

# THE BIOMECHANICAL APPROACH TO PROBLEM SOLVING FOR RUNNERS AND MARATHONERS: POSTURAL AND FLEXIBILITY BALANCING FOR RELIEF OF STRESS

Karl K. Klein  
Department of Kinesiology & Health Education  
The University of Texas at Austin  
Austin  
USA

Initial training for running takes many forms - run a little, walk a little. This develops an increased cardio-respiratory efficiency as muscular soreness and stress subside. If any of these factors persist, especially stresses in the ankles, knees, hips, or low back, the person seeks help from other runners and/or looks for professional help in the community.

From 1969 to May 1989 over 1,900 joggers/runners have visited the Rehabilitation Laboratory seeking aid. A standard procedure of evaluation has been set up: 1) to determine the mechanical malfunction that caused the problem, and 2) to identify distribution of mechanical faults. Table I illustrates data collected from 1,910 cases and shows that lateral postural asymmetries, bilateral ankle pronation, and muscular imbalance between the antagonistic muscles are major areas. "Pigeon toed" is the way "the leg bone is attached to the thigh bone", so that the lower leg inward position is essential.

Ryan (1973) points to the many failures observed in the evaluation of low back pain. He emphasizes that mechanical inefficiencies are the chief causes of stress.

Running is primarily a function of the hip joint flexors and extensors, as well as the musculature of the lower leg.

The major hip flexor is the ilio-psoas muscle. It attaches to the lateral sides of the lower five vertebrae and to the inside rim of the pelvis and then to the medial, posterior side of the upper leg (femur). This is a strong muscle and if short when standing, pulls the pelvis and low back down and forward, causing a "sway" back and tends to externally rotate the femur. According to Michele (1971), this is a major muscle that causes low back pain in today's society. A quadriceps muscle, the rectus femoris, originates to the anterior iliac spine of the pelvis and inserts below the knee joint. When tight, it also assists in pulling the hips downward, adding to the patella. When these two muscles are exercised, they tend to tighten and shorten. They need to be stretched daily.

The leg is extended by the gluteus maximus and the hamstrings. The latter is an active extensor of the knee in walking and especially in running when the foot is in contact with the ground. It is weaker than its antagonist and loses measured strength more rapidly. When the hip flexors are tight and the pelvis is dropped forward, the hamstrings are also stretched, causing them to lose some efficiency in function. This and lateral pelvic tipping are fundamental causes of hamstring injury.

Excessive tightness of gastroc-soleus can also add to stress. Problems resulting are: anterior "shin splints", ankle pronation, posterior "shin splints", turning outward of the foot in running, and knee stress (James & Brubaker, 1972).

Flexibility is an important key for forward mobility and in the prevention of injury. Stretching should be done daily only to the point of comfort (de Vries, 1966), 40-50 seconds each. Stretch before and after running.

Lateral tipping of the pelvis is a significant part of the total problem. Studies have shown it to be highly related to runner's stress (Klein, 1978) as well as to low back pain (Beal, 1950; Kraus, 1965; Klein, 1970; Lovett, 1912). Also, it is a prime factor in hamstring pulls primarily on the long leg side as caused by the dropping of the pelvis when the short leg is on the ground. This action pulls the long leg hamstring at its pelvic origin (Klein, 1987; Klein, 1988).

If there are no pathological problems present, then the condition is idiopathic and has been there since early childhood (Klein & Buckley, 1968). Correction of this problem can be achieved by a heel lift on the "short side". Some other causes may be due to one ankle pronation and/or one "knock" knee. The basic correction of ankle pronation is with the use of some type of orthotic device and exercise. Subotnick has reported that about 85 percent of all ankle problems are due to pronation (Jesse, 1977).

The Rehabilitation Laboratory makes use of a Rear Foot Control (Roberts, 1961) to aid in solving the

problems, along with a series of specifically designed exercises (Klein & Allman, 1971).

Early use of the "Rear Foot Control" is an important step in the correction of mechanical errors. They are effective in early training because they immediately promote better foot-leg function. This aids in the development of proprioceptive muscle action. Their use is also important during phases of muscle fatigue when the musculature tends to lose its effectiveness in action (Klein, 1979).

In conclusion, emphasis on the improvement of running mechanics, the specificity of exercise, and the use of the Heel Lift and "Rear Foot Control" are all useful in the basic approach to help runners make their exercise more pleasant and stress free.

TABLE 1 - 1990 Cases  
EVALUATION FINDINGS JOGGERS-RUNNERS and OTHERS-STRESS PROBLEMS (May '89)

MAY '89

TABLE 1 - 1910 Cases  
EVALUATION FINDINGS  
JOGGERS-RUNNERS and OTHERS-STRESS PROBLEMS

POSTURAL ASYMMETRIES		ANKLE PRONATION			KNEE STRESS			Muscle Tension	Hip Pain	Low Back	Shin Splints	
		Right	Bilateral	Left	Right	Bilateral	Left					
SHORT R 576=32% M=350 F=226  RANGE 2-7" 8	SHORT L 1205=67% M=679 F=526  RANGE 2-6" 8	M 9 F 7 16	M 715 F 499 1214 63.5%	M 13 F 6 19	M 163 F 115 278 30.3%	M 193 F 144 337 36.8%	M 185 F 116 301 32.8%	M 956 F 668 1624 85%	M 104 F 132 236 12.3%	M 164 F 102 266 13.9%	M 136 F 138 274 14.3%	
TOTAL R-L SHORT 1781=93.2% of the cases measured		TOTAL WITH ANKLE PRONATION 1249 of 1910 cases = 65.4% of the 1249 cases  M=737=59% F=512=41%			TOTAL WITH KNEE STRESS 916 of 1910 cases = 48% M=541=59% F=375=41%			of 1624 cases M=956 58.9% F=668 41.6%	<div style="border: 1px solid black; padding: 5px; text-align: center;">                     KEY M=MALE F=FEMALE                 </div>			
SACRAL BASE LEVEL 13=.007% of the 1794 cases measured		TOTAL WITH CHONDROMALCIA 325 of 916 knee stress cases=35.4%  M=154=47.4% F=171=52.6%										
NOT MEASURED 116=.061%												

#### REFERENCES

- BEAL, M.C.: "A Review of the Short Leg Problem". Journal of American Osteopathic Association, 1:3:1950.
- DE VRIES, H.A.: "Physiology of Exercise for Physical Education and Sports." Wm. C. Brown, Co., Dubaque, Iowa, 1966.
- JAMES, S.L. and BRUBAKER, C.E.: "Running Mechanics". Journal of the American Medical Association, 221:9:1014, August 28, 1972.
- JESSE, J.: "Running Athletes and Joggers." The Athletic Press, Pasadena, California 91105, 1977, Chapters 17, 18, 19.
- KLEIN, K.K. and BUCKLEY, J.C.: "Asymmetries of Growth in the Pelvis and Legs of Growing Children, Summation of a Three Year Study 1964-1967." American Corrective Therapy Journal, 22:2:53, March-April 1968: "Progression of Lateral Asymmetries of Growth: Comparison of Boys Elementary Through High School with Adults with Chronic Low Back Symptoms." The D.O., 11:2:107. October, 1970.
- KLEIN, K.K. and ALLMAN, F. A.: "The Knee in Sports." The Peaberton Press, Austin, TX 1971 (Second Printing), pp. 111, 112.
- KLEIN, K.K.: "Developmental Asymmetries of the Weightbearing Skeleton and its Implication in Knee Stress and Knee Injury." Athletic Training, Summer 1978, pp. 78, 80.
- KLEIN, K.K.: "From the Clinic - Exercises for More Effective Use of Foot Controls." American Corrective Therapy Journal, 33:2:58, March-April, 1979.
- KLEIN, K.K.: "Effect of the Short Leg Syndrome Compounded in Athletics." The First Aider, Feb. - March 1986, 55:5.
- KLEIN, K.K.: "Heel Lifts Correct Imbalance, Managing Hamstring Pulls in Runners." The First Aider, Sept. 1987.
- KLEIN, K.K.: "Knee Stress and Injury and Developmental Asymmetries of the Weightbearing Skeleton." The Texas Coach, Nov. 1987, pp. 20 - 22.
- KLEIN, K.K.: "Medical Update - Managing Hamstring Pulls in Runners." The Texas Coach, 1988.
- KRAUS, H.: "The Cause, Prevention, and Treatment of Backaches, Stress and Tension." Simon and Schuster, New York, 1965, p. 183.
- LOVETT, R. W.: "Lateral Curvature of the Spine and Round Shoulders." P. Blackistons Sons and Co., 1912
- MICHELE, A.A.: "Orthotherapy." M. Evans and Co, New York, 1971, p. 223.
- ROBERTS, C. A.: "Foot Balance and Athletic Achievement." Texas Coach, April 1961, p. 15.
- RYAN, A. J.: "What Causes Low Back Pain." The Physician and Sports Medicine 2:9:37, September 1973.
- SUBOTNICK, S.T.: DPH Personal Communication.