Stretch/Recoil & Driving distance: Implications for Training

Dr. Robert J. Neal
Golf Biomechanist
Mr. Michael Dalgleish
Physical Therapist/Exercise Scientist

Outline

- **Background**
  - Power **IS** the modern game
  - Developing a powerful golfer
    - You **MUST** know what and how to train
- **Method**
  - Approach to study the problem
  - Data analysis techniques and ways of measuring the variables
  - Defining terms and understanding the concepts
- **Results of the "research"**
  - X-Factor at TOB
  - X-Factor Stretch (XFS)
  - Rate of Stretch
  - Amount of recoil
  - Rate of recoil

Outline (ctd)

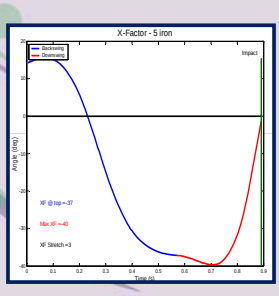
- **Systems/patterns to train**
  - Mobility ?
  - Stability ?
  - Resistance ?
  - Speed ?
  - Movement patterns ?
  - Activities ?
- **Measuring progress**
  - 3D dynamic measurements
  - Driving distance
  - Club head speed
  - Rate of force development
  - Field tests for power

Background

- Modern game relies on power
- As clinicians we need to know
  - The ways to develop power
  - The sources of power in the golf swing

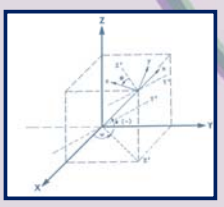
Revision – X-Factor

- X-Factor (McLean, 1992)
- Difference between hip and shoulder turns at the top of the backswing
- The bigger the better (initial idea)

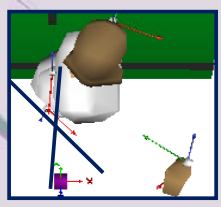


Ways to measure X-Factor

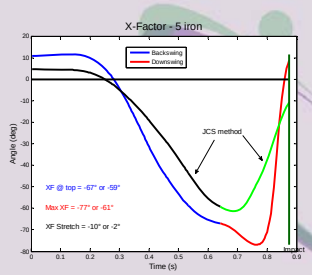
Joint Coordinate method (G&S)



Simple method (UT Turn – Hip turn)



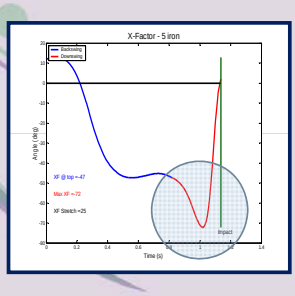
Example Measurements



	JCS	SM
X-Factor	-59°	-67°
Hip turn	-25°	-25°
UT turn	-92°	-92°

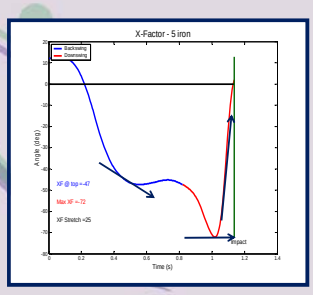
Revision – X-Factor Stretch

- Cheetham et al. showed that the increase in the hip-shoulder differential correlated with driving distance
- Confirmed by Neal

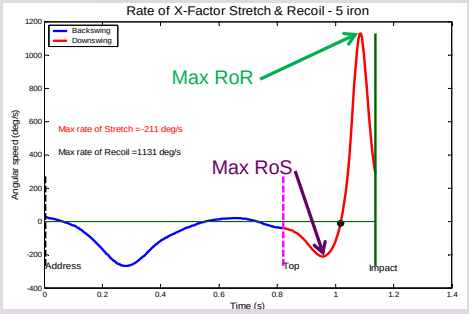


Calculating RoS & RoR

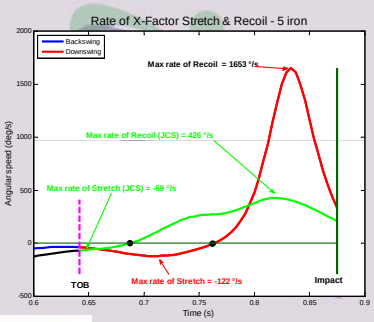
- Differentiate the X-Factor function
- Pick out the key features of this new function



Rate of Stretch (RoS) & Recoil (RoR)

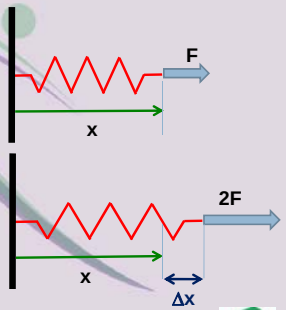


RoS & RoR – Method Variations



Springs!

- Let's try some experiments
- We can adjust the amount of stretch by increasing the force (F) that is applied



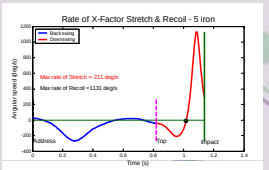
Rate of Recoil

Dependent on

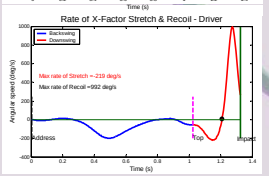
- Spring stiffness
- Amount of stretch
- Rate of stretch
- Viscosity
- Temperature

Let's try some experiments with some rubber tubing!

Cabrera

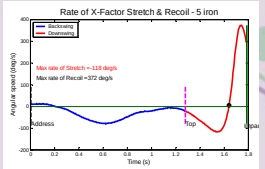


Max rate of Stretch = -211 °/s
Max rate of Recoil = 1131 °/s

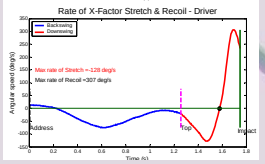


Max rate of Stretch = -219 °/s
Max rate of Recoil = 992 °/s

Senden

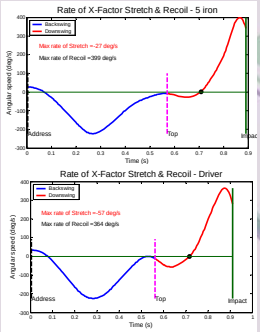


Max rate of Stretch = -236 °/s
Max rate of Recoil = 744 °/s



Max rate of Stretch = -256 °/s
Max rate of Recoil = 614 °/s

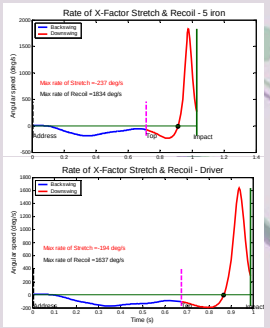
Abeshouse – 5 iron



Max rate of Stretch = -27 °/s
Max rate of Recoil = 399 °/s

Max rate of Stretch = -57 °/s
Max rate of Recoil = 364 °/s

Schroder



Max rate of Stretch = -237 °/s
Max rate of Recoil = 1834 °/s

Max rate of Stretch = -194 °/s
Max rate of Recoil = 1637 °/s

Hypothesis

- RoS & RoR highly correlated with driving distance
- RoS & RoR will be different between between short and long hitters

GOLF BIODYNAMICS swing excellence through 3D technology

THE GOLF ATHLETE

Method

- Collected data on two groups of tour pros
- Calculated X-Factor, XFS, RoS, RoR
- Compared means
- Correlated with driving distance

Results

Individual Data

Group 1 - Long hitters					
Subject	DD (y)	XFS (°)	Max XF (°)	RoS (°/s)	RoR (°/s)
1	310.9	-18.1	-55.9	-232.1	750.5
2	303.9	-33.7	-79.6	-296.1	826.6
3	303.7	-9.7	-61.7	-263.5	727.9
4	300.5	-9.7	-57.9	-216.7	509.0
5	300.2	-24.9	-74.1	-219.0	994.5
6	309.3	-9.9	-76.9	-293.0	1653.3
Mean	**304.8**	**-17.7**	**-67.7**	**-253.4**	**910.3**

GOLF BIODYNAMICS swing excellence through 3D technology

THE GOLF ATHLETE

Individual Data

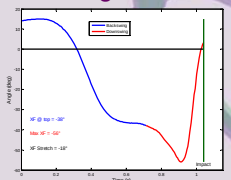
Group 2 - Short hitters					
Subject	DD (y)	XFS (°)	Max XF (°)	RoS (°/s)	RoR (°/s)
1	271.4	-12.5	-56.6	-165.1	435.4
2	271.2	-12.0	-54.6	-133.0	410.9
3	261.4	-14.7	-41.2	-154.9	398.1
4	270.4	-2.6	-48.3	-193.7	460.1
Mean	268.6	-10.4	-50.2	-161.7	426.1

Group Comparisons

	Driving Distance (y)	XFS (°)	Max XF (°)	RoS (°/s)	RoR (°/s)
Long Hitters	304.8	-17.7	-67.7	-253.4	910.3
Short Hitters	268.6	-10.4	-50.2	-161.7	426.1
Difference	36.2	7.2	17.5	91.7	484.2
% Difference	13%	69%	35%	57%	114%
p-value	0.000	0.113	0.009	0.001	0.022
Correlation		-0.36	-0.73	-0.86	0.69

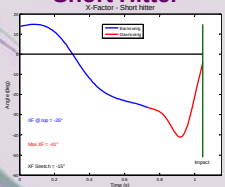
X-Factor & Stretch

Long Hitter



X-Factor = -38 °/s
Max X-Factor = -56 °/s
X-Factor Stretch = -18 °/s

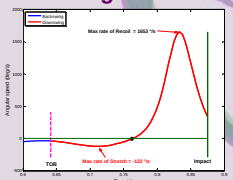
Short Hitter



X-Factor = -26 °/s
Max X-Factor = -41 °/s
X-Factor Stretch = -15 °/s

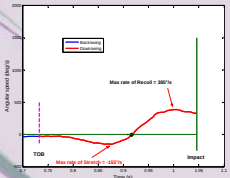
RoS & RoR

Long Hitter



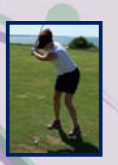
Max rate of Stretch = -122 °/s
Max rate of Recoil = 1653 °/s

Short Hitter



Max rate of Stretch = -155 °/s
Max rate of Recoil = 385 °/s

Implications



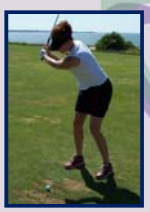
Technical

- **Limit "pause" at TOB**
- **Develop movement skill (independent motion of body segments)**
- **Identify key movements that utilize the stretch-recoil phenomenon**

Physical

- **Training MUST reflect these demands**
  - Mobility
  - Stability
  - Speed
  - Strength
  - Power
  - Patterns of motion
  - Variety

The Clinician's Perspective



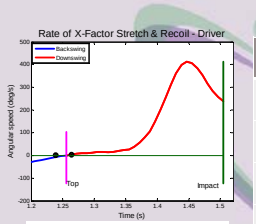
Player Presentation

- **Male - 5 handicap**
- **16 yrs of age**
- **Physically:**
  - Excellent stability
  - Excellent flexibility
  - Excellent strength
- **Ex-gymnast**
- **Driving Distance only average**

GOLF BIODYNAMICS swing excellence through 3D technology

THE GOLF ATHLETE

X-Factor & RoS/RoR Data



Max rate of Stretch = -1 °/s
Max rate of Recoil = 413 °/s

	Measured data (°)
Hip Turn	-45°
UT turn	-93°
X-Factor	-48°
X-Factor Stretch	0°

Factors Affecting RoS and RoR

- Inherited Characteristics
- History of Body Sequencing
  - Throwing
  - Implement Sports
- Anatomical Limitations
  - Arthropathy & Pathological states
- Development of Speed of Movement
  - Developmental Windows

Physical Competence Ability

- Flexibility/Range of Motion
- Control of Body Segments
- Coordination of Body Segments
- Strength and Power

Flexibility

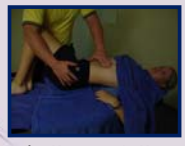
- **Muscular – Lower Half**
  - EO/IO and hip flexors
  - Gluteals, hamstrings, latissimus dorsi, iliocostalis thoracic/lumborum
- **Fascial connections**
  - Anterior Oblique
  - Deep Posterior
  - Posterior Oblique

Rotation Movement 1 - Mobilising

Rotation Movement 1 – End Position

Flexibility

- **Thoracic rotation**
  - Rib and Facet joints
- **Hip joint rotation**
  - Capsular and deep muscle
- **Shoulder rotation, HF & elevation**
  - Posterior cuff



Rotation Movement 1 - Massage

Rotation Movement 2 – Start Position

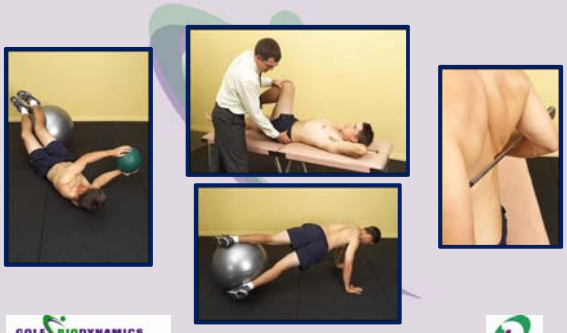
Coordination of Body Segments

- **Pelvis on Torso Rotation**
  - In posture
  1. Supported on the Wall
  2. Arms Folded
  3. Rotated with hands on the Wall
  4. Rotated with Arms Folded
- **Stability, Lateral Pelvic Tilt & Excellent Technique**
- **Must encourage Hip Bump!!**

Position Four

Position Four with Bump

A Clinical Case



Clinical Observations

- Med ball retraining drill: ball direction is important
- SB throwing game – possibility for the 'non throwing' group

Medicine Ball Throw
(Throw into the ground not the wall)

Summary

- Substantial RoS & RoR differences between long and short hitters on tour
- You should measure these variables (3D system + appropriate reporting)
- These data need to assist your decision making regarding training protocols
- Use your clinical skills and reasoning!!

Thankyou, Good golfing & Questions

GOLF BIODYNAMICS swing excellence through 3D technology

THE GOLF ATHLETE