Science Meets Practice: Form Before Footwear Effectiveness vs. Efficacy in Running Injury Management

Section: Sports PT Section
Session Code: SP-1A-5237
Date: Thursday, February 22, 2018
Time: 8:00 AM - 10:00 AM
Location: New Orleans Ernest N. Morial Convention Center
Room: The Great Hall A

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I. Introduction of Topic
II. Introduction of Speakers
   a) Rich Willy, PT, PhD, OCS
   b) Blaise Dubois, PT
III. Case Introduction:
   a) Teenage runner with chronic knee pain
      i) Background/History
      ii) Pain Location/Severity
          (1) Aggravating factors
          (2) Alleviating factors
      iii) Patient-reported functional outcome measure reports:
          (1) Peds-QL
          (2) IKDC
          (3) University of Wisconsin Running Injury & Recovery Index
      iv) Shoe Information
          (1) Shoe classification based on Minimalist shoe Index
      v) 2D & 3D Key Gait Analysis Findings
          (1) Step Rate
          (2) Overstriding
          (3) Medial Collapse
      vi) Clinical Exam Key Findings
      vii) Clinical Interventions
      viii) Outcomes with before & after comparison:
           (1) Patient-reported functional outcome measure reports
           (2) Clinical Exam key findings
           (3) 2D & 3D Gait analysis findings
      ix) Case Discussion on chosen interventions
Richard Willy, PhD, PT
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The presenter has no financial relationships or product endorsements to disclose
Presented at 2018 APTA Combined Sections Meeting

Outline for presentation:

1. Shoe prescription to reduce risk of injury: what’s the evidence? (12 min)
   a. Does pronation matter?
   b. Does shoe prescription reduce risk of running injuries?
   c. Comfort or shoe prescription?

2. Gait retraining (15 min)
   a. Envelope of function
   b. Where does gait retraining fit into a treatment plan?
   c. Structuring a gait retraining program
   d. Gait retraining for performance enhancement: what’s the evidence?
I. Slide 1: Cover slide
II. Slide 2: Disclosures
III. Slide 3: Outline for talk
IV. Slide 4: Where do runners get injured?
   a. Patellofemoral pain: ~25% of all running injuries with 62% being female.\textsuperscript{5, 29} High rate of recurrence.\textsuperscript{17}
   b. Tibial stress injuries account for 2.2-7.8% of all running injuries.\textsuperscript{6, 28}
   c. Achilles tendinopathy account for approximately 10% of all running injuries, although the rate is considerably higher in masters runners (18.5%).\textsuperscript{19, 28} Importantly, 45% have recurring symptoms.\textsuperscript{27}
V. Slide 5: Dose response relationship to loading and injury. Importance of adaptive homeostasis. Underloading is just as risky as overloading.\textsuperscript{12, 13}
VI. Slide 6: Viewing injuries in the context of the Tissue homeostasis model and envelope of function, as per Dye 2005, can be helpful to guide the clinician and the runner.\textsuperscript{10, 36}
VII. Slide 7: Running shoes: Why do they gain so much attention?
VIII. Slide 8, 9: Assigning shoes based on foot type has not been helpful in reducing risk of running related injury.\textsuperscript{16, 26}
IX. Slide 10: In a large prospective study of 927 runners, overpronation was found to be protective.\textsuperscript{23}
X. Slide 11: Door has been opened for alternative shoe prescription models:
   a. Minimalist shoe prescription\textsuperscript{9}
   b. Comfort model\textsuperscript{21, 22, 24}
XI. Slide 12: Training in minimalist shoes does not result in meaningful reductions in impact forces\textsuperscript{32} and may result in elevated risk of injury in some runners, particularly those who are novice or with higher BMI.\textsuperscript{11, 30, 31}
XII. Slide 13: Shoe drop. Large randomized control trial found no impact of shoe drop on injury rates.\textsuperscript{20}
XIII. Slide 14: Options for gait retraining to reduce impact forces
   a. Forefoot strike.\textsuperscript{8} Results in potentially deleterious increase in Achilles loads\textsuperscript{3}
   b. Feedback on impact forces, easily done with accelerometer.\textsuperscript{4} Results in similar increases in ankle work as feedback on forefoot strike however.\textsuperscript{4}
   c. Feedback on vertical oscillation of center of mass.\textsuperscript{1} Good to excellent agreement with motion capture from Garmin Fenix 2 with heart rate monitor strap.\textsuperscript{1} Cueing a reduction in vertical oscillation may affect running economy. How much to cue?
   d. Feedback on step rate effectively reduces loading rate in runners with high impact forces.\textsuperscript{34} Excellent agreement between shoe mounted
accelerometer (Garmin FR70) and instrumented treadmill (icc >0.9)\textsuperscript{34} with 95% LOA 2.9 steps per min.\textsuperscript{35} Reduces impact forces without increasing ankle work.\textsuperscript{4} Increase in hip flexor and hamstring forces when step rate is increased, but no change in running economy when increase in step rate <10% over preferred.\textsuperscript{7, 18}
e. All are likely effective at reducing impact forces in-field. Requires further study to determine which is most effective.

XIV. Slide 15: In-field gait retraining program.\textsuperscript{34}
a. 8 sessions. Self-controlled feedback.\textsuperscript{2} Can provide bandwidth feedback if desired.
b. Encouraged to continue normal running routine: matching performance context with therapeutic intervention increases the likelihood of lasting training effects.\textsuperscript{14}
c. 30-Day monitoring period

XV. Slide 16: Mobile monitoring
a. Assessment of adherence with program

XVI. Slide 17-18: Results of in-field retraining intervention to reduce impact forces in randomized controlled study \textsuperscript{34} and case study
a. 17.9-18.9% reduction in loading rate.
b. 30-day monitoring period: majority of retrainers retained new step rate pattern

XVII. Slide 19, 20: Gait retraining to address frontal plane mechanics in runners\textsuperscript{25, 37}

XVIII. Slide 20: Importance of motor learning principles to skill acquisition\textsuperscript{15, 33, 38, 39}

XIX. Slide 21: Review future directions and limitations Slide 24: Take home message

XX. Slide 22: Acknowledgements

4. Baggaley M, Willly RW, Meardon SA. Primary and Secondary Effects of Real-time Feedback to Reduce Vertical Loading Rate During Running. Scandinavian journal of medicine & science in sports. in press;epub:
32. Willson JD, Bjorhus JS, Williams DS, 3rd, Butler RJ, Porcari JP, Kernozek TW. Short-term changes in running mechanics and foot strike pattern after introduction to minimalistic footwear. PM R. 2014;6:34-43; quiz 43.
34. Willy RW, Buchenic L, Rogacki K, Ackerman J, Schmidt A, Willson J. In-field gait retraining and mobile monitoring to address running biomechanics associated with tibial stress fracture. Scandinavian journal of medicine & science in sports. epub ahead of print;
35. Willy RW, Meardon SA, Schmidt A, Blaylock NR, Hadding SA, Willson JD. Changes in tibiofemoral contact forces during running in response to in-field gait retraining Journal of sports sciences. epub;
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1. Running injuries
   a. Why, when, where
   b. Mechanical stress quantification and training errors
   c. Running biomechanics
   d. Running shoes

2. Gait retraining
   a. Foot Strike pattern
   b. Impact force and noise
   c. Stride Frequency
   d. Pronation, knee valgus and other kinematic peculiarities

3. Definition of running shoes
   a. The expert consensus (Minimalist index and its psychometric properties)
      Footwear providing minimal interference with the natural movement of the foot
      with its high flexibility, low weight, stack height and heel to toe drop, and the
      absence of motion control and stability technologies.
   b. The effects of footwear characteristics on running kinetics, kinematics
      and tissue stress.

4. How to prescribe running shoes
   a. Common recommendations on running shoes
   b. Level of evidence on injury prevention
c. Level of evidence on performance

5. Transition between shoes
   a. Guidelines on safe transition times between shoes characterized by different levels of minimalism.

6. Conclusions, Take home message, Acknowledgements


10. Esculier JF, Bouyer LJ, Roy JS. The effects of a multimodal rehabilitation program on symptoms and ground reaction forces in runners with patellofemoral pain syndrome. J Sport Rehabil 2015; Accepted.


29. Murphy, Kelly; Curry, Emily; Matzkin, Elizabeth Barefoot Running: Does It Prevent Injuries? Sports Medicine, 2013;Vol. 43 (11), 1131–1138.


