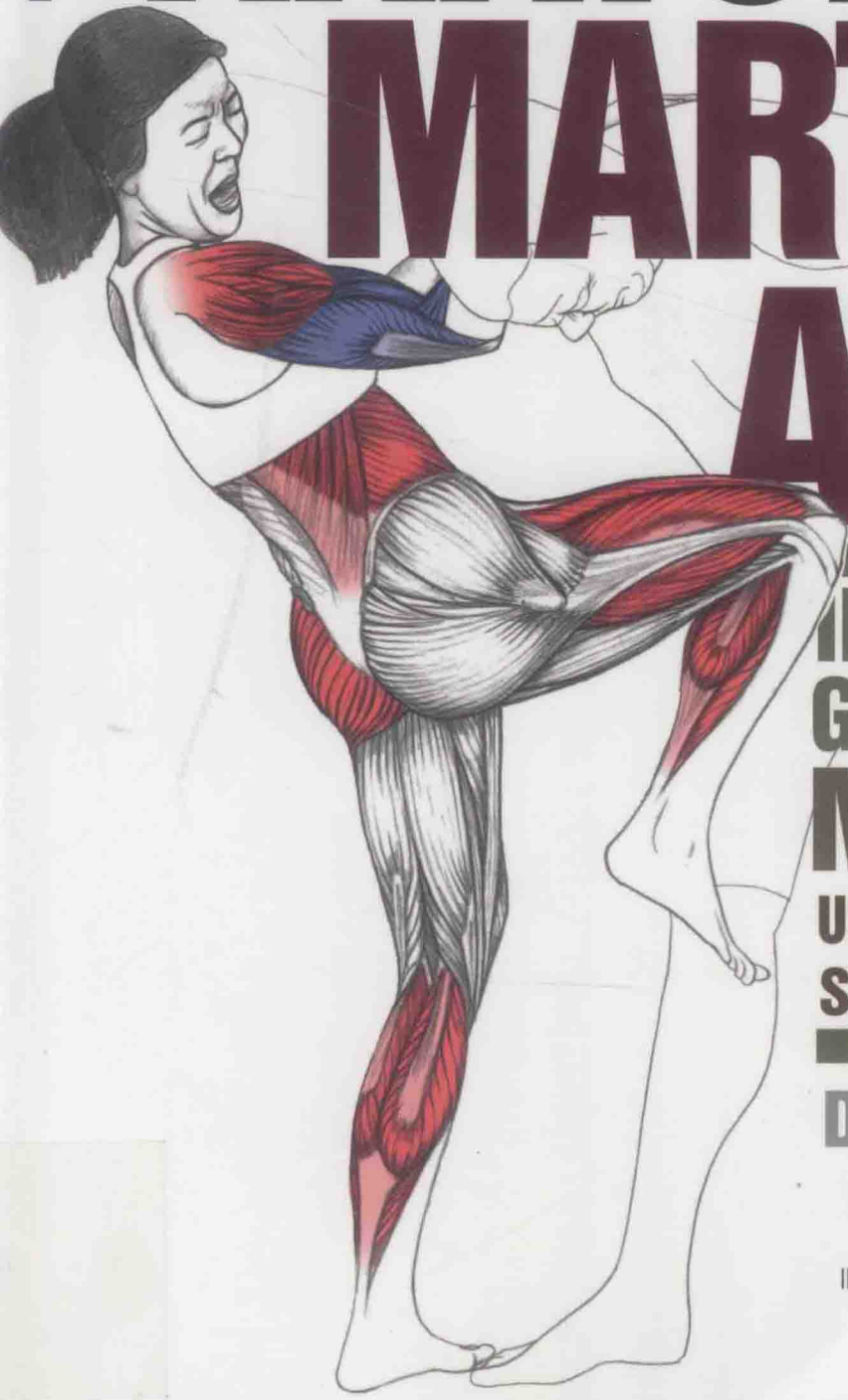
THE ANATOMY OF MARTIAL ARTS



AN ILLUSTRATED GUIDE TO THE MUSCLES USED IN KEY KICKS, STRIKES & THROWS

Dr. Norman Link and Lily Chou

Illustrations by SUMAN KASTURIA

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This book is dedicated with humble appreciation to Dr. Ken Kyungho Min, founder of the University of California at Berkeley's Martial Arts Program (UCMAP). It was Dr. Min's encouragement to explore all aspects of martial arts that made this book possible.

Published in the United States by
ULYSSES PRESS
P.O. Box 3440
Berkeley, CA 94703
www.ulyssespress.com

Library of Congress Control Number 2009940338
ISBN13 978-1-56975-787-1

Printed in Korea by Tara TPS through Four Colour Print Group

10 9 8 7 6 5 4 3 2 1

Acquisitions Editor: Keith Riegert
Managing Editor: Claire Chun
Editor: Lauren Harrison
Proofreader: Bill Cassel
Interior design and layout: what!design @ whatweb.com
Front cover design: Double R Design
Back cover design: what!design @ whatweb.com
Production: Judith Metzener
Anatomy illustrations: Suman Kasturia except on page 136 © ANATOMIA3D/shutterstock.com
Photographs: Rapt Productions
Models: Jon Bertsch, Lily Chou, David Commins, Luke Commins, Kelly Kim, Norman Link, Susan Link, Bob Matsueda
Index: Sayre Van Young

Distributed by Publishers Group West

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PART 1: OVERVIEW

INTRODUCTION

Welcome to *The Anatomy of Martial Arts: An Illustrated Guide to the Muscles Used in Key Kicks, Strikes and Throws.* Between the two authors, we have about 60 years of formal martial arts training and yet are just starting to scratch the surface of learning. This is not an attempt at being humble; it's a simple fact. As you train in whatever martial arts you choose, your body changes. With luck, it is sculpted to flow with the techniques that the art demands, and with time there should be a steady improvement. However, when looking at martial arts training over a longer period of time, our bodies inevitably age and our physical abilities slowly decline. The bottom line is that we spend more and more of our time trying to adapt the techniques we know to an ever-changing set of bones and muscles.

For this book we've been limited to showing 50 techniques from as wide an array of martial arts as we could. Thus, we chose a number of hand strikes (including breaks), kicks, throws, weapon and grappling techniques, and rolls and falls. While a beginning martial arts student may find this book interesting, it will be most useful to intermediate and advanced practitioners of the martial arts.

Unlike most other martial arts books, this book assumes that the reader is already familiar with the techniques that are featured. We don't teach any techniques; rather, we highlight and discuss the main muscle groups required for the technique to be performed and suggest ways to both strengthen and stretch those muscles to improve the technique's quality. Because even basic moves such as a front kick can be taught a variety of ways depending on the art in which they're used, we hope that by emphasizing the body's fundamental structures, particularly the musculature and kinetic chains, the foundation of each technique might be reopened to discussion.

Even if you decide that the muscles highlighted are incorrect or incomplete, then at least we've accomplished our primary goal of getting you to think about each technique's foundation. We hope that by reviewing your movements as to which muscles are being used, you can augment your training to improve the power and motion that actually drive the techniques.

ANATOMY AND MARTIAL ARTS

Every move we make, be it sitting, standing, running, or kicking, involves an elaborate choreography of the 250 skeletal (or voluntary) muscles as they move our 206 bones. These bones are arranged as follows:

29 in the head and neck

2 clavicles, or collarbones (the most commonly broken bone in the body)

2 scapulae, or shoulder blades

26 in the spine, or vertebral column

24 ribs

1 sternum

2 in the pelvis

60 in the arms (3 each) and hands (27 each)

60 in the legs (4 each) and feet (26 each)

In brief, each muscle group has a specific set of functions and is often paired with an opposing muscle or muscle group. The biceps, for example, are responsible for bending the arm at the elbow, while the triceps are responsible for straightening it. Contracting the biceps causes the arm to bend; at the same time, the triceps must relax. Any disruption in this play of opposites can affect the movement (for example, tight biceps will prevent full arm extension). The last page of this book features a color-coded illustration of the muscles and their actions. You'll also find charts in the appendix that list the key muscles and their functions.

The Anatomy of Martial Arts largely ignores the 29 bones in the head, except insofar as to recognize that the head must be protected (as with a chin tuck during a back fall). The movements of the remaining 177 bones and the muscles that move them are what make the practice of martial arts so very interesting and difficult to learn. The martial arts, when properly performed, aren't just a set of actions but a veritable symphony of movements. This makes identifying the muscles involved in any given technique a challenge. Even a technique as seemingly simple as a reverse punch requires the martial artist to perform a specific sequence of actions in a specific order and with specific timing.

It's beyond the scope of this book to describe all the muscles involved in each stage of a technique; rather, this book highlights the key muscles and the kinetic groups they work in. We hope that this will help you reconsider how you perceive the various techniques and how you might improve them.

LINES OF POWER FOR MOVEMENT: KINETIC CHAINS

Power is required not only for hand strikes and kicks but also for throws, jumps, falls, and twisting out of an attacker's reach. A number of people have used the term "kinetic chain" in reference to a power stroke of the body, or when muscles work together to produce a given line of power. While several kinetic chains have been defined and used in other works, this book features six major ones. (There are, of course, many others that can be defined, but for the sake of simplicity we'll stick with six.) With the remarkable complexity of even "simple" martial arts techniques, it's rare when there are not at least two of these kinetic chains working together to produce a flow of power in a desired direction.

The six kinetic chains described below are each responsible for a different key power drive of the body. Each description includes the relative effective range, speed, and strength, as well as a couple of examples of techniques that are based on that kinetic chain.

Posterior Kinetic Chain: This forward drive of the hips (sometimes referred to as a pelvic thrust) is a medium-range, slow, strong movement that's usually used to align the drive of the legs with either the weight of the torso or an upper-body drive. This kinetic chain is perhaps the hardest one to understand and is often a central component in *ki* exercises and other fundamental power-generation techniques. It gets its name from the fact that the muscles involved are on the posterior side of the body and range from the hamstrings in the legs all the way up to the latissimus dorsi in the upper back. It is essential in a standard reverse punch or a groundwork bridge.

Leg Extension Kinetic Chain: This long-range, fairly quick, strong drive involves the extension of the leg at the hip, knee, and ankle joints. It's usually associated with a kick or a lifting action of the body.

Hip Turn Kinetic Chain: This drive is short-range, slow, and very strong. The turn of the hip is intimately connected with leg movements and body twists, such as the sweeping hip throw.

Lateral Kinetic Chain: This medium-range, slow, mid-strength drive involves twisting the body to one side, such as with a side kick, some throws, and many ground techniques.

Shoulder Turn Kinetic Chain: This drive is short-range, medium speed, and strong. The turn of the shoulder is intimately connected with arm movements and, to a lesser extent, body twists. Hand strikes are common examples.

Arm Extension Kinetic Chain: This drive involves the extension of the arm at the shoulder, elbow, and wrist joints and is long-range, very quick, and medium strength. It's usually associated with a hand strike, block, or a pushing away of the body.

A strongly positioned base for each kinetic chain is critical for the efficient transfer of energy into an opponent. For example, a relaxed shoulder will result in the poor transfer of power during an arm extension such as a punch, while a solid pelvic girdle will result in a stronger, more effective kick. Thus, kinetic chains rely on muscle groups pushing against a firm part of the body or something solid, such as the ground.

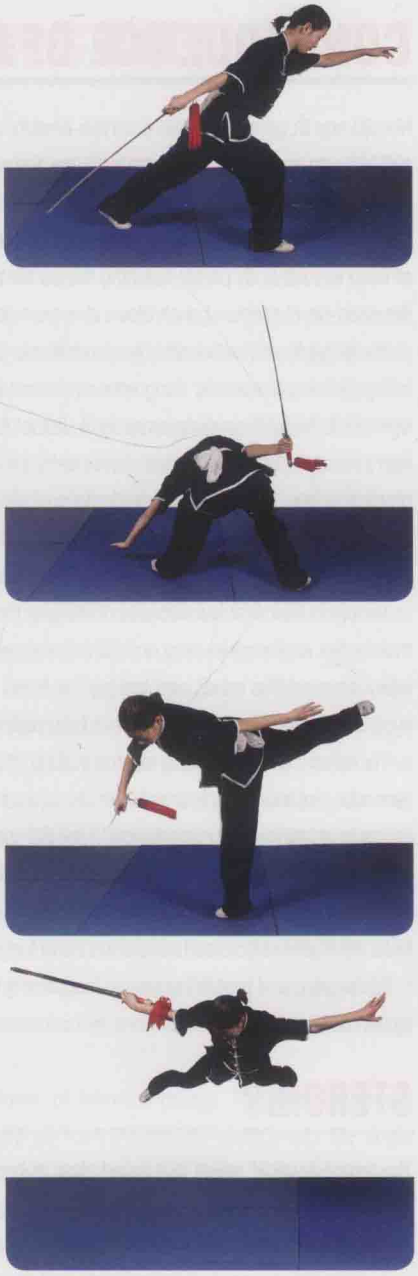
Let's look at a simplified example of the many kinetic chains used in a right-hand reverse punch:

1. Step forward with your left leg, driving your body forward with your back (right) leg [*posterior kinetic chain*].
2. Stiffen your front leg (to create a pivot point) and, using your back leg and hips, twist your right hip forward [*hip turn kinetic chain*].
3. Using the stiffening muscles of your legs, hips, and torso as a base, twist your shoulders to drive your right shoulder forward and your left shoulder back [*shoulder turn kinetic chain*].
4. Using the now-stiff muscles as a base, straighten and twist your right arm to deliver the punch [*arm extension kinetic chain*]. Note that turning the palm of your right fist down effectively twists the two bones of the forearm (ulna and radius) together to make a stiffer arm, which is more efficient at transferring the strike's energy to the target.

While the above is obviously oversimplified and incomplete, it illustrates the idea that even a "simple" reverse punch is the result of a complex and well-coordinated sequence of actions. This mixture of using both dynamic (moving) and static (tensed but not moving) muscles makes the timing and, thus, the description of the various techniques illustrated in this book very difficult. However, attempting to break down these techniques into their component parts allows us to suggest various exercises and stretches to further strengthen the moves.

Let's look at a much more complex example of the kinetic chains used in a butterfly kick:

1. From a standing position, turn sharply to the left and step out and back as your arms extend and your body dips parallel to the floor [*shoulder turn, hip turn, lateral, and arm extension kinetic chains*].
2. Bend your left leg and continue to drive your body down and around to gather momentum.
3. Extend your left leg to drive your body into the air as your straight right leg and arms arch behind your back [*leg extension kinetic chain*].
4. Open your body flat for the middle part of the flight [*posterior kinetic chain*].
5. Pull your right leg down and forward to catch your body weight as you land.



Butterfly kick

CONSEQUENCE OF IMPACT AND MISUSE

Martial arts in general involve a certain amount of impact to the body. Most of the impacts are obvious, such as kicks and punches in the striking arts and falls that are taken in the throwing arts. One of the most dangerous and least understood results of impact in any sport is a concussion or bruising of the brain, which can be caused by blows to or violent shaking of the head and neck; these must be taken very seriously as they can have both short- and long-term effects. Other impacts are not quite so obvious, such as the long-term effects of striking various body parts, including the hands and feet, against hard objects such as bricks and boards. Many don't recognize that while the short-term effects of such blows may be mild, the long-term effects (e.g., arthritis) can be serious and life-altering.

It's a staple of martial arts demonstrations to be struck in the abdomen with no ill effects. However, it's important to remember that being struck is inherently dangerous and must be done only under controlled circumstances; even the best-trained practitioners need a moment to tense their muscles so as to deflect the energy of the blow away from their vulnerable organs. When the world-famous magician Harry Houdini (1874–1926) was in his early 50s, he was still performing his physically demanding escapes and was by necessity in great physical shape. One of his demonstrations of his physical prowess was to invite big, strong, young men to punch him in the stomach. He did this repeatedly and suffered no ill effects from the blows. One day, a young man came into Houdini's dressing room and surprised him by punching him when he wasn't ready. Houdini died a few days later due to a ruptured bowel.

People in their first few decades of life who have decided to "toughen their limbs" should reconsider doing so—the damage they inflict on their bones and muscles may not start to severely impact their lives until they're in their 40s or 50s. Some of the more common long-term injury sites are the hands and feet as the result of striking hard targets, and the elbows and knees from repeated impacts, twistings, and hyperextensions. The latter injuries can be greatly exacerbated by the overuse of ankle and wrist weights.

Two other common muscle abuses include: (1) repeating an action until physical damage occurs (repetitive stress issue) and (2) so-called secondary injuries, which arise when an injured practitioner tries to continue training. The latter scenario results in the practitioner doing things in an awkward or imbalanced way. For example, if you injure your right knee, to avoid injuring it further you'll likely place additional stress on your left leg, resulting in a secondary injury due to this unbalanced practice. While from a practical point of view we understand that martial artists are often in a state of mild injury and that they must continue working out through these inconveniences, it must be done in an intelligent way so as to avoid incurring further injuries.

By learning and practicing proper martial arts techniques, the consequence of impacts on the body can be minimized and, within certain limits, martial arts can be practiced well into old age.

STEROIDS

The term "steroids" refers to a broad class of hormones. Some types of steroids, such as cortisone (only available by prescription and used to treat problems like asthma and arthritis), can be beneficial when used correctly. A group of artificial hormones called anabolic steroids comes in hundreds of varieties that are used to artificially enhance muscle mass, strength, and endurance. These illegal, testosterone-like hormones also cause numerous short- and long-term side effects, ranging from hair loss to heart disease to liver damage. While all the long-term issues that accompany taking anabolic steroids are not known, one thing has been well proven: The increase in muscle mass does *not* extend to the proportionate increased development of the bones and ligaments. Thus, the increase in muscle mass leads directly to irreversible joint and bone damage. It's our recommendation that steroids never be used unless prescribed by a doctor.

THE PHYSICS BEHIND A HIGH-ENERGY STRIKE

Martial arts practitioners commonly ask, "How can I get as much energy as possible into a strike?" The definitive answer is complex (think physics equations) and generally not very helpful. In addition, many factors are involved in generating a high-energy strike, including the relative velocity of the striking surface and the target, the elasticity of the striking surface (usually a hand or foot) and the targeted surface, body masses, etc. At the risk of oversimplifying the answer, we'll work with three relatively simple concepts.

Concept #1—Dynamic and Static Muscles: A *dynamic muscle* is defined as one that moves a part of the body; these are used to accelerate the body into a technique so that it has appropriate velocity. *Static muscles* are tensed but not moving, helping to put as much of a person's body mass behind a movement or blow as possible. Another way to think about this is to realize that many muscles work in opposition to others and, for a given action, one is the agonist, used for speeding the action, and the other is the antagonist, used for slowing it. For maximum velocity, the antagonist must relax when the agonist tenses, or contracts. For example, during a punch, the triceps (the agonist) extends the arm while the biceps (the antagonist) relaxes. However, at the end of the motion, it's usually recommended that the antagonists be used to slow the movement in a controlled manner as opposed to letting the joint be hyperextended.

Concept #2—Kinetic Energy: *Kinetic energy* is defined to be equal to the mass of the striking object times the square of the velocity of the object divided by two. In other words, it's important to have body mass behind a strike, which is why tensing static muscles is important—this mechanically connects the body's mass to the blow. For example, if you strike with a fist but don't use the static muscles of the shoulder and torso, then you might generate one unit of energy because only the mass of the fist and the forearm contribute to the blow. If you tense the upper arm and shoulder during impact, the effective mass of the strike could easily go up by a factor of five, as could the amount of energy generated. However, it's even more important to have good velocity behind a strike—if you double the speed of the blow, the amount of energy would go up by a factor of four (two squared). Thus, if you increased the effective mass or body mass by a factor of five and doubled the blow's speed, the amount of the energy in the blow could go up by as much as a factor of twenty (five times two squared).

The bottom line is that it's important to increase both the effective mass and the speed behind a blow. The problem is that to increase the effective mass of the blow, you must tighten the correct static muscles; tightening the wrong muscles will slow down the strike. On the other hand, to increase the strike's velocity, the dynamic muscles must be tensed and the opposing muscles must be relaxed, which will decrease the effective mass of the blow. Thus, when you want to increase a blow's energy, there's an intricate trade-off between the effort to increase the blow's effective mass and the effort to increase the velocity of the striking surface. The timing involved in tensing both the dynamic and static muscles is critical. However, given a choice, increasing speed usually proves more effective in magnifying the energy of a blow.

Concept #3—Elastic versus Inelastic Collisions: A strike has a certain amount of inherent energy. The laws of physics require that the energy goes somewhere since energy is always conserved: It might go from the striking surface into the target and cause damage to the target; it might go from the striking surface into the target and cause the target to fly, undamaged, backward (it may get damaged when it falls to the floor or hits a wall, but that's a different story); or the striking surface may hit a hard, immobile object and the striking surface will either be damaged or perhaps just bounce off the target. How often have you seen a beginner walk up to a swinging heavy bag and give it a good whack, only to find himself flung back and the heavy bag continuing to swing, relatively unimpaired? This is an example of an elastic collision, something martial artists hope to avoid. The following are a couple of traditional, physics-based examples of elastic and inelastic collisions of two rolling balls.

Example #1 (elastic collision): Take two billiard balls and bounce them off each other. They will fly away from each other at the same relative speed at which they struck, and no damage will occur to either ball. **Example #2 (inelastic collision):** Take a billiard ball and a clay ball and roll them toward each other. The two balls will become one mass as the clay ball is distorted by some of the energy of the collision; the rest of the energy propels the resulting mass away at a reduced speed.

Example #1 is what commonly happens with beginner martial artists—their strikes are ineffective. Example #2 is what a martial artist would like to achieve.

Author Lily Chou wins yet another point from fellow author Norman Link.