

EBM Running Injury

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Goals – review EBM Running Injury

- Offer a few pearls that may help you better approach your patient with a running injury
- Discuss:
 - Risk factors for injury
 - Shoes and Orthotics
 - Stretching, eccentric exercise, warmup
 - PFP/ cavus foot issues
 - Running and Osteoarthritis
 - Mortality and Running

A Prospective Trial of Risk Factors for Running Injuries

- 115 runners in controlled training of 18 to 20 months:
 - 85% injured
 - Training distance was risk factor
- Previous Injury in preceding 12 months (RR 1.51)
- Mileage greater than 40 per week (RR 2.88)
possibly daily running/ long runs (*Boven, et al Int J Sp Med, 1989*)
- Higher running mileage causes running injury

EBM for Causes of Running Injury Limited - Key Observations

1. Total Running Mileage - strong correlations at level of 64 Km per week or 40 miles per week A
2. Previous Injury A
3. Training errors. Ten studies found weak to moderate correlations with training patterns. B
4. Greater risk of stress fracture in females A
5. Possible greater risk for higher BMI. B

Training Error -

- Epidemiology to track the role of training error in sports injury used by Olympic and professional sports teams
- Data shows training loads above normal baseline for the individual has a high predictability for injury
- For recreational runners this likely indicates training error would lead to injury

History Pearls – to assess overtraining: 3 Key Questions

- How many KM/miles per week do you run?
 - Do they exceed 30 miles/ 60 KM per week – if so injury risk is higher
- What is the training pattern?
 - Do they do long runs of more than 90 minutes?
 - Frequency of speed work?
 - Rest days?
 - Did they increase their training above the traditional levels.
 - Did they do a "boot camp."
- Have you ever had a serious injury that took you away from running for 1 or more weeks?.

Cochrane 2011 Update on Preventing Running Injuries

- “Overall, the evidence base for the effectiveness of interventions to reduce soft-tissue injury after intensive running is very weak ...”
 - *Interventions for preventing lower limb soft-tissue injuries in runners. Yeung and Yeung. Cochrane*

EBM since the Cochrane Reviews

- Interval training seems protective against knee injury
- Abrupt changes in training regimen – military and other boot camps cause injury
- Protection from injury by cross training
- Prospective analysis of 264 runners
 - Lower risk if more time spent in other sports
 - Lower risk if used multiple shoes
 - Lower risk with more KM covered per workout time

Pearls about Emerging EBM for running injury

- Many traditional theories about prevention of running injury are myths. E.g. Running faster may be safer!
- Runners have a high rate of injury but most are not very serious.
- Cross training seems helpful.
- Specific interventions may help individual runners – custom orthotics, patellar straps or a calf compression sleeve;

SHOES AND ORTHOTICS

- What shoes are best?
- Do you match the shoe and the foot?
- Will the shoe successfully block pronation
- Do orthotics prevent injury?
- Do custom orthotics offer unique benefits?



Shoe Evolution

- Running shoes in 1912 looked like dress shoes today
- Shoe design has steadily changed and improved? Over past 40 years
- However, injury rates are similar
- Demographic is dramatically different
 - 1970 thin males 75% and generally elite
 - 2019 females now 54%, generally recreational and average BMI much higher

Jim Thorpe 1912/ Nike 2020



Shoes and Injury

Ryan et al BJSM 2014

- 2 studies of cushioned shoes did not show reduction of injury
- Neutral vs. minimalist vs. full minimalist shoes in 103 runners neutral or mild pronation
- High compliance with shoe use
- RR increase: 160% in minimalist and 310% partial minimalist
- Greater drop out of minimalist groups
- Greater Shin and calf pain full minimalist



Heel to toe drop in running shoes

Malisoux AJSM 2016

- Trial of 553 runners followed 6 mos.
- Assigned to 10mm, 6 mm or 0 mm drop
- Occasional runners saw reduced HR of 0.48 in 6 mm drop and 0 mm drop
- Regular runners saw a significant 1.67 HR increase using low drop



Barefoot Running

- Will work for certain individuals but surface can still be a problem
- Overall studies point to some increase in injury rate but are mixed
- More injuries seen in heavier runners or those who don't adjust to going barefoot
- Metatarsal stress fracture likely at increased risk – accidental foot strike?

Comfort Hypothesis for Running Shoes

Nigg, BJSM, 2015

- Runners will consistently pick shoes that provide the most comfort
- Comfortable shoes have association with lower injury
- Comfortable shoes lower VO₂ Max required for a given running effort
- “Best shoe is most comfortable”

Orthotics choice

- Nigg hypothesis – there is a preferred path of muscle firing for a given runner. If a shoe or orthotic supports this path, this could potentially reduce injury
- Individuals chose insoles based on comfort just like they choose shoes -
- Military study trying 5 insoles – those choosing comfort had 53% lower injury than those assigned by foot shape (*Muendermann, et al. MSSE 2001*)
- Softer insoles proved more comfortable

Orthotics and Injury

- Overall studies suggest that orthotics decrease running injury risk (5 early studies)
- Two good military studies
 - 400 runners – orthotic 21/ flat insole 61 injuries
 - 306 runners – orthotic 27/ flat insole 40 injuries
- Other studies show reduction in lower extremity pain with cavus foot and PFP
- Custom vs. prefab – variable results but favor custom

Pearls about Shoes and Orthotics

- Comfort hypothesis is best strategy for picking shoes and may reduce injury
- Shoe design (motion control, etc.) does not effectively reduce injury
- Insoles and custom orthotics also work best when comfortable
- Custom orthotics have potential to reduce injury and pose little risk
- Minimalist, low drop shoes and barefoot running may increase injury risk

Stretching to Prevent Sports Injury

- Stretching historically favored by a number of experts and in surveys by up to 95% of coaches
- Meta-analysis and multiple studies show strong EBM that stretching before running did not reduce injury.
- More recent emphasis to look at Yoga, Pilates, Tai Chi and moving stretching to other times or after work outs

– *Thacker, et. al. Medicine and Science in Sport and Exercise 2004.*

Is Stretching or eccentric strengthening Better for Lower Limb Flexibility?

- Meta-analysis of eccentric strength programs and lower limb flexibility (*O'Sullivan, BJSM, 2012*)
- Meta-analysis found 6 RCT that looked at joint ROM or muscle fascicle length
- Consistent strong evidence from all 6 studies of 3 different muscle groups showed that eccentric exercise improved lower limb flexibility by either type of measure
- Correlation with injury prevention has not been done

Warm Up for Prevention

- Studies of warm up and overall injury rates have generally been favorable but limited to study populations in middle/high schools and did not examine competitive runners
- In some stretching studies of running injury the control group focused on warm up and had lower injury rate than stretching group
- Warm Up probably prevents injury in physical education and maybe in running – EBM C

Pearls stretching and warm up

- Stretching before running is not helpful for injury prevention but a good warm up may be
- Runners who stretch should do so after the run
- Flexibility may be gained more efficiently by using yoga, pilates or tai chi and doing this twice weekly or more
- Eccentric strength workouts may prevent injury and often increase flexibility better than stretching

What EBM Relates to PFPS – “Runner’s Knee”

- 3 early studies showed more runners knee in *supinators* - often cavus foot
- Hip abduction weakness in particular seems to relate to PFPS or an imbalance
- *Orthotics often work*
- *Patellar straps help a number of runners*
- *VMO weakness is common and hard to rehabilitate*



Cavus Foot – Longer Term Prospective Study

DiCaprio J Spts Science and Med 2010

- 166 adult runners with average age of 31, all levels
- 5 Year follow-up after initial assessment of foot morphology and running style
- Non-traumatic injury to lower extremity limiting activity by 2 weeks
- Highest risk were rearfoot varus (87.5 % of injured runners) or pes cavus (71.4%)
- Most common injuries were plantar fasciitis (31%) and Achilles tendinopathy (24%)
- Competitive runners accounted for 70% of injuries

Cavus foot with TMT bossing and splaying between great and second toe



This photograph shows a foot with a high longitudinal arch (cavus foot), bossing at the TMT region involving the first and second rays (arrow), and splaying between the great and second toe (arrowhead).

TMT: tarsometatarsal.

Courtesy of Kari B Fields, MD.

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Prospective Trial of Running and OA of Knee

- Duration 14 years with initial radiographs on all runners and controls.
- Cohort of 48 runners and 53 controls with average age of 58 at onset
- At start of study 6.7% of runners and 0% of controls had signs of OA
- At end of study 20% of runners and 32% of controls had OA
- At end 2.4% runners and 9% of controls with severe OA
- Risk factors for worsening were OA on initial Xray, BMI and age –
NOT RUNNING

» Amer J Prev Med, Chakravarty, et al. 2008

Is Running Really High Impact ?

- Peak knee joint forces are much higher in running than walking
- High Peak joint forces have been associated with development of Knee OA
- Why do runners not show high levels of knee OA?
- Per Unit Distance (PUD) loads may be a key measure for predicting OA
- Study looked at running vs. walking and PUD and Peak loads



Why don't most runners get knee osteoarthritis? A case for per-unit-distance loads. Med Sci Sports Exerc. 2014 Mar;46(3):572-9.

Miller, et al.

- 14 healthy adults at self selected running & walking paces
- Ground reaction forces and motion camera analysis calculated the Peak and PUD forces
- Peak load was 3x higher in running but the PUD was not
- Peak load increased with faster running pace but PUD actually decreased
- Short duration of ground contact and long stride length for running blunt the effect of peak force on overall stress to the knee
- Altered running mechanics may negate this effect

Is Running Actually Protective Against OA

Williams, MSSE 2013

- Longitudinal study of 74,752 runners and 14,625 walkers for 7.1 yrs.
- Runners 2004 OA cases (1/37) and 254 THR (1/294)
- Walkers 696 OA cases (1/21) and 114 THR (1/128)
- Low/Medium and High activity lowered OA by 15 to 18% and THR by 35 to 50%
- Other non-running sport increased OA by 2.4% and THR by 5%
- Risk reduction in running was negated by increased BMI
- Conclusion: Running lowers OA risk partly because of decreased BMI

Is Running More Efficient for Weight Loss than Walking?

- 6.2 yr. prospective follow up of energy expenditure in running and walking correlated to change in BMI
- BMI declined with increasing energy expenditure in both running and walking
- For equivalent energy expenditure BMI declined more with running than walking
- Running led to greater loss in BMI in all 4 quartiles of men and in the 4th quartile of BMI in women
- At the 4th quartile in men and women there was 90% greater weight loss per MET-hours per day run
- Age related weight gain was attenuated in both sexes by running and by walking in women

•Williams, MSSE, 2013

Running and Mortality

- Strong EBM particularly from Blair, et al and studies at the Cooper Clinic demonstrate that fitness has a strong inverse correlation with mortality A
- 284 runners and 156 controls over age 50 completed a 21 year follow-up to assess mortality and disability
- Disability scores were higher in controls at all time points and increased more than in runners with age
- At 19 years, 15% of runners and 34% of controls had died ----lean BMI and low smoking rates in runners
- After adjustment of co-variables the survival benefit for runners was 0.61 (reduction 39%)

» *Chakravarty, Ann Int Med, 2008*

Summary - Running Injury Risk

- Running injury affects ~ 50% of LDR yearly and ~ 25% are injured at any time - A
- Strong EBM links training error- primarily total running distance with injury and interventions to reduce running miles did reduce injury A
- EBM strongly suggests that previous injury is a risk for subsequent injury. Weaker EBM that additional rehabilitation would change risk A
- Moderate EBM links cavus foot type with increased injury risk but less EBM to suggest that interventions reduce risk B

Summary – shoes and orthotics

- Comfort hypothesis is a key to choice - C
- Path of preferred muscle firing may explain why shoes and orthotics can work to reduce injury - C
- Minimalist and low drop shoes and barefoot running pose some risk and challenges - B
- Custom and some OTC orthotics show potential for injury reduction - B

Summary - Running Injury Prevention

- Some EBM supports warm-up but the research was not done on runners. - C
- Strong EBM show that eccentric strength exercises increase flexibility - A
- Pre exercise stretching to prevent running injury has not shown benefit and other approaches – stretch post exercise or alternatives like yoga merit study - A
- EBM for PFP support hip abduction exercises for treatment and prevention; use of patellar straps for pain reduction; and use of orthotics B

Summary – running and long term health

- Running appears to reduce the risk of OA of knee and of THR A
- Peak impact is higher in runners but cumulative impact per unit of distance is similar to walking B
- Running specifically and other activities that improve fitness lessen mortality and disability A