

Gymnastics Injury Prevention: Pearls and Pitfalls

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Introduction

- Injury Rates/Prevalence
- Injury Risk Factors
- Wrist Pain in Gymnastics
- Elbow Pain in Gymnastics
- How to Improve Elbow and Wrist Injuries
- Why are Lower Body Injuries so High?
- How to Reduce Knee and Ankle Injuries
- Early Specialisation/Year-round training

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Injury Rates/Prevalence

Gymnastics has one of the highest injury rates of all girls' sports- National Centre for Catastrophic Sports Injury Research 1992-2005

Injury rate of 13.1/1000 exposures 2nd to wrestling at 13.1/1000 athletes exposures higher than football or hockey (Singh et al., 2007)

Recreational gymnastics per year
Competitive women's 65-200/100 hours or 1-3.66/1000 hours
Competitive men's 9.6-204/100 gymnasts/year (Zetaruk, 2008)


Published injury rates for club gymnasts range from 0.5-9.5 (Benjamin et al., 2011)

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Injury Rates/Prevalence (Singh et al., 2007)

6-11 year olds: **upper extremity** fracture/dislocations most common (50.2%)
12-17 year olds: **lower extremity** sprains, strains were most common (51.8%)

<ul style="list-style-type: none"> Handsprings/Flips (42.3%) Cartwheels/RO (30.7%) Handstands (8.9%) Dismounts and Landings (5.8%) Somersaults (4.9%) Backbends/walk-overs (3.5%) Splits (2.1%) Headstands (1.7%) 	<ul style="list-style-type: none"> Strains/Sprains (44.3%) Fracture/Dislocation (30.4%) Abrasion/Contusion (15.6%) Laceration/Avulsion (3.7%) Concussion/head injury (1.7%)
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Injury Rates/Prevalence (Singh et al., 2007)

1990-2005, injuries reported to NEISS:

Average age: 11.5 years

Author suggested that increased skill difficulty coupled with maintaining the intensity and high competitive, has led to concern regarding the effects of injury to young gymnasts.

Injuries occurred in October (9.6%) and March (12.2%) peak months of club and high school competition seasons



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Injury Rates/Prevalence (Zetaruk, 2007)

Gymnasts spend 29% of each season modifying their training as a result of injuries

Risk of injury increases with increasing skill level


Elite level: 65% of athletes report injuries which require time away from training/year

33-55.8% of all gymnastics injuries are of the overuse type

UE are most commonly injured in men, LE in women

Sprains and Strains are the most common type of injury.

Risk of stress fracture is higher in women



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Injury Rates/Prevalence (O'kane et al., 2010)


Injury rate 3-17 year olds, 7-9 yr olds

Most common injury: **Distal radius/ulna fracture**

Majority of injuries occur on **bars and beams**

Overuse injuries: **Stress fractures**

Injuries: **ACL, meniscus, ligament sprains**




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Injury Rates/Prevalence (Edouard et al., 2017)

FIG 50 million registrants, 320 gymnasts at Olympics (3%), 2008, 2012, and 2016

Elite gymnasts 7-18 years old, train 21-37 hours per week for 11-12 months a year

Injury rate ranges from 1.6-4.1/1000 hours of training



Elite gymnasts are exposed to higher rates and more severe injuries and are at higher risk during competitions

Study analysis demonstrated a significant increase of injury incidents from 2008-2016.


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Injury Rates/Prevalence

"We need to talk about how equipment **technology**, mismanaged **work to rest ratios**, and being **too aggressive** with young gymnast in relation to **early specialisation** or **year-round training** is contributing to incredibly high injury rates. We also need to take the **best science** available on injury mechanisms combine them with the **expert opinion** of gymnastics **coaches**, and look for **innovative training** approaches that help reduce risk of overuse as well as acute injuries...we need to address the issues of **limiting** high skill numbers, **poor** flexibility methods, not using **periodization**, and lacking specificity of **medical care**" (David Tilley, 2018)

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Injury Risk Factors



Equipment: Reactive Model, Energy deficits/Overtraining, Poor technique Selection, High Impact Movement

Movement pattern: Dysfunction, Level, Fear, Poor physical preparation


Maladaptive training habit: BMI, Maturation, Early Specialisation

Age: Mismanaged Workloads, FIG code of points, Lack of communication, Poor Mental Preparation

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Injury Risk Factors (David Tilley, 2018)

- Coaches:**
 - Lack of monitoring of skill repetition, routine repetition and strength workloads
 - Gymnastics has become harder we cannot train an hour of an event until we "get it right" there must be a boundary
 - Must adopt current science for strength, energy systems, flexibility, periodization, and long-term athletic development models



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Poor Flexibility Methods



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Optimal Flexibility Methods

Correct position for 2 joint self stretch - keep knees - same foot back position

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Injury Risk Factors (David Tilley, 2018)

- Medical Community**
 Needs better information, improved diagnostic tools, superior rehabilitative strategies for gymnasts.

Must adopt formal strength and conditioning principles in rehabilitation and grasp a better understanding of gymnastics biomechanics and return to sport programs

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

- Most common body part injured in men, 6th most common in women
- Prompt evaluation and management is necessary to avoid negative sequelae

- Limit excessive loading
- Maintaining wrist flexibility
- Emphasis on proper technique
- Incorporating general wrist and core strengthening
- General return to play principles

Return to Play

Resolution of Pain

↓

Restoration of normal joint function

↓

Completion of a progressive rehabilitation program

↓

Use of proper technique

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

- “Gymnasts Wrist”**
 Commonly refers to distal radius growth plate injury
- Is of particular concern in adolescent adult while growing
- Joint capsule and ligamentous structures are stronger than growth plate
- Repeated axial loading and hyperextension of wrist

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

- Examination:**
 Tenderness over the volar radial region and dorsal radial region at the wrist level.
- Range of motion normal or slightly limited due to pain
- X-ray: often seen to be normal in severe cases there may be widening of the lateral and volar aspect of the radial physis
- MRI: not routinely indicated for these patients but if obtained would show widening

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

The diagram shows six stages of wrist pathology: Normal physis, Salter-Harris I, II, III, IV, and V. Each stage is illustrated with a lateral view of the wrist joint. To the right, two X-ray images show the distal radius and ulna with white arrows pointing to areas of sclerosis and widening of the physes.

Normal physis
Salter-Harris I
Salter-Harris II
Salter-Harris III
Salter-Harris IV
Salter-Harris V

Cartwheel
Back Hand Spring

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

- **Treatment**
- Cessation of causing stress. A minimum of **6 weeks** or until symptoms subside.
- **Important:** Resolution of widening physis and sclerosis may lag behind clinical symptoms but improvements can be seen within a few weeks of rest.
- X-rays recommended between 6 and 12 week post diagnosis or when symptoms have resolved to verify proper healing

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

- **Return to play**
- Gradual return to training loads are initiated.
- **3-5 reps** slow tumbling walkovers and handstands, gradually increase reps as long as pain free to **10-15** reps. Then repeat process for fast tumbling moves and vault (Zetaruk, 2000)
- Careful attention to biomechanics and proper form

Cartwheel
Back Hand Spring

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Wrist Pain in Gymnasts (Benjamin et al., 2017)

- **Prevention**
- Reducing high impact and/or physical stress loads
- Reduction of specific training repetition involving wrist usage during growth spurts
- Tiger paws to decrease wrist extension in the longterm
- Further sport specific research is needed

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Elbow Pain in Gymnasts (M.N. Zetaruk, 2000)

Osteochondritis dissecans (OCD)

- Lateral compression of the radial head or capitellum
- Most commonly seen at **13-16 yrs**

Symptoms:

- Lateral elbow pain with wb and valgus stress
- Decreased ROM of Elbow
- Swelling
- Locking
- Catching
- Tenderness over radius or capitellum


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Elbow Pain in Gymnasts


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Elbow Pain in Gymnasts (M.N. Zetaruk, 2000)

- Examination**
- X-ray may show lucency within the radial head or capitellum
- MR can detect early changes that X-rays can't



X-ray of OCD Lesion of Capitellum



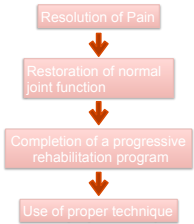

Elbow Pain in Gymnasts (M.N. Zetaruk, 2000)

- Treatment**
- Rest and splinting until symptoms resolved and there is radiographic evidence of healing (3-6 weeks)
- ROM exercises should begin as soon as symptoms permit
- Rehabilitation should focus on regaining full strength
- Return to gymnastics should only be permitted once full ROM and strength are achieved




Elbow Pain in Gymnasts

- Return to Play:**

How to Improve Elbow and Wrist Injuries (David Tilley, 2018)


- Better education




adaptations and to optimise performance.



Technique selection in young gymnasts: elbow and wrist joint loading in cartwheels and roundoff (Farana et al., 2000)





- In 2008 gymnastics injuries occurred 30% of the time during CW and RO
- UE injuries most common (42%) in young 10-14 year old gymnasts
- Study findings:** T-shape hand position reduced ground reaction force compared to the parallel technique to the elbow and wrist joints during RO



Lower Body Injuries, Why so High? (David Tilley, 2018)

- Ground reaction landing forces of a gymnast's lower body has been measured to be at **14.2-15x** body weight
- Inappropriate cultural acceptance of letting gymnasts "land short" multiple times and not fix technique or simply holding training of that skill that day
- Cultural misunderstanding related to scientific benefits of lower body resistance training in gymnasts

Lower Body Injuries, Why so High? (David Tilly, 2018)

Proper squat-based mechanics being undertaken that change to delay the force of highly impact young gymnast's al prep and leg the forces.

How low does the landing go into the mat? (What happens if it's not? What are they not doing for landing? What is the landing like? What is the athlete able to control? How many multiple landings?)

Look at the amount of landing force the athlete sees

Do their knees travel excessively past their toes?

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How to reduce knee and ankle injuries? (David Tilly, 2018)

- Objectively tracking
- Rotating daily event focus of hard landing impacts for tumbling passes, dismounts, or vaulting
- Rotating surfaces of impact (resili pit, rod floor, hard etc.)
- Understanding which gymnasts are at high risk based of times of rapid growth, being skeletally immature, not being physically or technically prepares, or being in a fatigued status

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Event	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Floor	Larouds x2 Back Tumble 1.5 Front Tumble x2		Larouds x2 Back Tumble 1.5 Front Tumble x2		Larouds x2 Shade 1.5	
Pommel						
Rings	Giant x 5 Dismount x2		Giant x 5 Dismount x2 Ring Stretch		Giant x 5 Dismount x2 Ring Stretch	
Vault		Vault x2		Vault x2		
P Bars		Dismount x 5		Dismount x 5		
High Bar		Dismounts x2		Dismounts x2		
Extension #	x18	x5	x18	x5	x11	Week Total 59 (Harder Surfaces)
Landing #	x20	x15	x20	x15	x11	0 (Soft Week 1/2)

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When you think about it... (David Tilly, 2018)

- May lose ability to squat and land well if all your soft tissue becomes too stiff
- Repetitive jumping or running can cause calf/ankle stiffness
- Each sport has these changes in movement patterns
- Regular maintenance care becomes very important

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When you think about it... (David Tilly, 2018)

- Proper Form**
 - Feet and legs together (adductors)
 - Toes pointed (calf muscles)
 - Knees straight (quads)
- Proper Squat**
 - Feet and legs apart (hip width)
 - Toes up into ankle dorsiflexion (calf muscle and ankle mobility)
 - Knees Bent (quad flexibility)

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The effects of a 4-week jump program (A. Colclough et al., 2017)

- Knee and ankle injuries (34%) in female gymnasts

reduce risk factors for injury

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Table 2
Judo training programs

WEEK 1	WEEK 2	WEEK 3
WALL JUMP - 20 x Tack jump - 20 x Head jump - 1 x 5 Round jump (barrel) 5 x 3 Side jump - 10 Large walk 2 x 15 m	WALL JUMP - 20 x Tack jump - 20 x Round jump - 1 x 5 Round jump (barrel) - 5 x 3 Side jump - 10 Large walk 2 x 15 m	WALL JUMP - 20 x Tack jump - 20 x Round jump - 1 x 5 Round jump (barrel) - 5 x 3 Side jump - 10 Large walk 2 x 15 m
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Early Sport Specialization and year-round training

(David Tilley, 2018)

- One of the most controversial topics in gymnastics
- An abundance of research exists on the negative effects that may come when young athletes do not participate in multiple sports
- In gymnastics we should encourage delay of specialization to at least 9-10 years old
- Entertain the idea of building a relative "off-season"



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Early Sport Specialization and year-round training


(David Tilley, 2018)

- Detailed **periodization** models
- Closely monitoring **workloads** (intensity, volume)
- Use of robust **physical preparation** programs that include **cross training** and **resistance** training
- Integration of **proactive medical care**
- Subjective and objective athlete **monitoring**
- Use of **long-term athletic development model** to reduce high force/ reps before puberty

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1. Detailed Periodization Models

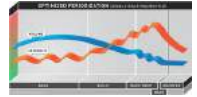
- Macrocycle**- entire training year
- Mesocycle**- several weeks to several months. (i.e. preparatory, transition, competitive, active rest, off-season)
- Microcycle**- each mesocycle is divided into two or more microcycles, 1-4 weeks



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1. Detailed Periodization Models

- Preparatory Phase**: usually the longest, limited number of sport-specific skill practice.
 - Goal: base level conditioning, technique training is not a high priority during this period.
 - Microcycles: gradually increase resistance loads and sport conditioning intensity, decrease training volume.
 - Matveyev's model: divide prep phase into three: **hypertrophy/endurance phase**, **the basic strength phase**, and **strength and power phase**.



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1. Detailed Periodization Models

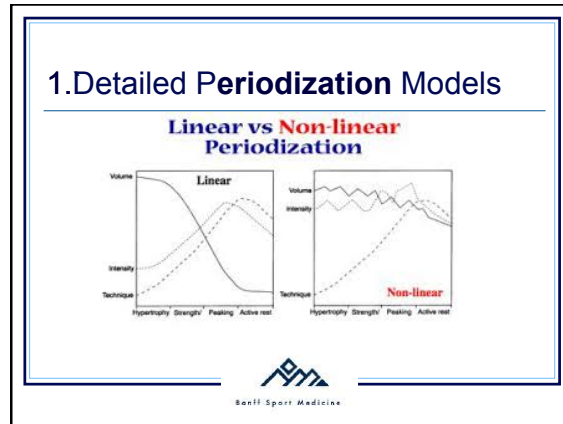
- Preparatory Phase**
 - Hypertrophy/Endurance Phase**: Low-moderate intensity (50-75% 1 RM) and very high-moderate volume (3-6 sets of 10-20 reps)
 - Basic Strength Phase**: High intensity (80-90% 1RM) and moderate volume (3-5 sets of 4-8 reps)
 - Strength Power Phase**: High intensity (75-90% 1 RM depending on exercise) and low volume (3-5 sets to 2-5 reps)

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TABLE 19.1
A Periodization Model for Resistance Training

Period	Preparation		First transition		Competition		Second transition (active rest)
	Phase				OR		
Variable	Hypertrophy and endurance	Basic strength	Strength/power	Peaking	Maintenance		
Intensity	Low to moderate 50-75% 1RM	High 80-90% 1RM	High 87-95% 1RM 75-90% 1RM*	Very high ≥85% 1RM	Moderate ≈80-85% 1RM		Recreational activity (may not include resistance training)
Volume*	High to moderate 3-6 sets 10-20 repetitions	Moderate 3-5 sets 4-8 repetitions	Low 3-5 sets 2-5 repetitions	Very low 1-3 sets 1-3 repetitions	Moderate ≈2-3 sets ≈6-8 repetitions		


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Thank you





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