GTR7-06-07

BIORID IIG RESPONSE TO VARYING COMFORT FEATURE STIFFNESS AND VARYING SEATBACK ROTATIONAL STIFFNESS (TESTS CONDUCTED UNDER IIWPG PROTOCOL)

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PURPOSE

Original

- Knowing that the seat response plays a significant role in rear impact neck injury protection, what is the influence of different comfort feature and seatback deflection combinations on the IIWPG rating

GTR7 Phase 2 Considerations

- Can the BioRID II distinguish between comfort systems and identify a better design choice for neck injury protection?
- Can the BioRID II response identify a difference in seat frame stiffness (rotation) for a given comfort feature?
- Is the BioRID II response repeatable enough to make reliable design choices for neck injury protection?
- Report observations relevant to the injury evaluation parameters and limits proposed by Japan

BioRID II build level: g
IIWPG Test Protocol

Same seat cushion and adjuster assembly design for all tests

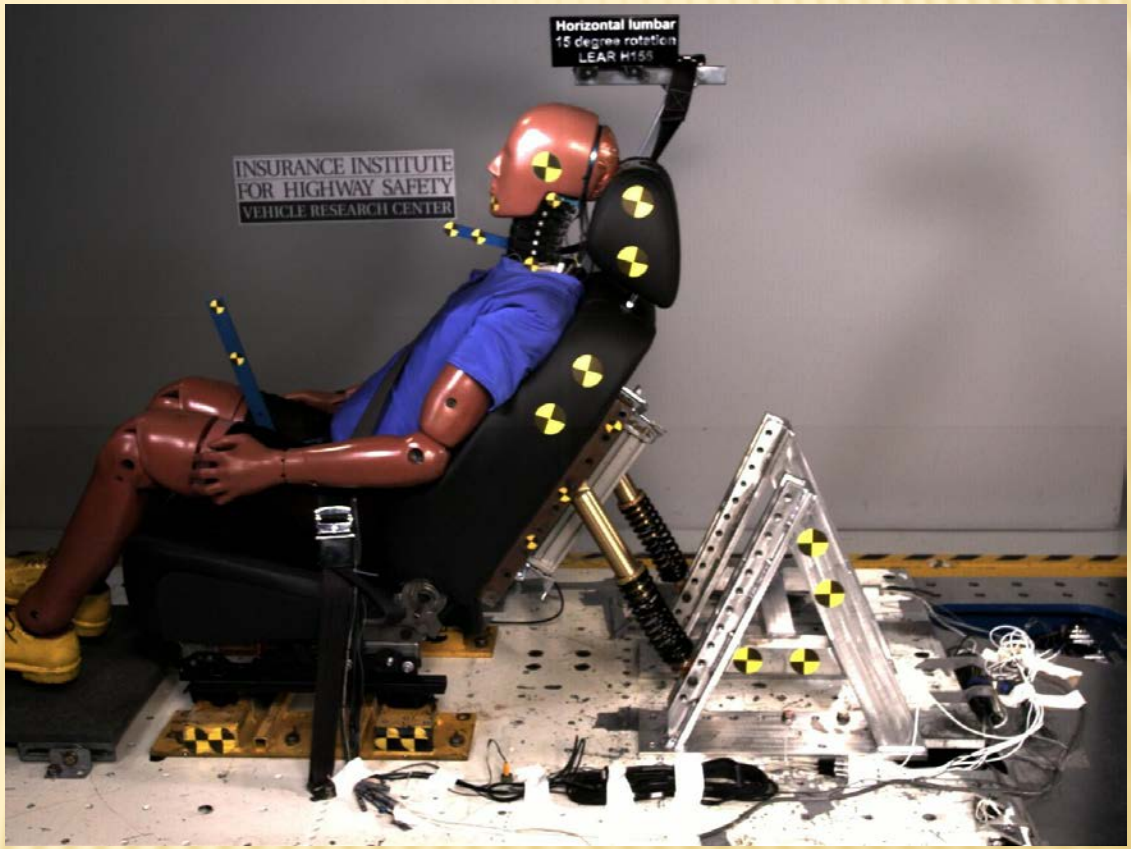
Fresh seatback assembly for each test - same backframe ,foam, trim and head restraint design for all tests

Passive h/r with EPP core

Recliners converted to free-pivots and seatback rotation controlled by spring-damper system – three rotation angles (7, 10 & 15 degrees)

Three common seatback comfort systems tested – two tests at each seatback rotation angle

String-potentiometers measuring upper and lower dummy penetration



TEST SET-UP

STATIC SUSPENSION

HORIZONTAL LUMBAR

VERTICAL LUMBAR

DESCRIPTION OF SEATBACK COMFORT SYSTEMS

Horizontal Lumbar has smallest backset as there is no foam support in the upper seatback and initial seatback angle is smallest

Static Suspension has largest backset due to most uniform and prominent foam support

Vertical Lumbar similar to, but slightly less than Static Suspension

Test ID	BioRID II		Seatback Angle
	Backset (mm)	Height (mm)	Initial (degrees)
H051	55	53	20.7
H052	50	54	20.5
H103	50	49	20.6
H104	56	56	20.5
H155	56	51	20.8
H156	53	56	20.5
S051	69	56	22.2
S052	70	60	22.2
S103	64	58	21.2
S104	67	61	21.4
S155	72	61	22.0
S156	64	60	21.7
V051	61	49	20.3
V052	70	57	21.8
V103	64	57	21.4
V104	66	62	21.2
V155	60	65	21.8
V156	65	56	21.9

TEST SET-UP: BACKSET BY SEATBACK COMFORT SYSTEM

MECHANICAL RESPONSE CONSIDERATIONS

- Sled pulse very consistent
- Spring-damper reaction repeatable
- Seat back rotation consistent by lumbar type, but rotation rate is influenced by lumber type (measured using DTS angular rate sensors)
- Static Suspension and Horizontal Lumbar showed consistent mechanical response
- Vertical Lumbar motor bracket (mid-frame and engages side-members) showed inconsistent deformation, contributing to BioRID response variation

7 DEGREE SEATBACK ROTATION

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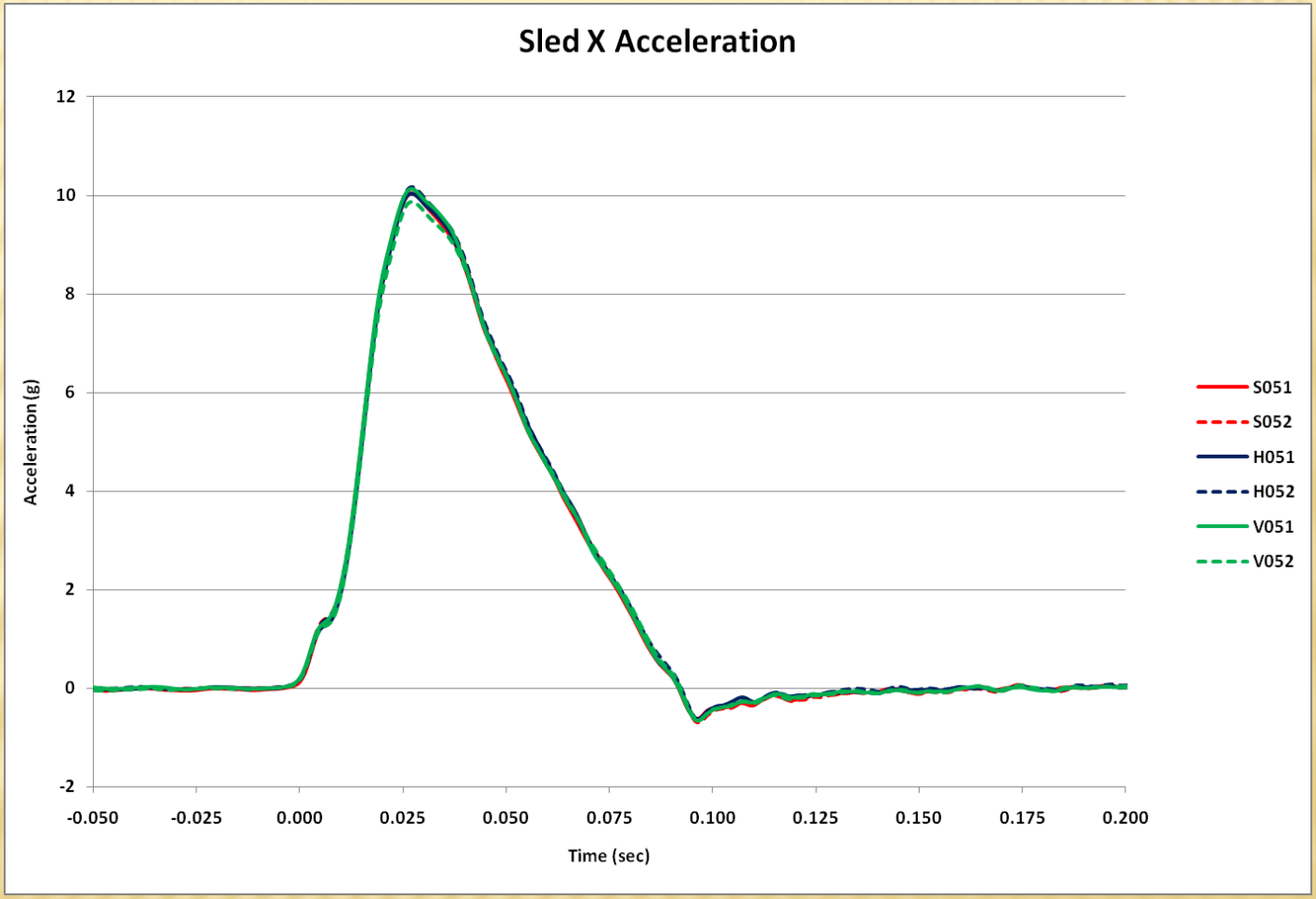

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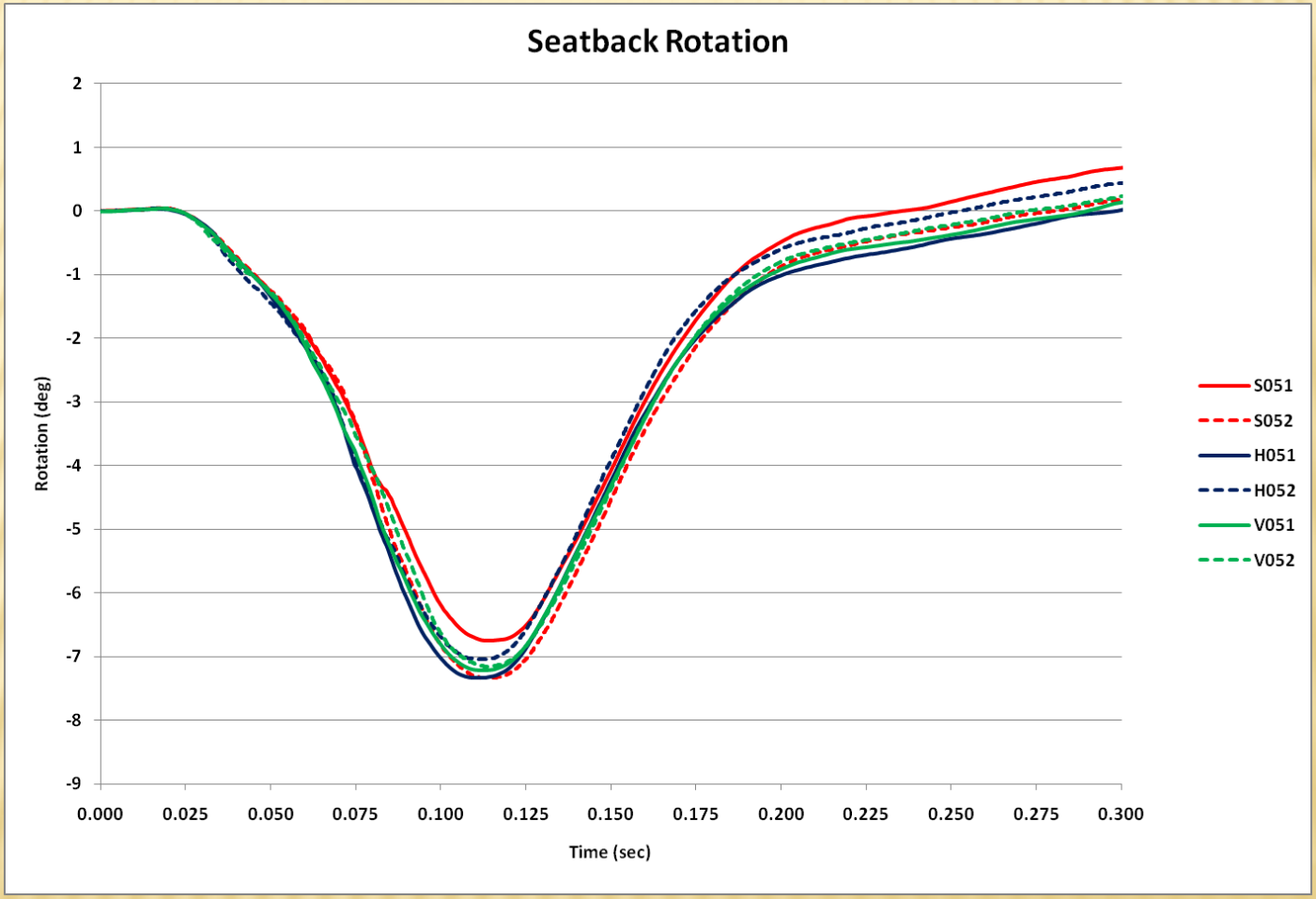

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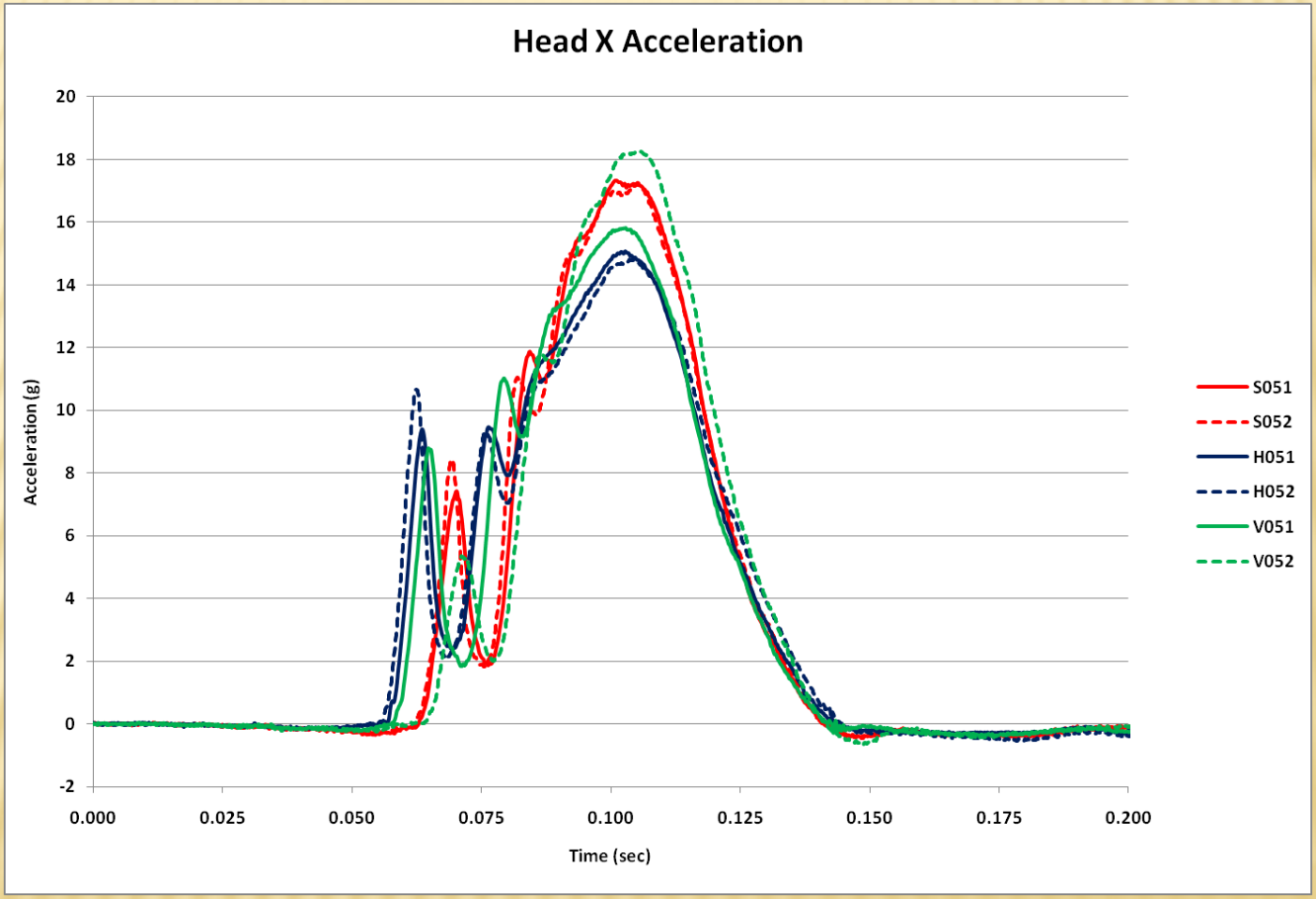

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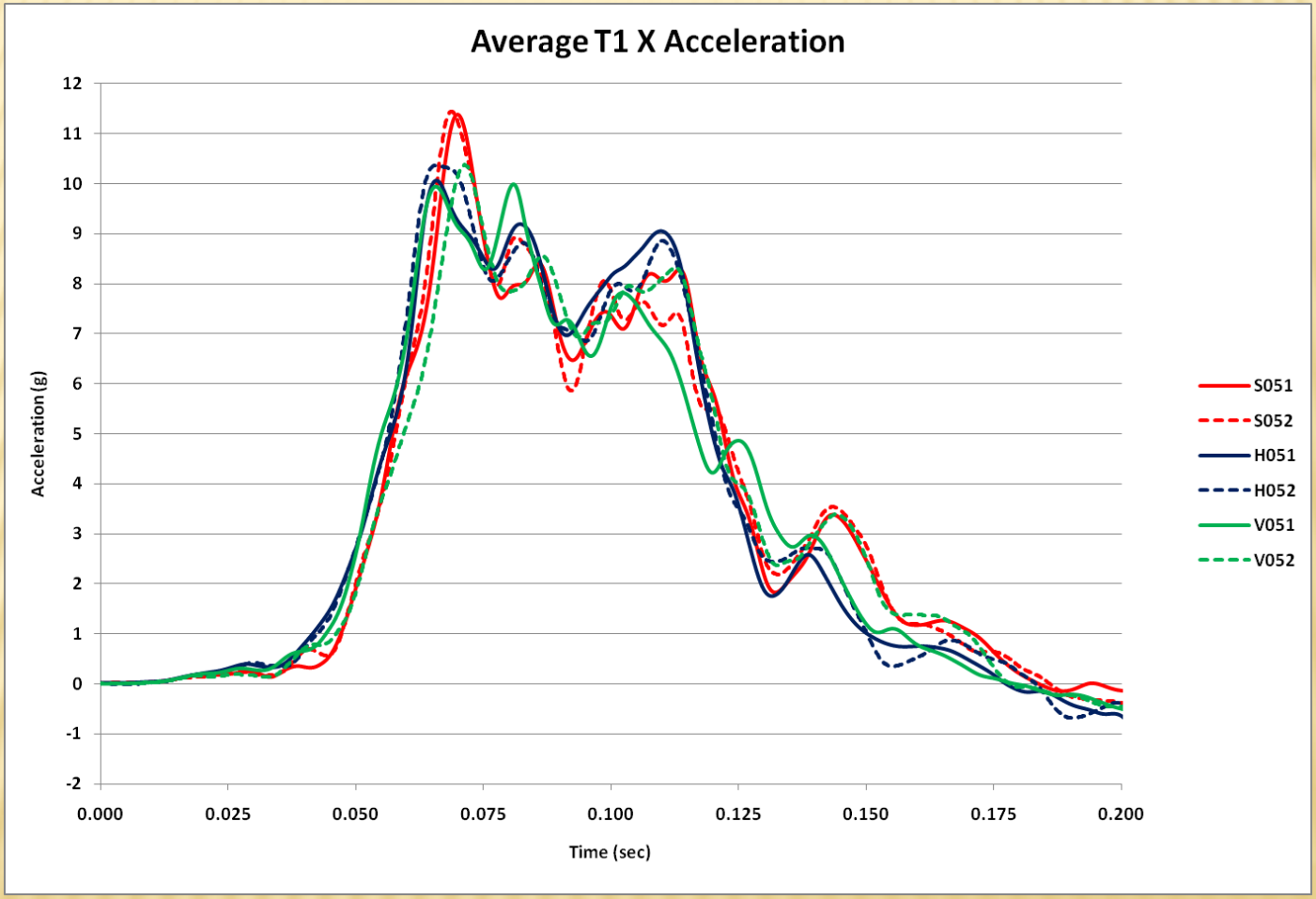

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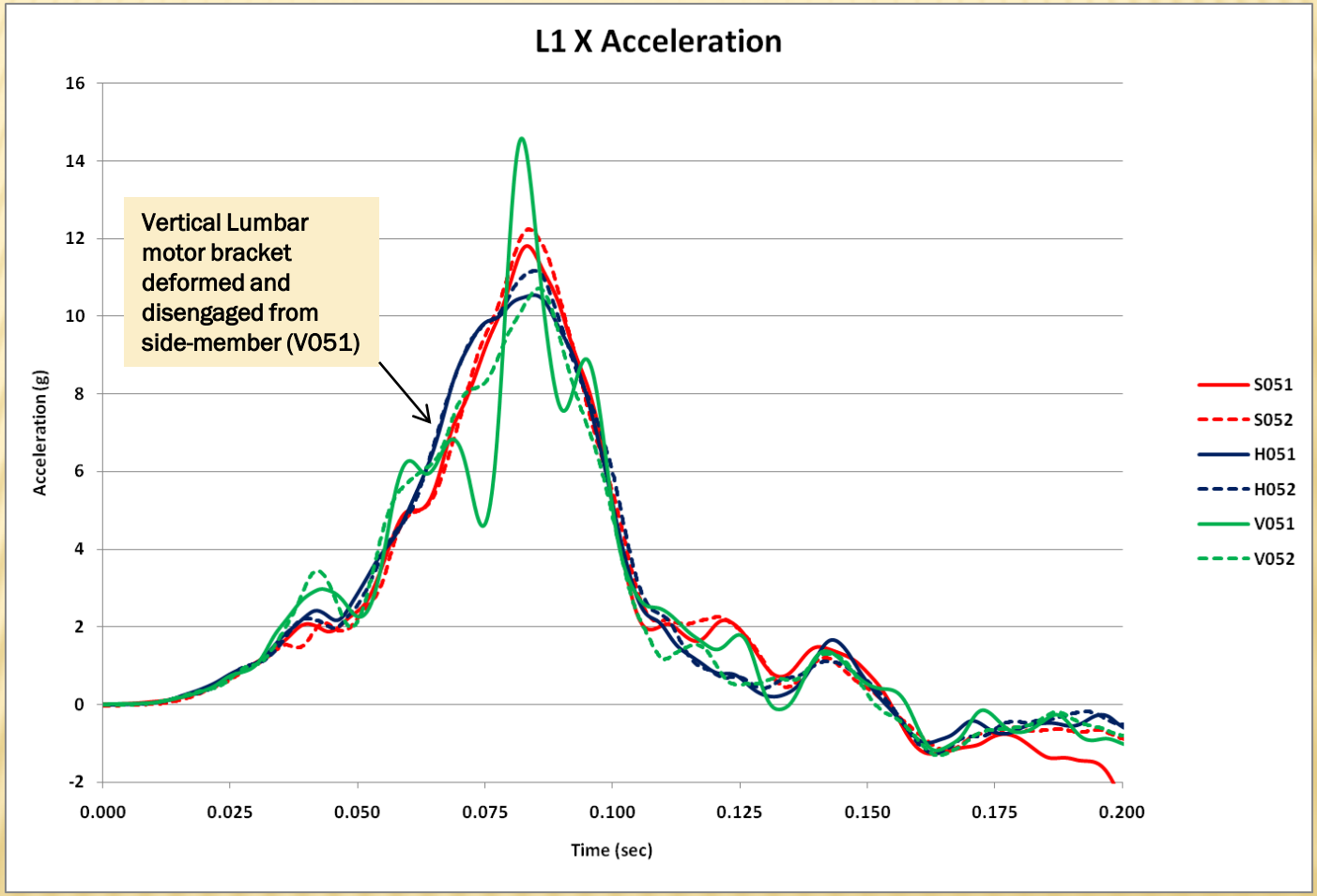

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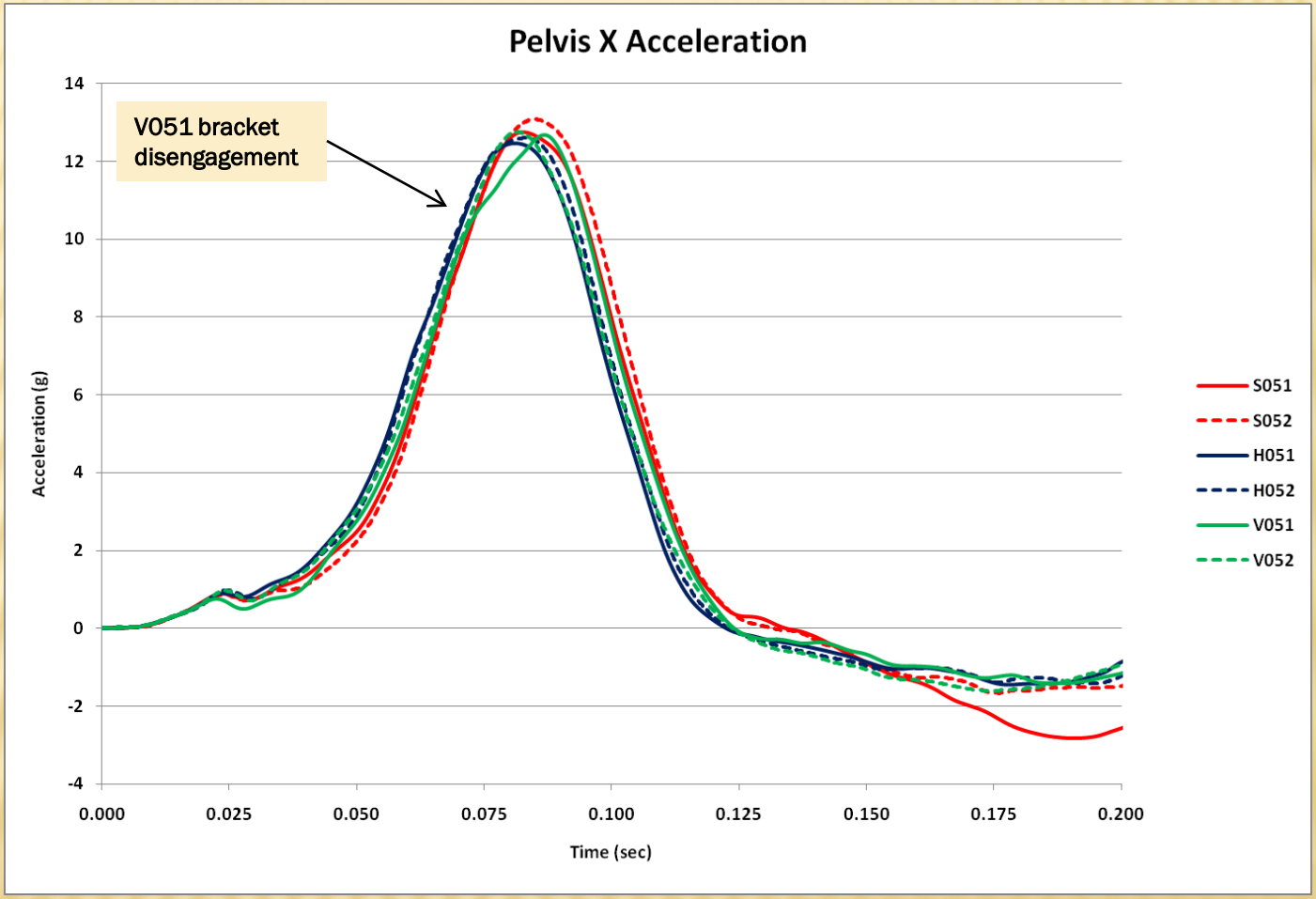

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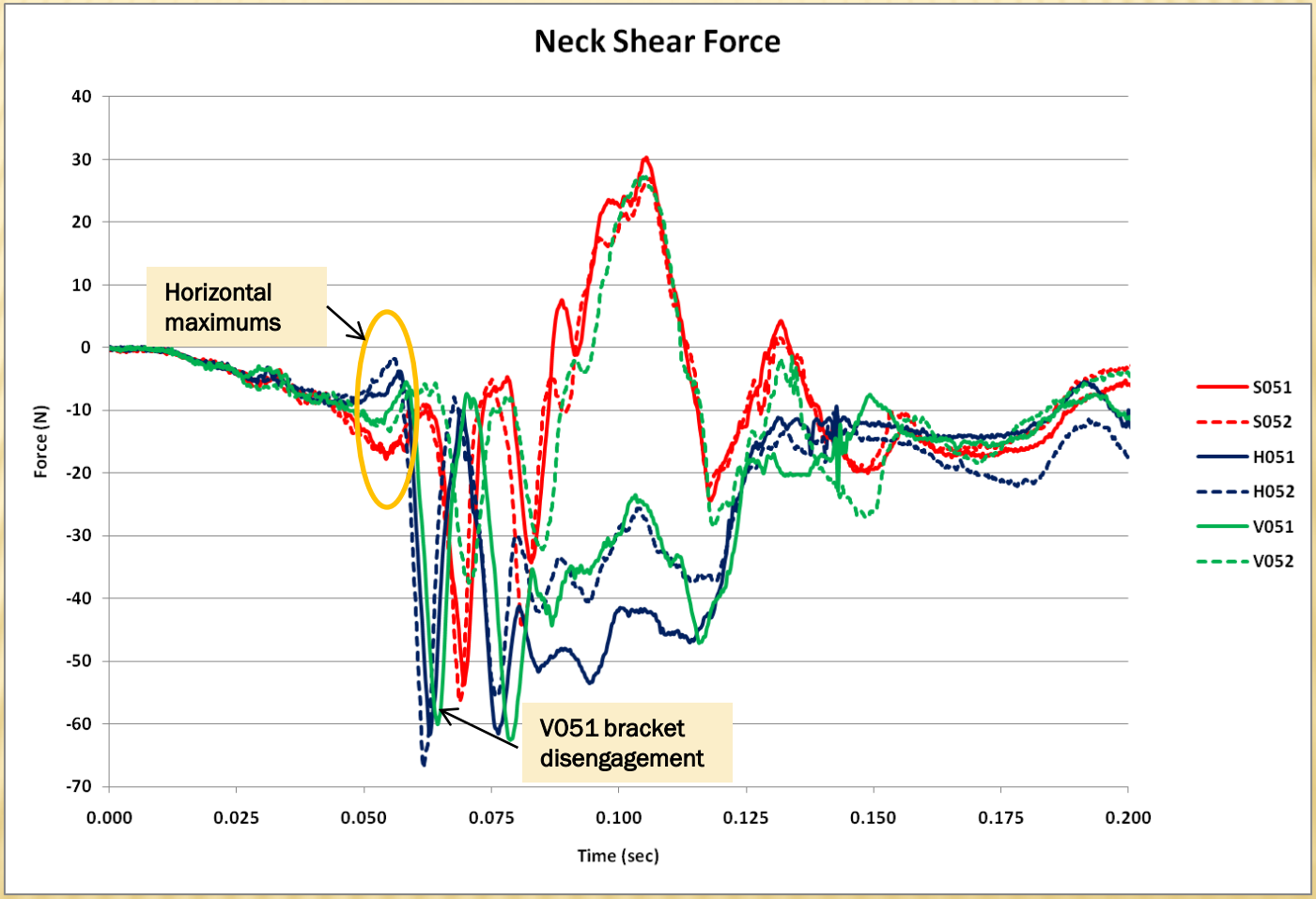

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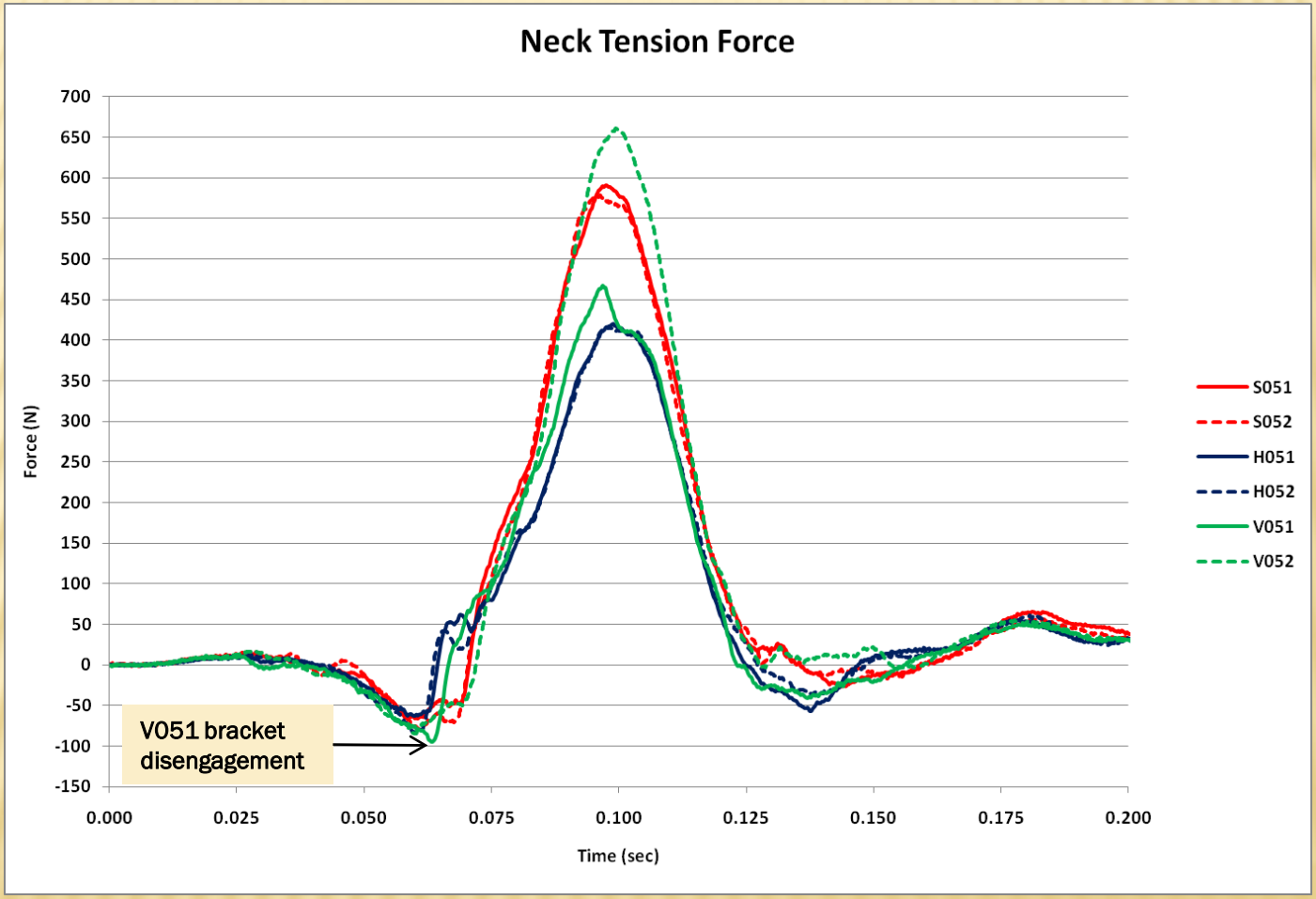

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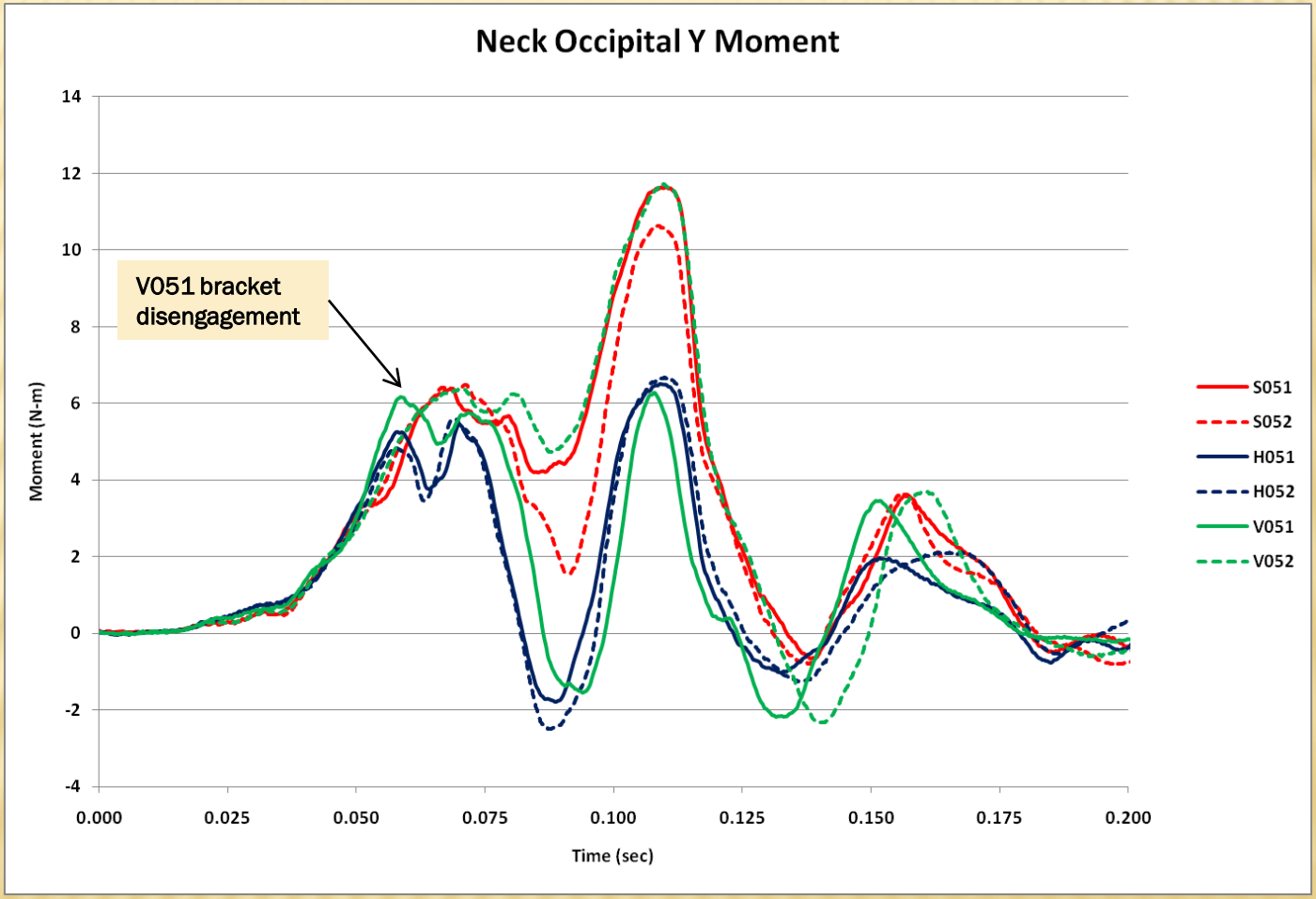

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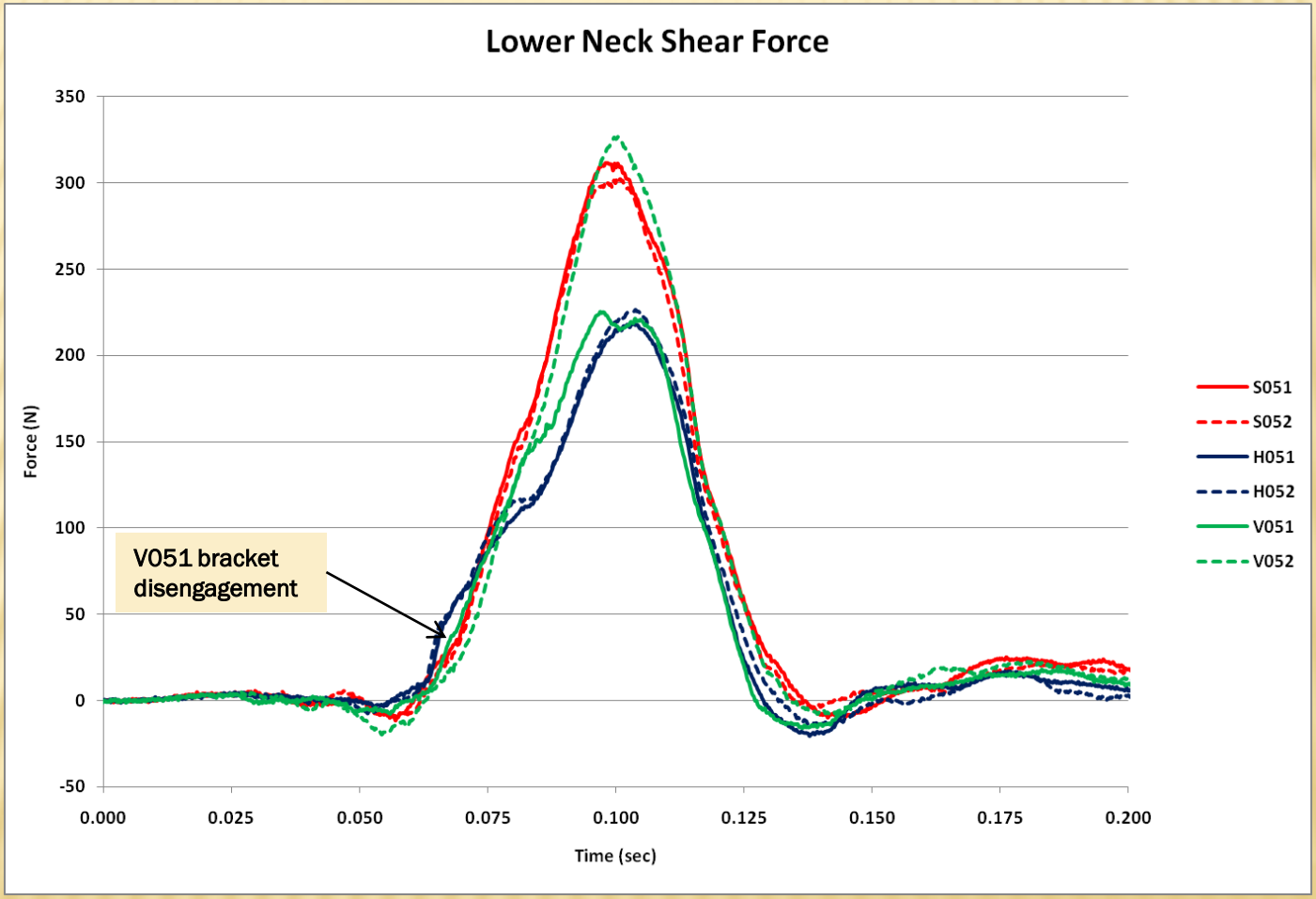

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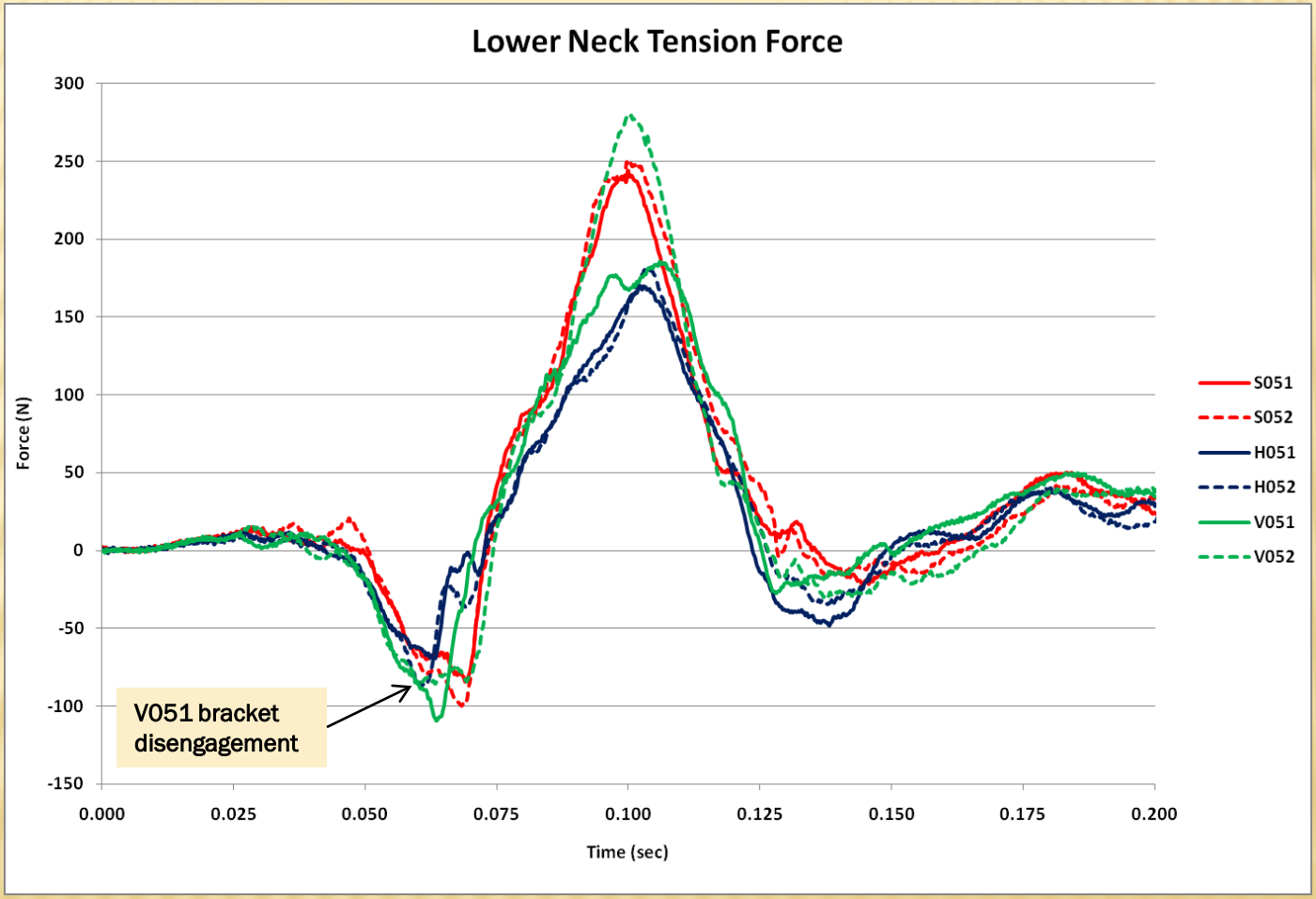

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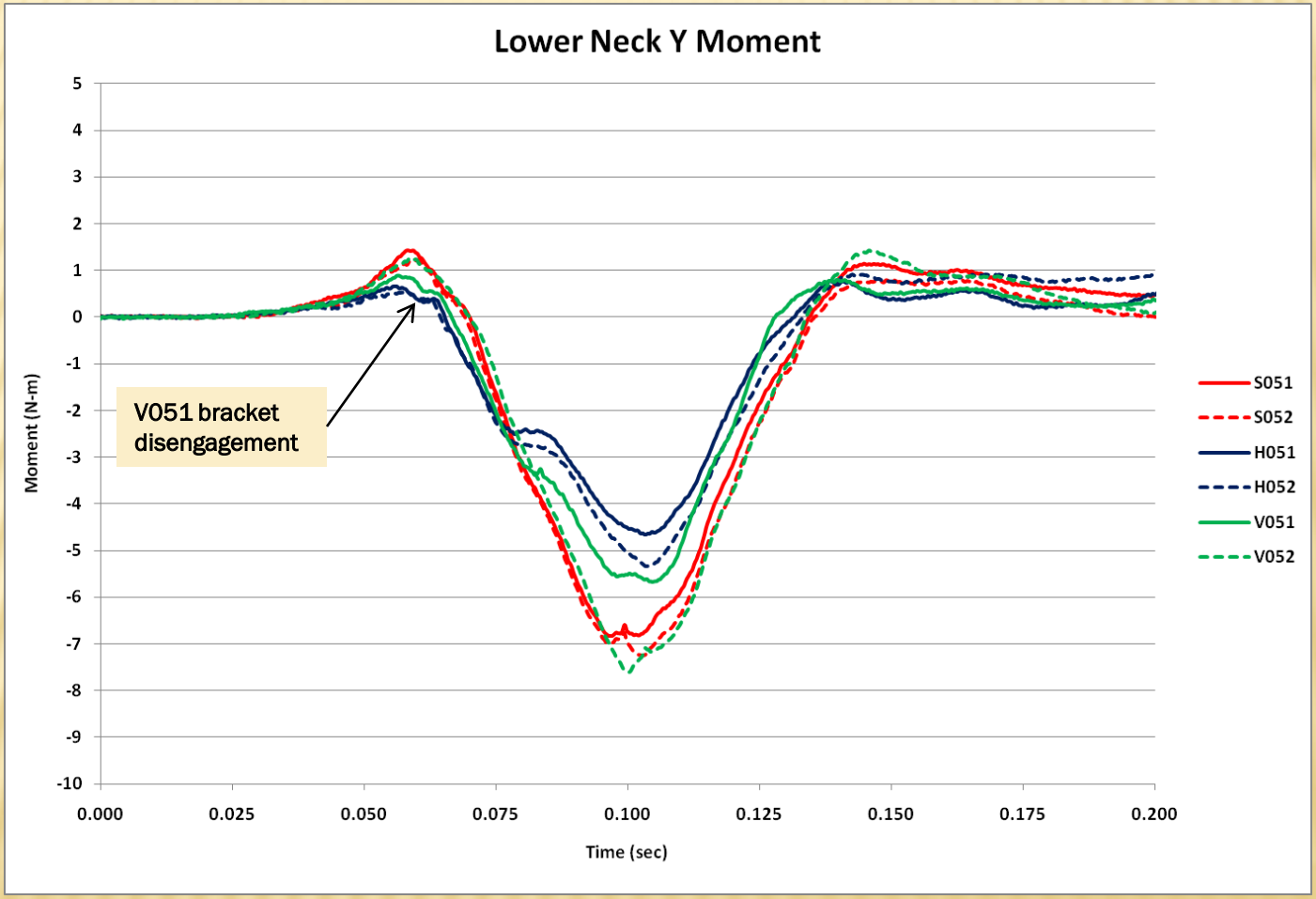

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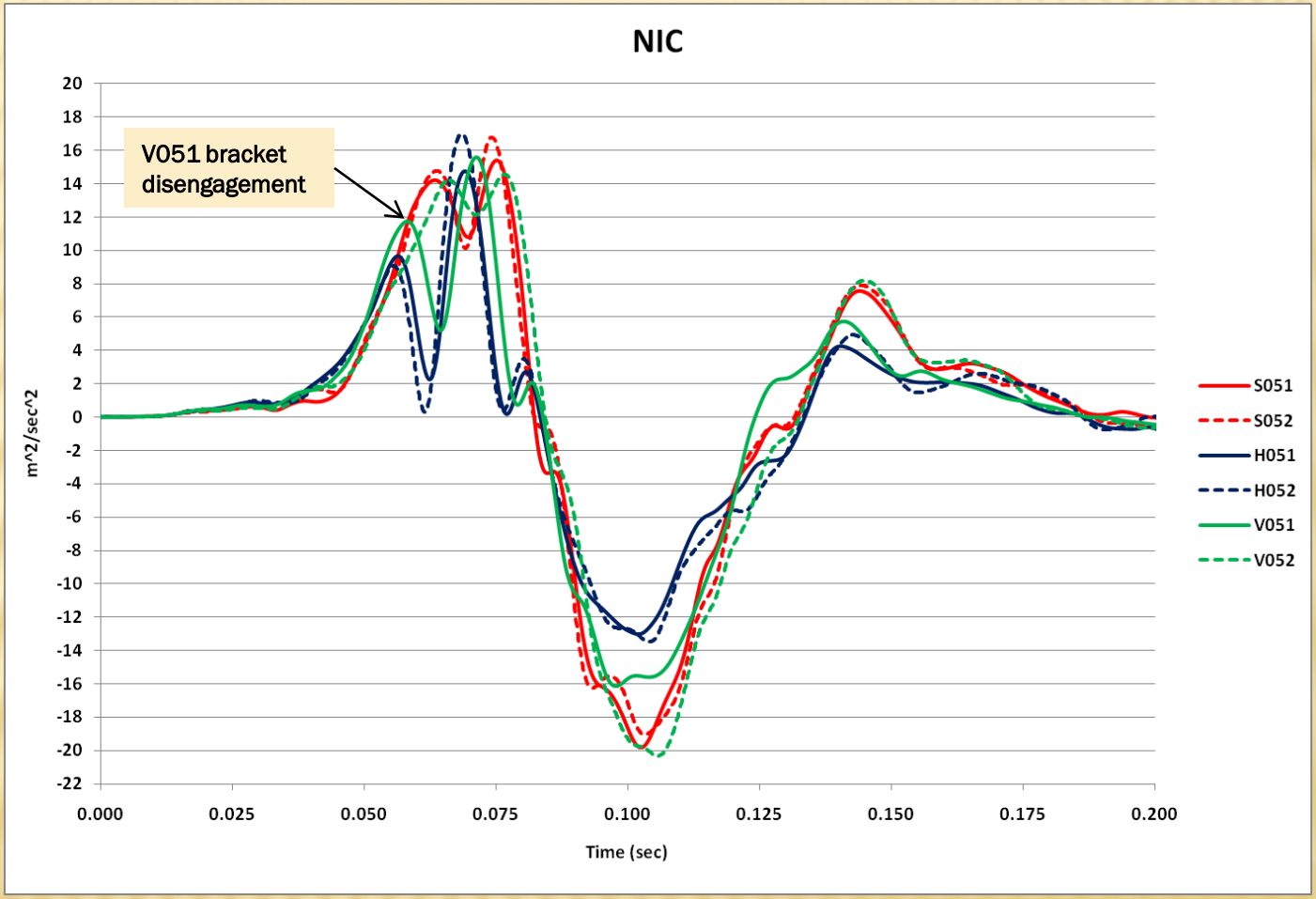

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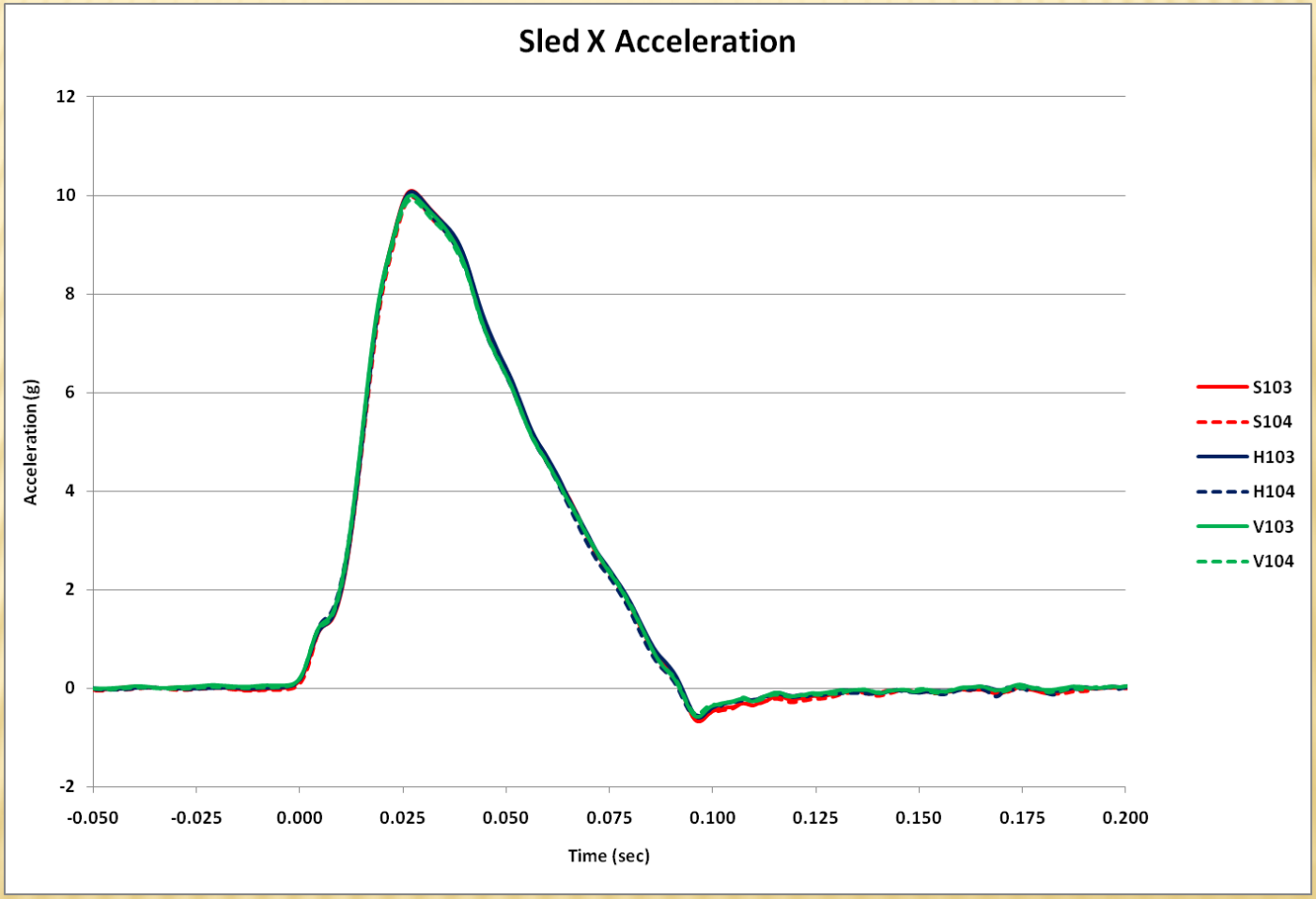

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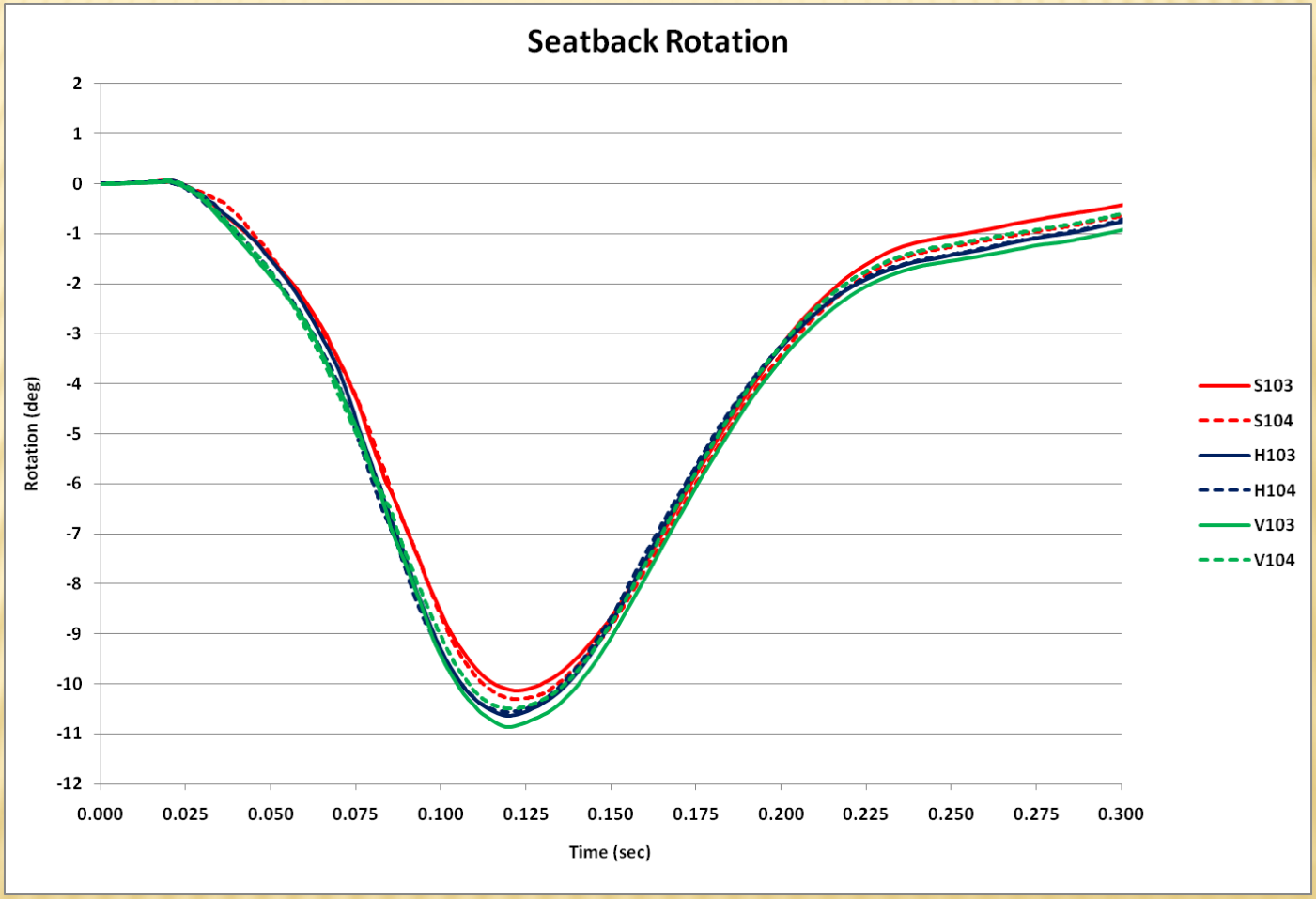

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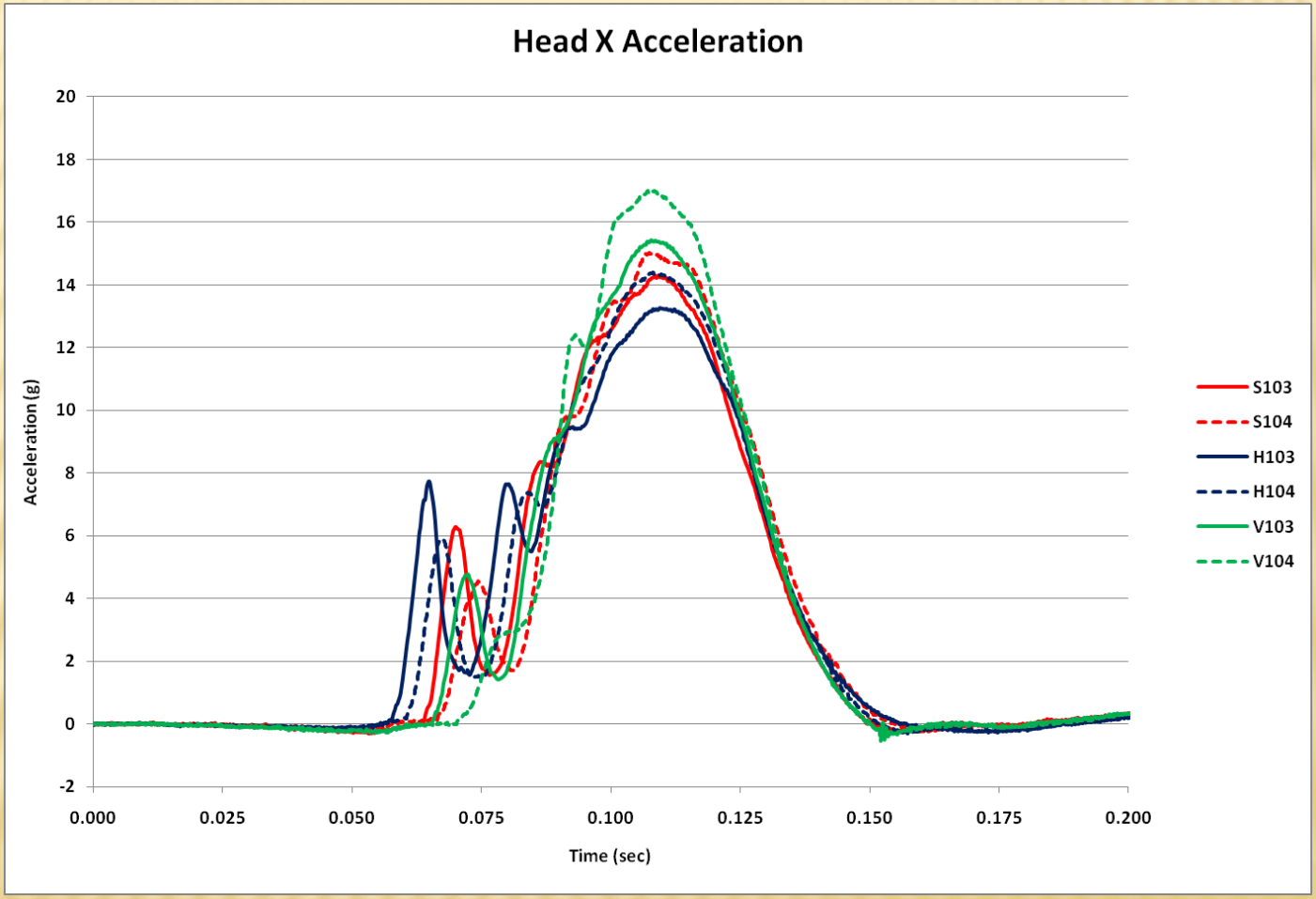

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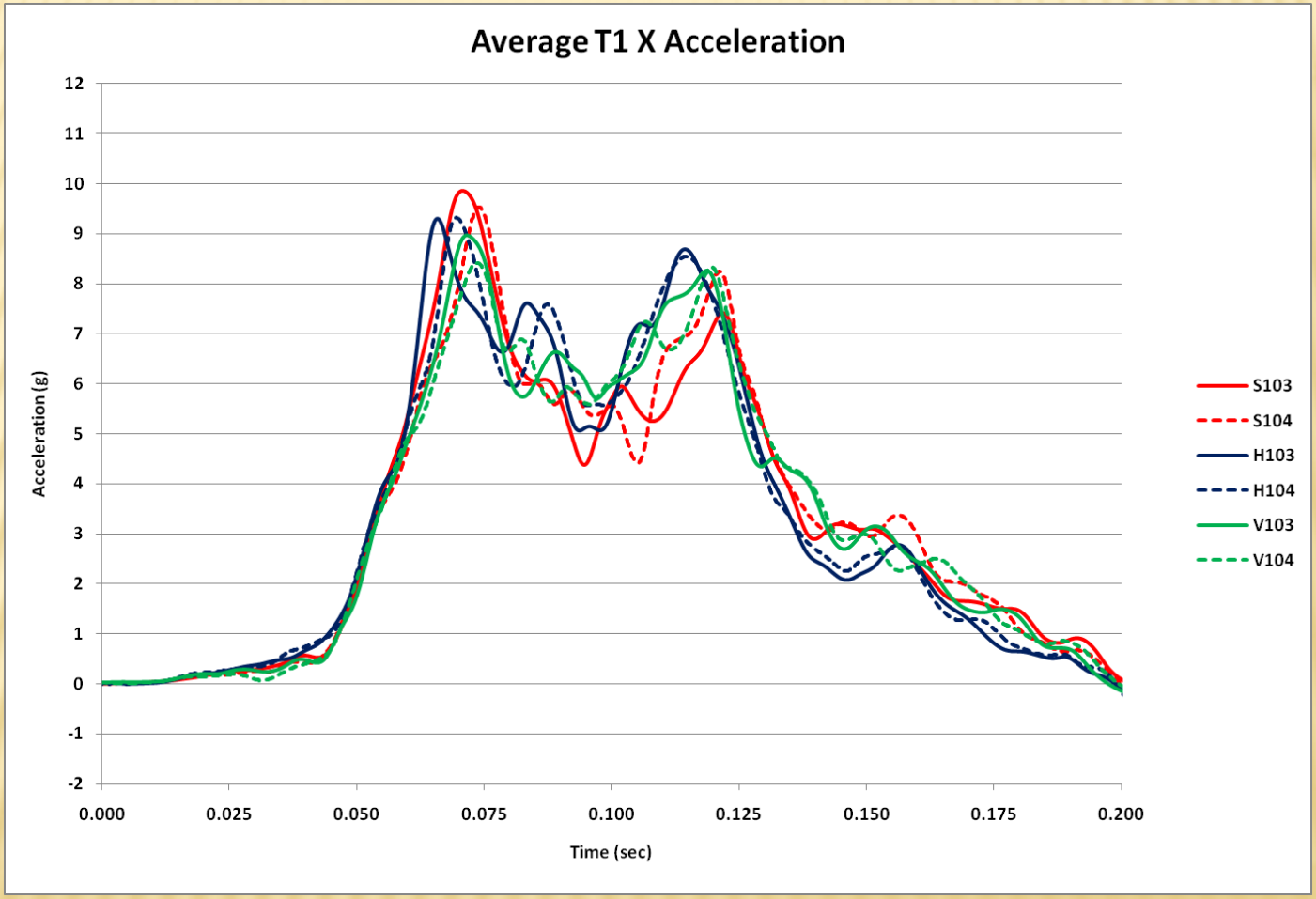

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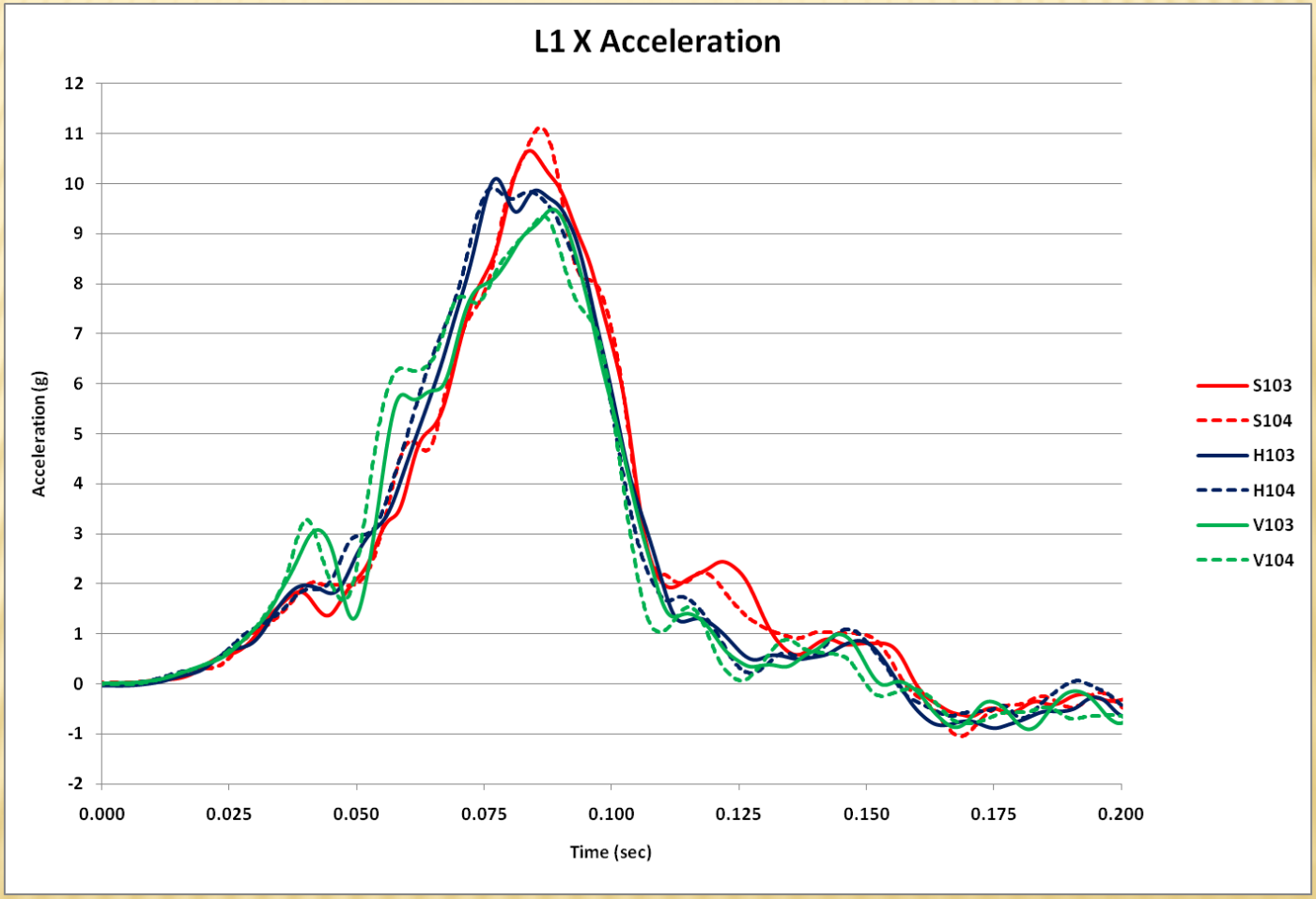

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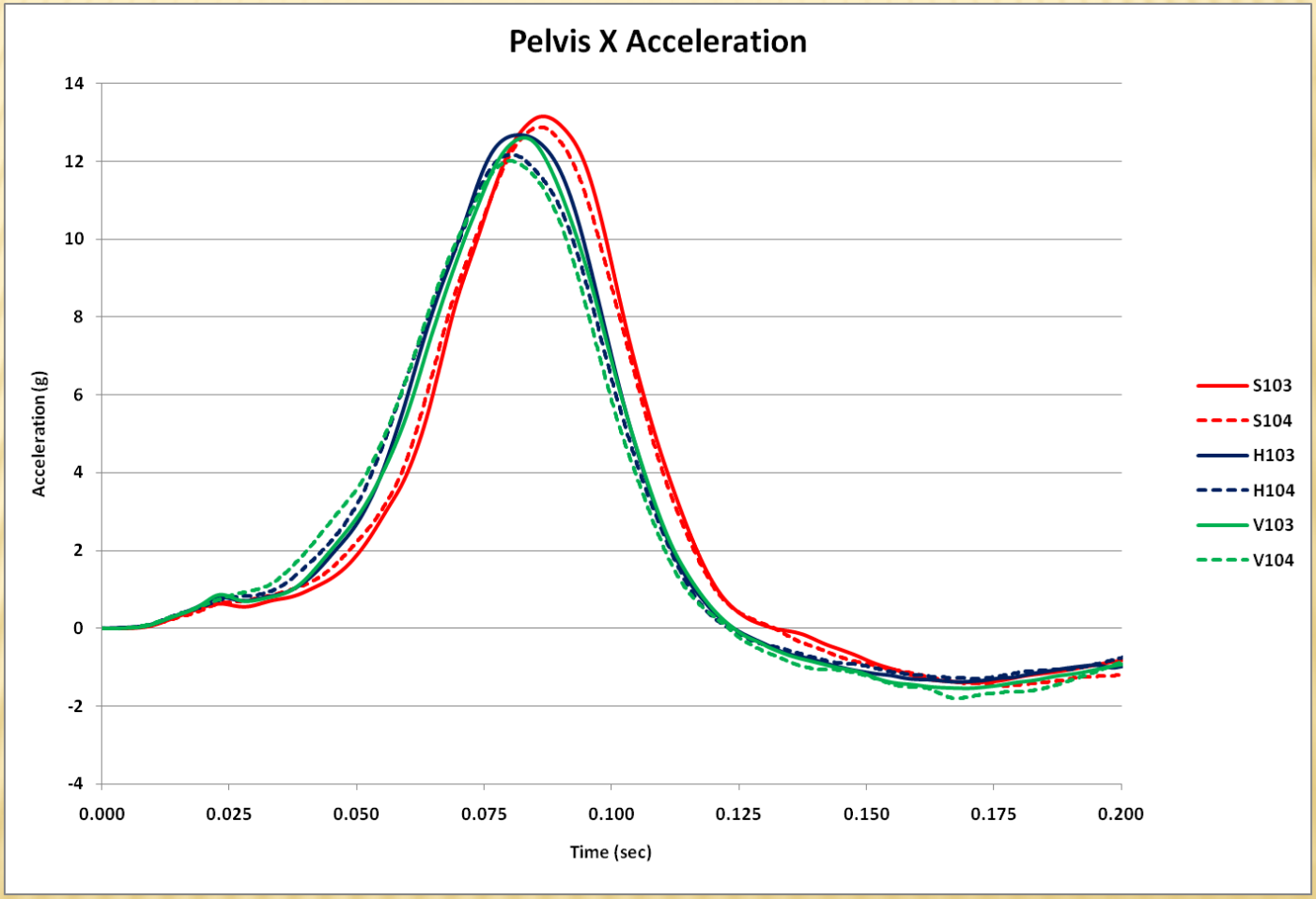

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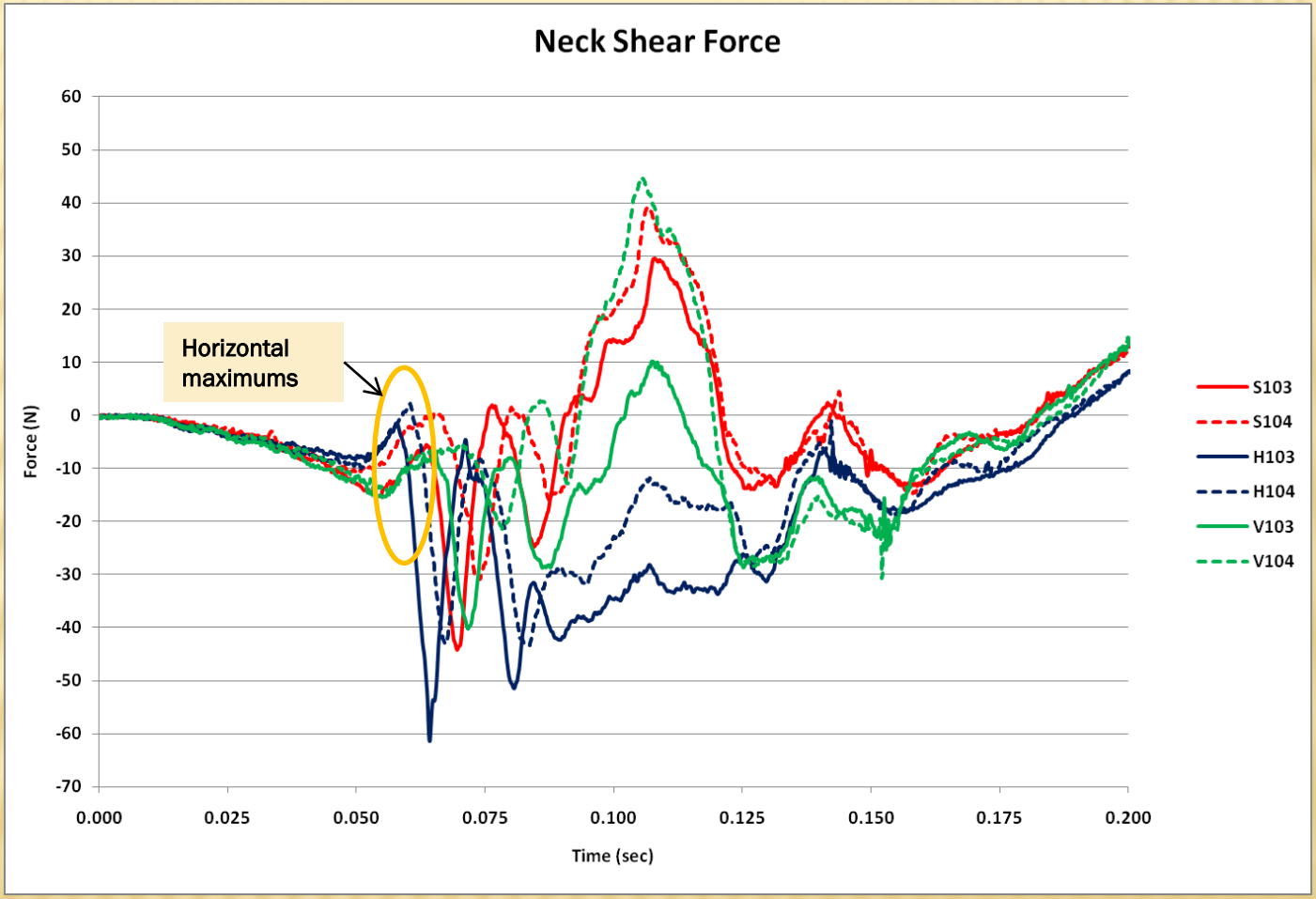

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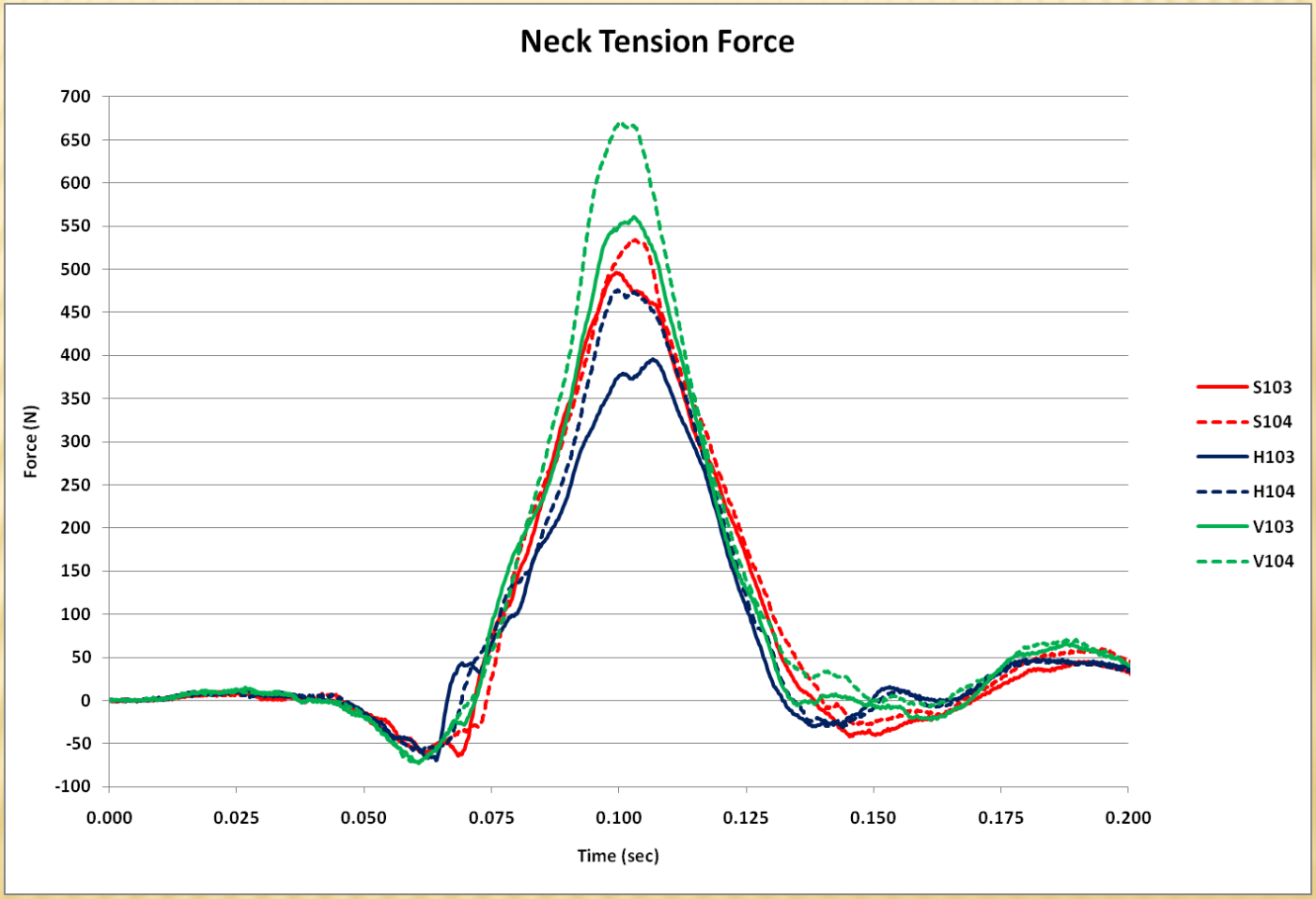

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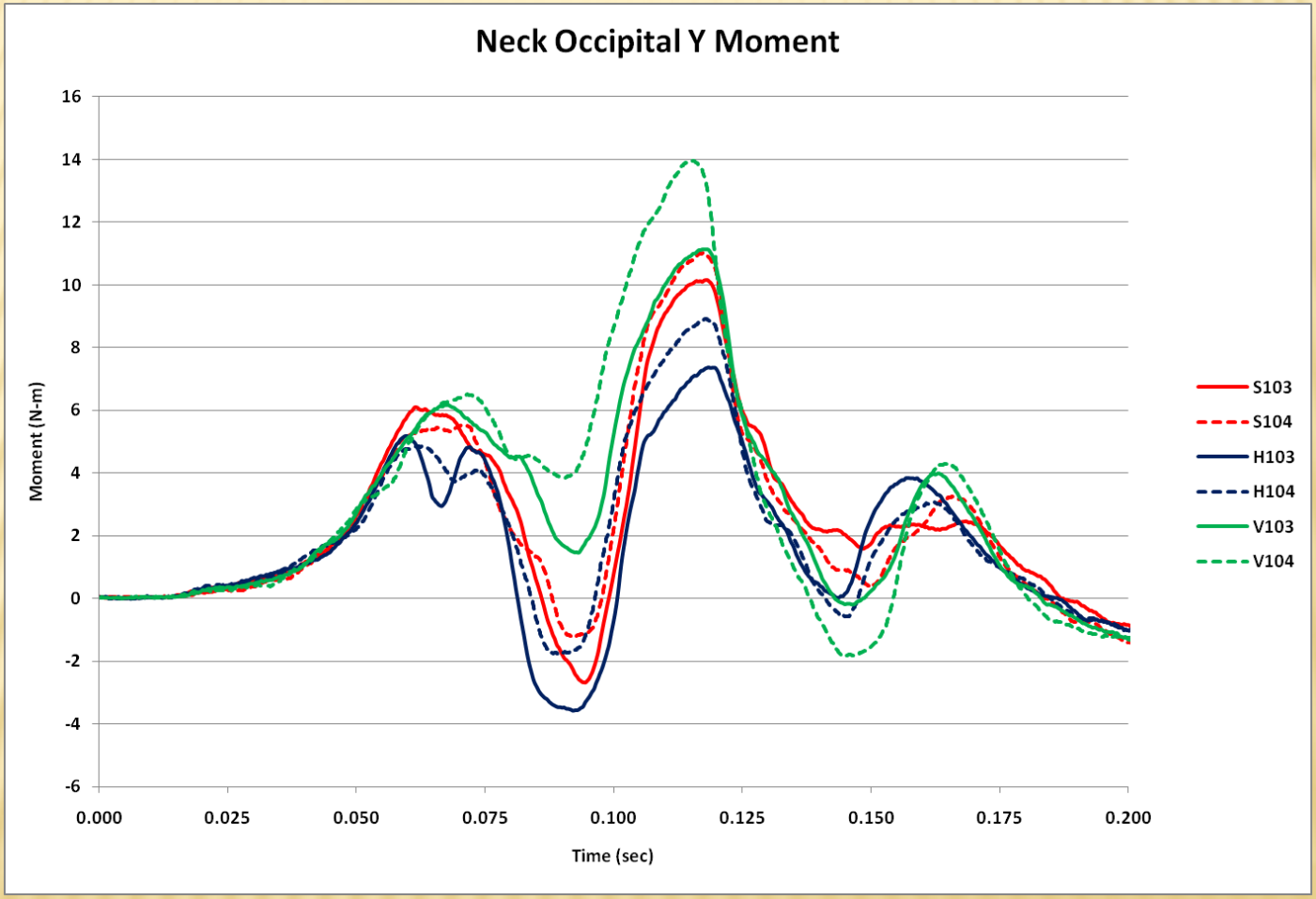

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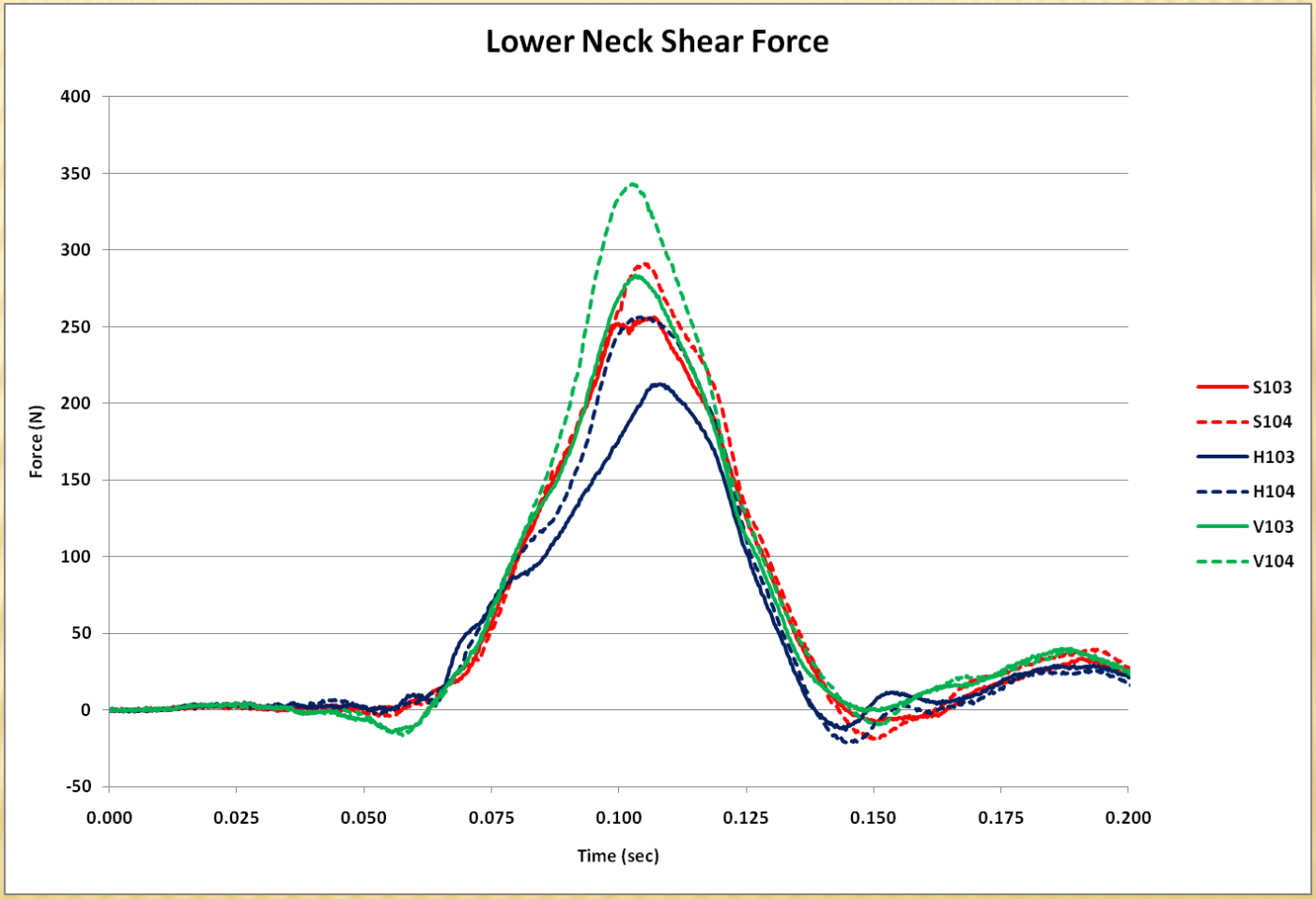

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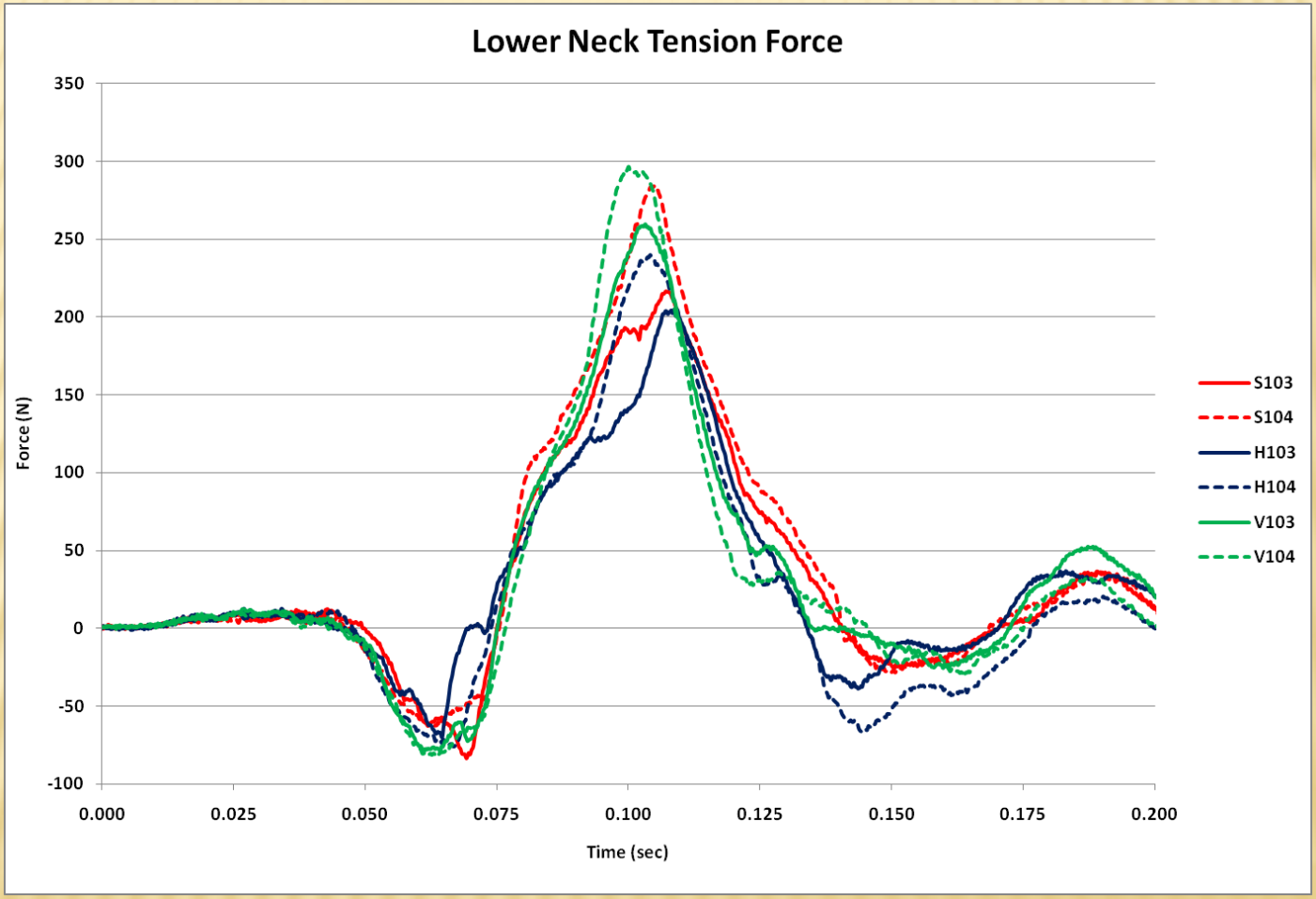

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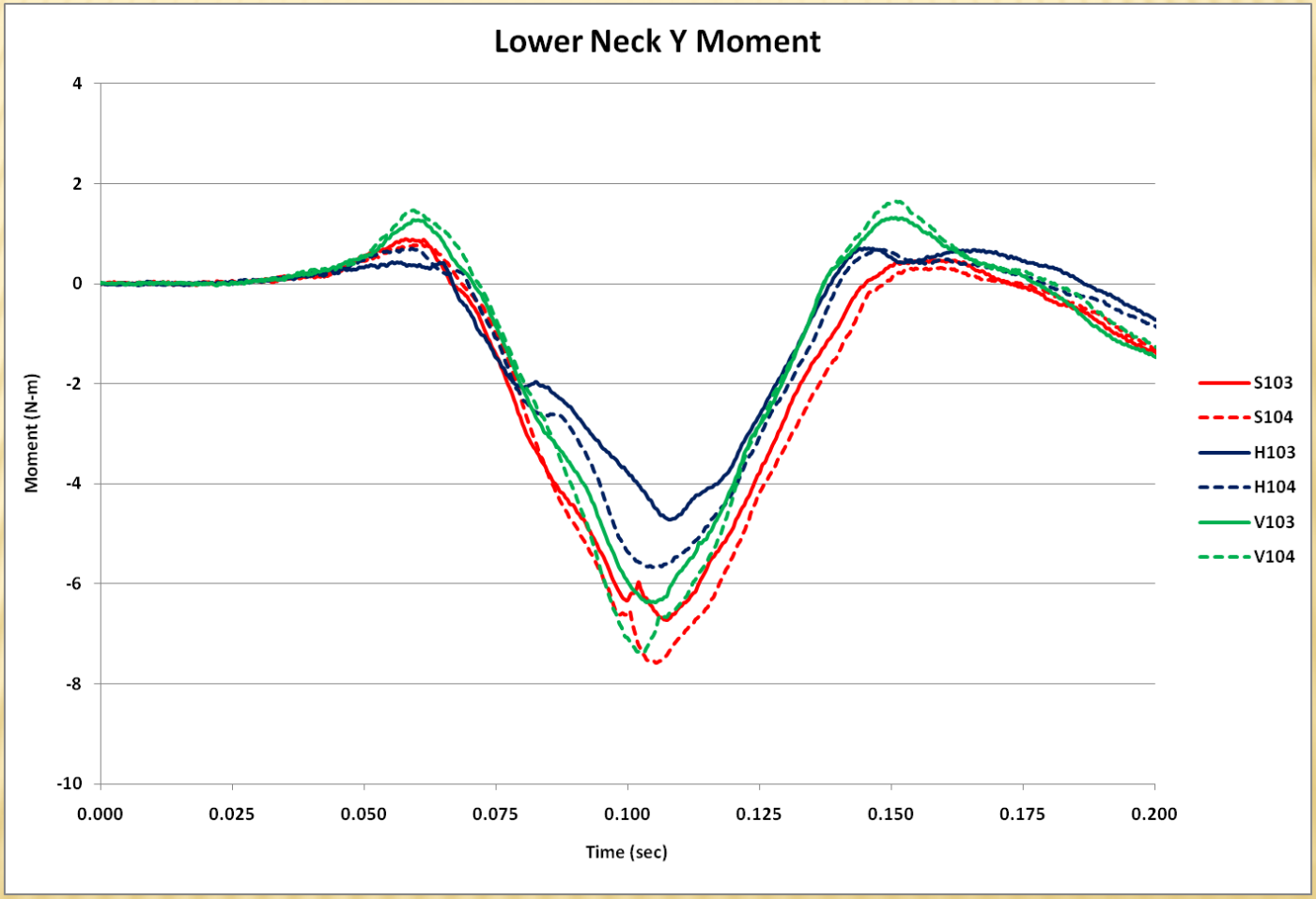

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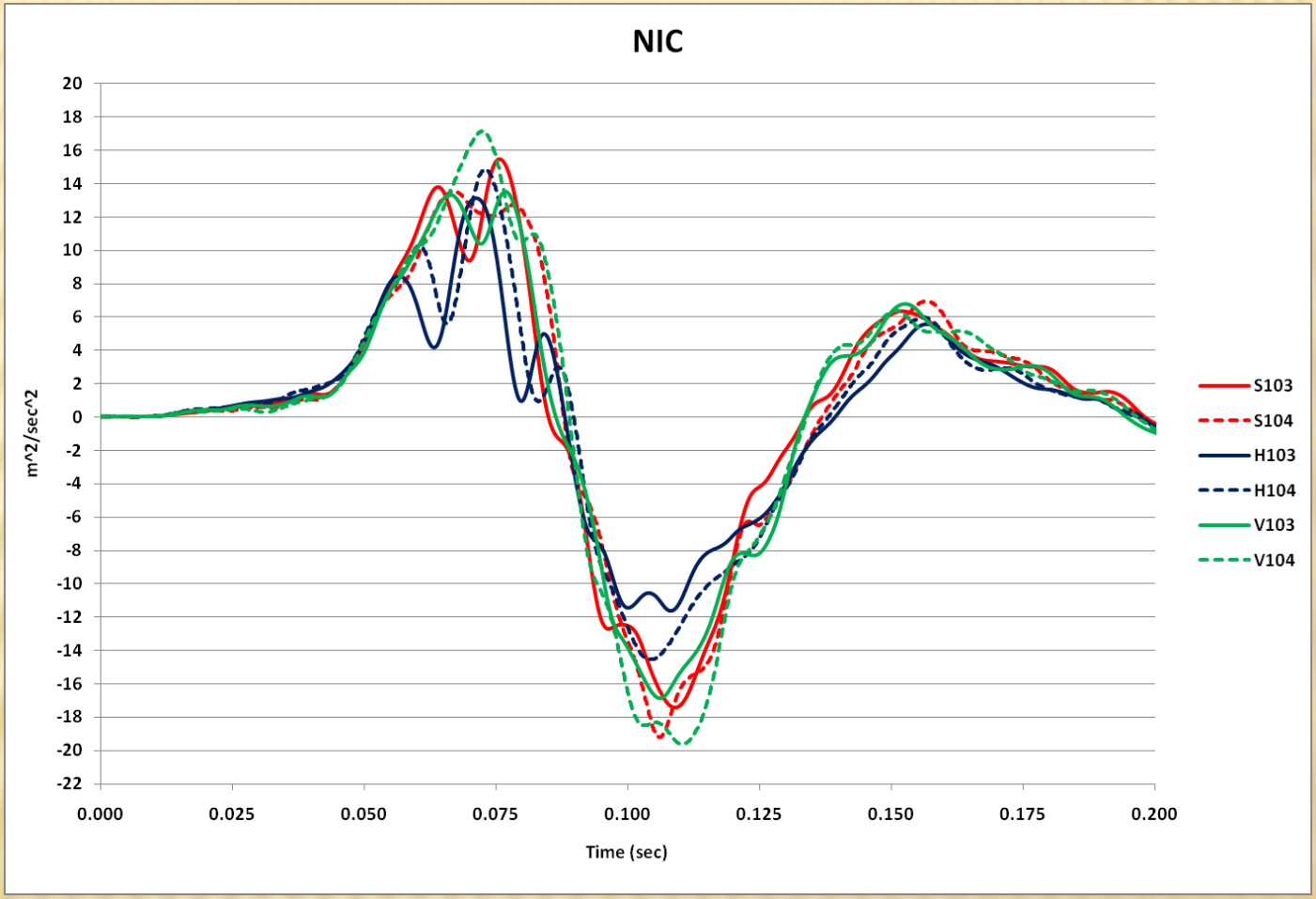

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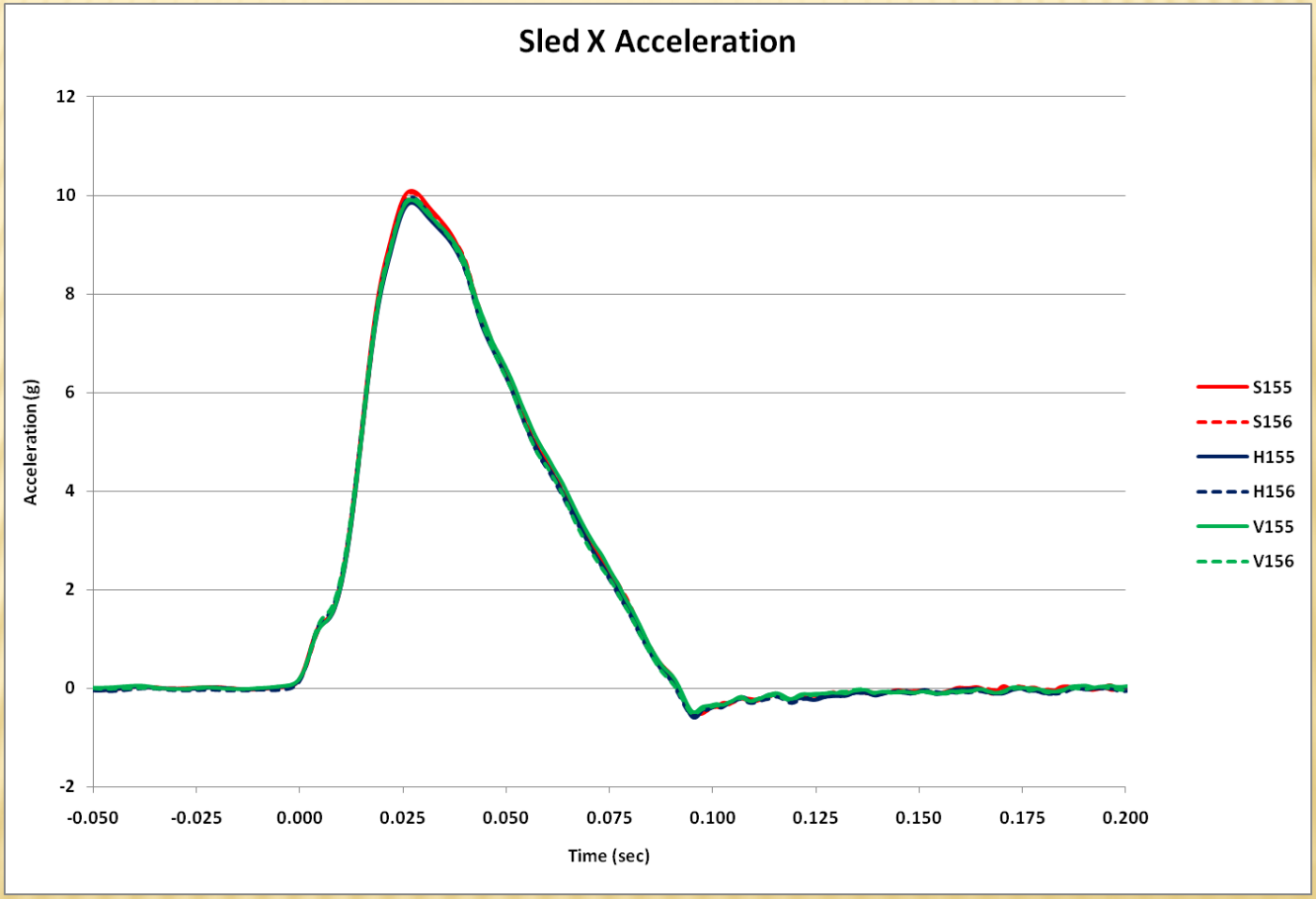

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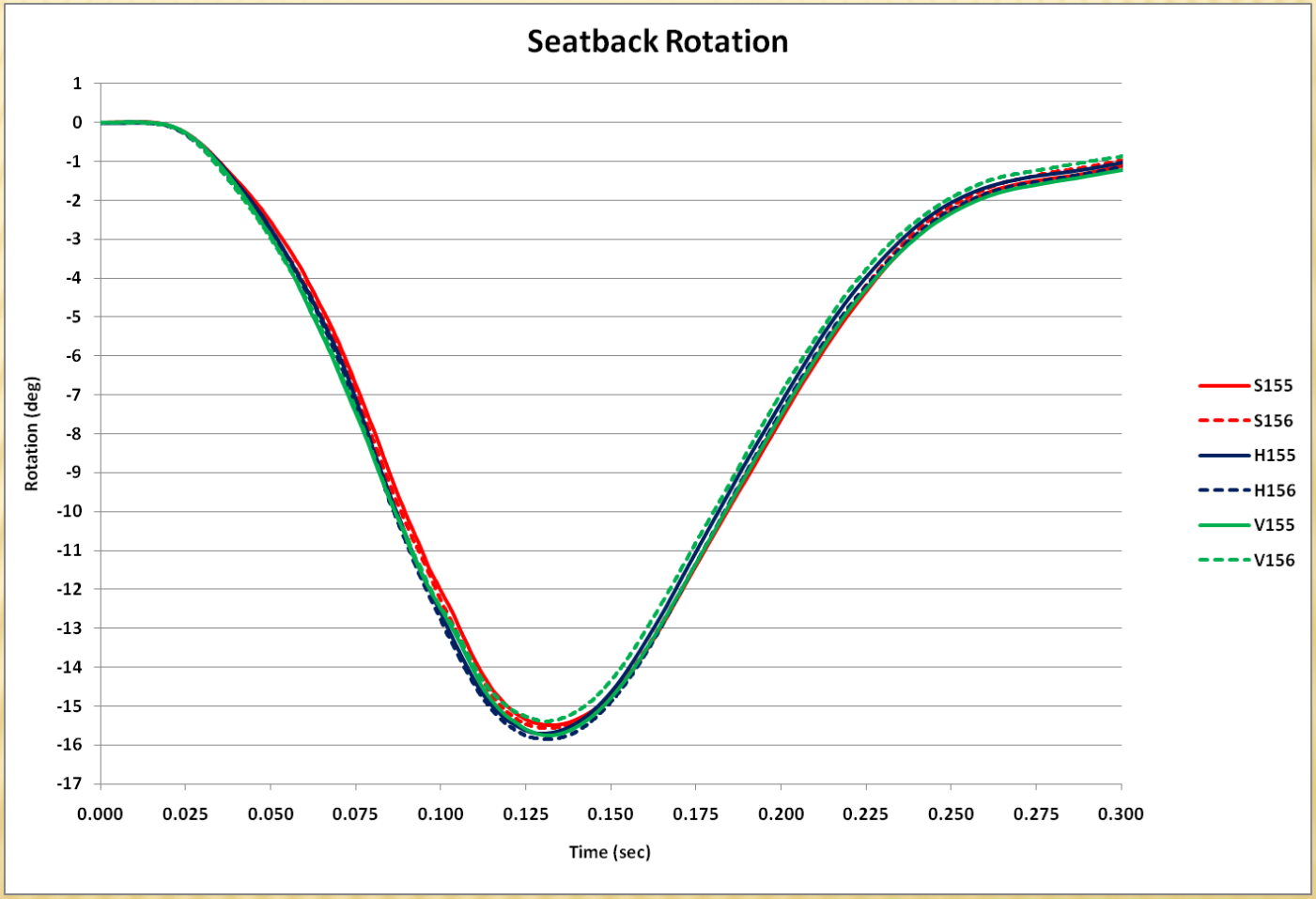

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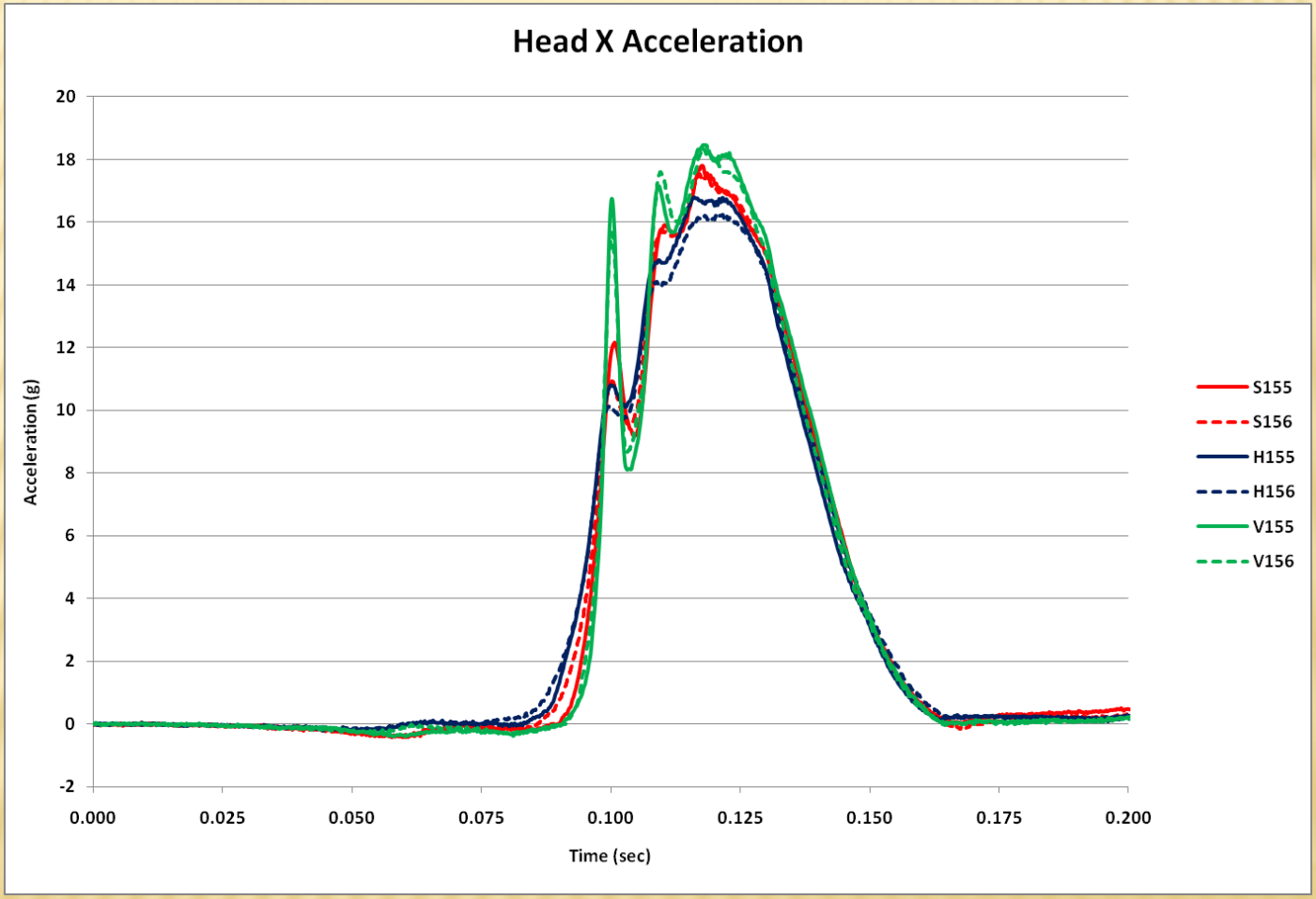

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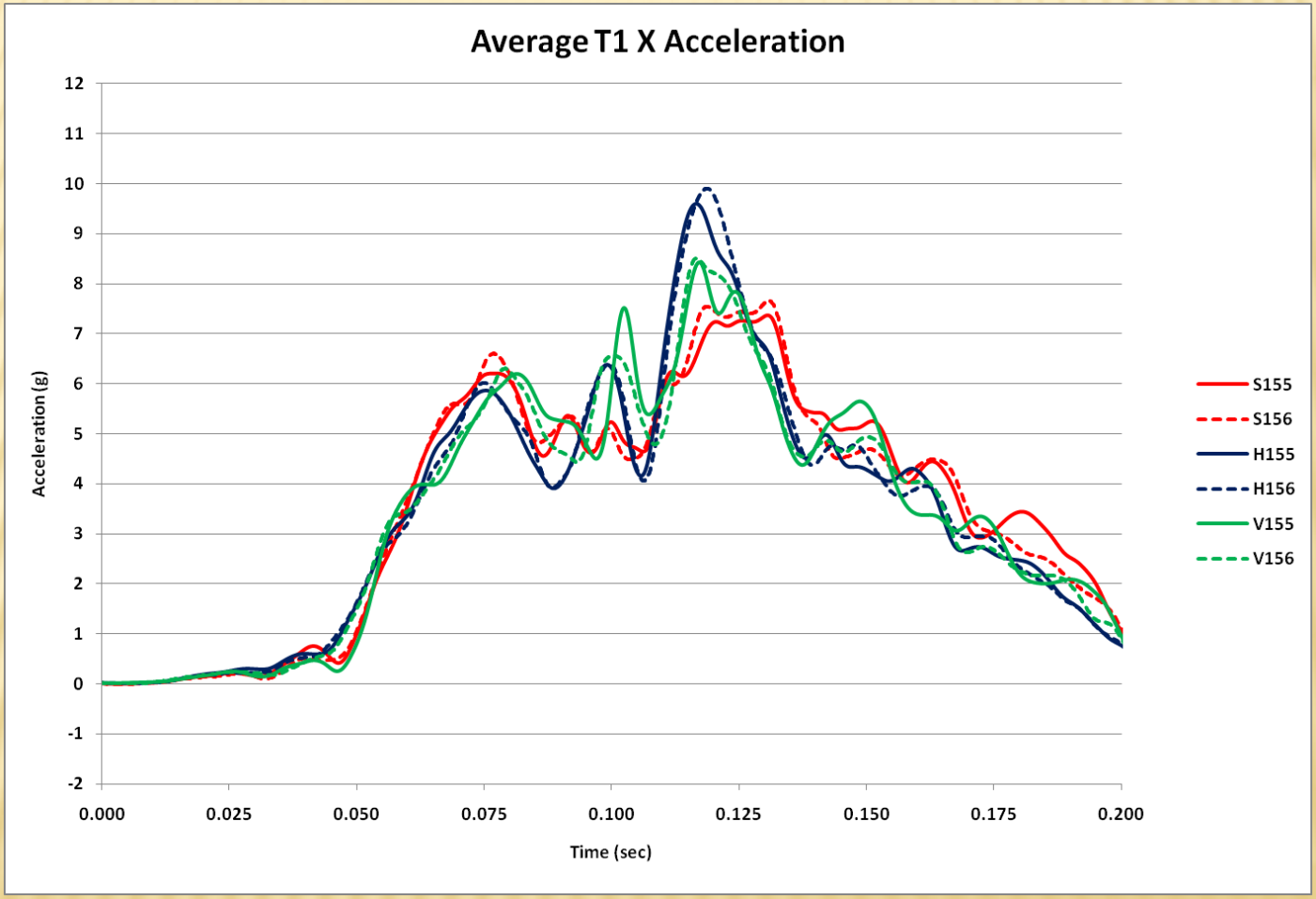

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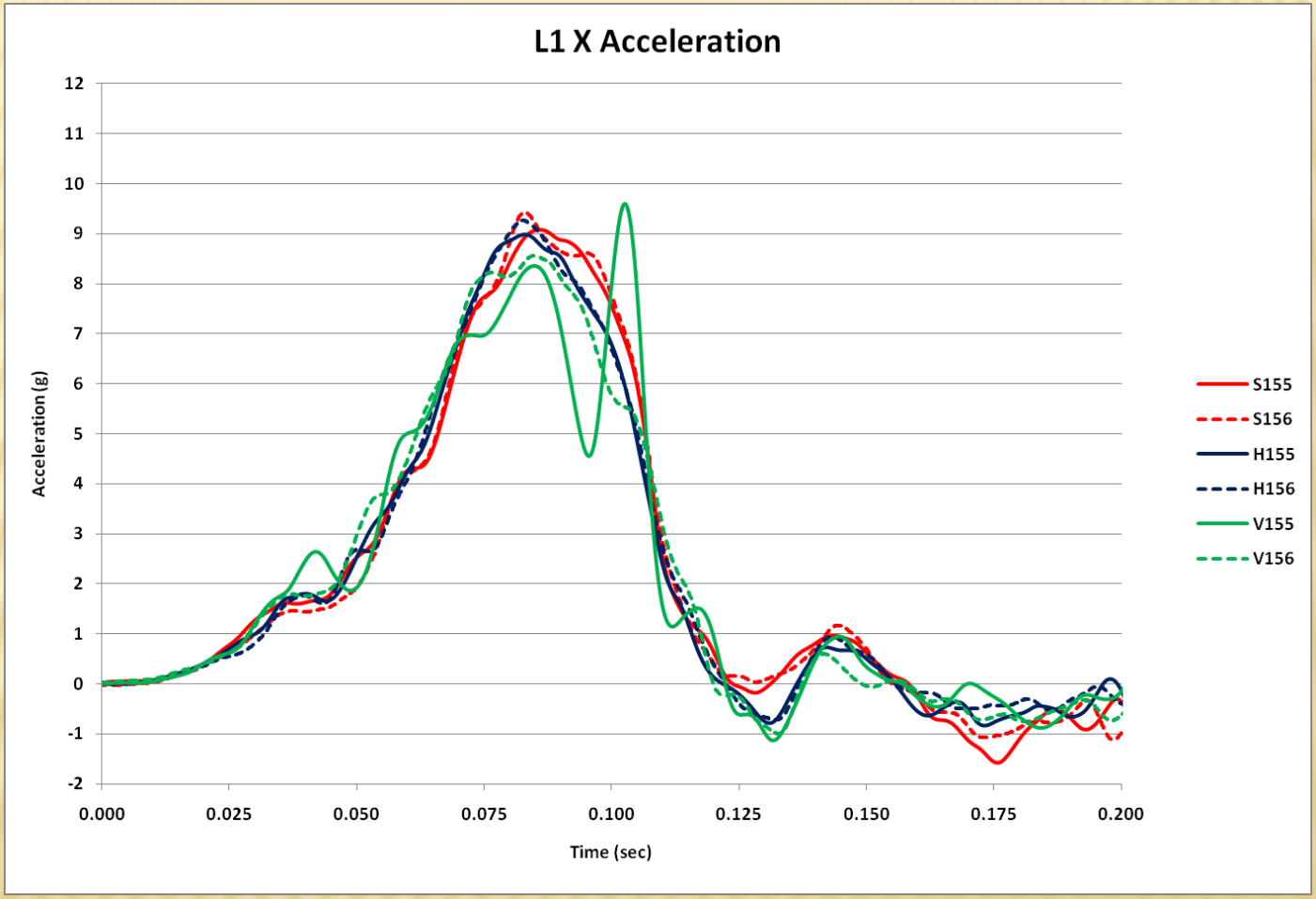

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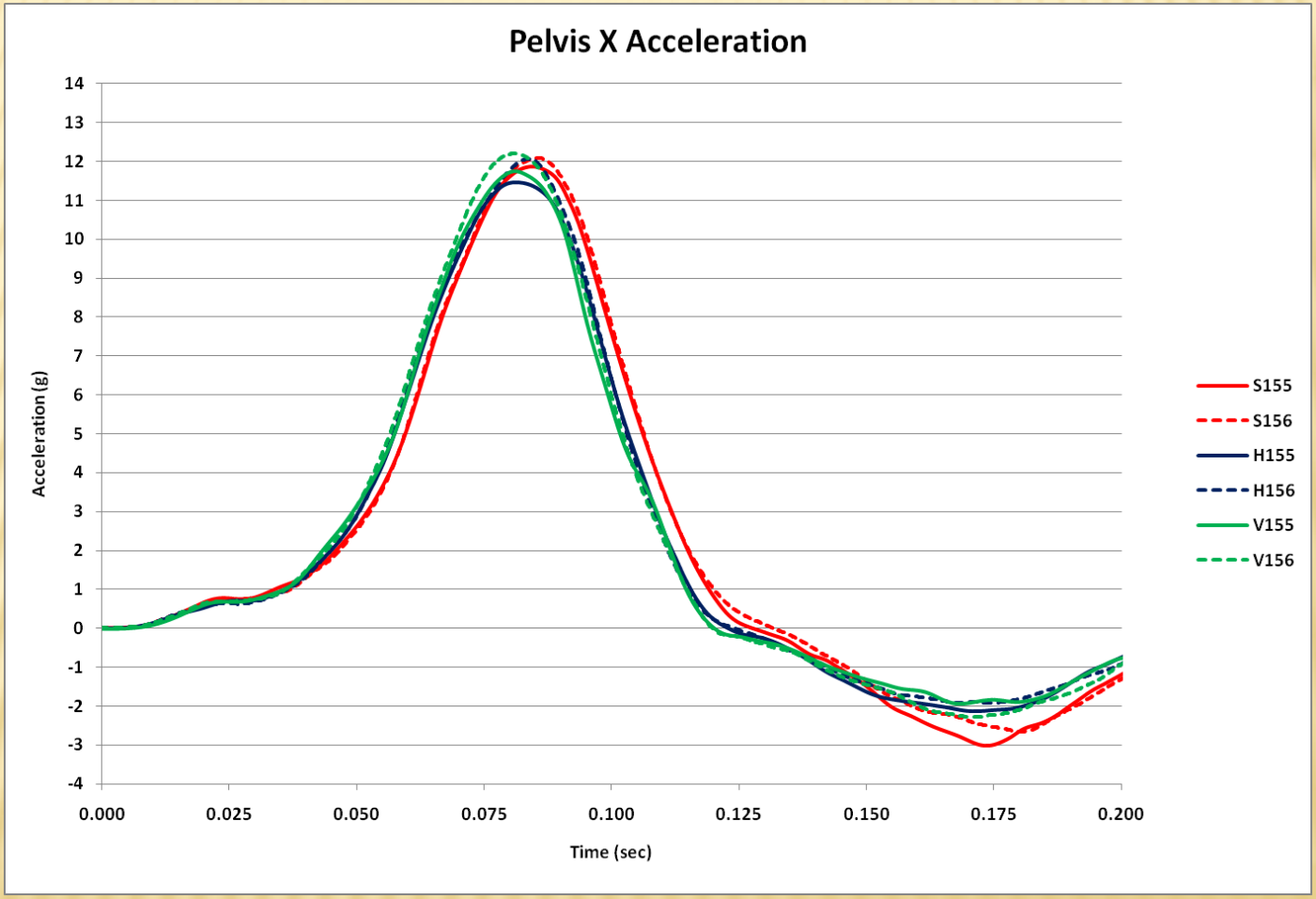

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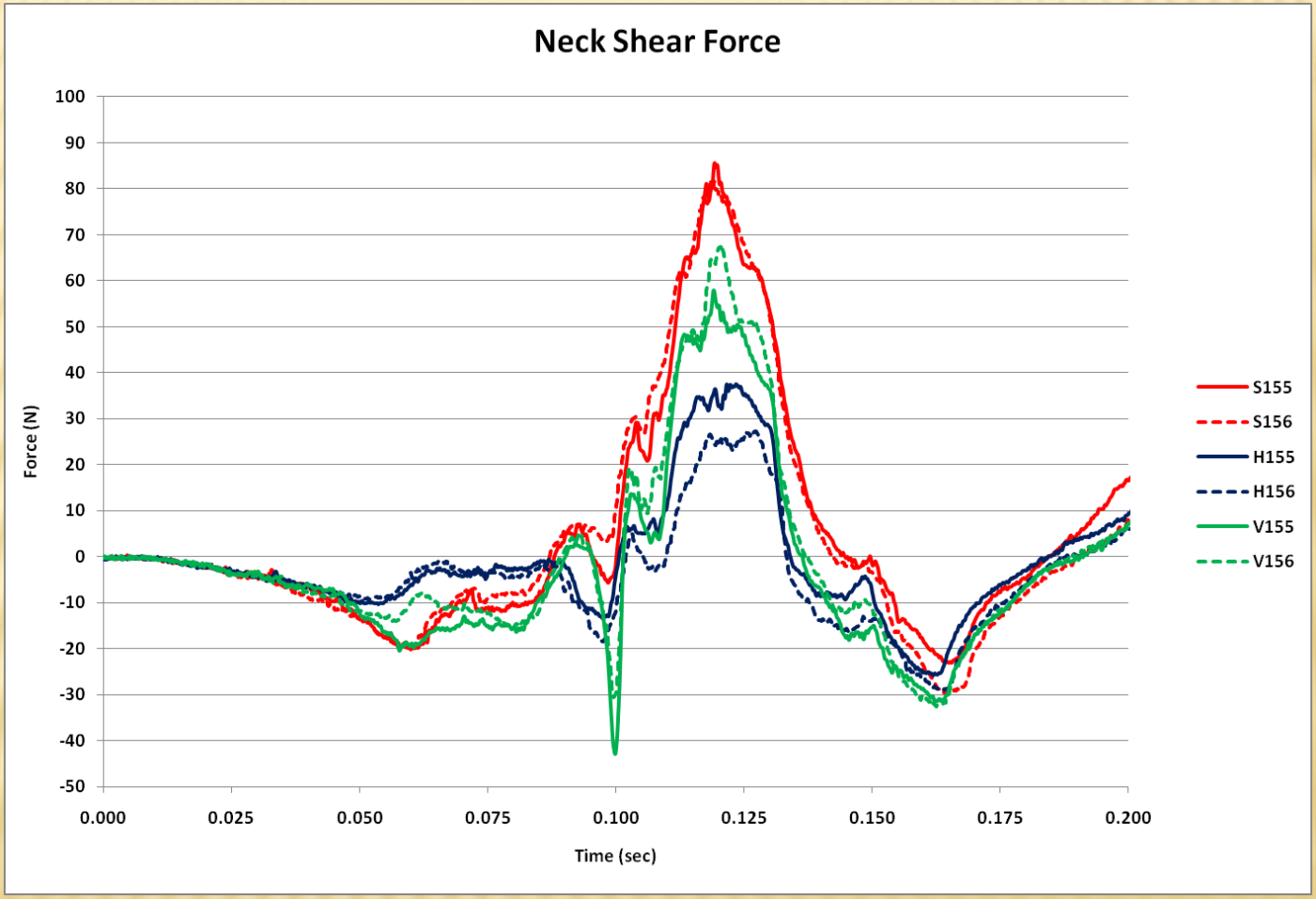

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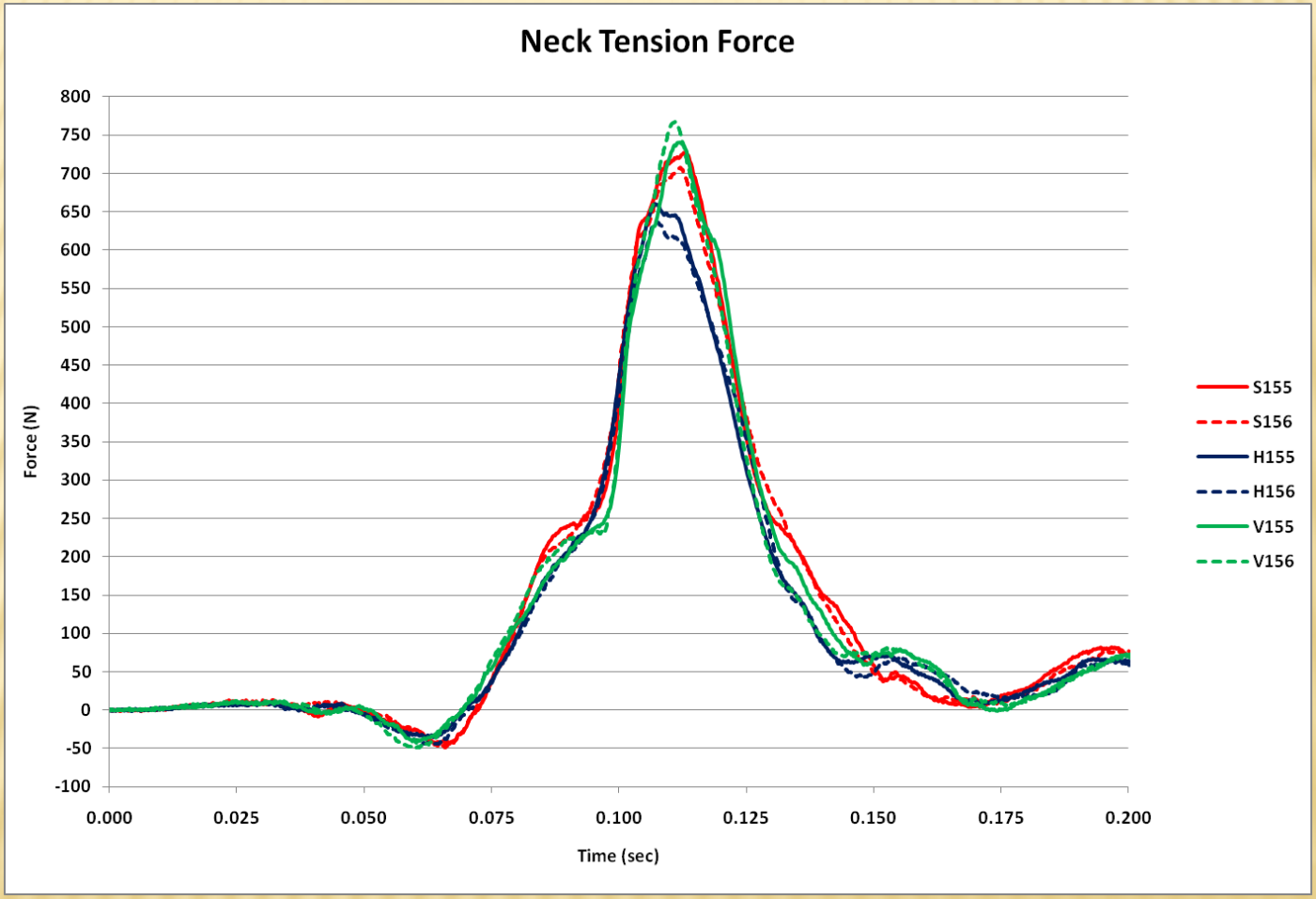

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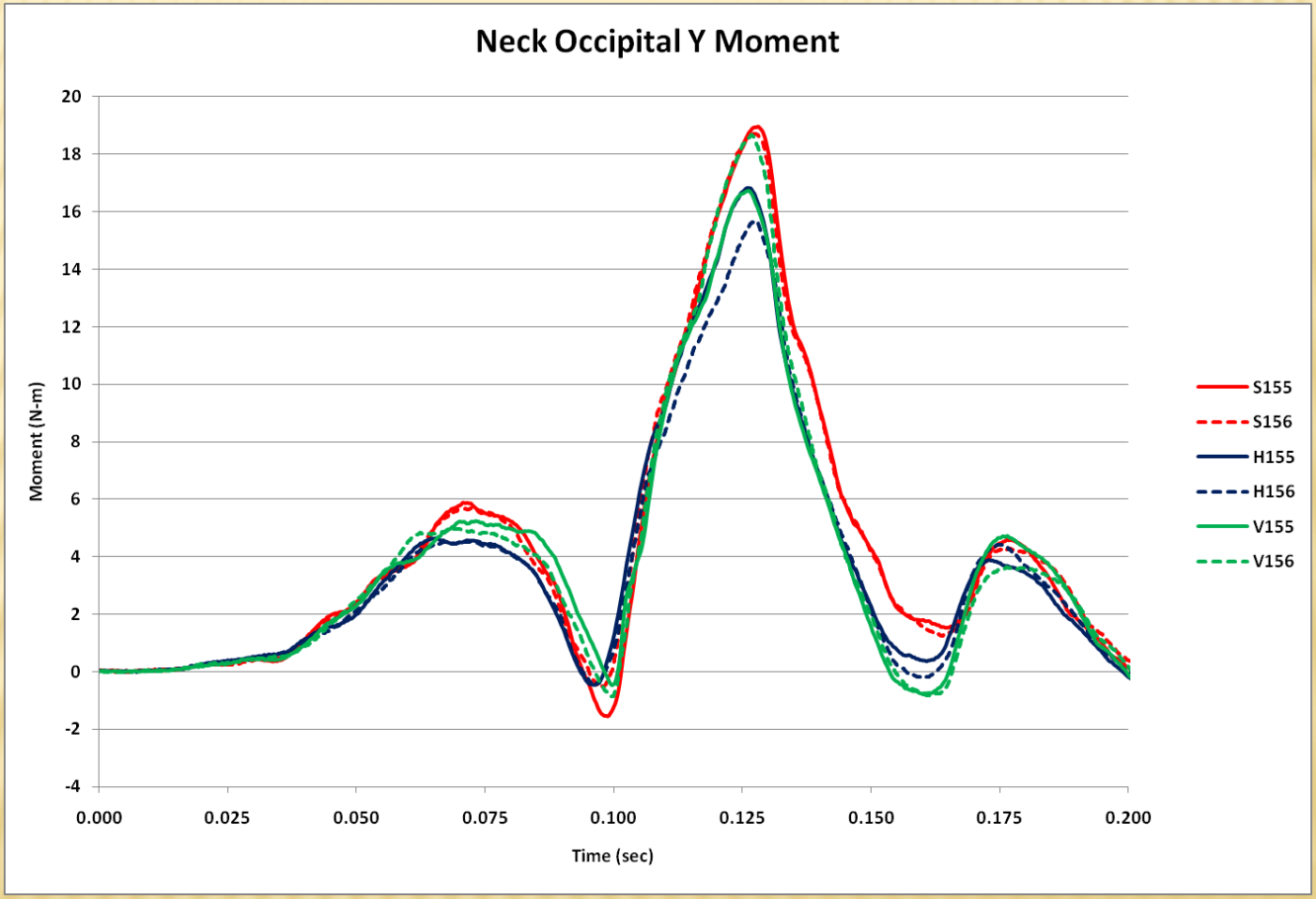

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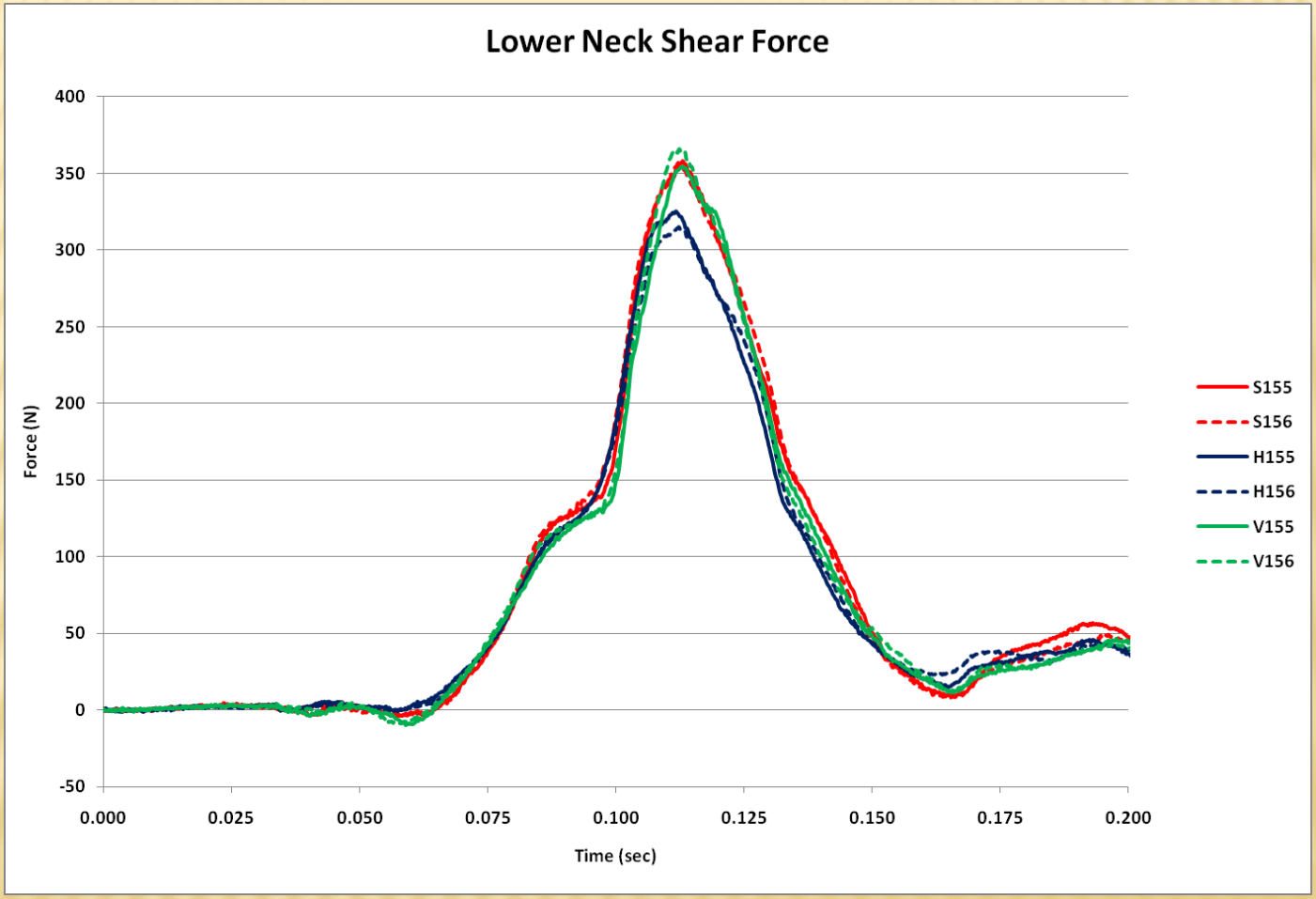

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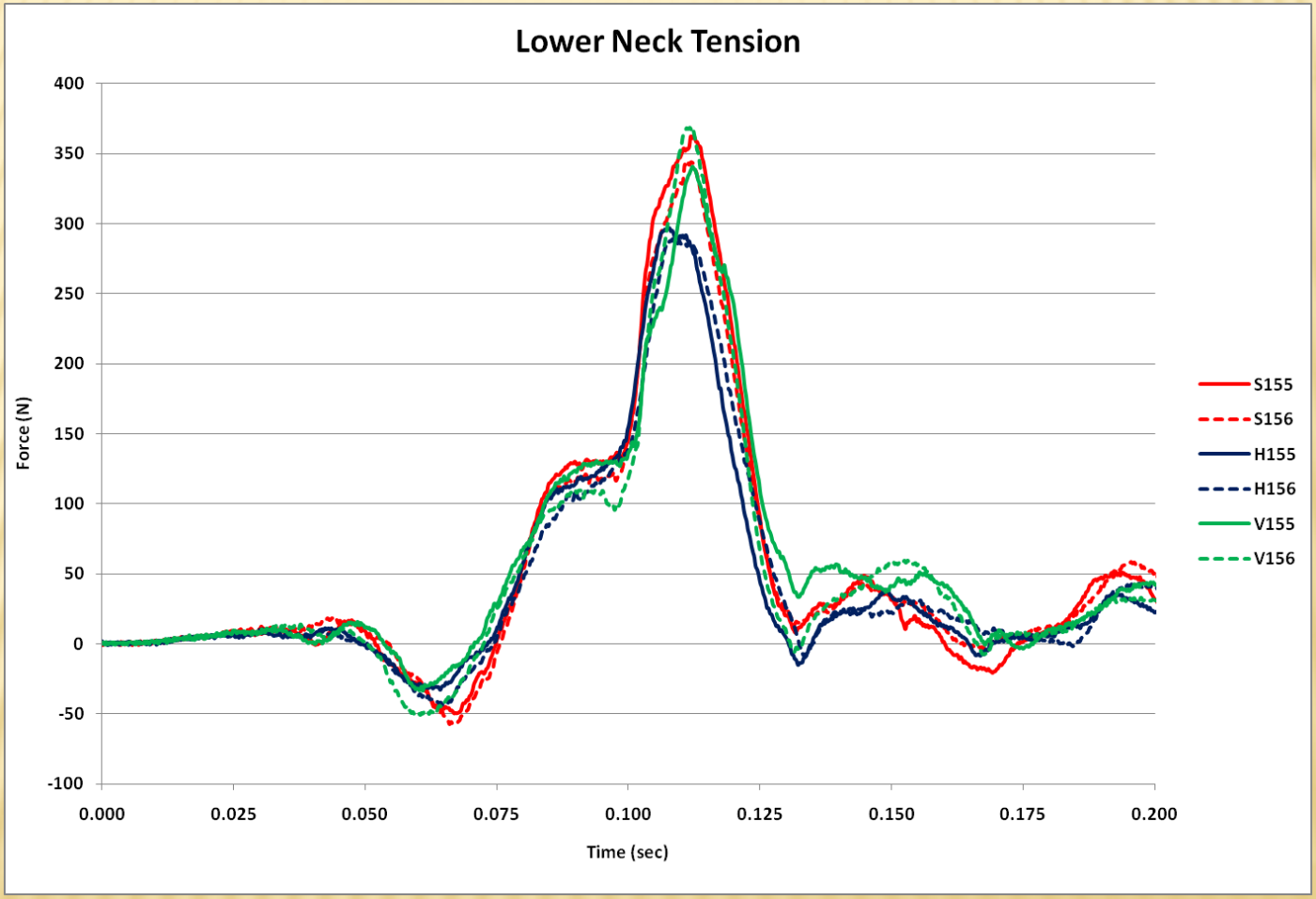

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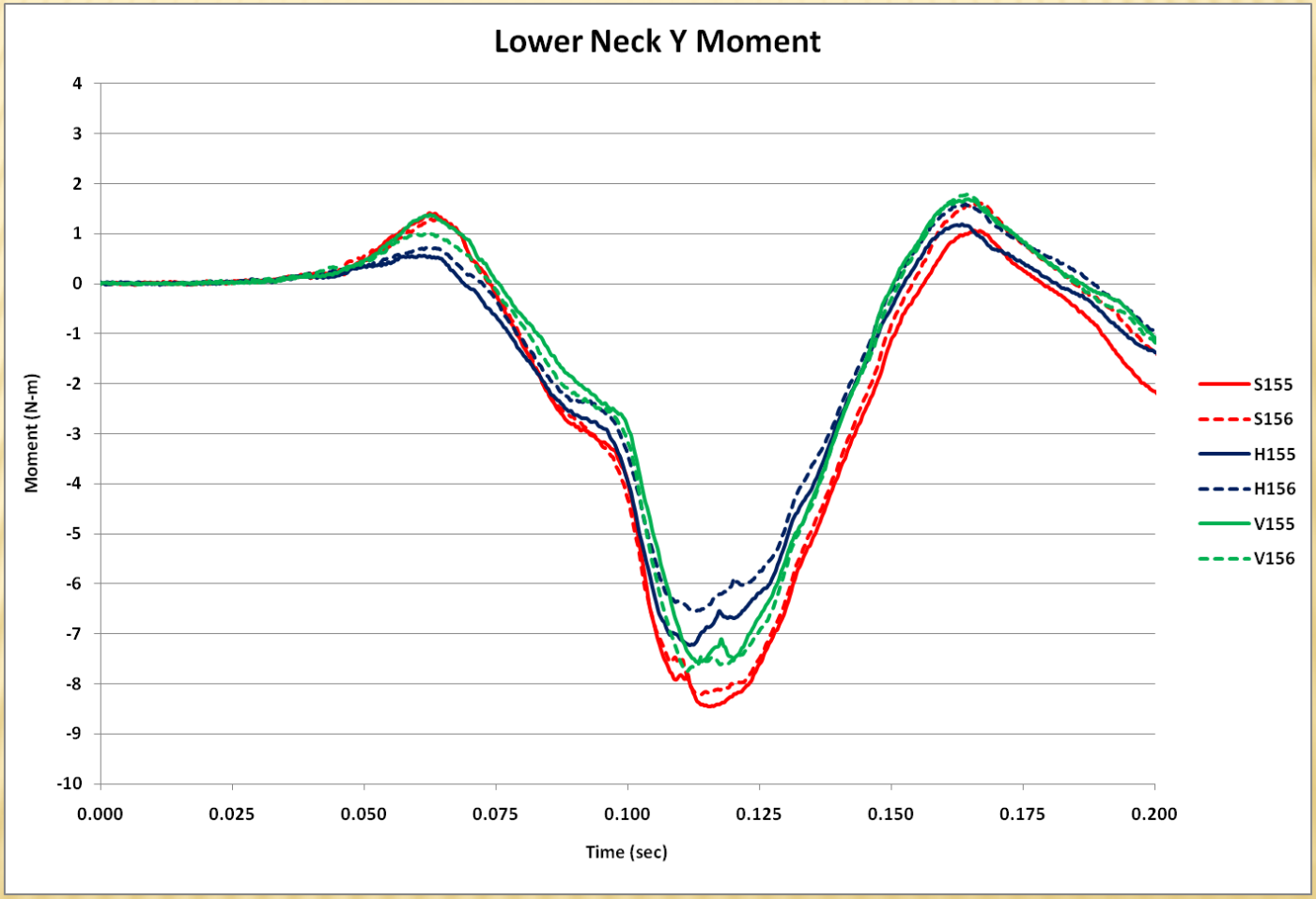

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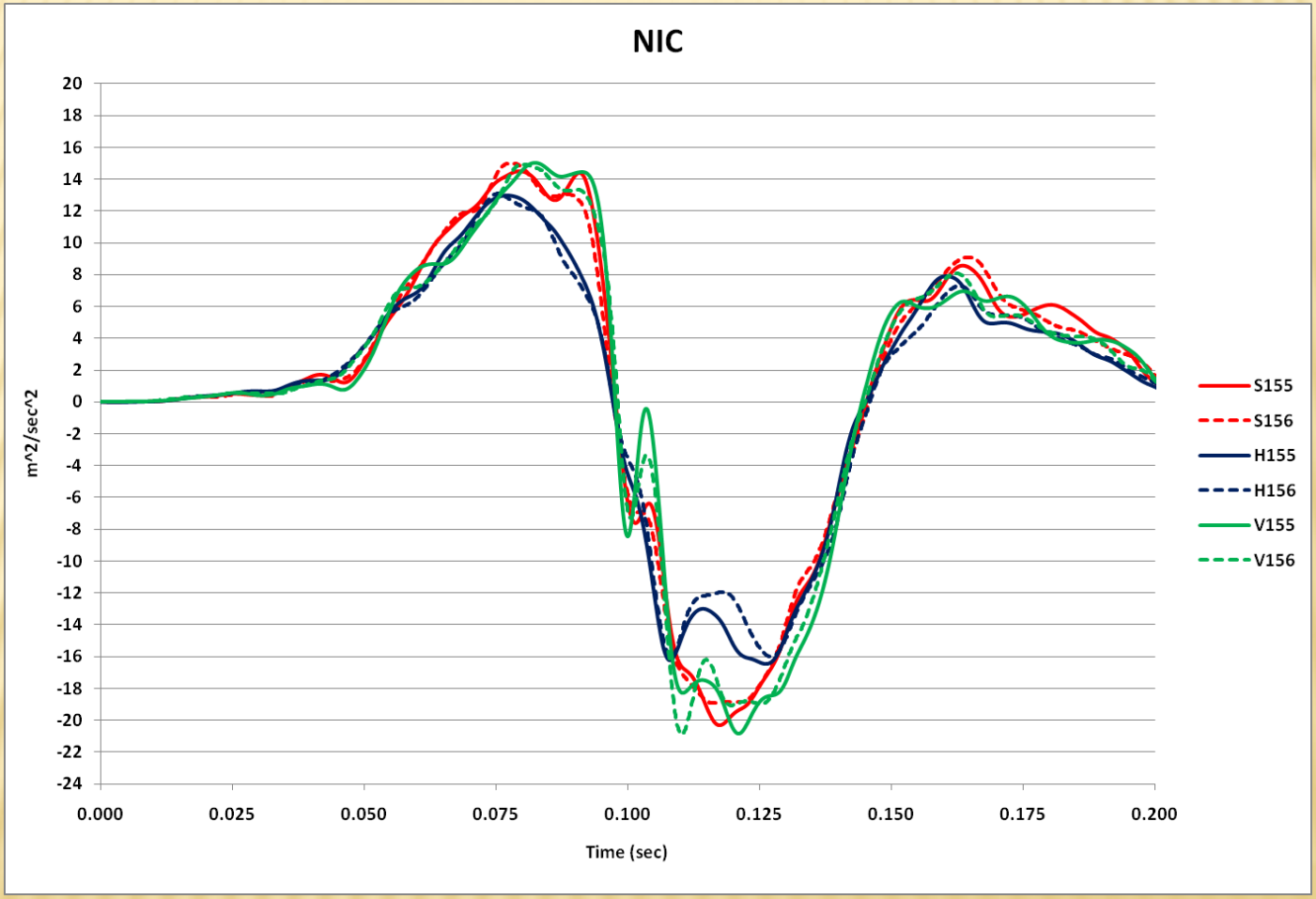
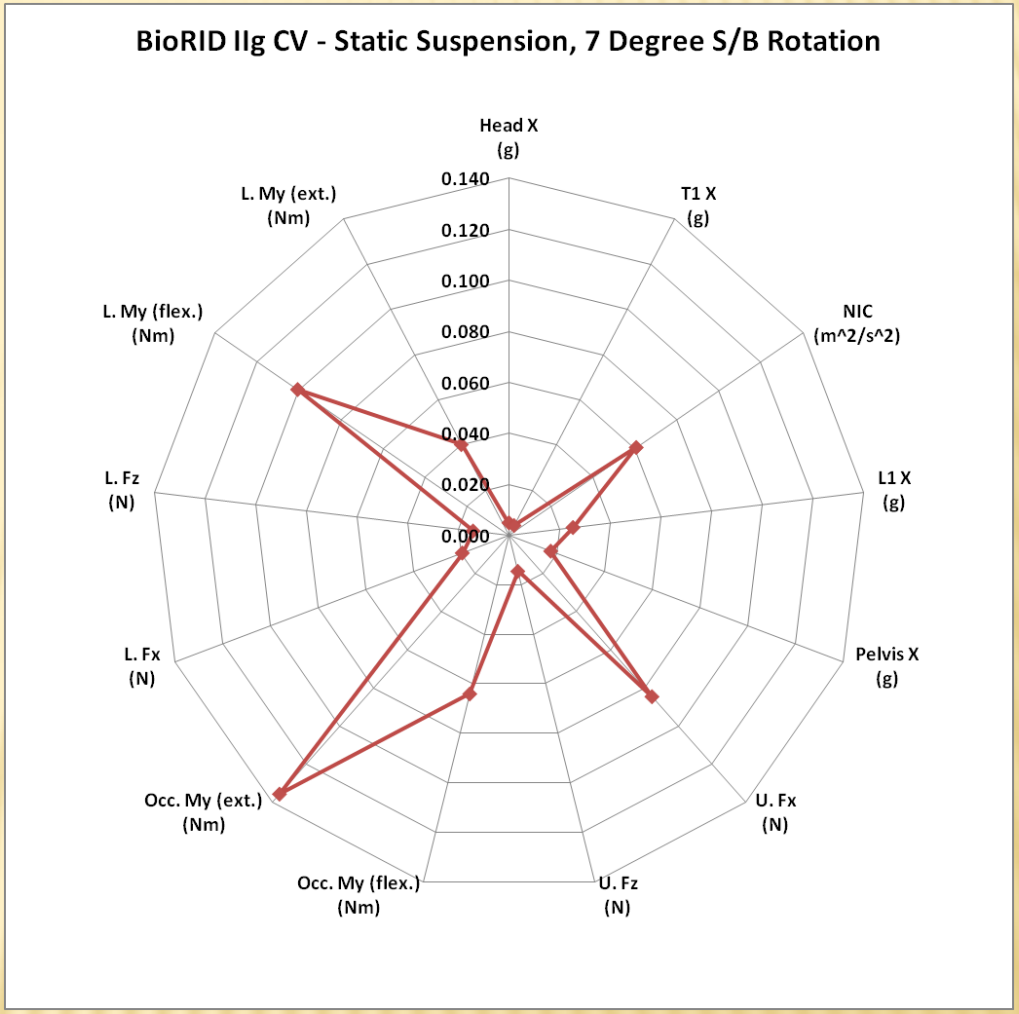


COEFFICIENTS OF VARIATION

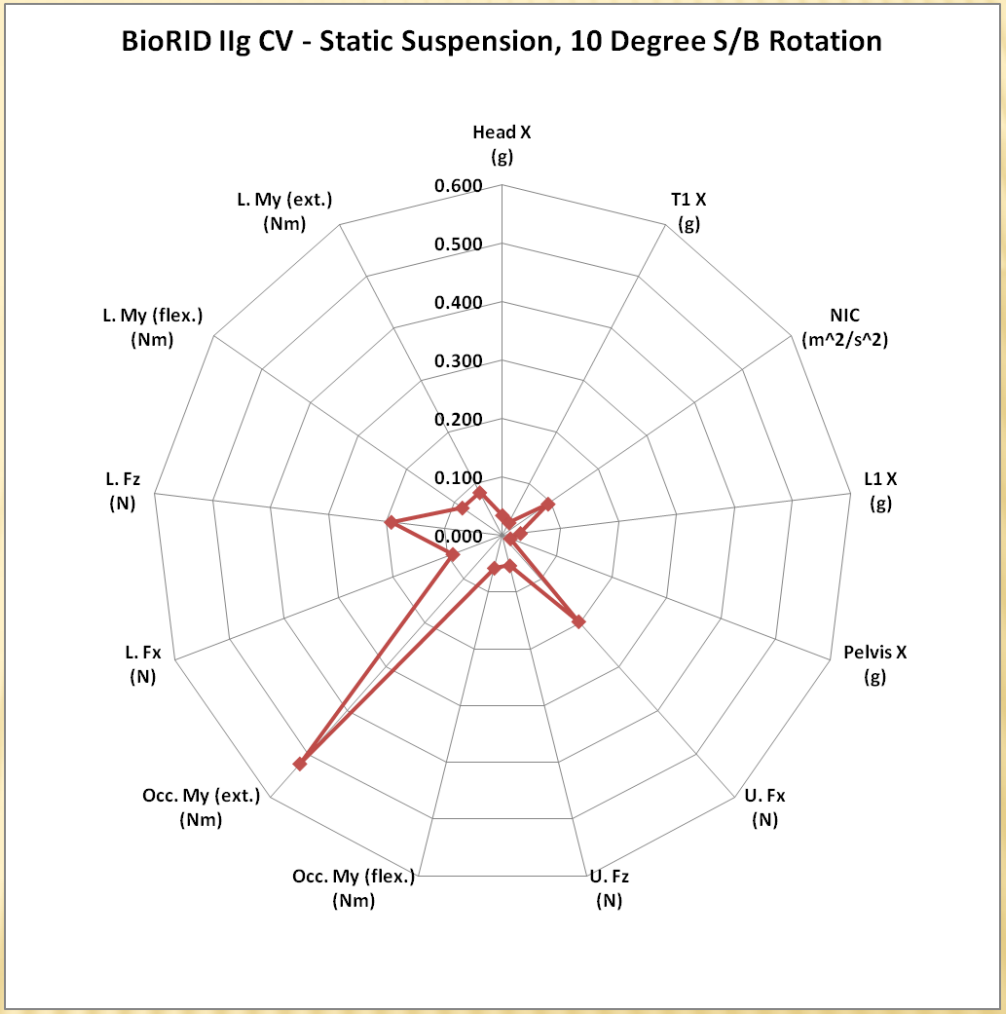
CV CALCULATION DISCLOSURES

- Sample size of two for all CV values reported
- Maximum values used for CV calculations were determined between time zero and the end of head contact
- Negative upper shear values defaulted to zero (per consumer rating system protocols
  - Undetermined if this is appropriate for regulation
- The absolute value of extension moment values were used
- In cases where data anomalies were correlated to seat mechanical issues (i.e.. Vertical Lumbar system), the CV will not be reported



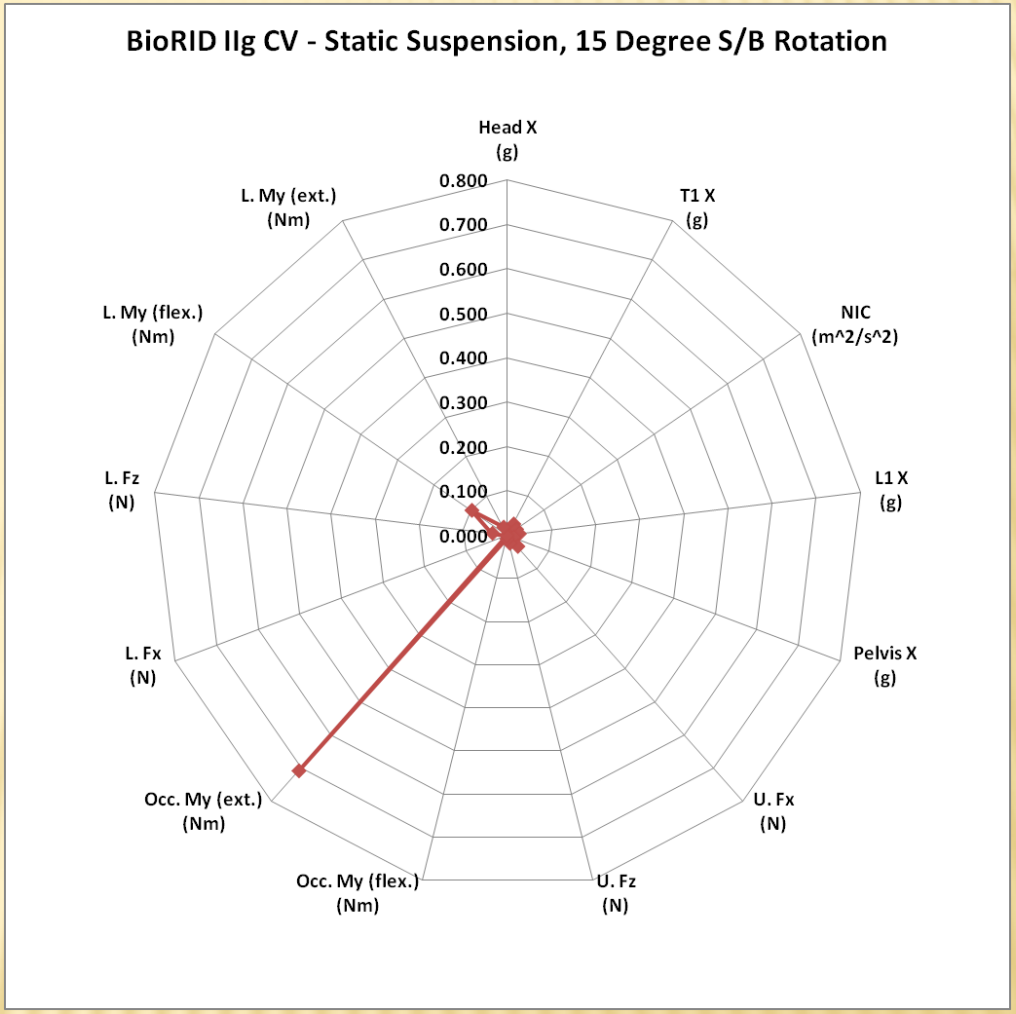
CV VALUES OF STATIC SUSPENSION AT 7 DEGREE S/B ROTATION

Occipital My extension values low (2.67, 1.23)



CV VALUES OF STATIC SUSPENSION AT 10 DEGREE S/B ROTATION

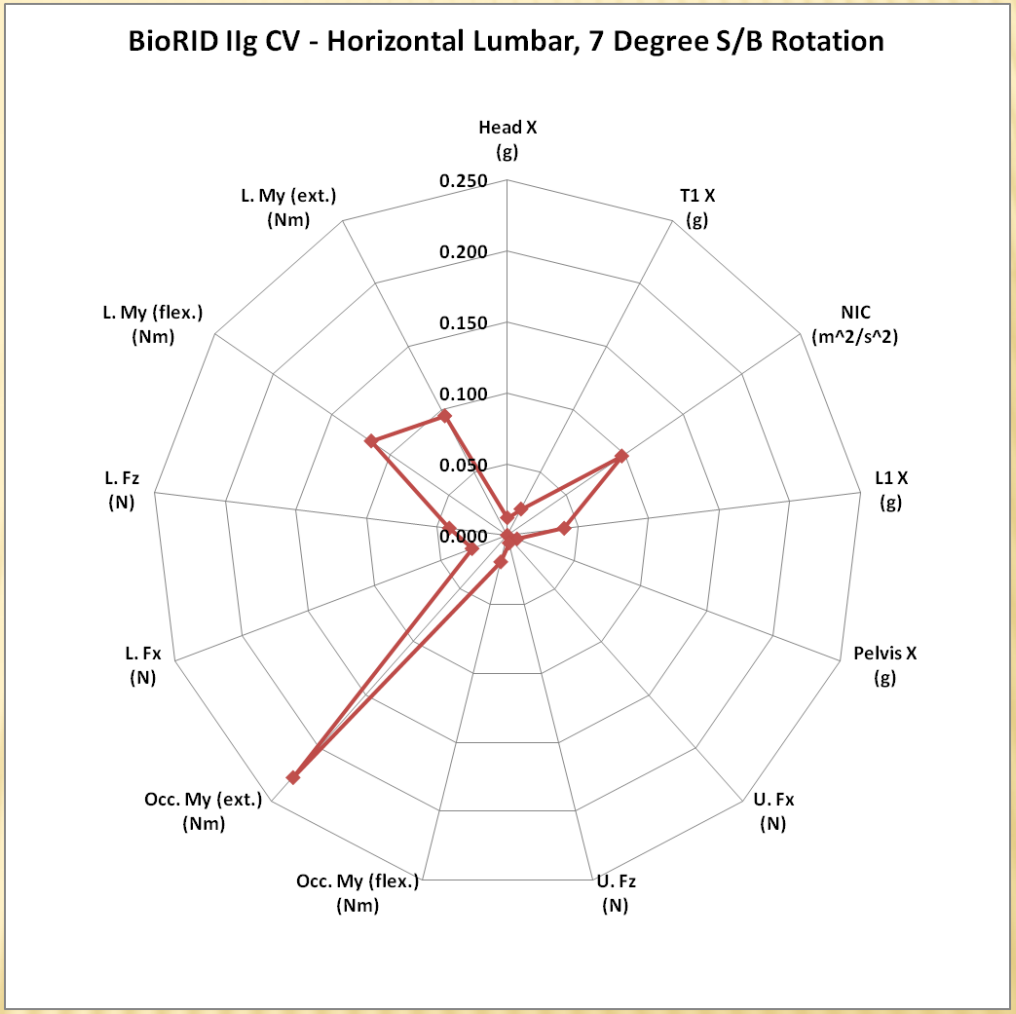
Occipital My extension values very low (1.56, 0.52)



CV VALUES OF STATIC SUSPENSION AT 15 DEGREE S/B ROTATION

Upper Fx actual values of -3.72 N and -1.78 N set to zero for CV calculation and CV=0 (otherwise, the CV=-0.499 or 49.9%)

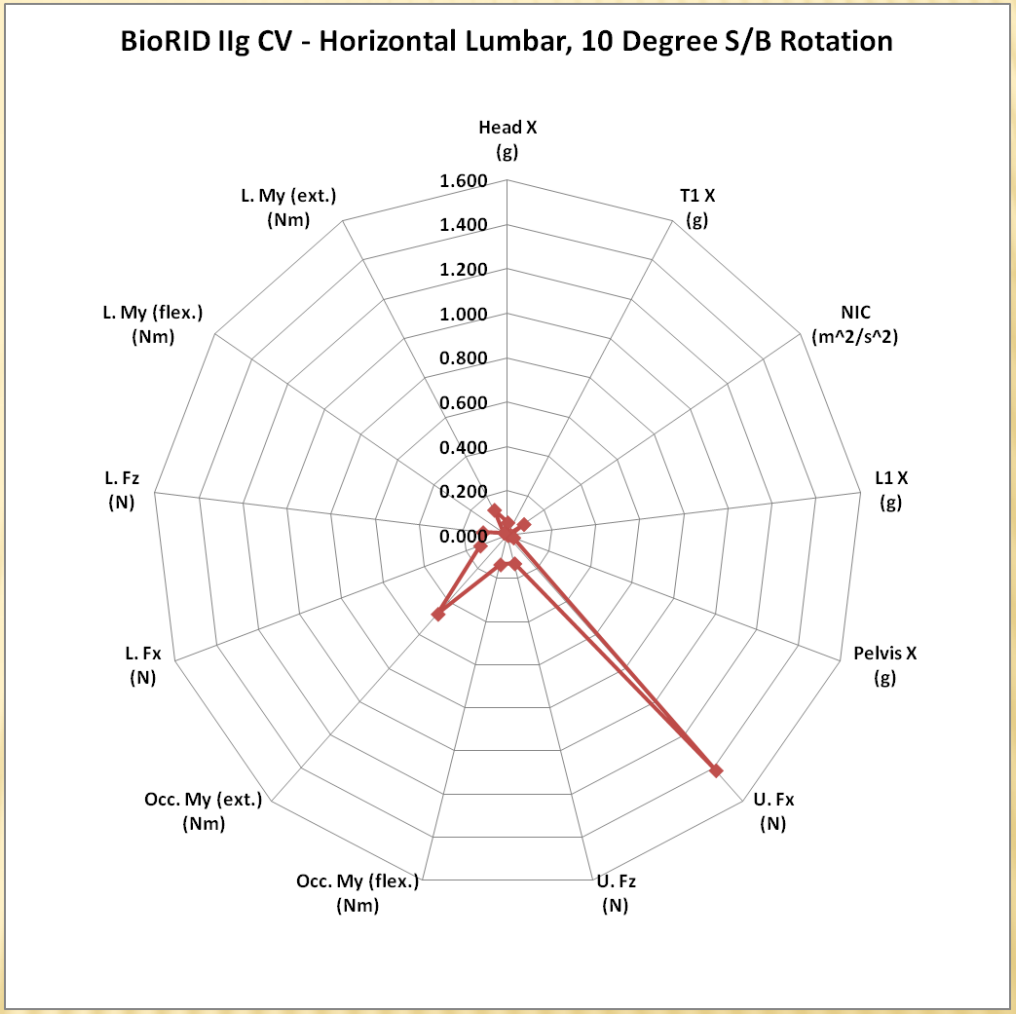
Occipital My extension values low (1.80, 2.49)



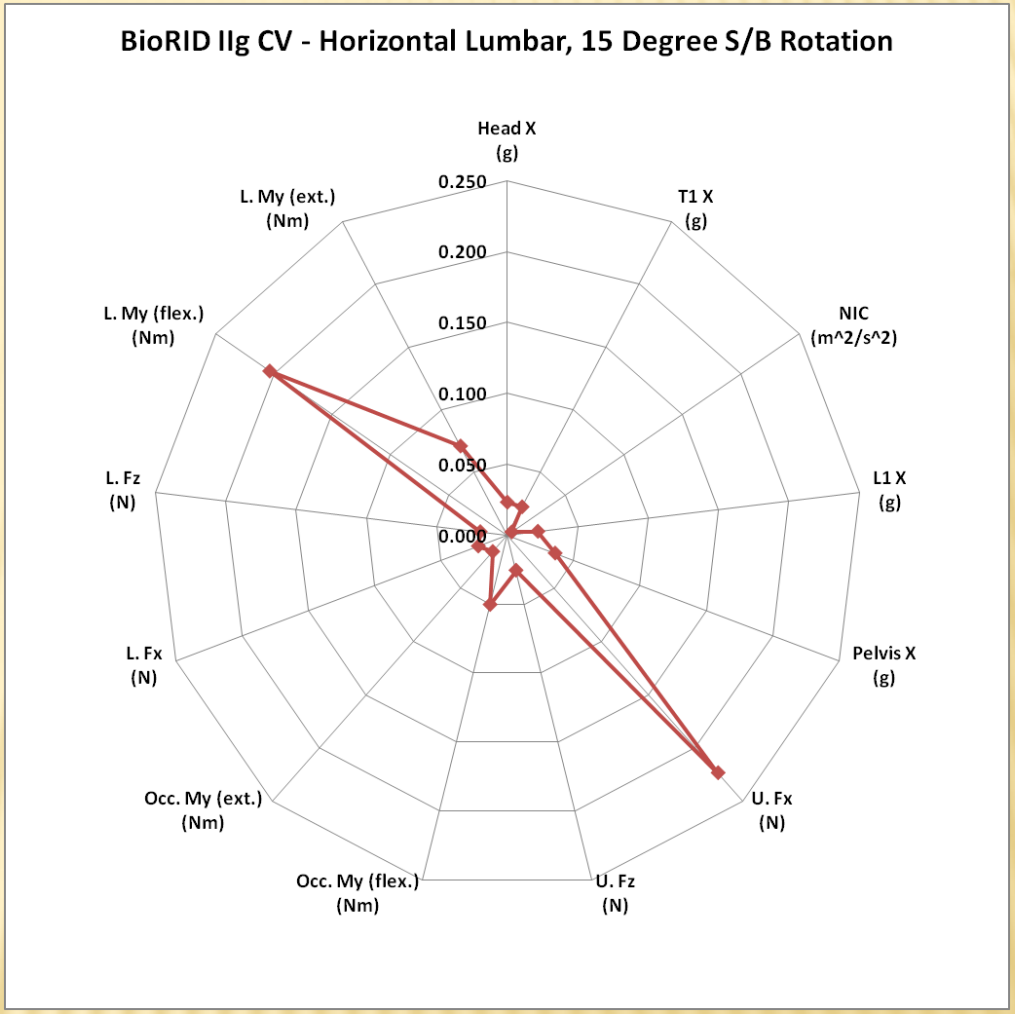
CV VALUES OF HORIZONTAL LUMBAR AT 7 DEGREE S/B ROTATION

Upper Fx values very low (-1.72, 2.2), negative value set to zero

Occipital My extension values low (3.57, 1.78)



CV VALUES OF HORIZONTAL LUMBAR AT 10 DEGREE S/B ROTATION



CV VALUES OF HORIZONTAL LUMBAR AT 15 DEGREE S/B ROTATION

CONCLUSIONS

- Caution: CV values of samples with small magnitudes (near zero) are exaggerated
- BioRID IIg acceleration responses are very repeatable (CV < 5%)
- BioRID IIg NIC value is repeatable (CV < 10%)
- BioRID IIg neck loads are marginal (CV<23%), with the exception of Occipital Extension Moment which is not repeatable
- BioRID IIg is capable of distinguishing between the various stiffness' of some comfort features currently in the market
- BioRID IIg is capable of detecting mechanical anomalies of seatback features
- BioRID IIg response generally increases with a decrease in seat frame stiffness (increase in seatback rotation)

BIORID IIG INJURY PARAMETER OBSERVATIONS

- BioRID IIg Lower Fx generally 4x-10x the magnitude of Upper Fx
  - stiffer seat has higher multiplier
- BioRID IIg Upper Fz generally 2x the magnitude of Lower Fz
- BioRID IIg Lower My is predominantly extension and generally 1.5x-2x the magnitude of Occipital My in flexion
  - less stiff seat has higher multiplier