

# Putt It Here

## The Ergonomics of Golf

By Tamara Mitchell



Golf requires a unique combination of strength, flexibility, and endurance. It is not a game to play to achieve fitness, however. The swing itself is a high-speed, explosive action and the repetitive nature of the sport predisposes participants to overuse injuries. Unlike many other sports, though, people who have physical limitations, who are out of shape, or those who were never athletic can enjoy golf.

The things you need to do improve your game will also reduce your risk of overuse injuries. Golf injuries generally occur as a result of both improper form and lack of fitness. 18 holes of golf can take over 4 hours to complete, may involve walking 4-6 miles and involves coiling and uncoiling the body approximately 100 to 130 times.<sup>1</sup> If you are not fit, you will be challenged to keep up the pace physically and to focus mentally. Not only that, but muscular fatigue will cause sloppy posture and lack of controlled movement patterns. Combined with poor swing mechanics, the golfer is an "injury waiting to happen". In one study, 80% of golf injuries were overuse injuries.<sup>3</sup> Excessive play/practice and poor swing mechanics are the most frequent causes of injury.<sup>2</sup> Many golf overuse injuries are preventable with appropriate equipment, proper swing technique, a good conditioning program, and a daily warm-up and limbering routine.<sup>2</sup>

### Who gets hurt?

In a questionnaire study of amateur and professional golfers, 82.6% of golf injuries were categorized as overuse injuries while only 17.4% were traumatic single-event injuries.<sup>4</sup> Over 90% of the back and upper extremity injuries, except wrist injuries, were reported to be from overuse. Professional golfers experienced back, wrist, and shoulder injuries, while amateur golfers reported elbow, back, and shoulder injuries.<sup>4</sup> Neither age nor sex of the golfer showed a significant effect on the likelihood of injury.<sup>4</sup>

Golfers who played four or more rounds of golf and who hit at least 200 balls per week reported significantly more injuries than less avid golfers, though it is reported that playing golf intermittently also contributes to higher injury rates, perhaps because such players do not have good swing mechanics.<sup>2,3</sup> The number of injuries to the back, shoulder, wrist, and hand increase with the amount of time spent either in practice or on the golf course.<sup>2,3</sup>

Carrying a golf bag rather than using a mechanical or electric trolley resulted in significantly more injuries to the lower back, the shoulder, and the ankle, especially professional golfers who carried their own bags.<sup>4</sup> Younger golfers tended to carry their own bag more than older golfers.<sup>4</sup>

Golfers who reported previous chronic musculoskeletal problems were more prone to injury than golfers who reported they had no previous problems, but more than half of the respondents did not feel that golf affected their problems.<sup>4</sup> Wrist problems were the most common problem to worsen from playing golf, and none of the players reported that wrist injuries improved from playing golf.<sup>4</sup> Knee problems were the second most common problem to worsen from playing golf. 19.6% of golfers reported that they felt their back problems improved from playing golf. A smaller percentage of golfers reported that hip, foot or

ankle problems improved from playing golf...each slightly over 9%.<sup>4</sup> Players who either used to or currently participate in sports other than golf did not have a higher percentage of injuries than players who played only golf.<sup>4</sup>

### **Conditioning**

In order to prevent injuries and to play a good game of golf, a regular strength and fitness training program is necessary to improve strength, cardiovascular endurance, coordination, flexibility, and balance.<sup>2,3,5</sup> A golf swing involves three moves: shift, turn, and hit, but the golf swing generates about seven times your body weight in compression on the spine and it is one of the most biomechanically complicated movements in any sport.<sup>5</sup> In order to perform the best you can, you need to be able to make these moves powerfully, repetitively, and accurately which demands that you are in good physical condition and you are not overweight.<sup>5</sup> The exercise program of a 65-year-old golfer with a total hip replacement should be different from that of a young golfer with no previous medical problems.<sup>2</sup> The most comprehensive source for preparing your body for golf that we have found is the book, *Fit to a Tee*.<sup>5</sup> There is an excellent test in this source which will enable you to determine what areas you need to improve and focus your training time on: flexibility, strength, endurance, aerobic capacity, balance, and hand-eye coordination or timing.<sup>5</sup>

### Start Slowly

As with any sport, if your body isn't conditioned or used to playing golf, you may do more harm than good by practicing too much when you first start out. Start slowly and build up your game as you perfect your mechanics and work to condition your body.<sup>3</sup>

### Warm up

Warming up for over 10 minutes significantly reduced the occurrence of injuries by about 60%.<sup>3,4</sup> Younger players, better players, and professionals were all found to be aware of the importance of a long warm up in comparison to older, amateur, and less competent golfers.<sup>4</sup>

Warming up for golf is as important as it is for any other sport. Muscles cool down quickly, so be dressed to play and spend about 15 minutes doing warmup exercises as soon as possible before starting your game. Ideally the time from warmup to tee-off should be within 5 minutes.<sup>5,6</sup>

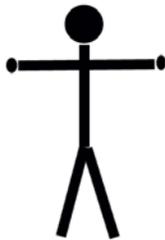
Many people confuse warming up exercises with stretching exercises. Warming up is a process of moving your body to get your heart pumping, to increase your breathing rate to increase oxygen intake, to increase circulation to the muscles, and to loosen up cold muscles and tendons. Stretching is an activity that is aimed at increasing range of motion and it should not be done before you are warmed up because you can tear or damage muscles and tendons by stretching them when they are cold and stiff.<sup>6,7</sup> In addition, research has shown that the power of your muscles is reduced following stretching so it is not an activity that should be done prior to a game.<sup>6</sup> It should be done on days when you are not golfing or after you have finished a game.

It is good to start with a brisk walk, jog, jump rope session, bike ride, or something similar for 3 to 5 minutes. After this initial general activity, you should do some exercises to limber up the areas of the body that will be involved during play. The following dynamic exercises will help you loosen up your body, get the circulation flowing, and prepare you for playing an excellent round of golf.<sup>6</sup> Doing a few arm circles and then several practice swings following these warm-up exercises will prepare your body for an injury-free round of golf by moving from general movement to those that more closely approximate the motions of the swing.<sup>8</sup>

## Pre-golf warmup exercises<sup>6</sup>



**Supported Squats:** Support yourself with a short club or other stationary object. Squat until your thighs are almost parallel to the ground with your torso upright. Stand back up. Repeat 10 times. For a more advanced squat, place one foot across on the opposite knee, then squat on just one leg.



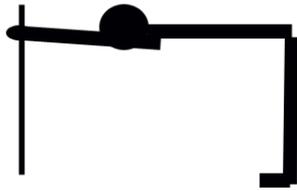
**Arm Swings:** Stand tall and swing both your arms across in front of your body. Repeat continuously for 30 seconds.



**Trunk Rotations:** Stand with feet shoulder-width apart and slightly bend at the waist as if you are going to swing a club. Swing both arms from side to side loosely, twisting at the waist. Repeat for 15-20 swings.



**Side Bends:** Bend from side to side at the waist with arms out straight or supported with a club on your shoulders. Keep your torso in the same plane as your legs. Do not lean forward or backward. Repeat side to side for 8-10 cycles.



**Standing Shoulder Stretch.** Feet shoulder width apart, support your body by holding a club with both hands. Lean forward until you feel a stretch in your shoulders. Hold for 10 seconds, release, and repeat 3 times.



**Wrist Extensions:** Stand tall, hold both arms out straight, pull back on one hand until you feel a stretch in your forearm. Hold for 10 seconds. Repeat with opposite hand.



**Leg Swings:** Stand tall and support yourself with a club. Swing one leg forward and back 10 times, keeping your upper body upright and stationary. Repeat with the opposite leg.



**Alternate Toe Touches:** Do not do this stretch if you have low back pain or this causes you discomfort! Spread your feet as far apart as comfortably possible. With your arms outstretched, try to reach with your hand to the opposite foot, then rotate with the alternate hand to opposing foot. Swing back and forth from one foot to the other continuously for several seconds.

*Give It Your Best Shot with an Exercise Program*

A regular exercise program prepares your body for the game and reduces the likelihood of overuse injuries by strengthening the body's core muscles, ensuring that there is a full range of motion, training for rotational speed, and increasing flexibility.<sup>5,9</sup> If you are overweight, you will need to focus almost all of your training time to aerobic exercise until you reduce your weight to a level where range of motion is not impeded by your weight and you are not fatigued by a round of golf.<sup>5</sup> Core exercises need to be aimed at increasing stability of the low back and shoulder, but they need to focus on improving the quick response (quick twitch) sensors around the joints.<sup>9</sup> Slow training movements do not condition the quick twitch response. Flexibility and full range of motion will allow the golfer to do the twisting and rotating of the body and head necessary to move smoothly and without stiffness through the swing in good form without damaging the body. If you want to increase your rotational speed, you need to use lighter weights and move them faster. And you can increase your speed by swinging clubs that are 15% lighter than your normal clubs (or a related exercise with that same motion), not weighted clubs that will actually reduce your speed.<sup>9</sup> Finally, training should focus on improving your golf form so that you are training your muscles to remember what a proper swing feels like.<sup>9</sup> You can practice your swing forever, but without proper form, you will be training your muscles to remember movements that are incorrect. Retraining

and constant perfection of your technique will enable you to become a more powerful and accurate golfer with fewer injuries.

### **More Ways to Improve Your Health & Your Game**

- **No Smoking.** Smoking has had a strange connection to golfing for decades, but things are changing. In 1962, Jack Nicklaus saw himself smoking while playing golf on film and decided it sent a bad message to youth. He stopped smoking while playing, and later stopped smoking entirely.<sup>10</sup> As with any sport, your overall health is negatively affected by smoking including increasing the carbon monoxide binding to the hemoglobin in your blood where oxygen molecules should bind.<sup>11</sup> This means that your blood is not able to carry oxygen to your muscles and the heart has to pump harder and faster to try counteract this.<sup>11</sup> Smoking also narrows the blood vessels, increases the resting heart rate, and increases the resistance of the rate that air enters your lungs which is also hindered by tar buildup and inflammation of the mucous membranes.<sup>11</sup> Increased risks of cancer, emphysema, and bronchitis add up to a very unhealthy profile for smoking and performance on the golf course.<sup>11</sup>
- **Hydration.** Eating for overall health, staying hydrated and keeping weight down are all very important for injury prevention.<sup>5,12</sup> Being outside for a couple of hours on the links can dehydrate you, so start out the day by drinking a couple of glasses of water before your first cup of coffee, then carry plenty of water with you and drink before each shot.<sup>12</sup> Stay away from so-called sports drinks which are full of artificial colors, sugar or high fructose corn syrup, genetically modified organisms, artificial sweeteners, and artificial flavorings.<sup>12,14,15</sup> Nothing beats water, but if you want a bit more flavor, you can drink unsweetened tea or tea sweetened with stevia, water with a couple of drops of organic essential oil such as lemon, peppermint, orange, or spearmint, or you can add a few slices of strawberries, oranges, or cucumbers to the water bottle.<sup>14,15</sup> If you're playing on an especially hot day, you can add 1/3 teaspoon of *unrefined* sea salt to 3 cups of water (never use refined salt or sea salt) to increase electrolytes and a balance of trace minerals.<sup>14</sup>
- **Keep weight down.** Excess weight puts tremendous pressure on the spine which adds to the stress of the golf swing.<sup>5</sup> There is no way you will be able to have ultimate endurance or perfect form if you are carrying a lot of extra weight.<sup>5</sup> Stay away from gimmicks, pills, and fad diets. For help making healthy dietary choices, refer to the following websites:
  - President's Council on Fitness, Sports, & Nutrition - <http://www.fitness.gov/eat-healthy/>
  - National Institute on Aging - <http://www.nia.nih.gov/health/publication/exercise-physical-activity/chapter-6-healthy-eating>
  - Mayo Clinic - <http://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/basics/nutrition-basics/hlv-20049477?reDate=14042015>
- **Adequate rest.** Giving your body time to rest and recover between days of practice and play will reduce the chances of overuse injury.<sup>16</sup> Take days off between playing to allow the body to rebuild and recover from the game.<sup>16</sup> Also, sleep deprivation can hinder performance and, if continued long term, it can result in changes in hormone levels, especially those associated with stress and mood.<sup>16</sup>
- **Push the cart.** Golfers who carry their own bag suffer significantly more injuries to the lower back, shoulder, and ankle than those who use a pull-cart or caddie.<sup>4</sup> Pushing the cart rather than pulling it puts less torque on the spine.<sup>20</sup> You can push a 2-wheeled cart, use a 3-wheeled pushcart, or opt for a motorized push-cart.<sup>17</sup>

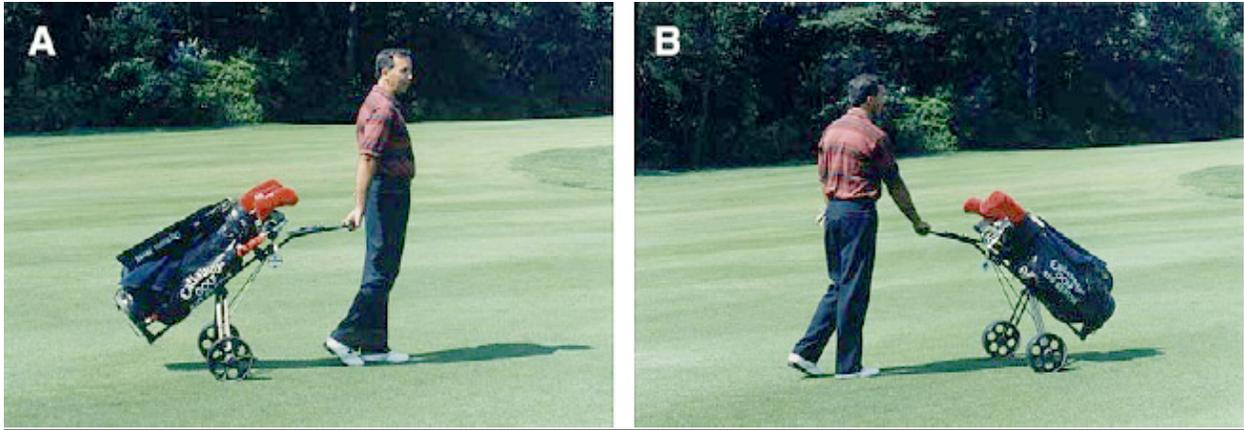


Photo courtesy of Reference 20

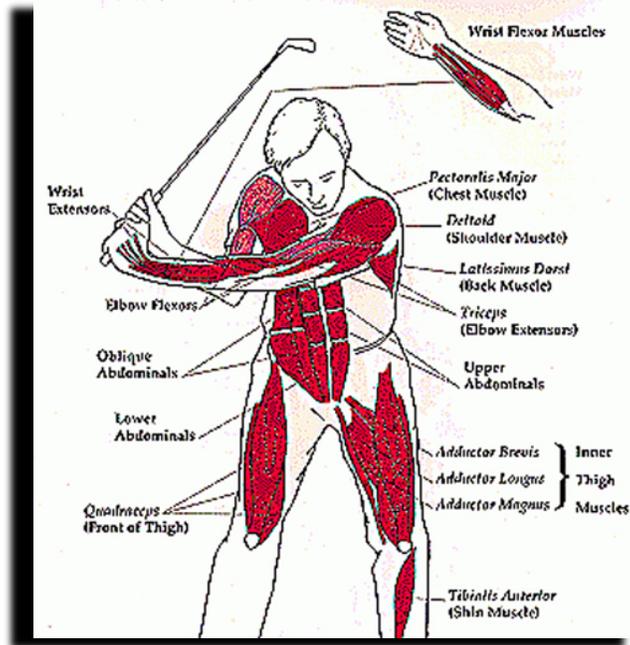
- Take lessons and attend clinics. The best way to develop proper swing mechanics is to work with a PGA professional instructor who can watch your swing and give you specific guidance to improve your technique and reduce your risk for injury.<sup>18,19</sup> There are lots of books on the subject of golf, but you will never be able to see what you are doing wrong by reading books. The help of a professional observer can correct problems with your swing.

### **Choose proper equipment.**

- Golf Clubs
  - Materials. Modern shafts made out of alternative materials are lighter and more flexible, and are reported to be capable of absorbing more vibratory forces than steel. Golfers with degenerative arthritis and other upper extremity problems may be able to reduce the stress to their joints by using graphite, titanium, and other force-dampening shafts. Unfortunately lighter and more flexible shafts are much more expensive and typically do not perform as consistently as their steel counterparts.<sup>1</sup>
  - Shaft length. Due to the prolonged periods of time golfers are in a forward flexed, and somewhat rotated, position, long-shafted putters are recommended for golfers with lumbar (lower back) problems.<sup>1,18</sup>
  - Cavity-backed irons. If you have elbow pain, using cavity-backed irons, which have larger heads and "sweet spots", will dampen the vibrations transmitted to the wrists and forearms from off-center hits.
- Shoes. Golfers with knee or hip joint problems should experiment with soft-spike shoes and the newer "sneaker" type of golf shoes that have molded, non-spike soles.<sup>1</sup> Shoes with metal spikes are designed to create more friction and torque between the ground and the golfer. They can produce more torque in the knee and hip joints as well.

### **Troubleshooting Pain**

Specific problems in the golf swing technique lead to pain in specific parts of the body. Below, we provide a table with physical symptoms and potential sources of the problem, and solutions to correct your swing and resolve the source of the pain. Unfortunately, not all symptoms can be relieved by modifying technique. Even professionals with an excellent swing experience injuries and pain largely due to overuse. The breaking point of "how much is too much" appears to be playing over 4 rounds of golf per week.<sup>2,4</sup> People who practice and play more than this will likely experience problems simply due to the repetitive nature of golf and the forces exerted to the various body parts.<sup>2,4</sup>



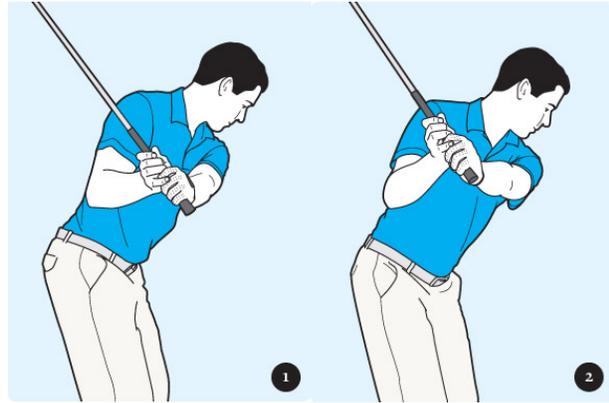
**Muscles Involved in Golf**

(Illustration courtesy of Source 7)

## Troubleshooting Pain<sup>9,20-25</sup>

SYMPTOM	POTENTIAL PROBLEM/SOLUTION
<p><b>Neck pain</b></p> 	<p><b>Problems:</b></p> <ul style="list-style-type: none"> <li>• Head too far forward</li> <li>• Shoulders tightened into permanent shrug</li> <li>• Backswing too far</li> <li>• Poor neck flexibility</li> </ul> <p><b>Solutions:</b></p> <ul style="list-style-type: none"> <li>• Do not drop head. Keep head in line with your spine.</li> <li>• Shorten backswing to keep head still and work on neck flexibility. Source 16 shows some great neck flexibility exercises.</li> <li>• Use gentle neck rolls to warm up the neck prior to playing.</li> <li>• Focus on relaxing the shoulders and letting them drop.</li> </ul>

**Shoulder: Lead shoulder pain. (Left shoulder in right-handed golfer)**



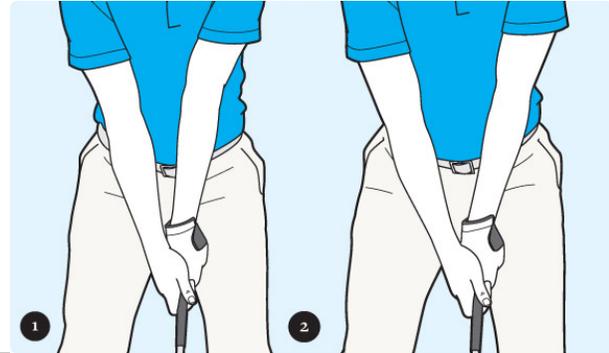
**Problems:**

- Overuse. Downswing stresses the rotator cuff muscles as they pull the left arm forward and rotate the arm.
- Taking too large a divot. Downswing plane is too steep/vertical.
- Mis-hits. eg. hitting a root or rock.
- Arthritic degeneration or limitations in left shoulder motion may cause pain.

**Solutions:**

- Turn the upper body and arms back with the backswing. Turn more, swing less. Do not pin your left arm to your body. Swing your arms with your turn (2) rather than using the muscles in your shoulders to swing your arms back (1) in the backswing.
- Shorten the backswing and end the backswing with the club head at 1 o'clock behind you, rather than at 3 o'clock.
- Hit "up" on the ball rather than hitting "down" on the ball to reduce deep divits. (Please read Reference 17).

**Elbow pain: Lead elbow, "golfer's elbow"**



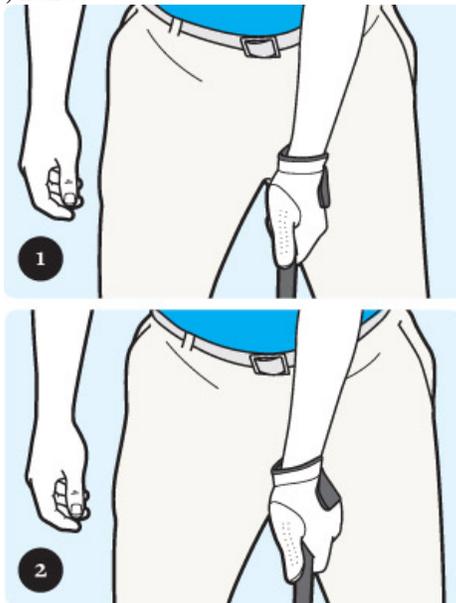
**Problems:**

- Overuse. Contraction of the lead elbow on ball impact.
- Locking the lead elbow (1)

**Solutions:**

- Keep elbows soft from start to finish (2) and let momentum of the downswing pull your arm straight rather than locking your elbow.
- Clubs should have large grips, flexible shafts, and heads with larger sweet spots to reduce vibration.

**Wrists, hands**



**Problems:**

- Flat, weak position of the wrist. (1) Forceful grasp, sideways (ulnar) deviation of the wrist, repetitive use of thumb.
- Amateurs may use "casting maneuver" or premature uncocking of wrists during downswing rather than at ball-strike.
- Trigger finger in leading hand. Finger locking caused by excessive grip tension.

**Solutions:**

- Bend the lead wrist about 30 degrees inward from the target with the thumb at about 1:30 on the club handle toward the right side of the grip (for a right-handed golfer) as shown in Illustration 2. When you hit the ground, your wrist will flatten whereas, if you use a flat wrist, the tendons on the outside of your wrist will be strained leading to tendinitis.
- Do not grip the handle any harder than necessary.

<p><b>Lower back, lumbar</b></p> 	<p><b>Problems:</b></p> <ul style="list-style-type: none"> <li>• Poor swing mechanics</li> <li>• Separating rotation of the pelvis from rotation of the trunk pulls ligaments, tendons, and muscles in the lower back.(1)</li> <li>• Large shoulder turn and less hip turn for power.</li> <li>• Poor physical fitness, lack of flexibility and strength.</li> <li>• Fatigue</li> </ul> <p><b>Solutions:</b></p> <ul style="list-style-type: none"> <li>• Pelvis, torso, and shoulders should rotate together in a smooth classic swing with the forward heel lifting off the ground at the top of the backswing to reduce torque on the spine. (2)</li> <li>• Adopt a straight-up body position in the follow-through and avoid hyperextension of the lower back.</li> <li>• Always warm up just prior to a game.</li> <li>• On alternate days, work to improve core strength and flexibility.</li> </ul>
<p><b>Knee pain</b></p>	<p><b>Problems:</b></p> <ul style="list-style-type: none"> <li>• Weight shift and rotation during follow-through.</li> <li>• Inward twisting of the forward leg from the hip to the foot.</li> </ul> <p><b>Solutions:</b></p> <ul style="list-style-type: none"> <li>• Strengthen opposing muscles. The muscles on the outside of the leading leg are overused. Ride a bicycle or stationary bike for 30 minutes at least 3 times a week and make sure the seat is high enough to keep both legs working the entire rotation.</li> </ul>
<p><b>Ankle/foot pain</b></p> 	<p><b>Problem:</b></p> <ul style="list-style-type: none"> <li>• Inadequate strength, stabilization, and proprioception (balance).</li> </ul> <p><b>Solution:</b></p> <ul style="list-style-type: none"> <li>• Stop playing to allow healing, then work on balance and strengthening exercises prior to returning to golf.</li> </ul>

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