Carrie A. Jaworski, MD, FACSM
Director, Division of Sports Medicine
NorthShore University HealthSystem
Assistant Clinical Professor
University of Chicago
Disclosure Statement

- I have nothing to disclose.
Dance statistics

- Dance participation continues to rise
- Of the 50M children grades K-12, 3.5 million participated in dance in 2004
- 32,000 dance studios in the US
- Injury rates related to dance rose 37.2% between 1991 and 2007
Dance Genres

- Classical Ballet
- Tap
- Jazz
- Hip Hop
- Irish Step Dance
- Ballroom
- Competitive Dance
Basics of Ballet

- Founded during the Renaissance times
- French, Italian and Russian influences
- Focus on alignment, turnout, extremes in joint motion either on flat, demi-pointe or pointe

www.abt.org/education/dictionary
Dance 101

- 5 traditional foot positions
  - Arms = port de bras = carriage of the arms
  - Pulling up = feet grounded with ribcage elevated, shoulders relaxed
Dance 101

- Barre
- Centre
- Across the floor
Arabesque

[air-uh-besk]

Arabesque is a position where the dancer’s body is supported on one leg, with the other leg extended directly behind the body with a straight knee.

Arabesque can be done at various heights.
Passé
[pa-say]

Passé translates to “passed” and is when a dancer bends one leg into a triangle so the knee is in line with the hips and the toes are attached to the other leg’s knee.
Attitude

- A position in which a dancer stands on one leg (the supporting leg) while the other leg (working leg) is raised and turned out, with knee bent to form an angle of approximately 90° with the foot pointed to align with the lower leg.
Grand Jete’

- A long horizontal jump, starting from one leg and landing on the other. Known as a split in the air. It is most often done forward and usually involves doing full leg splits in mid-air.
Pas de Deux

- Partnering work
- Risk of injury changes
Equipment - Ballet

- Ballet flats
- Pointe shoes
- Sprung floor in studio
Anatomy of a Pointe Shoe

- Platform (base)
- Shank (last)
- Vamp
- Wings
- Ribbons and elastics
- Padding
- “Extras”
Making pointe shoes bearable

Pointe Shoe Hacks

- **Lamb's Wool**: even out toes or add some extra cushion
- **Toe Tape**: wrap and protect toes
- **Stretch Ribbon**: secure fit and prevents buckling
- **3/4” Elastic**: strong support for max. heel security
- **Ouch Pouch**: cushion your toes
- **Heel Grips**: secure slipping or baggy heels
- **Instant Wings**: add extra wing support
- **Jet Glue**: extend the life of your pointe shoes
- **Toe Spacers**: toe alignment corrector
- **Dancer Dots**: spot protection
- **Freshify**: soothe and refresh stinky feet
- **Stitch Kit**: durable thread and needle set
Irish Dance – Terminology

- Rocks
- Birdie
- Performances/competition = Feis
Irish Dance – Equipment

- Soft shoes - Ghillies
- Hard shoes – Like a tap shoe without the metal plates
- Costume!
Modern – Terminology

- Mostly from ballet
- Usually barefoot
Getting back to the young dancer
Why screen?

- Increased participation of young people in dance
  - All types
  - Classical ballet, modern, performance dance teams, Irish dance, etc
- Usually no required sports physical unlike “traditional” athletes
  - Definitely athletes
  - Definitely underserved
- Prevention of injuries
- Opportunity to educate
Who to screen?

- Dancers of all ages
- Pre-professional
- Professional
- Recreational
What to screen?

- Dance specific medical history
  - Hours of dance, years of training
  - Injuries
  - Menses/nutritional status
  - Other activities
- Biodynamic evaluation and physical assessment
- Functional evaluation
- Patient education
Questionnaire Example

● Basic past medical history
  ● Injuries/illnesses
  ● Surgeries or other interventions
  ● On set and regularity of menses
  ● Family history

● Assess the amount of training hours
  ● True dance hours vs. technique
  ● Years/seasons of dance training
  ● Pointe vs non-pointe, age started
  ● Dance style

● Nutritional and sleep assessment

● Dance injury knowledge

● Strength and conditioning/Injury prevention
Screening in Pre-professional dance

- Serious ballet training starts around age 8 with “everyday” training
- Increases around age 12 with training increasing to ~6 days a week
- Age range from 12-18
- Typically exceeds 20 hours per week
- Results in “overscheduling injuries”
Survey of Joffrey Pre-professional students

- Anonymous survey of 56 pre-professional dancers
- Primarily females between the ages of 13-18 (50 females, 6 males)
- Classical ballet program
- Looked at injury as well as daily habits related to sleep, nutrition and recovery
2016 Survey results

- **94.44%** reported pain while dancing
- **72.2%** have been injured while dancing

Most common areas that hurt:
- Feet -50%
- Knees -44.4%
- Hips -44.4%
- Toes 39%
- Ankles -39%
- Back -22.2%
Survey results

Number of meals

- 3/day = 11.11%
- 4/day = 44.44%
- 5/day = 38.89%
- >7/day = 5.57%

- Granola bars are #1 snack choice
- Multivitamin is #1 supplement

Glasses of water

- 2/day = 5.56%
- 3/day = 16.67%
- 4/day = 38.89%
- 5/day = 16.67%
- 6/day = 24%
- >7/day = 5.56%
Survey results

Sleep

- <5 hours = 16.67%
- 5-7 hours = 38.89%
- 8-10 hours = 44.44%
- >10 hours = 0%
What young dancers do…

<table>
<thead>
<tr>
<th>Approach to soreness</th>
<th>Their reported concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>63.5% ice and stretch</td>
<td>Achilles pain</td>
</tr>
<tr>
<td>72.2% warm bath/shower</td>
<td>Frequent ankle sprains</td>
</tr>
<tr>
<td>77.78% sleep</td>
<td>Stress fractures</td>
</tr>
<tr>
<td>66.67% foam roll/stretch</td>
<td>Back pain</td>
</tr>
<tr>
<td>33.3% medication</td>
<td>Snapping hips</td>
</tr>
</tbody>
</table>
What adult dancers do...

- Study of college dance program
- 47.5% rely on teacher for treatment advice
- 30% on a Physical Therapist
- 12.5% seek care from a physician
- 10% rely on colleague for advice

- We need to build trust in our young dancers!
Study of young dancer injury rates

- Cross sectional study from Harvard 2000-2009
- 2,133 charts reviewed
- 171 dancers between 8-17 years
- Compared under 12 to over 12 age ranges
- Different injury patterns

Dance Injuries in Pre-pubescent vs. Pubescent Dancers

70% of injuries were in the lower extremities

IADMS studies also demonstrated 58.1%-91.1% lower body injury rates

32-76% of pre-professional dancers sustain a time loss injury each year

1.09-1.87 injuries per 1,000 dance exposures

Recreational dancers/multi-type dancers more likely to injure knee
  - Hip Hop dancers 2.5x the rate of time loss due to injury
  - Irish dancers – most commonly knee overuse injuries or stress fractures in sesamoids, MT, navicular or 1\textsuperscript{st} proximal phalanx
COMMON INJURIES
Types of injury

- Overuse
  - Tendonitis/Bursitis
  - Stress reaction/stress fracture
  - Back pain

- Acute
  - Sprains/Strains
  - Fractures
  - Bumps and bruises
  - Concussion
Common Injuries

- Stress fractures
  - Metatarsals
  - Tibia
  - Low back (spondylolysis)

- Knee pain
  - PFPS

- Feet
  - Bunions
  - FHL tendinitis
  - Posterior ankle impingement - os trigonum
  - 5th MT fracture

- Hip
  - Psoas tendinitis
  - FAI
Foot and Ankle Injuries

- Ankle Sprain
- Achilles tendonitis
  - Back of ankle
- Peroneal tendonitis
  - Outside ankle
- Posterior tibialis tendonitis
  - Inside ankle
- Impingement
  - Anterior with plies
  - Posterior with releves
- Toes/Sesamoids
  - “Trigger Toe” = FHL tendonitis
Stress Fracture

- Overuse or rapid increase in intensity/workload
  - Injury is a progression…
  - Shin splints…stress reaction…stress fracture…fracture

- Inadequate nutrition
  - Irregular menses

- Back, shins, feet most common

- Warning signs:
  - Pain at rest
  - Pain at night
  - Loss of periods
Knee Pain

- “Tracking issues” – Runner’s Knee
- Patellar Tendonitis – “Jumper’s Knee”
- Meniscal tear
- Cartilage damage
- IT band
Patellofemoral Syndrome

- **Mechanism**
  - Multifactorial
  - Tight IT bands, loose kneecaps, weak hips

- **Key Findings**
  - Anterior knee pain
  - Pain with long sitting
  - Swelling and giving out can occur

- **Treatment**
  - Non-surgical
    - Ice
    - Medications
    - PT
    - Taping/bracing
Iliotibial Band Syndrome

- **Mechanism**
  - Overuse
  - Biomechanical
  - Tightness of IT band rubbing over outside aspect of knee

- **Key findings**
  - Lateral knee or hip pain
  - Can get snapping

- **Treatment**
  - Foam rolling
  - Ice
  - PT
  - Taping
**Internal Snapping Hip Syndrome**

- Iliac spine
- Psoas major muscle
- Femoral head
- Greater trochanter
- Iliopsoas tendon
- Ilipectineal eminence

Internal snapping hip syndrome occurs when the iliopsoas tendon catches on the femoral head or iliopsectineal eminence during hip flexion.

**External Snapping Hip Syndrome**

- Greater trochanter
- Iliotibial band
- Gluteus maximus
- Gluteus maximus tendon

External snapping hip syndrome occurs when the gluteus maximus tendon or iliotibial band catch on the greater trochanter during flexion.
Low Back Pain

- Low back pain estimated to occur in 10-15% of young athletes
- Certain sports with much higher prevalence
  - Gymnastics 50%
  - Rhythmic gymnastics 86%
  - Dance > 50%
Spondylolysis

- Presenting symptoms
  - Activity-related back pain
  - Worse with extension
  - Progresses to pain at rest

- Exam
  - Midline bony tenderness
  - Limited forward flexion/hamstring tightness
  - + pain with hyperextension

- Treatment
  - Rest until pain-free
  - Physical therapy
  - ? Brace
Importance of Exam Evaluation

- Detect MSK conditions that predispose the young dancer to an injury
- Assess the overall fitness of the dancer and/or readiness for next level (Pointe work)
- Apply a research-based standardized screen to provide a personalized training protocol
- Educate the dancer on potential injury risks and interventions to reduce
Biomechanical Issues Unique to Dance

- Movement dysfunction
  - Need to evaluate the dancer as a whole
    - Spinal and pelvic issues
    - Knees, ankles and feet
    - Can be either too much motion or too little motion at the spine, pelvis or hip

- Unique considerations with regard to dance
  - Receptiveness of dancer and dance teacher
  - Individual intrinsic factors
  - **Neuromuscular control**
  - Motor learning and muscle memory
The “Basics”

- Importance of pelvic tilt and psoas flexibility
Turnout

- Turnout: 180° external rotation of lower extremities
- Unique stress to the knee and ankle due to compensatory mechanisms
Turnout

• ‘Perfect turnout’ – requires 90° of ER of each extremity -- 180° angle between the long axes of the feet

• 60°-70° occurs at the hips; 10°-15° knee and 10°-15° ankle

• Emphasizes the need for TTO measurement inclusive of all components

• TTO (Total Turnout)
  • Accessible during functional movement
  • Differs significantly between individuals
  • Affected by soft tissue and skeletal anatomy

Hamilton J Sports Med 1992
Turnout

- Improper compensation for lack of turnout
  - *Rotating the pelvis forward, relaxing the iliofemoral ligament*
    - Increased lumbar lordosis and shear forces the spine
    - “Screwing the knee” - externally rotating the tibia with bent knee
    - Rolling the foot in (pronation)
  - Stress to the hip flexors, patello-femoral, medial ankle

Dance Alignment

Plié
- "Rolling in"
- Normal
- "Rolling out"

Relevé
- "Winging"
- Normal
- Sickling
Dance Injury Assessment

- Postural Assessment *Alignment *
  - Scoliosis
  - Arches/feet
  - Alignments
  - Winging scapulas
  - Lordosis
  - Kyphosis

- +/- Stork test – presence or absence of pain
Dance Injury Assessment

- Strength
  - Abdominals, gluteals, hip, foot/ankle

- Balance/functional movement
  - 1st position and passé
Dance Injury Assessment

**FLEXIBILITY** (goniometer)

- Thomas Test:
- Ober Test:
- Marshall Test or Beighton Test
- Ankle
  - Passive Ankle Plantar flexion with knee straight
  - Passive Ankle Dorsiflexion with knee straight
  - Passive Ankle dorsiflexion with Knee bent
Pointe Shoe Readiness

- Physical and psychological maturity
- Do not base on age alone
- X-rays are not indicated
- Functional assessment
- Slow, steady progression
FUNCTIONAL DANCE ASSESSMENT

• Turnout
  • Standing 1\textsuperscript{st} Position on board to measure turnout 2\textsuperscript{nd} toe - step off board and then measure angles as compared to appearance on floor

• Core strength
  • Double leg lower

• Neuromuscular control
  • Airplane plie
FUNCTIONAL DANCE ASSESSMENT

- Metatarsal Heads in Relevé
  - (circle one) 5 – 4 – 3 – 2 – 1 (*optimally 4)

- Demi Plié (look for knee to be over 2nd toe)
  - *Over second toe vs Medial vs Lateral

- 1st Position in Passé - hip position
  - *Over the Center vs Sitting in the Hip
Dance Injury Prevention Programs

- To determine effectiveness of conditioning program on injury prevention
- Professional ballet company over 3 years; N=50-58/year
- Intervention – individual conditioning programs developed based upon injury history and functional movement screening
- The injury count reduced significantly in years 2 and 3 (P < 0.001)
- Conclusion – demonstrated the benefit of individualized training programs

Purpose: to assess changes in lower extremity strength and ROM in young dancers pre and post a summer intensive dance program designed to improve strength, knowledge of overall health (nutrition, sleep, injury etc.)

Prospective cohort study assessed biomechanical measurements N = 58 dancers (F=55, M=3) 12-17 yrs before and after 5-week summer intensive dance program
The Evaluation of Flexibility, Strength, and Functional Performance in the Adolescent Dancer During Intensive Dance Training

RESULTS

- Functional athletic performance
  - No change on SEBT and vertical jump test
  - Dance technique improved
    - More dancers demonstrated correct knee alignment during demi-plié ($P<0.001-0.002$) and hip alignment during plié ($p=0.014-0.035$)
    - Greater active hip turnout in first position passé of 2-3° ($p=0.018-0.048$)
The Evaluation of Flexibility, Strength, and Functional Performance in the Adolescent Dancer During Intensive Dance Training

RESULTS

- Passive flexibility - significantly reduced by the end of the program in all tested ranges bilaterally
  - 5-6° increase in hip flexor tightness ($P<0.001$)
  - 4-5° decrease in hip internal rotation ($P<0.001$)
  - 4-6° decrease in hip external rotation ($P<0.001-0.001$)
  - 3-4° decrease in hip turnout ($P=0.01-0.03$)
  - 2-5° decrease in ankle dorsiflexion ($P<0.001-0.02$)

- Strength of first toe flexion and hip abduction improved bilaterally ($P<0.001$)

- Abdominal strength - 11° improvement in performance Kendall test ($P<0.001$)
Dance Training to Prevent Injury

- Inherent muscle imbalances - dominant and contracted external rotators over internal rotators ⇒ may contribute to excessive anterior sliding of the femoral head
- Strength training in parallel position
- Strengthen through full ROM and in both directions
Dance Injuries and Strength

- Strength – historically not considered a necessary ingredient for success
  - Unfounded diminish in dance aesthetics

- Supplemental resistance training for hamstrings and quadriceps leads to improvements in strength without interfering in performance

- No change in muscle size

- Improvement in neuromuscular control or elevated ‘neural environment’ may explain exercise induced increase in strength

Koutedakis Sport Med 2004
Supplementary strength training programs on professional dancers has been shown to be beneficial both in decreasing fatigue and increasing peak knee flexion and extension torques.

- Improved strength without alteration in selected aesthetics

Koutedakis et al J Str and Cond Res 2004
Injury Care 101

Return to Dance Criteria:

- Full range of motion
- Full strength
- Functional
- Psychologically ready
Other areas of concern

- Mental Health
- Energy imbalance
  - Eating disorders
  - Lack of knowledge regarding nutrition
  - REDS
Recovery is key

- Sleep is when our bodies repair themselves
  - Muscle repair
  - Maintains hormone balance
- Lack of sleep results in illness or injury
- Goal of 8-10 hours per night
Take home points

- Young dancers are susceptible to injuries based on their growth status, overtraining and type of dance
- Educate dancers - early and often
- Primary prevention programs are essential
Thank you!