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Baseball (Part I): Dynamic Flexibility

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BEFORE PARTICIPATING IN A practice session or a game, it is common to see baseball players performing either static (stretch held for 10–30 seconds) or passive stretching (an outside force or resistance provided by oneself, partner, gravity, or a weight to help joints move through their range of motion) before engaging in the activities of their sport, such as throwing, fielding, or hitting. To most baseball players these forms of preactivity warm-up have been taught as the appropriate way to prepare themselves before stepping onto the diamond. However, neither of these activities appears to be the best approach to physiologically prepare the baseball player's body for competition. According to Shellock and Prentice (10), the best way to prepare for more strenuous exercise (daily training session or competition) is to perform specific warm-up exercises because they provide a rehearsal of the activity and increase body temperature.

The purpose of this article is to focus on the 3 components of a specific warm-up: cardiovascular, neural, and dynamic flexibility, with special attention paid to the latter. Dynamic flexibility is an active range of motion within a full range of motion in a joint or joints (7). When dynamic flexibility exercises are performed in the same or similar movement patterns that are required in practice or game situations, they prepare both the large muscles of the hip and back and the smaller stabilizing muscles of the groin, knee, and ankle (3). Described within this component will be the scientific and theoretical reasons why dynamic flexibility is a more appropriate prepractice or pregame warm-up than static stretching. Considerations on how to match a training or game session with the appropriate warm-up session will also be explained and displayed in table format.

Dynamic Flexibility Versus Static Stretching

Dynamic flexibility, the act of quickly moving a joint through its range of motion with little resistance, improves flexibility, coordination, balance, proprioception, and movement speed (6). It also raises core body and deep muscle temperatures, elongates active muscles (elasticity), decreases the inhibition of antagonist muscles, stimulates the nervous system (arousal), and helps to decrease the chance of injury (3, 4, 6). Additionally, dynamic flexibility teaches running mechanics/technique that would normally be taught during a speed, agility, or plyometric training session. This means that dynamic flexibility can be used to improve running mechanics/technique independent of a training session aimed at achieving the same goal. Thus, if a baseball player engages in different types of training sessions, he will receive twice the opportunity to practice proper mechanics in hopes of maximizing his athletic potential by making fluid, explosive movements second nature.

Static stretches, on the other hand, may only improve flexibility, and will do very little physiologically to warm-up the baseball player's body for competition. Fur-

thermore, statically stretching before practice or competition may even have adverse effects, such as calming the athlete, decreasing blood flow to previously active muscles, and reducing the overall strength output (5). In a study by Purdam et al. (8), athletes were tested on torque production during knee flexion following static or dynamic stretching to see if there were any significant differences in strength output. The results showed that static stretching produced a significant reduction in eccentric hamstring strength when compared to dynamic stretching for a time period lasting up to 1 hour poststretching. The researchers believed that the reduction in eccentric strength following static stretching was due to suppression of the central nervous system. These findings support the use of dynamic flexibility prior to competition, and suggest that static stretching should be used for postcompetition cool down.

Elements of a Dynamic Warm-Up

A thorough dynamic warm-up prior to a practice session or game must consist of 3 components: cardiovascular, neural, and dynamic flexibility. All 3 components are equally important to the baseball player to ensure the greatest potential for maximal performance in that given dynamic session.

Cardiovascular

Physiologically, the importance of incorporating low/moderate intensity (<75% HRmax) activities, such as butt kicks, high knee skips, carioca, and strides in the prepractice or pregame warm-up is to improve the efficiency of the cardiovascular and respiratory systems (4). Low/moderate intensity, continuous rhythmic activities will prepare the heart for the physiological demands and processes that will soon be placed upon it, increase blood flow to the working muscles, as well as raise the body core and active muscle temperatures. In extreme weather conditions, low/moderate intensity activities become much more important.

When playing in cold weather, a baseball player could lose fine motor skills, such as the finger dexterity needed to catch and throw a baseball. Also, agonist and antagonist muscles may begin to shiver that could further impair a baseball player's normal movement patterns during a game. Cooled muscles would ultimately lead to a decrease in strength (2). Thus, a dynamic warm-up including low/moderate

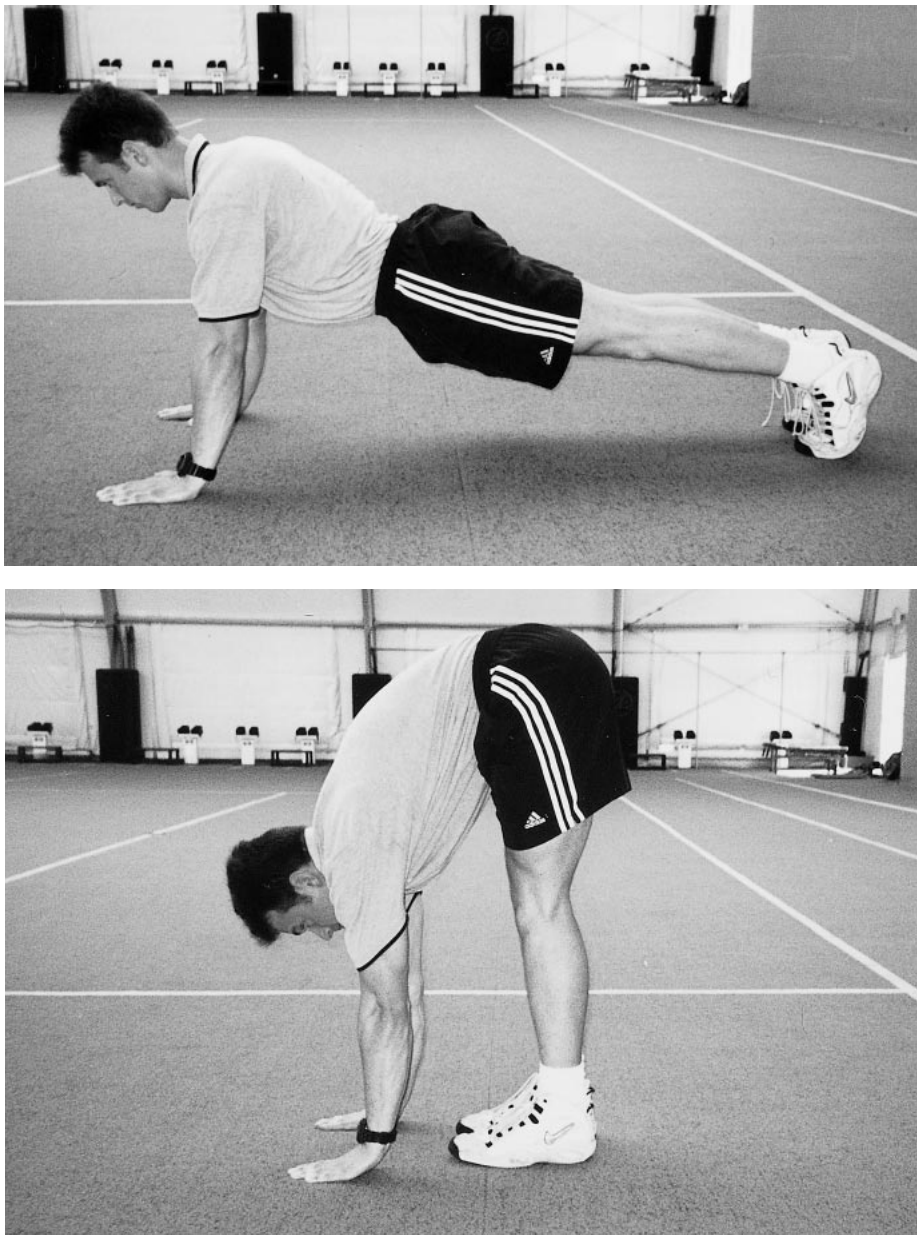

Figure 1. **Hand walk: (top) starting position and (bottom) ending position.**

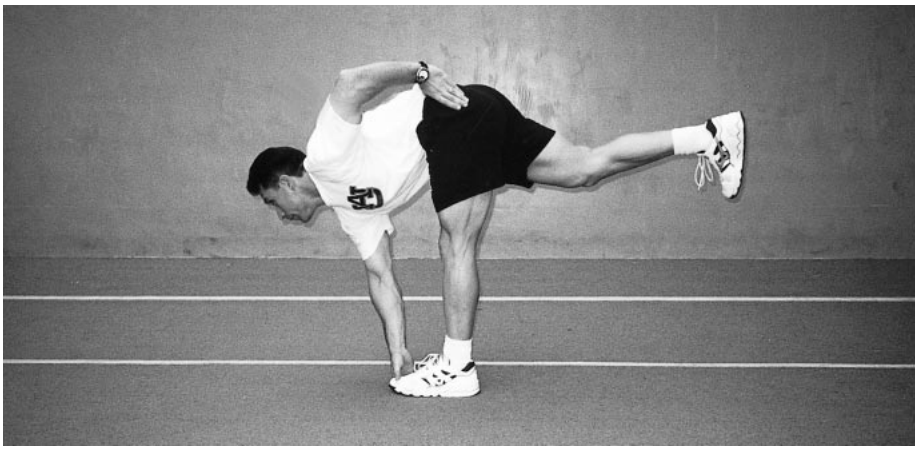

Figure 2. **Inverted toe touch (opposite hand to opposite toe).**

intensity activities would help the baseball player better acclimate to his environment by increasing body core and active muscle temperatures and countering the shivering mechanisms to generate heat. This would make movement patterns smoother and more fluid.

In hot weather, the temperature of the player's peripheral tissues (i.e., skin and muscle) will resemble the environmental temperature. Additionally, muscle temperature is determined by muscle blood flow, metabolic rate, and hydration status (2). The core

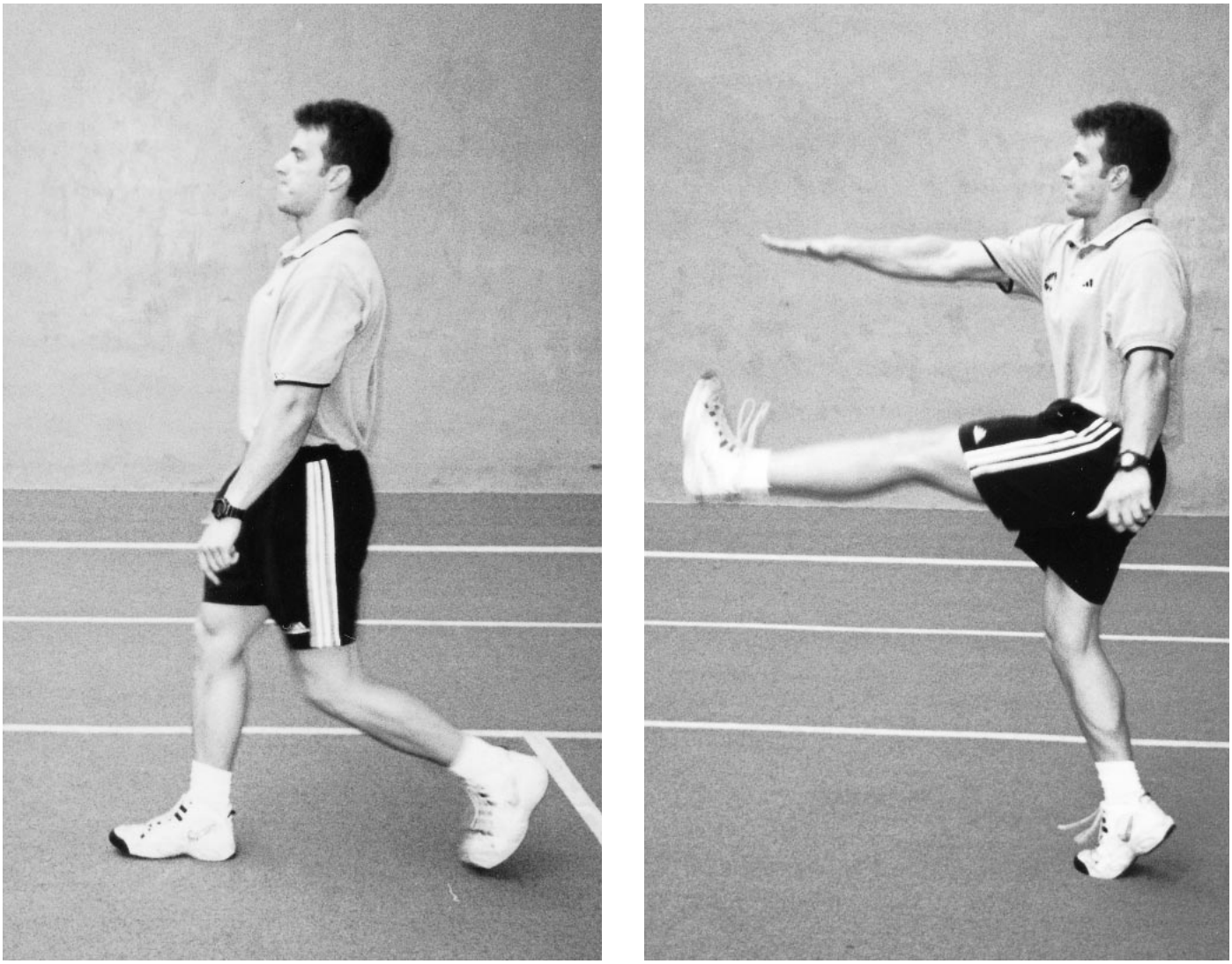

Figure 3. **Straight leg march: (left) starting and (right) ending position.**

body temperature, on the other hand, remains relatively constant and rises in direct proportion to relative exercise intensity (2). Thus, the greater the relative exercise intensity, the more core temperature will rise. Muscle temperature tends to be higher on a warm day for a given exercise intensity than on a cool day. However, regardless of the environmental temperature, it is still important to perform a dynamic warm-up before practice or a game because it increases muscle and ligament elasticity and movement flexibility, in addition to increasing core body and active muscle temperatures (7). Because these changes occur sooner due to the high environmental temperature, less time needs to be spent on the dynamic warm-up (15–20 minutes) prior to practice or a game.

Neural

Although the cardiovascular and neural components are divided into 2 separate categories in this article, it should be noted that many of the changes or responses due to exercise are not solely one or the other. In fact, the control over circulatory and respiratory functions are neurally regulated via chemoreceptors, baroreceptors, and muscle afferents (1). However, it is the purpose of this article to discuss the neural aspects as they relate to motor unit and muscle fiber activation.

The importance of incorporating a neural component into a well-rounded prepractice or pregame dynamic warm-up is to raise the level of excitation of the nervous system. According to Sale's (9) ramp theory of motor unit and muscle fiber recruitment, a progressively increasing force recruits the motor units at a gradual and increasing level from a slow twitch force (twitch speed) to a fast twitch force (twitch speed). Thus, as the baseball player goes through a gradual progression of dynamic warm-up exercises that become more demanding, starting with joint mobility exercises, then moving to general movement preparation, and finally to multidirectional preparation (see Table 1), the activation of more motor units will occur. This will allow them to be physiologically ready at game time. In addition, the neural warm-up component prepares the body for the increased motor unit recruitment of the task-depen-

Table 1
Movement Preparation

A. General warm-up: jog 5 min at own pace

B. Joint mobility
1. Neck rotations
2. Shoulder shrugs
3. Arm circles/arm hugs
4. Alternating straight arm swings to arm runs
5. Supine bent knees crossover
6. Prone leg over
7. Seated arm runs
8. Supine straight leg crossover
9. Press-up
10. Calf stretch
11. Standing trunk twist
12. Standing side bend

C. General movement preparation

1. Ankle
a. Heel/toe raise
b. Heel to toe walk
c. Ankle circles
d. Toe up/toe down
e. Toe tap
f. Cocky walk with arm circles

2. Hamstrings
a. Hand walk
b. Inverted toe touch
c. Straight leg march
d. Straight leg skip

3. Quadriceps/hip flexors
a. Forward lunge with forearm to instep
b. Backward lunge
c. Butt kicks

4. Hips/groin
a. Leg cradle
b. Drop lunge
c. Dog and bush
d. Backwards dog and bush
e. Lateral lunge

D. General linear preparation
1. Knee hug lunge
2. Ankle skip
3. Ankle flip
4. Progressive toe up/knee up skip
5. Power skip
6. Toe up/knee up run

E. General multidirectional preparation

1. Lateral/base
a. Lateral high knee march
b. Lateral high knee skip
c. Lateral base slide

2. Crossover
a. In-place crossover
b. Carioca
c. High knee carioca

3. Dropstep/backpedal
a. Dropstep squat
b. Dropstep skip
c. Backward reach run

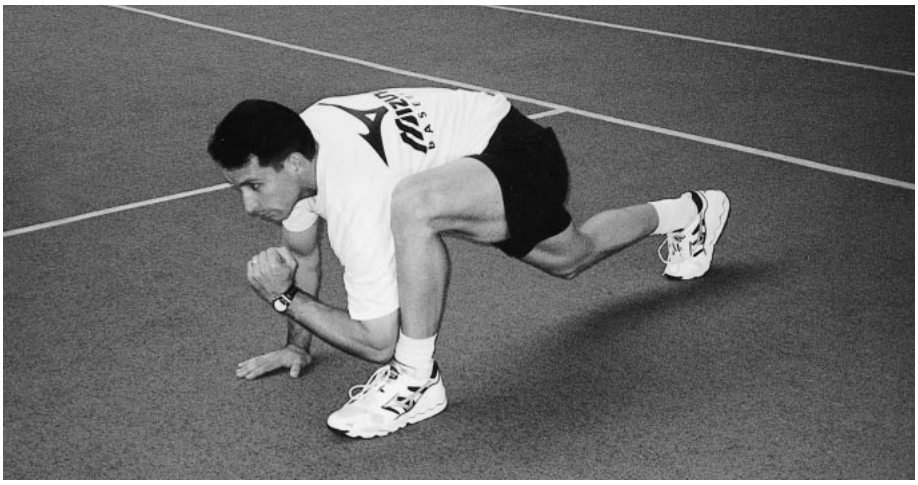

Figure 4. **Forward lunge with forearm to instep.**

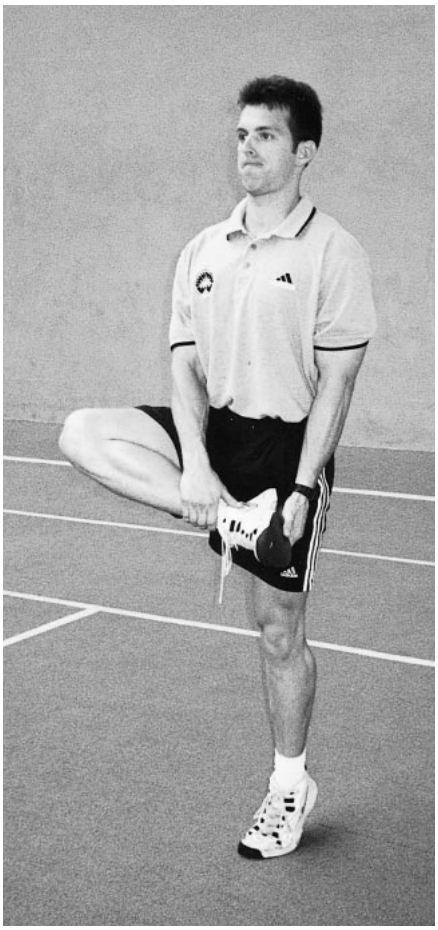

Figure 5. **Leg cradle. While walking, leg is crossed in front of body and gently lifted by foot and ankle. Repate with the other leg.**

dent, specific movement patterns used by the multifunctional muscles involved (9). Simply put, there is a different motor unit recruitment order and firing pattern for 2 different, but similar, movements that use the same muscles (i.e., a diagonal single leg bound versus a diagonal lunge).

Dynamic Flexibility

There are numerous reasons why incorporating a dynamic flexibility component into a prepractice or pregame warm-up is important. Dynamic flexibility improves movement flexibility, balance, coordination, proporioception, elasticity of the muscles and ligaments, changes the surfaces of joints in the process of long-term flexibility training, and increases core body and active muscle temperatures (7). Its purpose is to take the baseball player gradually from a resting state to practice or game speed without fatiguing them.

Dynamic flexibility includes a myriad of prepractice or pregame exercises for improving joint mo-

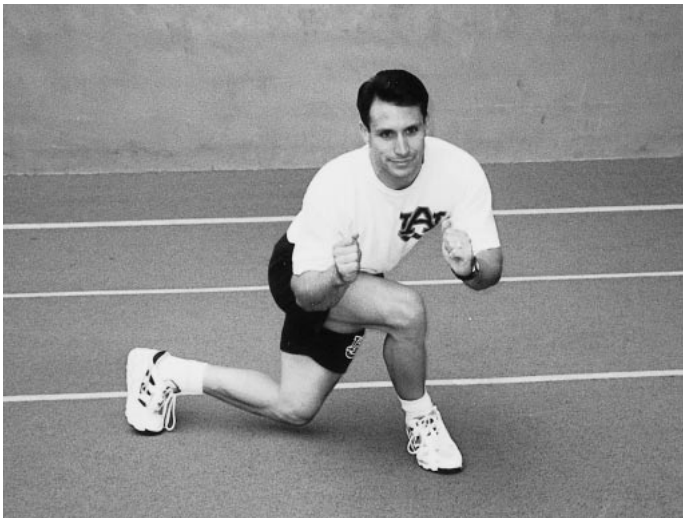

Figure 6. **Drop lunge (carioca step behind).**

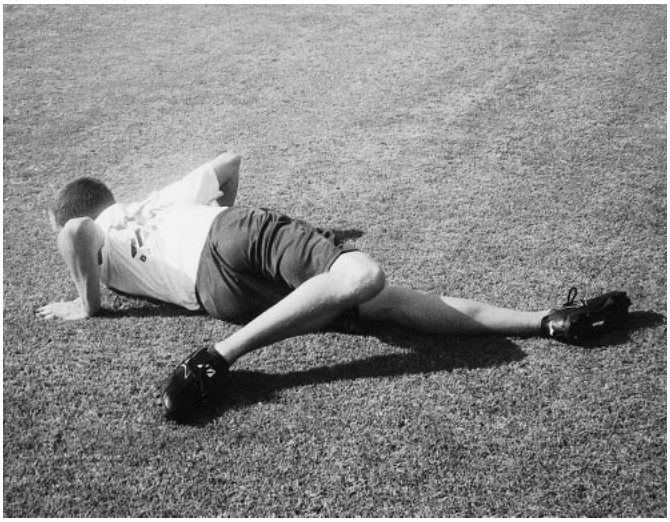

Figure 7. **Prone leg over. Alternate touching toe to opposite side of body. Repeat with other foot.**

Figure 8. **Cocky walk with arm cir cles. Ball of foot is snapped down while walking and performing arm circles. Heels do not touch ground. Palms of hands face up.**

bility and muscle and ligament elasticity. It can be further subdivided into 4 groups: joint mobility, general movement preparation, general linear preparation, and general multidirectional preparation. Table 1 lists these groups, along with a number of exercises contained within each group. Figures 1–14 demonstrate some of these movements.

How to Implement

The entire dynamic warm-up session should take about 15–20 minutes but can go as long as 35 or 40 minutes depending on the environmental temperature. The length of the session is also determined by the emphasis of the training day. For instance, a speed, strength, or highly technical day, as well as a cold day would require a longer warm-up session. An endurance-based or low technical day, as well as a hot and humid day, would require a shorter warm-up session (4). The intensity of the session is based on both the type of training to be emphasized and the environmental conditions. On a power day, dynamic flexibility should be more intense. That is, it should include more ground contacts or impacts, such as skipping to increase neural stimulation. On a preparation or regeneration day (low intensity, decreased volume), dynamic flexibility should be less intense and include more walking and lunging exercises. The movements should be performed in a continuous and "down and back" fashion over 15–20 yards.

The dynamic flexibility warm-up should mirror the days' training objective or competition. It should prepare the baseball player to be able to optimally achieve that days' training goal and be sport specific to baseball movements. Whether the days' training focus is predominately linear, lateral, or multidirectional, the dynamic warm-up should mimic that goal. Baseball is multidirectional, thus the dynamic warm-up should include all 3 aspects of movement. It should be noted that regardless of the training focus or game preparation, all dynamic warm-ups should contain and begin with joint mobility.

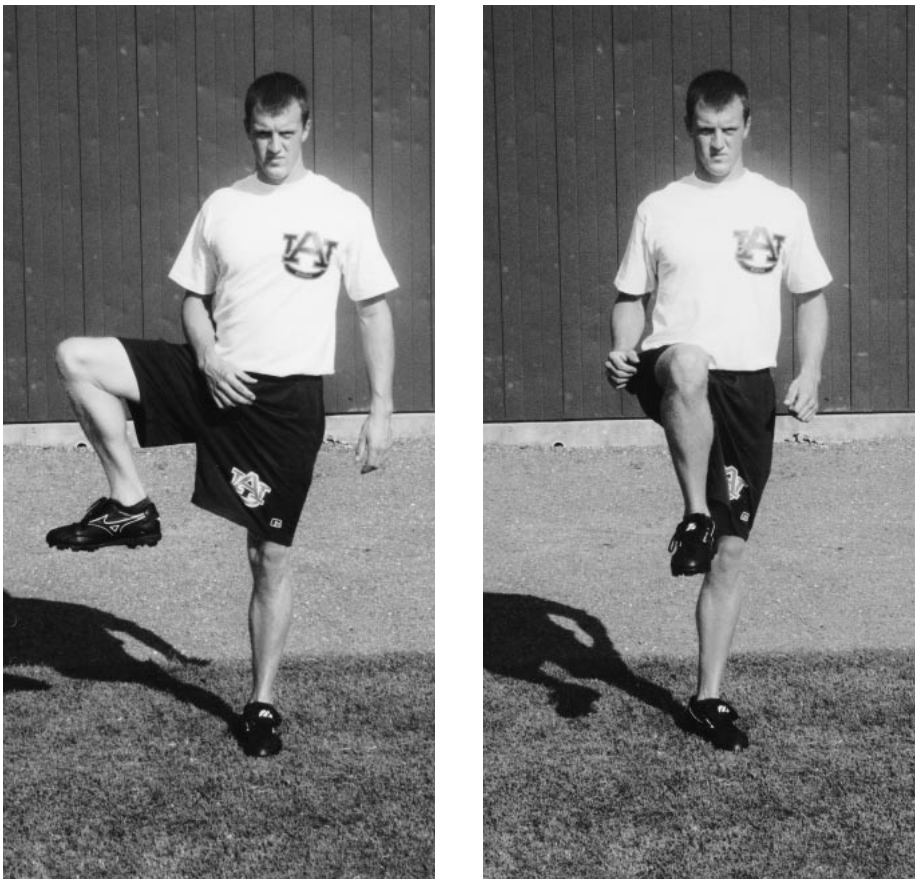

Figure 9. **Dog and bush: (left) knee is raised laterally to waist height, and (right) adducted to midline of body, then lowered to ground. Repeat with other leg.**

Table 2
Training Day Planner

H	M	L	P	Joint mobility
x	x	x	x	Neck rotations
x	x	x	x	Shoulder shrugs
x	x	x	x	Arm circles/arm hugs
x	x	x	x	Alternating straight arm swings to arm runs
x	x	x	x	Supine bent knees crossover
x	x	x	x	Prone leg over
x	x			Seated arm runs
x	x	x	x	Supine straight leg crossover
x	x	x	x	Pressup
x	x	x	x	Calf stretch
x	x	x	x	Standing trunk twist
x	x	x	x	Standing side bend

H	M	L	P	General movement preparation Ankle
x	x			Heel/toe raise
x	x	x		Heel to toe walk
x	x	x	x	Ankle circles
x			x	Toe up/toe down
x			x	Toe tap
x	x	x	x	Cocky walk with arm circles

H	M	L	P	Hamstring
x	x	x		Hand walk
x	x	x		Inverted toe touch
x	x		x	Straight leg march
x	x		x	Straight leg skip

H	M	L	P	Quadriceps/hip flexors
x	x	x	x	Forward lunge with forearm to instep
x		x		Backward lunge
x	x		x	Butt kicks

H	M	L	P	Hips/groin
x	x	x	x	Leg cradle
x	x	x		Drop lunge
x	x		x	Dog and bush
x				Backward dog and bush
x			x	Lateral lunge

General linear preparation	H	M	L	P
Knee hug lunge	x		x	
Angle skip	x	x	x	x
Ankle flip	x	x	x	x
Progressive toe up/knee up skip	x	x		x
Power skip	x	x		
Toe up/knee up run	x		x	

General multidirectional preparation Lateral/base	H	M	L	P
Lateral high knee march	x	x	x	
Lateral high knee skip	x	x		x
Lateral base slide	x	x		x

Crossover	H	M	L	P
In-place crossover	x	x	x	
Carioca	x			x
High knee carioca	x		x	

Dropstep/Backpedal	H	M	L	P
Dropstep squat	x	x	x	
Dropstep skip	x		x	x
Backward reach run	x		x	
Total	**45**	**33**	**26**	**32**

H = high intensity, M = medium intensity, L = low intensity, P = pre-event.

Table 2 lists which exercises and how many exercises are to be done when considering the training days' objective (high, medium, or low intensity, or pre-event).

Conclusion

Many performance coaches believe that the key to obtaining an optimal training or game performance is to train sport specific. With this in mind, it makes sense to warm-up dynamically prior to a practice or a game, and to cool down statically afterward. This point is argued well by

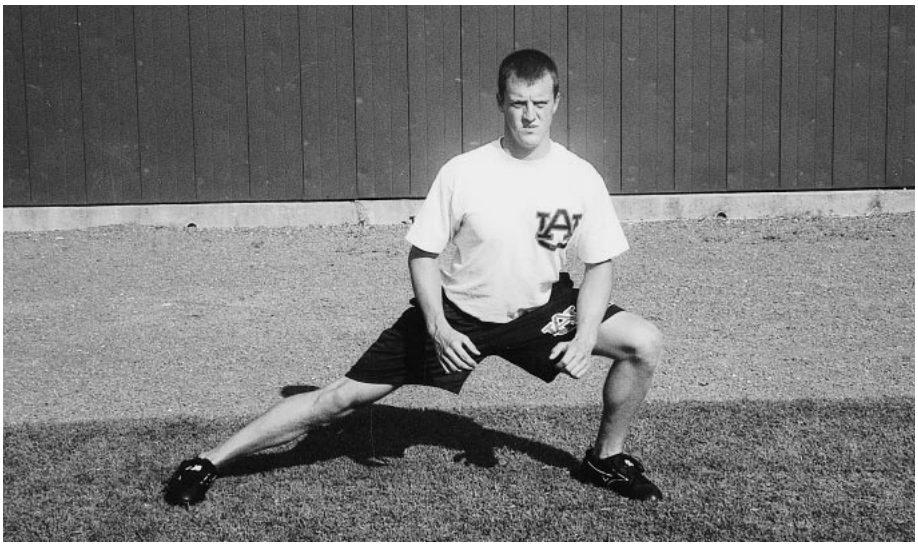

Figure 10. **Lateral lunge with both feet pointed forward. Keep weight on heel of lead foot so knee does not extend over toes.**

Gambetta (5), who states, "…static stretches before warm-up or competition can actually cause tiredness and decrease coordination. In addition, static stretching improves static flexibility, while dynamic stretching improves dynamic flexibility; therefore, it is not logical to use static stretches to warm-up for dynamic actions." Simply stated, dynamically warming up prior to practice or competition will enable baseball players to have a greater dynamic range of motion in sport specific movements.

Dynamic flexibility physiologically prepares the athlete for practice or a game. It can be an enjoyable way for athletes to get

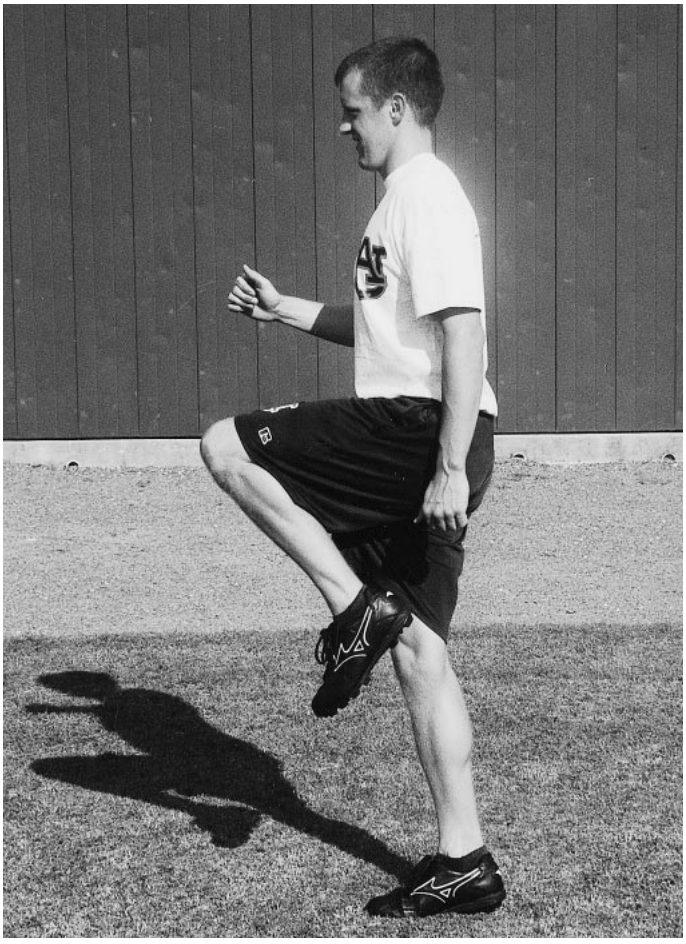

Figure 11. **Power skip is performed by raising opposite arm and leg. Emphasize height and powerful down ward action of raised leg.**

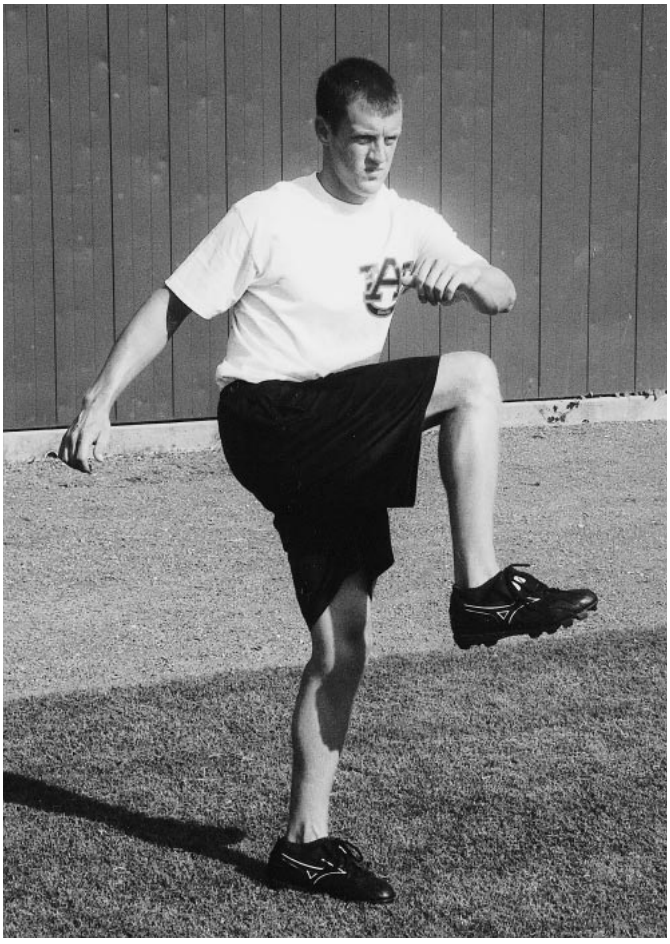

Figure 12. **High knee carioca. After raising knee high, emphasize a powerful downward action of the foot.**

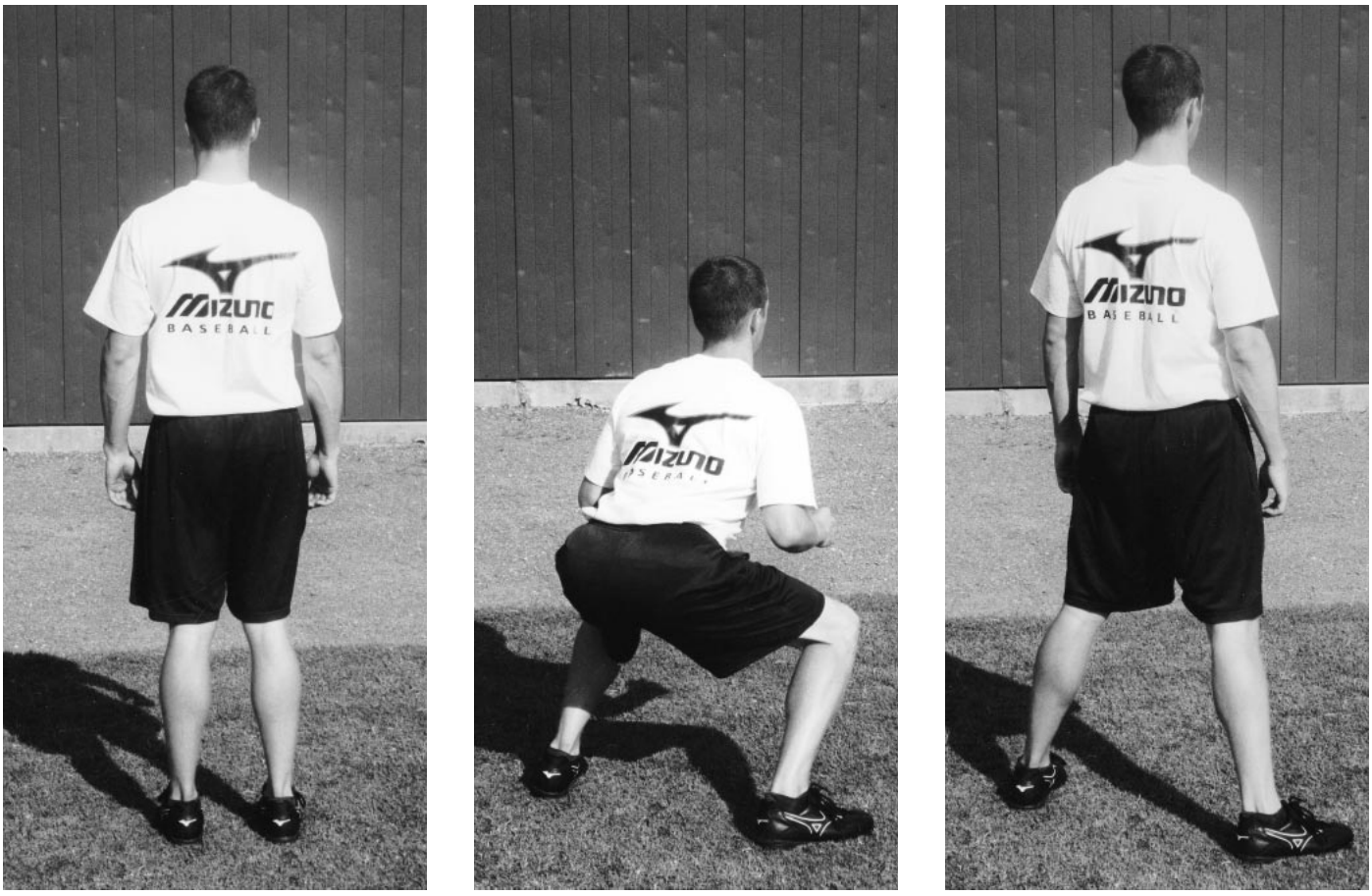

Figure 13. **Dropstep squat. Start in (left) normal position, then (center) abduct hip laterally and take a dropstep backwards, finally (right) performing a standing squat. Repeat with opposite leg.**

emotionally and psychologically ready to play, or even calm those athletes who become nervous before competition. Finally, it can serve as a speed mechanic/technique and movement teaching tool. Give dynamic flexibility a try, be creative, and use a variety of movements to avoid redundancy. ▲

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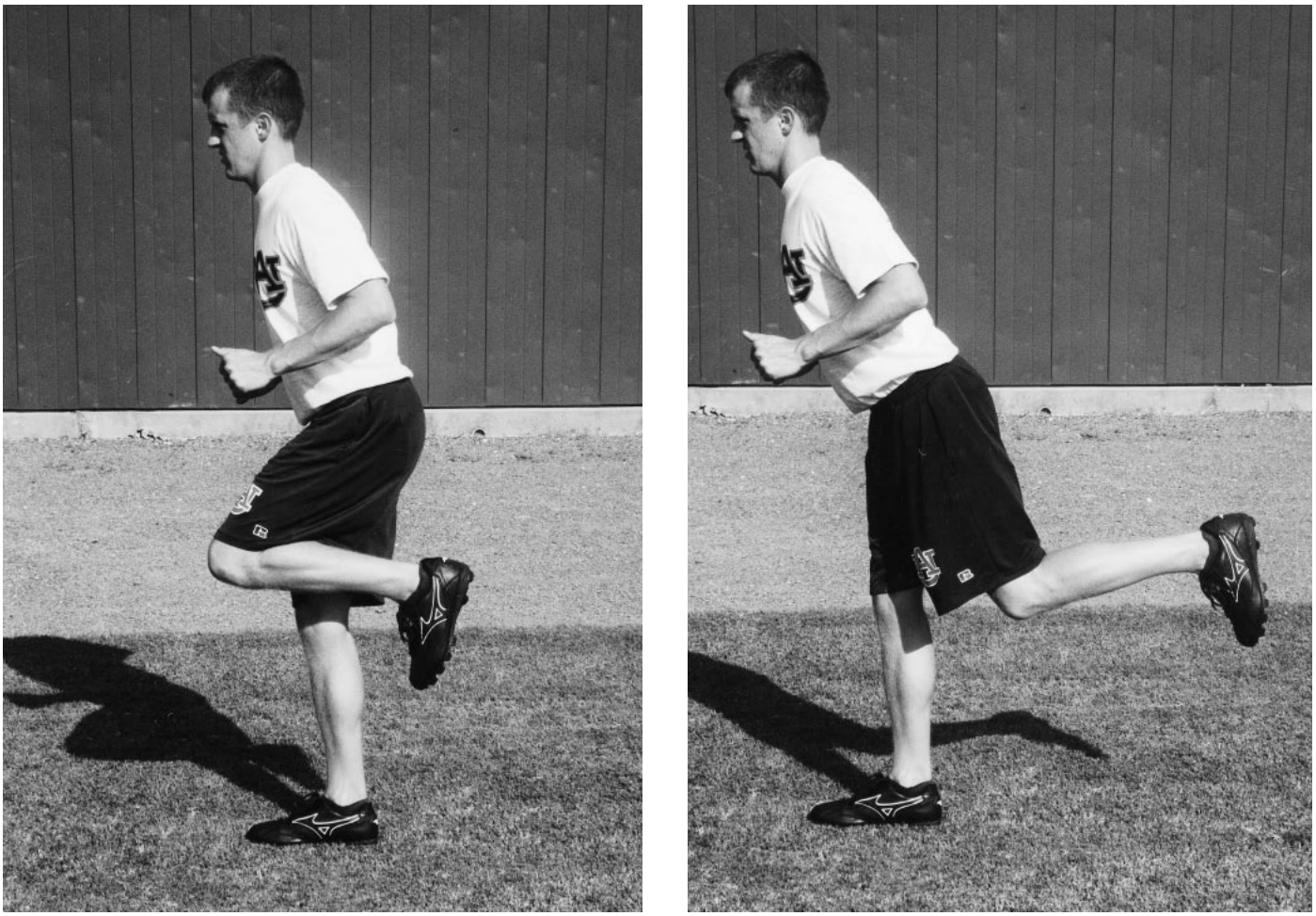

Figure 14. **Backward reach run. First, (left) raise the heel to the buttocks to backpedal, then (right) extend knee and reach foot back.**

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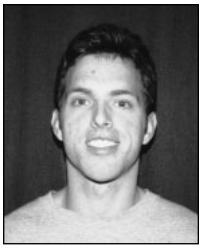

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