335.5	388.8	246.2	85.8	7.73	4.23	15.0
St. Dev.	8.64	4.07	6.01	2.52	0.26	0.26	0.53
CV (%)	2.58	1.05	2.44	2.93	3.36	6.17	3.55
Judgement *	Good	Good	Good	Good	Acceptable	Acceptable	Acceptable
t-IARV **	318	318	318	318	12.7	12.7	20
St.Dev./t-IARV (%)	2.72	1.28	1.89	0.79	2.04	2.05	2.66
Judgement *	Good	Good	Good	Good	Good	Good	Good

* Injury assessment items and monitoring items were evaluated.

** t-IARV: Tentative Injury Assessment Reference Values

Judgements

Good: < 3%

Acceptable: 3% ≤ and < 7%

Marginal: 7% ≤ and < 10%

Not Acceptable: > 10%

Injury
Assessment
Items

Monitoring
Items

Flex-GTR-prototype JAMA Round Robbing Test Results
(JAMA-Apr.09-B1, B2, B3)

Flex-GTR-prototype JAMA Round Robbing Test Results

Kinematics (JAMA-Apr.09-B1, B2, B3)

JAMA-Apr.09-B1



JAMA-Apr.09-B2



JAMA-Apr.09-B3



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10 ms

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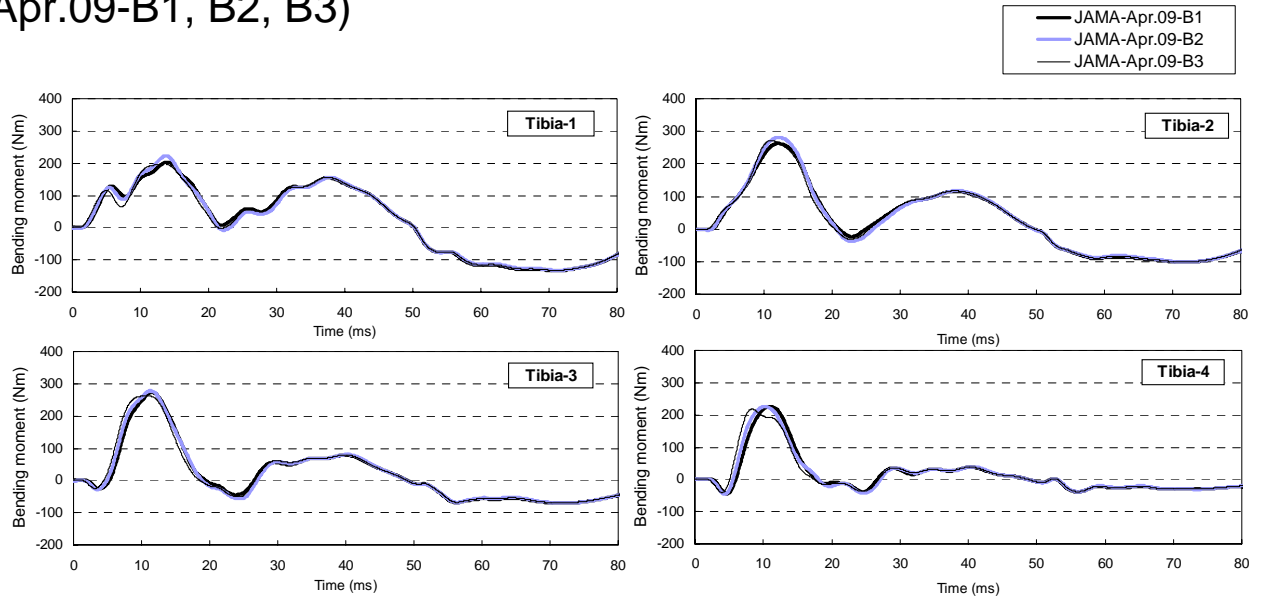
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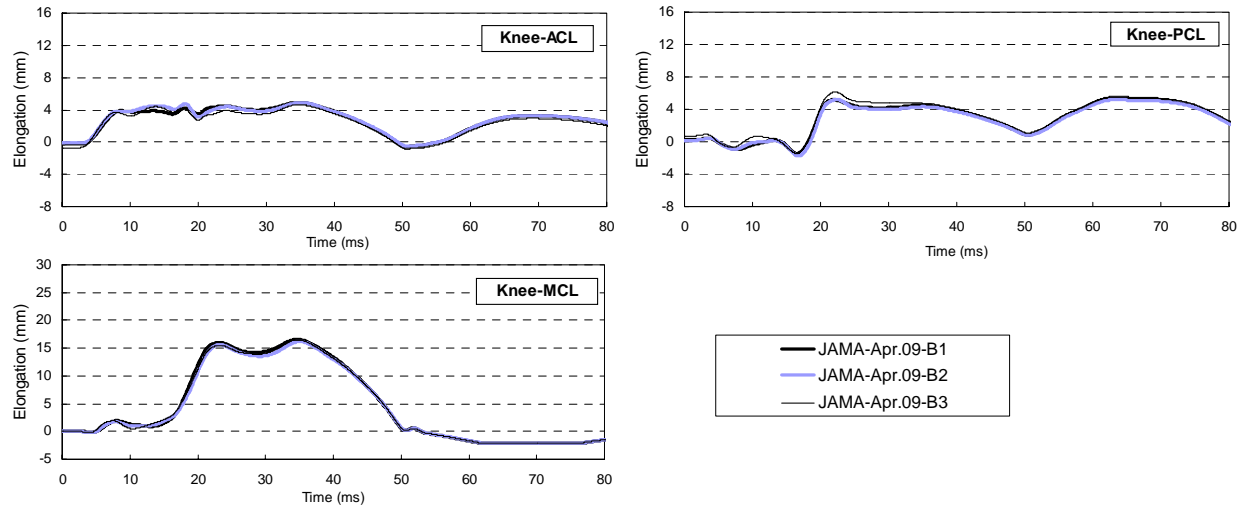
Flex-GTR-prototype JAMA Round Robbing Test Results

Waveforms (JAMA-Apr.09-B1, B2, B3)

- Tibia-1
- Tibia-2
- Tibia-3
- Tibia-4



- Knee-ACL
- Knee-PCL
- Knee-MCL



Flex-GTR-prototype JAMA Round Robbing Test Results

Maximum Values (JAMA-Apr.09-B1, B2, B3)

Repeatability Check for GTR-prototype

Impactor: Flex-GTR-prototype (SN03)
 Test Method: Subsystem (Free freight)
 Test Rig: Car

	Max. values						
	Tibia-1 (Nm)	Tibia-2 (Nm)	Tibia-3 (Nm)	Tibia-4 (Nm)	Knee-ACL (mm)	Knee-PCL (mm)	Knee-MCL (mm)
JAMA-Apr.09-B1	203.3	263.1	273.8	226.3	4.94	5.35	16.6
JAMA-Apr.09-B2	223.4	280.8	278.2	226.0	4.91	5.20	16.2
JAMA-Apr.09-B3	198.5	271.7	262.6	218.2	4.63	6.12	16.5
Avg.	208.4	271.9	271.5	223.5	4.83	5.56	16.4
St. Dev.	13.21	8.85	8.00	4.61	0.17	0.50	0.20
CV (%)	6.34	3.26	2.95	2.06	3.54	8.94	1.23
Judgement *	Acceptable	Acceptable	Good	Good	Acceptable	Marginal	Good
t-IARV **	318	318	318	318	12.7	12.7	20
St.Dev./t-IARV (%)	4.15	2.78	2.52	1.45	1.35	3.91	1.01
Judgement *	Acceptable	Good	Good	Good	Good	Acceptable	Good

* Injury assessment items and monitoring items were evaluated.

** t-IARV: Tentative Injury Assessment Reference Values

Judgements

Good: < 3%

Acceptable: 3% ≤ and < 7%

Marginal: 7% ≤ and < 10%

Not Acceptable: > 10%

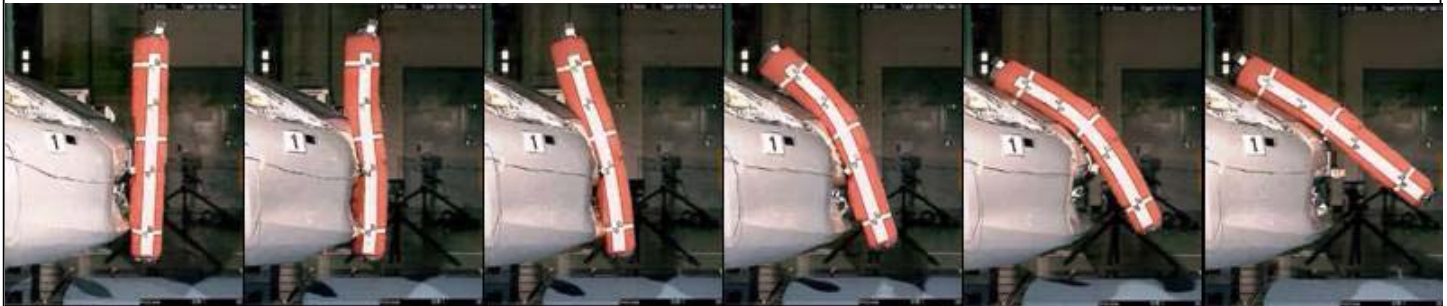
Injury
Assessment
Items

Monitoring
Items

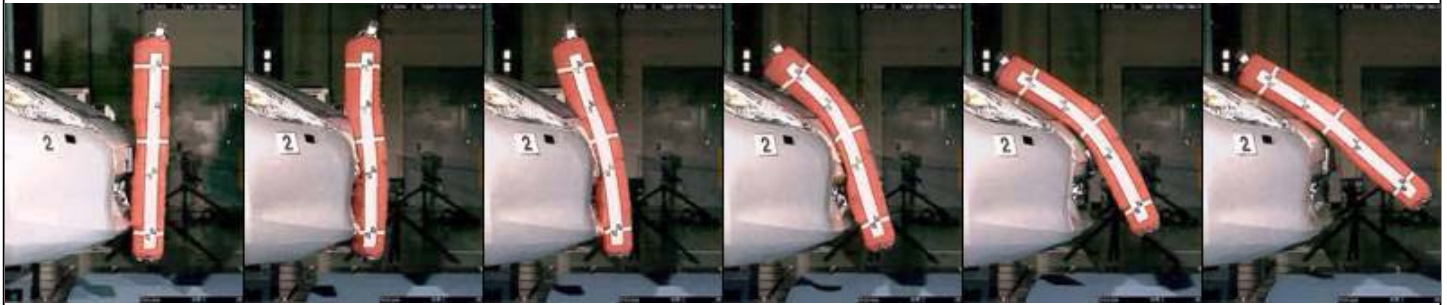
Flex-GTR-prototype JAMA Round Robbing Test Results
(JAMA-May.09-A1, A2, A3)

Flex-GTR-prototype JAMA Round Robbing Test Results Kinematics (JAMA-May09-A1, A2, A3)

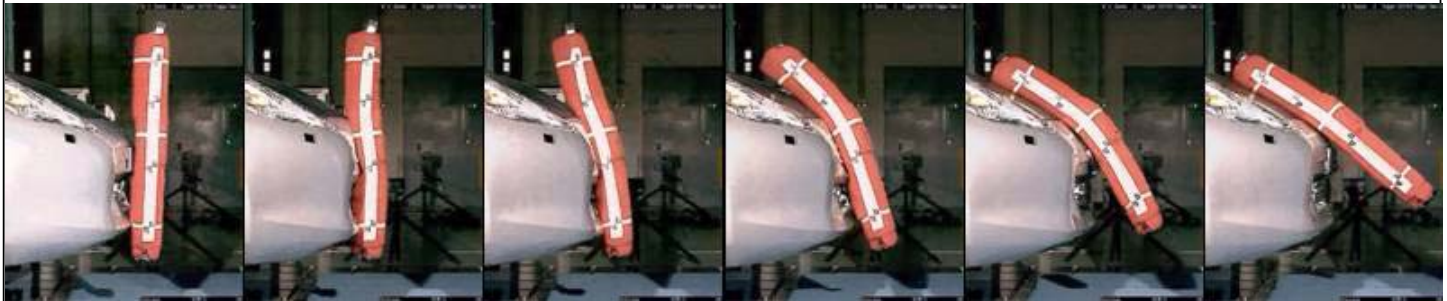
JAMA-May09-A1



JAMA-May09-A2



JAMA-May09-A3



0 ms

10 ms

20 ms

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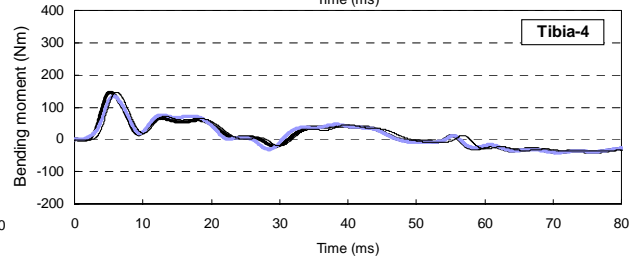
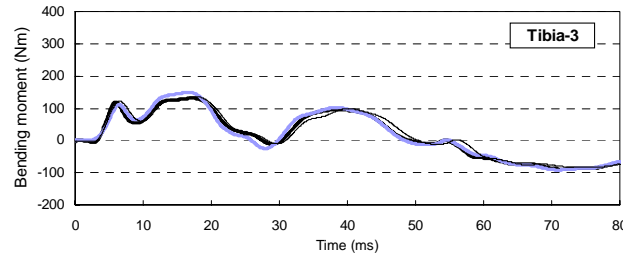
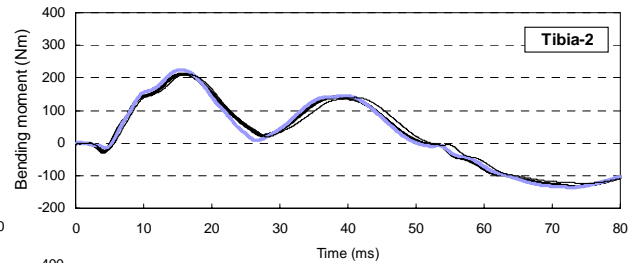
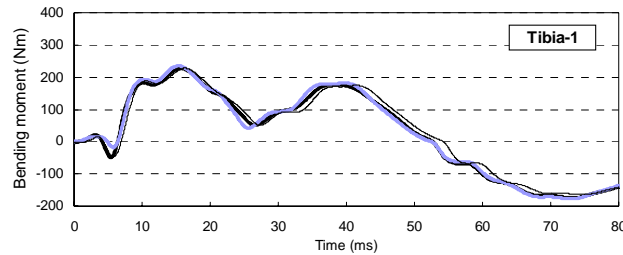
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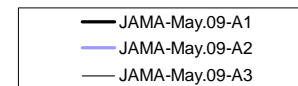
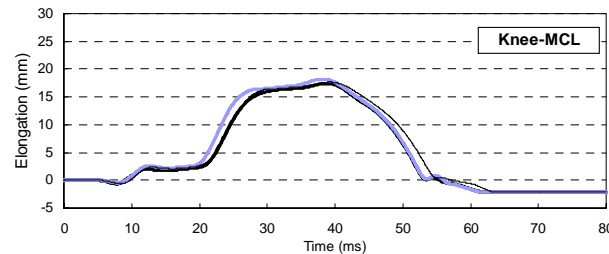
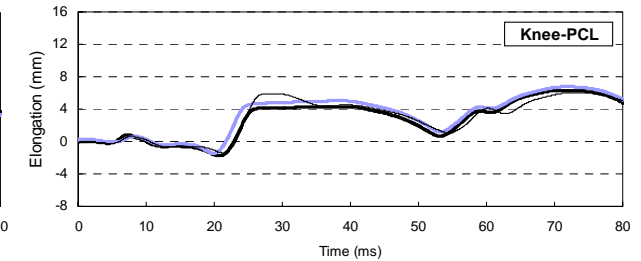
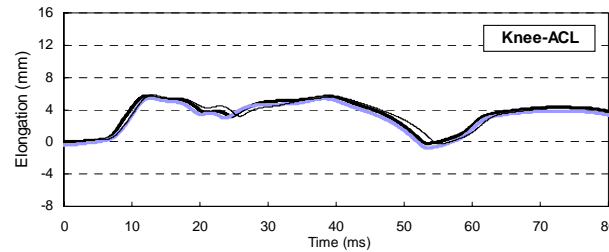
Flex-GTR-prototype JAMA Round Robbing Test Results

Waveforms (JAMA-May.09-A1, A2, A3)

- Tibia-1
- Tibia-2
- Tibia-3
- Tibia-4



- Knee-ACL
- Knee-PCL
- Knee-MCL



Flex-GTR-prototype JAMA Round Robbing Test Results

Maximum Values (JAMA-May.09-A1, A2, A3)

Repeatability Check for GTR-prototype

Impactor: Flex-GTR-prototype (SN03)

Test Method: Subsystem (Free fright)

Test Rig: Car

	Max. values						
	Tibia-1 (Nm)	Tibia-2 (Nm)	Tibia-3 (Nm)	Tibia-4 (Nm)	Knee-ACL (mm)	Knee-PCL (mm)	Knee-MCL (mm)
JAMA-May.09-A1	227.4	211.7	131.1	146.8	5.70	6.33	17.4
JAMA-May.09-A2	235.2	224.8	149.2	134.1	5.44	6.76	18.2
JAMA-May.09-A3	227.6	211.6	135.9	146.6	5.81	6.05	17.7
Avg.	230.1	216.0	138.7	142.5	5.65	6.38	17.8
St. Dev.	4.41	7.56	9.36	7.30	0.19	0.36	0.41
CV (%)	1.92	3.50	6.74	5.12	3.36	5.62	2.28
Judgement *	Good	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Good
t-IARV **	318	318	318	318	12.7	12.7	20
St.Dev./t-IARV (%)	1.39	2.38	2.94	2.29	1.50	2.82	2.03
Judgement *	Good	Good	Good	Good	Good	Good	Good

* Injury assessment items and monitoring items were evaluated.

** t-IARV: Tentative Injury Assessment Reference Values

Judgements

Good: < 3%

Acceptable: 3% ≤ and < 7%

Marginal: 7% ≤ and < 10%

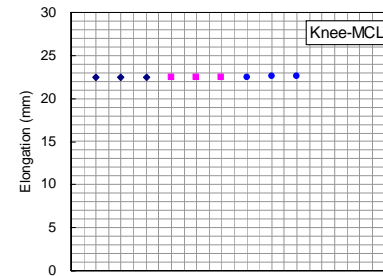
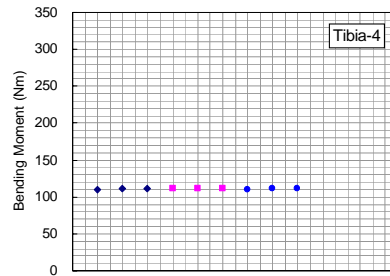
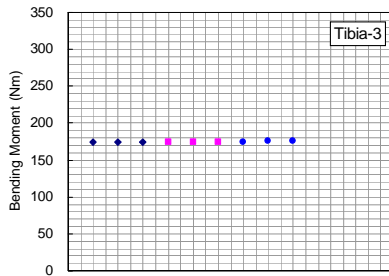
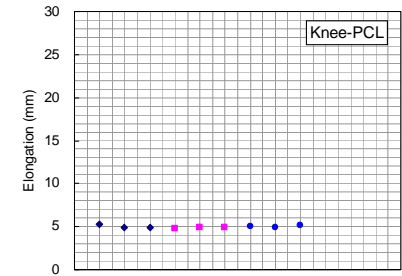
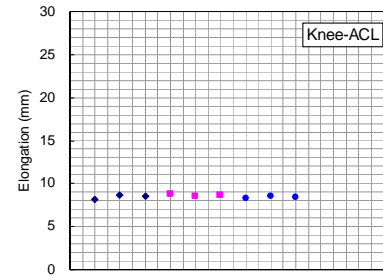
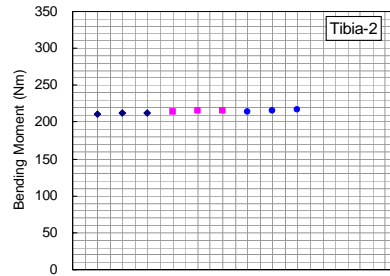
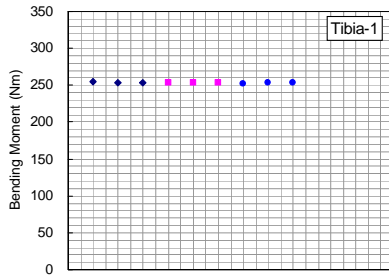
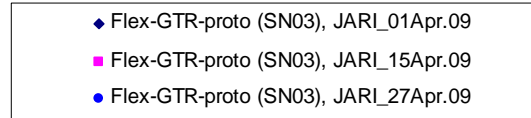
Not Acceptable: > 10%

Injury
Assessment
Items

Monitoring
Items

Flex-GTR-prototype Pendulum Test Results
During the JAMA Round Robbing Tests

Flex-GTR-prototype Pendulum Test Results During the JAMA Round Robbing Tests Maximum Values, Graph (JARI, April 2009)



Flex-GTR-prototype Pendulum Test Results During the JAMA Round Robbing Tests

Maximum Values, Table (JARI, April 2009)

Repeatability Check for GTR-prototype

Impactor: Flex-GTR-prototype (SN03)

Test Method: Pendulum Test

Test Rig: Pendulum Test Rig for Flex-GTR-prototype

	Max. values						
	Tibia-1 (Nm)	Tibia-2 (Nm)	Tibia-3 (Nm)	Tibia-4 (Nm)	Knee-ACL (mm)	Knee-PCL (mm)	Knee-MCL (mm)
JARI_01Apr.09-1	254.1	210.9	173.8	110.0	8.20	5.25	22.5
JARI_01Apr.09-2	253.8	211.6	173.9	110.7	8.61	4.87	22.5
JARI_01Apr.09-3	253.7	211.7	174.1	111.0	8.57	4.90	22.5
JARI_15Apr.09-1	252.8	213.8	173.7	110.9	8.74	4.73	22.5
JARI_15Apr.09-2	253.6	215.1	174.3	111.6	8.55	4.93	22.5
JARI_15Apr.09-3	253.9	215.1	174.3	111.8	8.60	4.88	22.5
JARI_27Apr.09-1	251.9	213.7	174.4	110.3	8.32	4.97	22.5
JARI_27Apr.09-2	253.6	215.8	175.8	111.6	8.51	4.88	22.6
JARI_27Apr.09-3	253.7	216.2	175.9	111.9	8.37	5.11	22.6
Avg.	253.4	213.8	174.5	111.1	8.50	4.95	22.5
St. Dev.	0.67	1.95	0.80	0.66	0.17	0.15	0.04
CV (%)	0.26	0.91	0.46	0.60	1.98	3.04	0.18
Judgement *	Good	Good	Good	Good	Good	Acceptable	Good
t-IARV **	318	318	318	318	12.7	12.7	20
St.Dev./t-IARV (%)	0.21	0.61	0.25	0.21	1.32	1.18	0.20
Judgement *	Good	Good	Good	Good	Good	Good	Good

* Injury assessment items and monitoring items were evaluated.

** t-IARV: Tentative Injury Assessment Reference Values

Judgements

Good: < 3%

Acceptable: 3% ≤ and < 7%

Marginal: 7% ≤ and < 10%

Not Acceptable: > 10%

Injury
Assessment
Items

Monitoring
Items

Conclusions

- Three JAMA member companies have conducted the round robin tests, and then their findings up to now are as follows.
- Repeatability of the Flex-GTR-prototype regards to the Injury Assessment Items
 - Car Tests
 - ✓ CV: Good = 60 % (9/15), Acceptable = 40 % (6/15)
 - ✓ St.Dev./t-IARV: Good = 93 % (14/15), Acceptable = 7 % (1/15)
 - Pendulum Tests
 - ✓ CV: Good = 100 % (5/5)
 - ✓ St.Dev./t-IARV: Good = 100 % (5/5)
- Repeatability of the Flex-GTR-prototype regards to the Monitoring Items
 - Car Tests
 - ✓ CV: Acceptable = 84 % (5/6), Marginal = 17 % (1/6)
 - ✓ St.Dev./t-IARV: Good = 84 % (5/6), Acceptable = 17 % (1/6)
 - Pendulum Tests
 - ✓ CV: Good = 50 % (1/2), Acceptable = 50 % (1/2)
 - ✓ St.Dev./t-IARV: Good = 100 % (2/2)
- Durability of the Flex-GTR-prototype: No serious issues on the durability.
- Usability of the Flex-GTR-prototype: No serious issues on the usability.

JAMA are going to continue this round robbing tests by the end of July 2009.