

## Musculoskeletal Disorders affecting Musicians and Considerations for Prevention

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[www.musicianshealth.co.uk](http://www.musicianshealth.co.uk)

You will find a full list of all references used  
to produce this lecture in the last few slides  
of this presentation.

*“If I don’t practise for one day, I know it;  
if I don’t practise for two days, the critics  
know it; if I don’t practise for three days,  
the audience knows it”*

Ignacy Jan Paderewski.

### Playing-Related Musculoskeletal Disorders (PRMDs)

“Pain, weakness, numbness, tingling, or other  
symptoms that interfere with (their) ability  
to play (their) instrument at the level (they)  
are accustomed to.” (Zaza et al., 1998)

### Impact of PRMDs on Players

(Caldron et al., 1986)

Musicians reported their loss of facility in playing in  
terms of:

- Loss of speed,
- Loss of control of major motions,
- Loss of control of fine motions\*\*,
- Loss of power (forte)\*\*,
- Loss of finger span,
- Other.

### Predisposing Factors of PRMDs

#### Intrinsic Factors (Zaza, 1993)

- Gender,
- Hypermobility,
- Age,
- Genetic predispositions,
- Size,
- Strength.
- Flexibility,
- Muscle tone,
- Physical conditioning,
- Underlying musculoskeletal disease,
- Malalignment.

### Predisposing Factors of PRMDs

#### Extrinsic Factors (Zaza, 1993)

- Change or error in one or a combination of:
- Technique,
  - Instrument,
  - Instrument group,
  - Instrument size,
  - Teacher,
  - Repertoire,
  - Increase in playing time,
  - Practice habits,
  - Ergonomics and technique,
  - Posture,
  - Holding the instrument.

### Grading System for Severity of Injury

(Hoppmann, 1998)

Grade	Description
0	No Pain.
1	Pain while playing, or for a short period after playing.
2	Pain that persists for a longer period after playing.
3	Pain that progresses while playing and requires the practice session to be shortened, but resolves between sessions.
4	Pain that progresses while playing and does not totally resolve between sessions.
5	Continuous pain that markedly reduces or prevents playing.

### Prevalence of Medical Problems

ICSOM Study (Fishbein et al., 1988)

Location	Side	Problem	Severe Problem
Hand	Right	9%	5%
	Left	14%	10%
Shoulder	Right	20%	13%
	Left	20%	11%
Neck	Right	21%	13%
	Left	22%	12%
Lower Back	Right	22%	13%
	Left	22%	11%
Stage Fright		24%	16%

### Prevalence of Severe Musculoskeletal Problems by Instrument Group and Gender: ICSOM Study

(Fishbein et al., 1988)

Overall	58%
String	66%
Woodwind	48%
Brass	32%
Other	60%
Male	52%
Female	70%

### Injury Incidence Rate of Performance-Related Hand Problems among Music Students (n=114, median age: 20) over 3 years (Manchester & Flieder, 1991)

Overall	8.5%
Keyboard	10.4%
String	9.6%
Wind	2.7%
Male	6.1%
Female	10.9%

### Prevalence of Injury among Secondary School Students (Fry et al., 1987)

	Music Students (n=98)	Non-music Students (n=98)
Male	49%	14%
Female	63%	12%

### Severity of Injury at a Canadian Music School (n=300) (Zaza, 1992)

Severity	%
No Problem	57%
Very mild (< 1 wk)	28%
Mild (1 wk < < 1 mth)	4%
Moderate (1 mth < < 3 mths)	7%
Severe (> 3 mths)	4%

### BBC SSO: Edinburgh Festival 2003 (n=11) (Berque, 2003)

Instrument	Location	Side	Percentage
Violin & Viola	Shoulder	Right	18%
		Left	28%
	Elbow	Right	9%
	Wrist	Right	9%
Woodwind	Hand	Right	9%
Brass	Shoulder	Both	9%
	Lumbar Spine	Central	9%
Conductor	Neck	Left	9%

### Most Common Pathologies

(Caldron et al. 1986, Lockwood 1989, Nagai & Eng 1992, Elbert et al. 1998, Hoppmann 1998)

- Muscle-tendon unit overuse syndromes.
- Muscle imbalance: movement impairment syndromes.
- Nerve entrapment syndromes.
- Focal dystonia (occupational cramp): painless loss of motor control, with uncoordination of finger movement. Also affects facial muscles.
- Bone, joint, and bursal injuries.

### Overuse Syndrome: Definition

Defined, in relation to playing an instrument, as:

“Damage that occurs when a tissue is stressed beyond its anatomic or physiological limits.” (Lederman & Calabrese, 1986)

“Exceeding the biological limits to achieve a certain level on one or more instruments causes breakdown and soft tissue damage.” (Hartsell & Tata, 1991)

“A condition of pain and loss of function in muscle groups and joint ligaments as a consequence of excessive or unaccustomed use.” (Fry 1986, Fry 2000)

### Overuse Syndrome: Symptoms

(Lederman & Calabrese 1986, Hoppmann 1998, Fry 2000)

- Pain in muscles and tendons (musculotendinous unit), ligaments. Pain is aggravated with activity, lessened by rest.
- Localised tenderness over the affected structures, swelling may be present.
- Loss of function, characterised by: loss of strength, loss of stamina, increased fatigue.

### Overuse Syndrome: Factors

- Increase in duration and intensity of practice.
- “Normal” movements done correctly, but too many times.



(Berque, 2003)

### Overuse Syndrome: Factors

- Problems with playing technique.
- Inappropriate static position of the left wrist.



(Berque, 2003)

### Overuse Syndrome: Factors

- Inappropriate static posture causing muscle tension and excessive elevation of the left shoulder, possibly due to inadequate shoulder and chin rests. (Nagai & Eng 1992, Ackermann et al. 2002)
- A significant reduction in Trapezius muscle activity was shown when using a shoulder rest compared to not using a shoulder rest. (Levy et al., 1992)

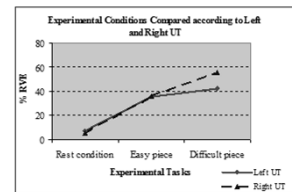


(Brandfonbrener, 2000)

### Overuse Syndrome: Factors

(Palmerud et al. 1995, Hoppmann 1998, Berque & Gray 2002)

- Static and dynamic loading of muscles:
  - Overstabilisation of the left shoulder joint.
  - Increased frequency of leaps on the four strings for the bowing arm.



(Berque & Gray, 2002)

### Overuse Syndrome: Scale

(Fry 1986, Fry 1988)

Grade 1	Pain in one site on causal activity.
Grade 2	Pain in multiple sites on causal activity.
Grade 3	Pain with some other uses of the hand, tender structures demonstrable, may show pain at rest or loss of muscle function.
Grade 4	Pain with all uses of the hand, post activity pain with minor uses, pain at rest and at night, marked physical signs of tenderness, loss of motor function (loss of response or control), weakness.
Grade 5	Loss of capacity for use because of pain which is continuous, loss of muscle function, particularly weakness, gross physical signs.

### Overuse Syndrome: Conservative Treatment

(Fry 1986, Fry 1988, Lederman 2002)

- Strategies (Grades 1,2,3):
  - Reduction in playing time to 10-minute sessions,
  - Increase in length and number of breaks,
  - Control of posture and body awareness,
  - Reduce static loading with instrument adaptations (woodwinds),
  - Review of playing technique,
  - Vary content of a practice session,
  - Stop repertoire or exercises causing pain.

## Overuse Syndrome: Radical Rest

(Fry 1986, Fry 1988, Lederman 2002)

- Strategies (Grades 4,5):
  - Prolonged rest for several weeks until pain-free and structures are non-tender,
  - Avoidance of pain-inducing activities,
  - Adequate medication,
  - Very gradual return to playing (few minutes daily),
  - All other strategies mentioned in previous slide apply.

## Muscle Imbalance

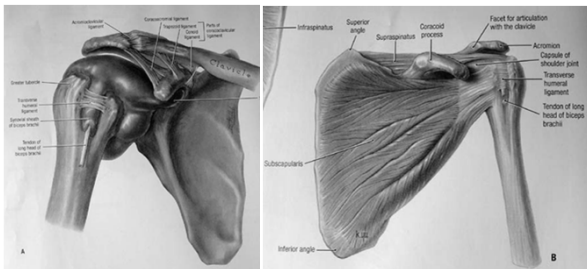
(Mottram 1997)

- Imbalance in scapula (shoulder blade) muscles can result in:
  - Movement dysfunction, or “abnormal” movement,
  - Causing impingement syndromes, recurrent tendinitis of some shoulder muscles, and pain.



(Berque, 2003)

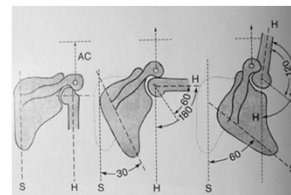
## Shoulder Anatomy



(Grant's Atlas, 1999)

(Grant's Atlas, 1999)

## Muscle Imbalance and Impingement

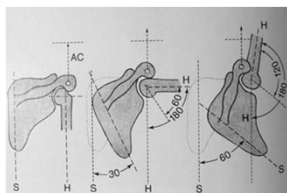


(Sahrmann, 2002)



(Berque, 2003)

## Muscle Imbalance and Impingement

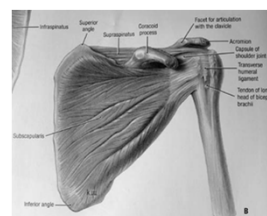


(Sahrmann, 2002)



(Berque, 2003)

## Muscle Imbalance and Impingement



(Grant's Atlas, 1999)



(Berque, 2003)

## Muscle Imbalance

- The problem is not “weakness” of the stability muscles, but “inhibition”, which means:
  - Poor recruitment of the muscles by the higher central nervous system.
  - Delayed recruitment timing.
  - Altered recruitment sequencing between muscles.

These stability muscles need to be recruited prior to movement to fulfil their role.

(Mottram, 1997)

## Inflammation of Tendon Sheaths

(Hoppmann 1998, Baron and Eaton 1998, Wynn Parry 2000)

- De Quervain’s syndrome affects two tendons of the thumb at wrist level.
- Instrumentitis affected: pianist (“thumb under”), string player’s bowing arm, oboe and clarinet players.
- Management: rest, splinting, physiotherapy, nonsteroidal drugs, corticosteroid injection.



(Grant's Atlas, 1999)

## Hypermobility

(Hoppmann 1998, Brandfonbrener 2000)

- Correlation between musicians with hand and arm pain and the presence of significant joint laxity, especially of the finger and wrist joints.
- Benign laxity (Hypermobility Syndrome) typically affects young and female musicians, and is due to laxity in the ligaments protecting joints.



(Brandfonbrener, 2000)

## Hypermobility

(Hoppmann 1998, Brandfonbrener 2000)

- Prevalence of 5-10% in the general population, 20% in a population of musicians.
- Hyperlaxity is considered as detrimental, putting the individual at increased risk of musculoskeletal complaints.
- Management: finger splints, exercise programme, adaptive devices, attention to technique.

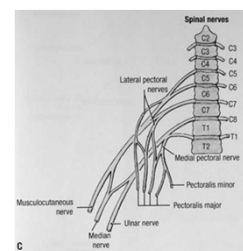
## Nerve Entrapment Syndromes

- Nerve root compression in the cervical spine.
- Thoracic outlet syndrome (TOS).
- Carpal tunnel syndrome (CTS).

## Nerve Root Compression

(Bejjani 1996, Lederman 1998, Wynn Parry 2000)

- Compression of nerve roots in the cervical spine.
- Symptoms: neck pain; radiating down the arm; pins & needles; weakness.
- Associated with degenerative changes.
- Posture related: increased neck rotation and side flexion.

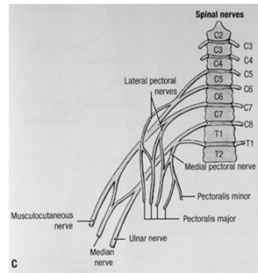


(Grant's Atlas, 1999)

## Nerve Root Compression Cervical Spine



(Brandfonbrener, 2000)

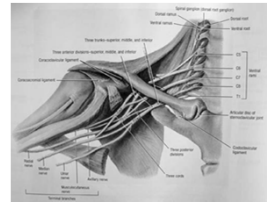


(Grant's Atlas, 1999)

## Thoracic Outlet Syndrome

(Bejjani 1996, Lederman 1998, Wynn Parry 2000)

- Compression at the brachial plexus.
- Symptoms: pain on inner side of forearm, ring and little fingers, pins & needles.
- Causes: "droopy" shoulders, downward traction of the shoulder and internal rotation during prolonged playing.



(Grant's Atlas, 1999)

## Carpal Tunnel Syndrome

(Lederman 1998, Wynn Parry 2000)

- Most common entrapment neuropathy.
- Not necessarily performance-related.
- Affecting middle-aged women more often.



(Grant's Atlas, 1999)

## Carpal Tunnel Syndrome

Signs & Symptoms (Lederman, 1998)

- Common: pain; pins and needles in the hand: thumb, index and middle fingers; symptoms at night.
- Later stages: sensory loss and numbness; weakness and atrophy; diminished tendon reflexes.

## Carpal Tunnel Syndrome (CTS) Classification (Wynn Parry, 2000)

- 1- Classical CTS unrelated to performance: abnormal nerve conduction tests.
- 2- CTS due to acute positional factors: only occurs when playing (flexed wrist of guitarists).
- 3- Pins and needles associated with swelling of flexor tendons: related to playing, relieved by rest.

## Carpal Tunnel Syndrome



(Tubiana, 2000)



(Grant's Atlas, 1999)

## Management of CTS

(Spinner & Amadio, 2000)

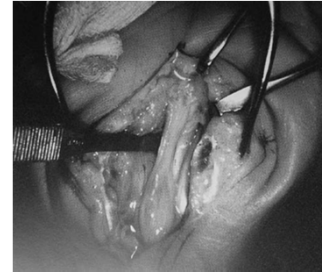
- Modification of activity: more neutral wrist.
- Splinting.
- Steroid injection.
- Surgery.



(Spinner & Amadio, 2000)

## Management of CTS

(Spinner & Amadio, 2000)



(Spinner & Amadio, 2000)

## Focal Hand Dystonia

(Bejjani et al. 1996, Elbert et al. 1998, Lederman 2002, Brandfonbrener et al. 2004, Frucht 2004)

- Painless motor disorder.
- Loss of fine motor control/coordination of individual finger movements.
- Usually involving 3<sup>rd</sup> to 5<sup>th</sup> digits.
- Seen in pianists, wind players, guitarists, string players, pipers.
- Thought to be associated with many hours of daily practice.
- Affecting between 5% and 14% of musicians.

## Focal Hand Dystonia

(Bejjani et al. 1996, Elbert et al. 1998, Pantev et al. 2001)

- Related to other conditions associated with prolonged performance of rapid, alternating, and/or forceful movements of the digits (typing, data processing...).
- Movements of some fingers of a hand become involuntarily linked to those of others.
- No clear cause, no physiological mechanism determined (idiopathic).
- Treatments: temporary and palliative.

## Focal Hand Dystonia Prevalence per Instrument

(Tubiana & Chamagne 2000, Brandfonbrener et al. 2004, Frucht 2004)

- Piano: right hand mainly.
- Guitar: right hand more often than left.
- Violin and viola: left hand mainly.
- Cello: left hand mainly.
- Flute: left hand mainly.
- Oboe and clarinet: right hand more often than left.

## Focal Hand Dystonia



(Sakai, 2006)



(Tubiana & Chamagne, 2000)



## Focal Hand Dystonia



(Ackermann & Adams, 2005)



(Tubiana, 2000)

## Focal Hand Dystonia Use-dependent Central Nervous System Plasticity

(Elbert et al., 1995)

- Cortical territory occupied by the representation of the left hand digits in string players has expanded.
- String players exhibit a use-dependent enlargement of portions of the somatosensory map in cortical representational zones of the digits of the left hand, which are used intensively to play the instrument.

## Focal Hand Dystonia Neurological Changes

(Elbert et al., 1998)

Extensive simultaneous stimulation of the digits and other types of prolonged, unusual types of sensory input can produce a use-dependent reorganisation of digital receptive fields.

## Fusion of Cortical Representations

(Elbert et al., 1998)

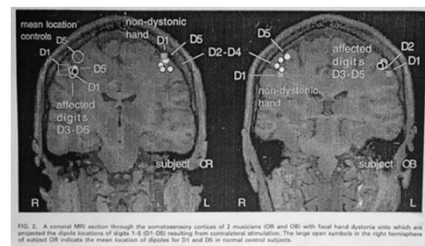


FIG. 2. A coronal MRI section through the somatosensory cortex of 5 musicians CR and DB with focal hand dystonia who are presented the spatial locations of digits 1-5 (D1-D5) resulting from contralateral stimulation. The large open symbol in the right hemisphere of subject CR indicates the mean location of digits for D1 and D5 in normal control subjects.

## Focal Hand Dystonia Study Results

(Elbert et al., 1998)

- Reduced distance between the representational zones of the digits in primary somatosensory cortex for the affected hand of dystonic musicians.
- Fusion of cortical digital receptive fields.
- Fusion also occurred in the cortex opposite the non-dystonic hand in 4 of 7 musicians studied.

## Focal Hand Dystonia Treatment Options

(Elbert et al. 1998, Byl 2004)

If cortical digital fusion is the cause of dystonia:

- Intervention to break apart the fusion may be effective.
- Sensory relearning: extensive practice in tactile discriminations with individual fingers.

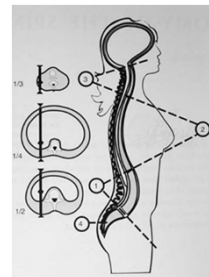
## Focal Hand Dystonia Treatment Options

(Elbert et al. 1998, Byl 2004)

- Dystonia is a disturbance of motor production:
  - Extensive practice in making discrete individual finger movements.
  - In combination with constraint-induced movement therapy.

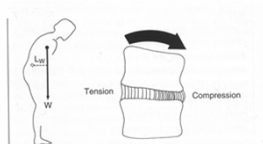
## Normal Posture

- The normal spine has 4 curvatures:
  - Cervical lordosis,
  - Thoracic kyphosis,
  - Lumbar lordosis,
  - Sacral kyphosis.



(Kapandji, 2000)

## Posture and Disc Pathology



(Nordin & Schecter-Weiner, 2001)



(Green et al., 2000)

## Posture and Back Pain

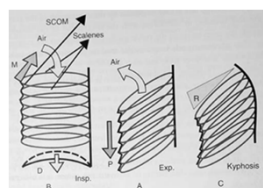


(Kapandji, 2000)



(Kapandji, 2000)

## Posture and Breathing



(Kapandji, 2000)



(Green et al., 2000)

## Sitting Posture and Back Pain

(Norris & Dommerholt, 1998)

- Forward-sloping seat to avoid: flattening of lumbar spine, strain on back muscles and ligaments, diminished breathing capacity.
- Wedge cushion.
- Exercise programme, frequent breaks, body awareness.



(PhysioMed, 2003)

### Prevention: Posture Correction



(Kapandji, 2000)



(Perrin, 1999)

### Prevention: Posture Correction



(Dommerholt, 2000)



(Dommerholt, 2000)

### Prevention: Posture Correction

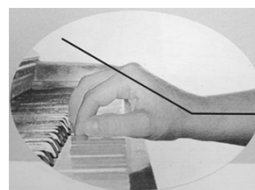


(Green et al., 2000)



(Green et al., 2000)

### Prevention: Posture Correction

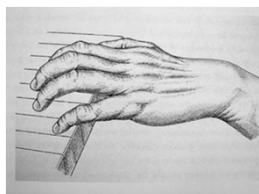


(Bros & Papillon, 2001)



(Bros & Papillon, 2001)

### Hand Posture (Glenn Gould's Hand)

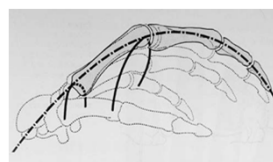


(Green et al., 2000)



(Wilson, 2000)

### Prevention: Hand Posture



(Tubiana, 2000)



(Brown, 2000)

### Return to Play Schedule

(Norris, 1996)

Level	Play	Rest	Play	Rest	Play	Rest	Play	Rest	Play
1	5	60	5						
2	10	50	10						
3	15	40	15	60	5				
4	20	30	20	50	10				
5	30	20	25	40	15	45	5		
6	35	15	35	30	20	35	10		
7	40	10	40	20	25	25	15	50	10
8	50	10	45	15	30	15	25	40	15
9	50	10	50	10	40	10	35	30	20
10	50	10	50	10	50	10	45	20	30

### Ergonomics: Instrument Modifications

(Norris & Dommerholt, 1998)

String players:

- Orthoses: Custom moulding of shoulder and chin rests, tail-piece centred chin rest.
- Instrument supports: "Voelkow" rest for violin, angled end pin for cello.
- Instrument modifications: viola, guitar.
- Adapt size of instrument to anatomical features of the musician.



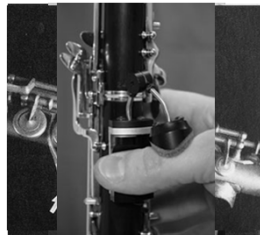
(Norris, 2000)

### Ergonomics: Instrument Modifications

(Norris & Dommerholt, 1998)

Woodwind players:

- Orthoses for better hand positioning: right thumb and left index rests for the flute.
- Instrument supports: neck strap, end pin for English Horn, adjustable-height post for clarinet and flute, angled staple for oboe, vertical post for bassoon.
- Instrument modifications: angled-head flute, key extensions for the flute.



(Norris, 2000)

***"There is no generalizable data for guidance on healthy practice, nor can there be a formula dictating how many times a phrase can be safely repeated over a specific time period."***

***"Common sense and sensitivity to one's body is the only gauge for determining a "safe" number of repetitions."***

***"However, it is clear from all data on musicians that because practice sessions are times of risk it is incumbent on teachers to discuss and guide their students in practicing techniques".***

(Brandfonbrener, 2000)

### Prevention: Practice Habits

(Fry 1986, Nagai & Eng 1992, Zaza 1994, Norris 1996, Zaza & Farewell 1997)

- Musical "neuro-muscular" warm-up \*\*,
- Stretches can be used as a cool-down, but need to be appropriately performed,
- Inclusion of breaks every 20-30 minutes during practice sessions\*\*.
- Pacing: gradual increase of practice before concerts, recitals, competitions,
- Variety of content of the practice session: styles of music, types of exercises,
- Cognitive rehearsal: away from the instrument,
- Body awareness and control techniques: Alexander, Feldenkreis, Yoga,
- Stress and anxiety management.

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