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Get a Grip: An Anatomical Survey of Four-Mallet Grips for Solo Marimba

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GET A GRIP: AN ANATOMICAL SURVEY OF FOUR-MALLET GRIPS

FOR SOLO MARIMBA

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ABSTRACT

GET A GRIP: AN ANATOMICAL SURVEY OF FOUR-MALLET GRIPS FOR SOLO MARIMBA

by

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This document examines the three primary grips used in playing four-mallet concert marimba. It focuses on each grip's relationship to the anatomy of the fingers, wrist, and forearm, with particular attention to the grips' movement characteristics. The discussion aims to support professionals, students, and teachers interested in developing a greater understanding of each grip's similarities, differences, and basic physicalities. The first section is a detailed examination of Traditional, Stevens, and Burton Grips. The primary focus is the hand's composition around the mallets and the movement characteristics of standard stroke types. The second section provides a comparative analysis of each grip's anatomy and movement characteristics. This survey illustrates the value of understanding all three grips at a fundamental level to further the rising standard of four-mallet marimba pedagogy and performance.

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CHAPTER ONE: INTRODUCTION

Four-mallet solo marimba performance has become a formal discipline for concertizing marimbists of all levels. The growing body of literature and increasingly virtuosic playing techniques demand physical manipulation equal to that of violinists, pianists, and other well-established instrumental disciplines. This document focuses on the three primary grips for playing four-mallet concert marimba: the Traditional Grip, Stevens Grip, and Burton Grip.

With continually increasing standards and limits of what is capable at the marimba, grip discussions appear in academic articles, method books, and among pedagogical circles. Most available literature aims to develop musicianship exclusive of a particular grip. However, publications such as *Method of Movement* (addressed later) redefine grip and technique capabilities.[1]

Regardless of the latent impact literature has, the "most effective marimba grip" has long been debated—a debate like traditional grip versus matched grip with snare drumming. Others take a laissez-faire approach to this discussion, often saying, "Regardless of the grip you use…." Thus, considerable subjectivity surrounds the topic of grips. Discourse on any playing style or technique warrants reasonable trepidation among serious musicians. To some degree, a marimbist's grip is their first musical statement to an audience. It is a form of identity that may imply or represent a player's schooling, stylistic preferences, or even (loosely) nationality. While this subjectivity among keyboard grips is a fascinating byproduct of rapid diversification among marimbists and vibraphonists alike, this document aims to objectively examine the physiological

[1] Leigh Howard Stevens, *Method of Movement* (New York: Marimba Productions, 1979).

components of each grip exclusive (where possible) of technique. Summarized excellently, The University of Michigan Professor Emeritus Michael Udow states:

> There is a quasi-type of symbiosis that exists between an individual "grip" and "technique." Gripping is the act of holding the mallets. Technique refers to how the mallets are manipulated, and the motions used to generate strokes.[2]

Thus, this document again aims to examine both grip and movement mutually exclusive of specific techniques where possible.

The first section of this document is an examination of basic arm anatomy. Understanding the arm and hand provides a foundation for future discussion of each grip's impact on extremities alongside each grip's physical advantages and disadvantages relative to arm anatomy. Udow believes that

> Having a basic understanding of the anatomy of the human hand is vital in discovering what grips and stroke motions are healthy and will allow performers to play at their peak technical and musical potential.[3]

Moreover, while thoroughly examining each grip's health implications is not within this document's scope, it is addressed where appropriate.

The second section presents an analysis of each grip. A brief historical overview of the grip precedes a survey of the grip's anatomy and movement characteristics. Finally, the third section presents a comparative analysis of the three grips. A comparison of each grip's movement anatomy provides a valuable tool for pedagogues and a wide array of students of all levels using

[2] Michael W. Udow, Percussion Pedagogy: A Practical Guide for Studio Teachers (New York, NY, United States of America: Oxford University Press, 2019), 177.

[3] Udow, 7.

any grip. Likewise, cross-examination of each grip's physical stressors exposes the potential for injury, and a survey of the most common strokes and movements used in four-mallet marimba playing further illustrate health and pedagogical considerations.

The scope of this examination considers five-octave solo marimba performance practice, as "the five-octave marimba has become a standard that is used by many composers and marimbists today."[4] While other considerations in four-mallet keyboard playing exist beyond this scope, they are omitted for brevity and focus. Instead, the outcome of this document addresses the physical mechanisms of the grips and movements most used in five-octave solo marimba performance.

Personal Experience

My experience from a young age with little instruction was a case of misfortune and providence. I began studying marimba, using a grip without consideration for others simply because it was the first and only grip I had witnessed. Through lack of proper instruction, I would continue developing poor habits rendering unfocused tone quality and tension that would later cause injury. A nearly-torn rotator cuff, onset carpal tunnel syndrome, and an entrapped radial nerve resulted in several months of physical therapy without playing.

Meanwhile, most of my early professional career consisted of teaching four-mallet grips and their techniques to players of all development ranges. The challenge of teaching these grips while not fully understanding them myself was not optimal. In addition, the pedagogical triage of

[4] Rebecca Kite, "Keiko Abe's Quest Developing the Five-Octave Marimba," 1998, 54.

speaking to rooms ranging from beginners to highly advanced students rendered a need to develop a deeper understanding of how mallets move and how the hands manipulate them.

Eventually, my injuries would redefine my approach to four-mallet marimba. I began exploring treatments from Tai Chi to arm care for baseball pitchers. I fostered a desire to understand arm mechanics and began investigating various grips more analytically. Through my exploration, I found that Burton Grip yielded significantly less strain and recurring pain for me while implementing various arm care regimens. What ultimately transpired was a nearly decade-long journey to develop a strong understanding of how a grip and muscles interact.

I intentionally avoided all resources regarding four-mallet techniques (e.g., method books and instructional videos) during this time. Instead, I aimed to develop my understanding of Burton and Musser-Stevens Grips through experiential learning. In concert with a growing knowledge of anatomy, my understanding of the subtle mechanics of these grips has developed into a valuable tool both for my playing and education. This document synthesizes my discoveries, the commentary of highly regarded marimbists, and historical context where appropriate.

Literature Review

Examining nearly one hundred grip and technique-related journal articles, I found no direct comparative analysis to any degree among the three primary grips. Upon surveying numerous books, Gary D. Cook's book *Teaching Percussion* presented concise pedagogical introductions to each grip with brief commentary regarding the strong suits of each grip.[5] Michael Udow's

[5] Gary Cook, *Teaching Percussion*, Enhanced Third Edition (Boston, MA: Cengage, 2019), 127–32.

book, *Percussion Pedagogy*, likewise discusses varying techniques and ventures closer (but not entirely) to direct comparative analysis with metaphors and various examples that excellently complement Cook's introductions to the grips.[6] Stevens's *Method of Movement* also briefly surveys some fundamental differences among the grips.[7] While many other method books illustrate the fundamentals of "building" grip (e.g., instructions on mallet placement, etc.), no publications compare the grasp and movement characteristics of the grips in detail. Sans Adam Berkowitz's 2011 thesis of a similar nature to this document, almost no available literature discusses grips from a comparative perspective.[8]

This document is, in large part, an extension of Berkowitz's contribution to this topic. A thorough examination of each grip's characteristics and anatomical drivers builds upon Berkowitz's research.

Basic Anatomy and Terminology

This section provides abbreviations, standard terms, and definitions for clarity and consistency (see figure 1.1). Finger numbering is abbreviated accordingly: thumb (F1 or 1), index (F2 or 2), middle (F3 or 3), ring (F4 or 4), and pinky (F5 or 5). Mallets are numbered 1, 2, 3, and 4 from left to right (from the player's perspective). "Inside/inner" and "outside/outer" are used interchangeably to denote specific mallets. Similarly, "upper" and "lower" may indicate the mallet handles resting above or below each other in the hand. At times, terms like "back fingers"

[6] Udow, *Percussion Pedagogy*, 176–82.
[7] Stevens, *Method of Movement*, 8–9.
[8] Adam Eric Berkowitz, "A Comparative Analysis of the Mechanics of Musser Grip, Stevens Grip, Cross Grip, and Burton Grip" (Boca Raton, FL, Florida Atlantic University, 2011).

and “front fingers” are used for brevity, where front fingers are fingers 2 and 3 (and occasionally the thumb) and back fingers are fingers 4 and 5.

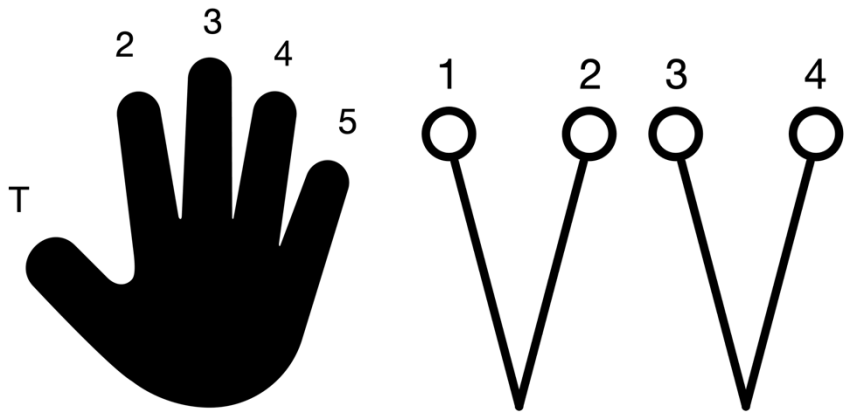

Figure 1.1: Finger and mallet numbers

Due to the complexity of each four-mallet grip, there is no single grip point as with a single stick or mallet. Therefore, “hand composition” refers to the hand’s overall grasp of the mallets—focusing on finger placement, pinch points, mallet weight distribution, wrist angle, and other factors.

Movement Terms and Anatomy

Due to the anatomical analysis of each grip, some standard physiology terms will follow; most notable are the terms used for movements such as pronation, supination, flexion, and extension of the wrists and arms. Figure 1.2 illustrates each movement.

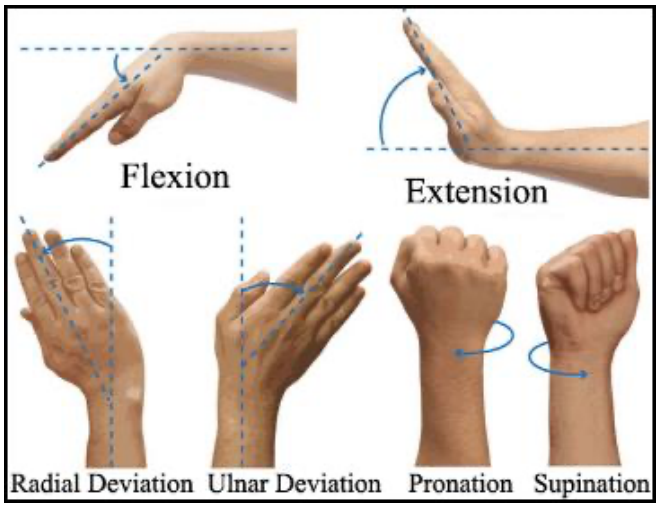

Figure 1.2: Wrist movements[9]

Arguably the most critical movements in four-mallet marimba playing are "pronation" (palm facing downward) and "supination" (palm facing upward), which are rotational movements that occur at the proximal radioulnar joint (the inner elbow).[10] "Wrist rotation" often describes pronation and supination; however, the wrist joint does not rotate. Instead, during pronation, the pronator teres and pronator quadratus muscles in the forearm (see Figure 1.3) pull the radius bone, which rotates at the elbow and wrist joints around the ulna and brings the palms downward.[11]

[9] Mark Papas, "Stroke Consistency," Revolutionary Tennis, 2008, https://www.revolutionarytennis.com/wristuse.html.

[10] Shahab Shahid, "Pronation and Supination," Kenhub, December 29, 2022, https://www.kenhub.com/en/library/anatomy/pronation-and-supination.

[11] Tim Taylor, "Pronation/Supination - Anatomy Pictures and Information," Innerbody, July 3, 2018, https://www.innerbody.com/image/musc03.html.

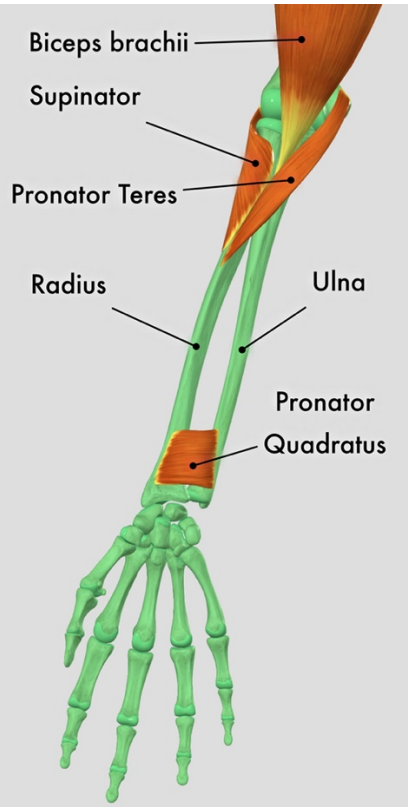

Figure 1.3: Forearm anatomy involved in pronation and supination[12]

Supination occurs when the supinator muscle and the biceps brachii (upper arm) pull the radius in the opposite direction of the pronator muscles (Figure 1.3).[13] Forearm rotation is a definitive characteristic of four-mallet marimba playing, as "lateral rotation" separates the discipline from a single "up-and-down" wrist motion of playing with a single stick (or mallet).

This typical up-and-down wrist motion (like when bouncing a tennis ball) is known as flexion and extension. "Flexion, or bending, involves decreasing the angle between the two entities taking part in the movement (bones or body parts). In contrast, extension, or

[12] "Complete Anatomy 2023," iPadOS (Amsterdam: Elsevier, 2023).
[13] Taylor, "Pronation/Supination - Anatomy Pictures and Information."

straightening, involves increasing the respective angle."[14] During wrist and finger flexion, muscles in the *anterior compartment* of the forearm contract to pull the hand toward the inner forearm and fingers to the palm. Extension occurs when the *posterior compartment* muscles pull the hand toward the outer forearm and straightens the fingers. These muscle compartments run from the elbow to various insertion points in the intricate webbing of tendons and bones of the wrist (Figure 1.4).

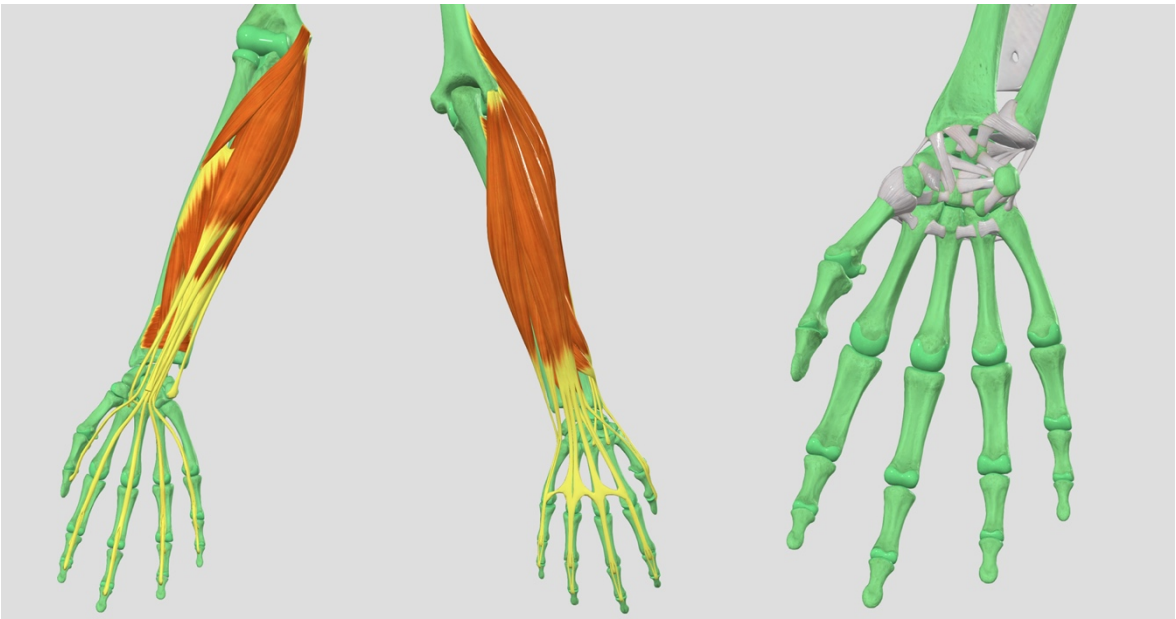

Figure 1.4: Anterior (left) and posterior (center) compartments and wrist ligaments (right)[15]

Flexion and extension of the wrist and fingers are the primary motions of virtually all ordinary drumming activities. That said, marimbists rarely employ *pure* wrist flexion and extension while playing. Instead, "wrist orientation" (the degree of pronation or supination)

[14] Adrian Rad, "Types of Movements in the Human Body," Kenhub, December 29, 2022, https://www.kenhub.com/en/library/anatomy/types-of-movements-in-the-human-body.

[15] "Complete Anatomy 2023."

yields minor deviations from pure flexion and extension—this plays a significant role in the movement of a typical stroke. To illustrate this, Figure 1.5 shows a drumstick held at varying degrees of pronation found among various playing scenarios. All positions share a commonality in "wrist deviation," which combines with flexion to produce most strokes.

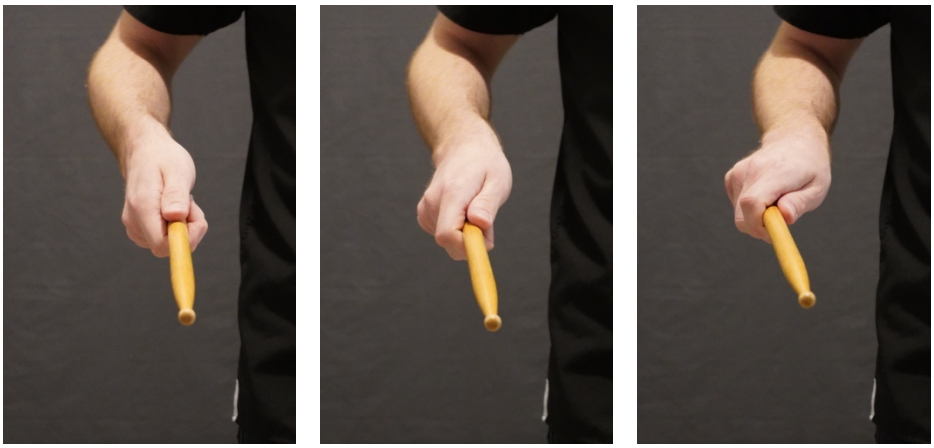

Figure 1.5: Varying pronations; neutral (left), partial (center), full (right)

Deviation is a particular type of movement restricted to the wrist joint.[16] Radial deviation involves the hand moving toward the thumb side (or the radial bone), while ulnar deviation results in the hand moving toward the side of the little finger (or the ulnar bone).[17] Radial and ulnar deviation are interchangeable with "abduction" and "adduction," respectively. These movements have relatively small ranges of motion compared to flexion at approximately 30º for ulnar deviation and 7º for radial deviation.[18] However, these deviations are crucial as they work

[16] Rad, "Types of Movements in the Human Body."
[17] Ibid.
[18] Roberto Grujičić, "Radiocarpal Joint," Kenhub, December 22, 2022, https://www.kenhub.com/en/library/anatomy/the-wrist-joint.

with flexion and extension in all hand orientations to ensure a straight stroke path by aligning the stick or mallet with the forearm.

In the neutral position, deviation is the only wrist movement able to produce a stroke, as flexion would result in a horizontal stroke. However, when the wrist is pronated entirely flat, the wrist must adduct slightly to ensure the mallet is mostly in line with the forearm. The inverse applies during partial pronation, as a modest abduction occurs during wrist extension to ensure the mallet rotates straight upward. Thus, understanding wrist deviations is crucial to the awareness of the complexity of wrist movement regarding four-mallet marimba playing.

Nerves and Arteries

Hand nerves and arteries often receive little attention when examining percussion playing techniques. Instead, as musician-specific health and wellness literature grows, a common focus is on muscle or ligament strain, repetitive stress injuries (RSI), pinched nerves (e.g., carpal tunnel syndrome), and other conditions. However, four-mallet grips involve more substantial compression in the palm and against the sides of each finger than many other musical activities. As a result, the fingers in a given grip may squeeze excessively into soft tissue above nerves or arteries. Grips may also force a mallet handle into the palm or press them into the boney parts of various fingers. Of course, gripping the mallets too tightly is always discouraged, but numerous positions and movements produce considerable stress on the susceptible hand and finger anatomy—notwithstanding tense, repetitive motions.

Figure 1.6 shows the median and ulnar nerve branches. These branches run along each finger's anterior (palmar) side, where players apply pressure to mallet handles for stability. Similarly, branches of arteries run parallel to these nerves.

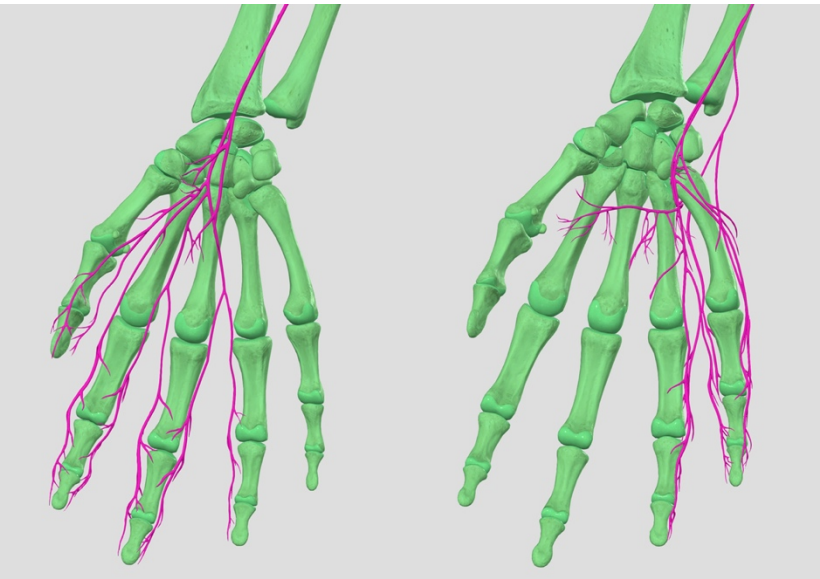

Figure 1.6: Median (left) and ulnar (right) nerve branches[19]

The median nerve branches extend into the palmar side of the thumb, F2, F3, and part of F4. The superficial branch of the radial nerve (not shown) branches into the dorsal side of the same fingers, while the ulnar nerve branches into F4 and F5 on both the palmar and dorsal sides. Awareness of these three primary nerves and their branches is paramount to grip considerations for a healthy approach to holding and manipulating four mallets.

Grip and Technique Terms

Each grip chapter contains two main sections: "Grip Anatomy" and "Movement Anatomy." The grip anatomy section examines the hand's grasp of the mallets in a resting position.[20] The movement anatomy section investigates the four main movements of four-mallet marimba

[19] "Complete Anatomy 2023."
[20] "Resting position" meaning the mallets are parallel to the marimba bars.

performance: interval adjustments, double-vertical strokes, single-independent strokes, and lateral strokes. In addition, the movement anatomy sections examine muscular engagement, beginning with the fingers and moving up the arm based on the type of movement.

Since the anatomical terms (e.g., pronation, abduction) predominantly describe the finger, wrist, and arm movements, mallet movements are described differently. Most notable is the distinction between mallet "actuation" and "rotation," which are movements achieved by some combination of the wrist and finger movements.

Actuation refers to the initiation of mallet movement either together (double-vertical) or individually (single-independent) on a straight, up-and-down plane to or from the playing surface. Actuation may also refer to the movement of a mallet horizontally during interval adjustments. Lastly, rotation is a type of actuation referring to the movement of a single mallet *interdependently* with another mallet. Rotation typically results in a slightly curved stroke path as the wrist pronates and supinates around the ulnar axis. "Mallet rotation" is often used with "wrist rotation" for simplicity.

Terms such as "fulcrum" and "pinch points" illustrate specific control points between the fingers and the mallet handles. While fulcrums are not a typical attribute of mallet keyboard grips (as they are with drumstick grips), occasional connections to fulcrums provide comparative reference points. Pinch points, however, are an essential concept unique to mallet grips, as each grip features various points where the fingers pinch down on the mallet handles to secure them. Each grip has a primary and secondary pinch point, which illustrates a grip's two principal control points.

Stroke Types

The following stroke types are the primary movements of marimba playing. While hand position (relative to the keyboard) is a subjective component of various techniques, everything examined hereafter assumes the hands are positioned low to the keyboard. Low hand positioning maximizes mallet rotation and ensures mallet heads strike the tone bar with the most surface area. Additionally, low hands prevent the over-extension of various wrist movements and limit bicep engagement to move the forearm, which is beyond this document's scope. Therefore, all analyses of stroke types (sans lateral strokes) hereafter begin from an upward position.[21]

Interval Adjustments

Interval adjustments are the most challenging and complex component of four-mallet marimba playing. While not a stroke type, this document discusses interval adjustments in detail. Interval adjustments are the movements that spread and close the mallets. They rely exclusively on finger engagement, significantly affecting wrist motion and stroke types. This document does not detail the complex muscle activity of interval adjustments. However, interval adjustment mechanics receive considerable attention, as they are the most contrasting mechanism among all three grips and considerably affect all other movements.

[21] "Upward position" meaning the mallets angle upward from the playing surface to produce a downward stroke.

Double-vertical Strokes

A double-vertical stroke is when both mallets in hand strike the playing surface simultaneously. It is the most precise movement after establishing the hand composition and is often the starting point for four-mallet studies. However, young marimbists often find double-vertical strokes challenging at first because the mallets often flam. Double-vertical strokes are achieved by wrist flexion/extension, deviation, or a combination. The goal is to ensure that both mallets strike the instrument simultaneously and with equal strength and volume.

Single-independent Strokes

The single-independent stroke is when a single mallet moves independently of the other mallets and is the second most complex component of four-mallet playing. This stroke requires varying combinations of flexion/extension and deviation to activate inner and outer mallets. It is essential to understand that the mallets always move somewhat *interdependently*.[22] The mallets will inevitably rotate around each other and create axes secondary to the central axis running through the ulna (see Figure 2.6).

Lateral Strokes

The lateral stroke is when a single mallet rotates around the axis of the arm. Lateral strokes are the most idiomatic movements for marimbists. The lateral stroke and its variations (e.g., double-lateral, triple-lateral, and one-handed rolls) provide marimbists the unique ability to

[22] Udow, *Percussion Pedagogy*, 179.

arpeggiate notes and quickly rotate the mallets to achieve various textures and sequences that would otherwise be impossible with just two mallets As opposed to single-independent, these strokes are entirely interdependent, as the lateral movement (or “rotation”) is defined by the oscillation of the mallets and their counterbalance of one another. All analyses assume this stroke begins from a resting position (mallets down).

CHAPTER TWO: TRADITIONAL GRIP

Traditional Grip is the earliest grip found in pedagogical literature.[23] The exact genesis of Traditional Grip is unknown, though observations confirm the presence of Traditional Grip (and similar variants) among marimbists of Africa and Central America.[24] These early observations are often of indigenous people playing on handmade marimbas and xylophones that are, in essence, ancestors of the modern-day concert marimba. The grip's pervasiveness in proximity to the marimba's origins and early development indicates its practicality.

Grip Anatomy

The hand composition of Traditional Grip has the front fingers open and the primary pinch point at the back of the hand. Figure 2.1 shows the mallets beneath the grasp of fingers 4 and 5.

[23] Dean Gronemeier, "An Evolution of Keyboard Percussion Pedagogy," *Percussive Notes* 31, no. 2 (December 1992): 19.

[24] Linda Pimentel, "The Marimba Bar," *Percussive Notes* 16, no. 1 (1977): 46–48. This author notes that such variants included what is now called Burton Grip

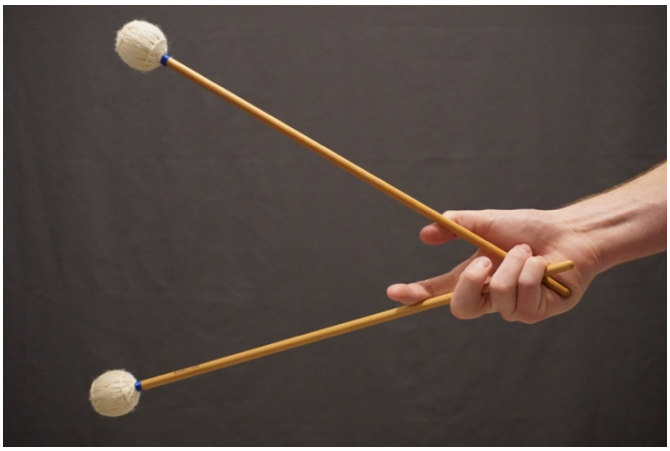

Figure 2.1: Traditional Grip palmar view of back fingers

The outside mallet passes through the F2 and F3 gap, resting just above the second joint on F2, while the inside mallet rests outside the thumb above the second joint. A helpful teaching tool for building this grip is its similarity to holding a ball (like a baseball), as shown in Figure 2.2.

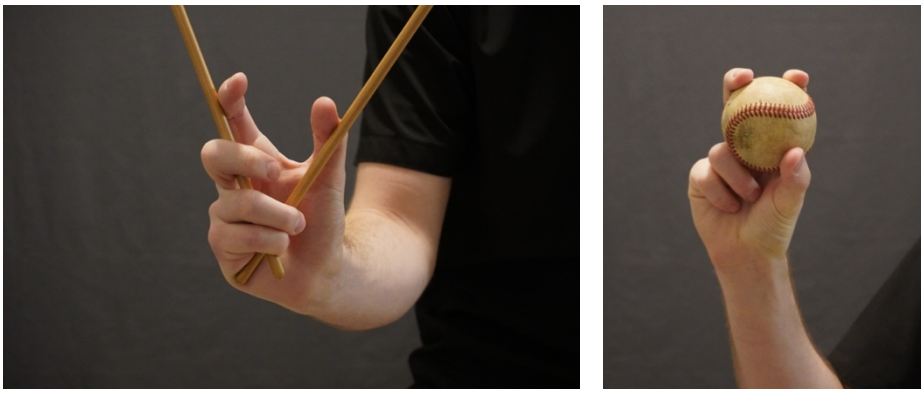

Figure 2.2: Similarity between finger positions of Traditional Grip and gripping a baseball

While fingers 4 and 5 secure the crossed mallets for the primary pinch point, the thumb and F2 push outward on the mallets as a secondary pinch point. This grip requires well-developed

strength in fingers 4 and 5, and those who find this grip difficult "often have short fingers or weak 4th and 5th fingers."[25]

Surprisingly, this grip resembles the right-hand grip used by many Civil War-era snare drummers and, most notably, Sanford Moeller (see Figure 2.3).[26]

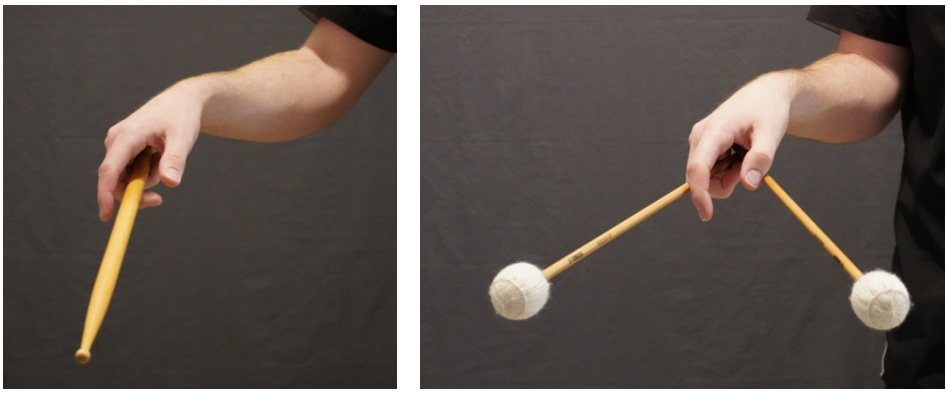

Figure 2.3: Similarities of back-finger hold between Traditional Grip and Moeller's relaxed grip

This back finger hold allowed for powerful rotational strokes appropriate for the sling-style snare drums worn at the time.[27] This power is the byproduct of gripping the stick (or mallet) near the end, supplying the player with its total weight to generate momentum and volume.

Additionally, mallets in the early days of solo marimba playing were significantly shorter, with thinner handles made of rattan.[28] One prolific composer-performer of modern solo marimba, Keiko Abe, uses Traditional Grip and states that it "has the benefit of being able to

[25] Nancy Zeltsman, *Four-Mallet Marimba Playing: A Musical Approach for All Levels* (Milwaukee, WI: Hal Leonard Corp, 2003), 2.

[26] John Lamb, *Anatomy of Drumming*, 2nd ed. (San Berndardino, CA: John Lamb, 2020), 156.

[27] Ibid.

[28] Mallets were up to three inches shorter and birch handles had not yet been widely used.

convey the performer's energy directly to the audience… This particular grip can maintain a powerful presence with good tone quality…."[29]

The resting orientation of the hand is mostly neutral (slight pronation of about 5–10º), while the wrist is slightly extended, approximately 5º from neutral.[30] The primarily neutral position and open hand make this grip particularly accessible. Due to the configuration of the mallet handles, the mallet's weight acts against the hand's grasp, creating reverse pressure. Figure 2.4 shows the points of opposing pressure.

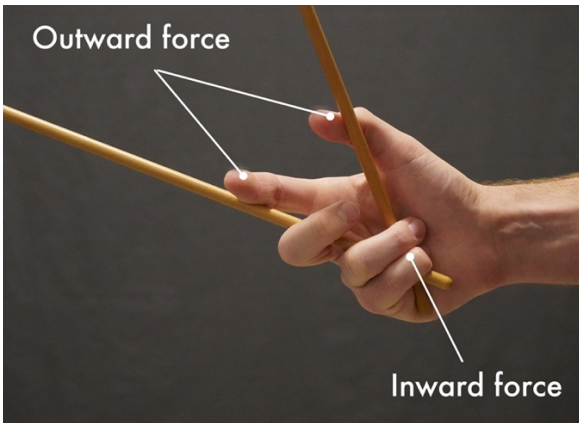

Figure 2.4: Points of opposing force in Tradition Grip

There is significant exertion by F4 and F5 to stabilize the mallets, which results in a higher baseline muscular engagement on both compartments of the forearm muscles. The mallets pressing against the sides of the thumb and F2 also exert pressure near the median nerve branches running along those fingers. This pressure along median nerve branches is more pronounced in Traditional Grip than the other two grips.

[29] Keiko Abe, email to Adam Berkowitz. February 7, 2011.

[30] Neutral position is defined by the palm facing medially toward the body as if hanging down at one's side or in a "handshake" position.

Movement Anatomy

The movement anatomy of Traditional Grip is relatively simple. Because the back fingers stabilize the mallet intersection near the ulna, the mallets will feel responsive to wrist movements since the ulna is the central point of wrist actuation. Additionally, because of the mostly neutral orientation of the wrist, this grip has minimal engagement from both forearm muscle compartments while in a resting position.

Interval Adjustments

Interval adjustments—while mechanically simple—are the most challenging aspect of the Traditional Grip for beginning players. In order to expand and contract the mallets, the back fingers must remain clenched to keep the mallets in hand. In addition, as the index and thumb extend to expand the mallets, only finger 5 may control them at their intersection (Figure 2.5).[31] This puts considerable strain on finger 5 and the ulnar nerve branch running along its palmar side. Likewise, flexing the back fingers and extending the front fingers in a large interval spread significantly strains the entire forearm, thus stiffening wrist movements.

[31] Zeltsman, *Four-Mallet Marimba Playing*, 6.

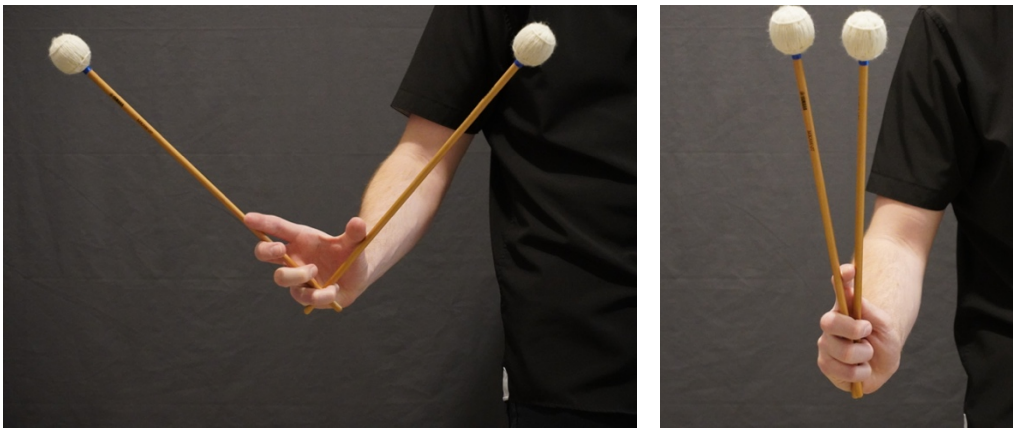

Figure 2.5: Open (left) and closed (right) intervals in Traditional Grip

As the mallets contract to smaller intervals, F2 extends while the thumb adducts toward the first knuckle of F2 (Figure 2.5). All other fingers flex (or wrap) around the two mallets, and the grip becomes similar to a drumstick grip and allows for powerful double-vertical strokes. However, in this position, independent mallet movement is limited (as it is with all grips) and requires tremendous rotational efforts of the forearm. However, because the thumb and F2 press down on each mallet relatively far from the rotation point at the wrist base, this grip has more leverage than is often assumed at small intervals.[32] The lack of leverage in all grips with closed intervals should be understood. Conversely, wide intervals require much less rotational force.

Double-vertical Strokes

This grip offers powerful and easily controlled double-vertical strokes. However, this power accompanies the risk of developing pain along the thumb and F2 bones due to the pressure needed to control such strokes. Because of the slight pronation from neutral, the double-vertical

[32] Marimbist Theodor Milkov's playing provides an excellent example of the Traditional Grip's rotational power at small intervals.

stroke has access to the power of flexion and extension rather than the pure deviation needed in a completely neutral position. The primary pinch point at the end of the handles also allows nearly all the mallet weight to aid in tone production from a relaxed stroke. However, large intervals diminish the strength of double-vertical strokes in Traditional Grip. While all grips lose strength at wide intervals, Traditional Grip may suffer the most. This loss of strength is due to significant forearm muscle engagement to stabilize the fingers and maintain the spread. All of this engagement creates tightness that hinders fluid wrist movement.

Single-independent Strokes

Rotating individual mallets poses a more complex engagement of forearm muscles in Traditional Grip. Independently actuating mallets require supination (outside mallet) or pronation (inside mallet) *and* flexion. This complex muscle movement is needed because neither mallet aligns with the arm. That said, players will often deviate the wrist accordingly to access the energy provided by a better alignment with the forearm. When making this adjustment, Traditional Grip provides tremendous volume. John Lamb, in his book *Anatomy of Drumming*, states:

> The radius and ulna set up two different paths for energy to travel through the arm. One line lines up along the ulna through the pinky and ring fingers, and the other travels through the radius to the middle finger, index finger and the thumb. Since the ulna lines up behind the pinky and ring fingers, these small fingers have access to a lot of power.[33]

[33] Lamb, *Anatomy of Drumming*, 119.

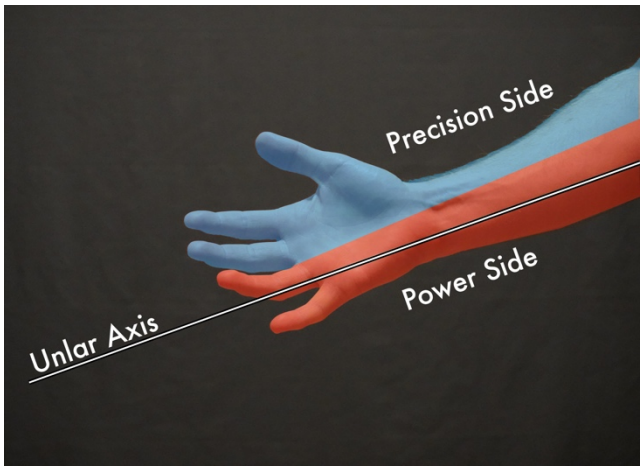

Figure 2.6: Ulnar axis of forearm rotation and relative “power” and “precision” sides

Since the back fingers secure both mallets at the ulna (the power side), the volume potential of this grip is notable (Figure 2.6). While the inner mallet does not benefit as much from the “power side” since it runs medially away from the ulna, a player can consciously allow it to leave the thumb by relaxing the back fingers slightly, allowing the mallet to move (essentially wiggle) more freely (Figure 2.7). Allowing the mallet to do this preserves energy and creates a whip-like motion for the inner mallet to achieve more velocity and volume.

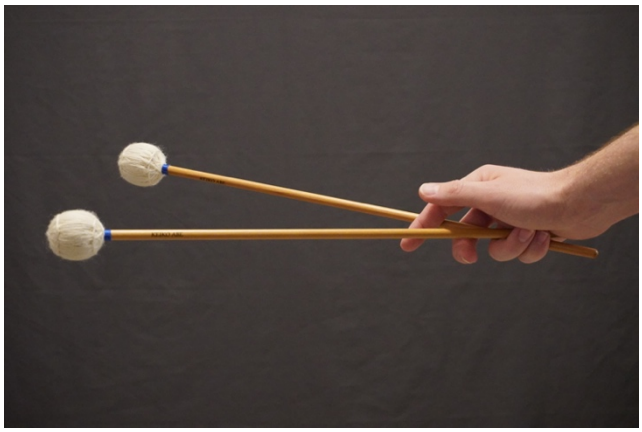

Figure 2.7: Space between the inner mallet and thumb in Traditional Grip

Lateral Strokes

The Traditional Grip offers great rotational potential due to the neutral wrist position. In addition, securing the mallets near the ulna makes them highly responsive to all wrist movements. However, the challenge during lateral rotation is reverse pressure against the thumb and F2. Due to the lack of fleshy padding along the fingers where the mallets rest, aggressive or fast lateral strokes may cause pain along the fingers and loss of control. Likewise, the outward flex of the thumb and F2 might restrict or stiffen the wrist in varying positions during forearm rotation until a player can compartmentalize the muscular engagement.

Additionally, because the mallets rotate around an axis from the base of the handles, the entire length adds weight and potential energy to the wrist rotating. This weight generates a natural energy transfer between the mallets for relaxed, constant lateral strokes (e.g., a one-handed roll).[34] However, as with most grips, extreme intervals pose challenges for lateral strokes. When the mallets are close together, there is always less leverage and torque, as the forearm must rotate significantly to turn the mallet. The challenge when playing with large intervals is stabilizing the interval with the clenched back and extended front fingers.

[34] Although, this is likely the most difficult technique to execute with Traditional Grip.

CHAPTER THREE: BURTON GRIP

The Burton Grip is a crossed grip named after vibraphone virtuoso Gary Burton. While Burton did not intentionally "invent" the grip, he is credited with developing an approach to manipulating the mallets in this configuration to achieve pianistic virtuosity. The Burton Grip, like the Traditional Grip, existed for an indeterminable time before Burton's influence. A quasi-Burton Grip, known by some as the "Classical European grip," expanded in Chiapas, Mexico, where some of the oldest and most prolific marimba bands emerged and still call home.[35] However, in 1968, Burton published *Four Mallet Studies,* illustrating his preference for this grip and musical justifications for its use.[36] Many prominent vibraphonists and marimbists now espouse the Burton Grip. His global prominence as a virtuosic performer, and 30 years of faculty instruction at the Berklee College of Music, make Gary Burton worthy of the grip's namesake.

Grip Anatomy

Perhaps the most immediately recognizable characteristic of the Burton Grip anatomy is its resemblance to a matched drumstick grip (see Figure 3.1). The hand composition of Burton Grip is easiest to achieve by loosely holding a single mallet like a drumstick in a pronated position and inserting a second (outer) mallet between F2 and F3, which rests between the first (inner) mallet and palm.

[35] Udow, *Percussion Pedagogy*, 176.
[36] Gary Burton, *Four Mallet Studies* (Glenview, Illinois: Creative Music, 1968).

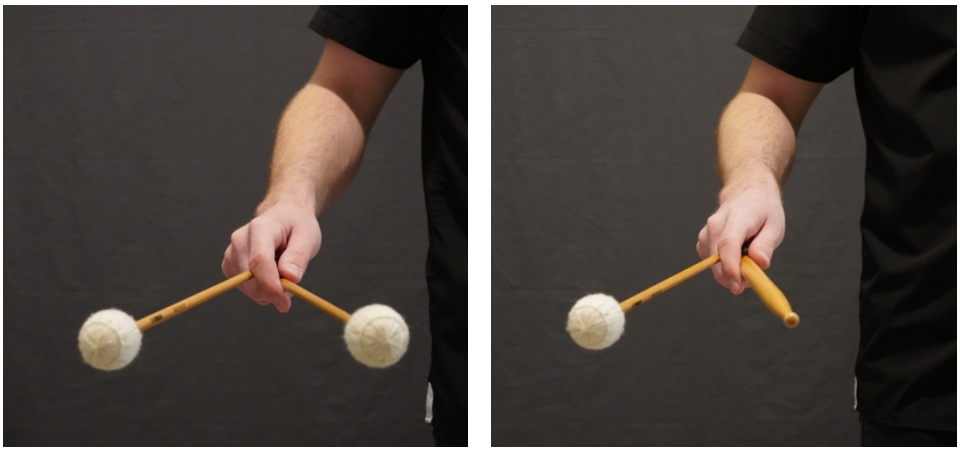

Figure 3.1: Burton Grip's similarity to a matched drumstick grip

Thus, the outside mallet is closest to the palm, and the mallets cross beneath fingers 3 and 4 near the center of the palm. In a resting position, the inside mallet is held like a drumstick with a pinch point between the thumb and index finger while lightly cradled by fingers 3, 4, and 5 (Figure 3.2). Next, the outside mallet runs along the outside of finger 2, where a small amount of pressure is applied (similar to Traditional Grip). Depending on the interval, the inside mallet and fingers 3 and 4 secure the outer mallet.

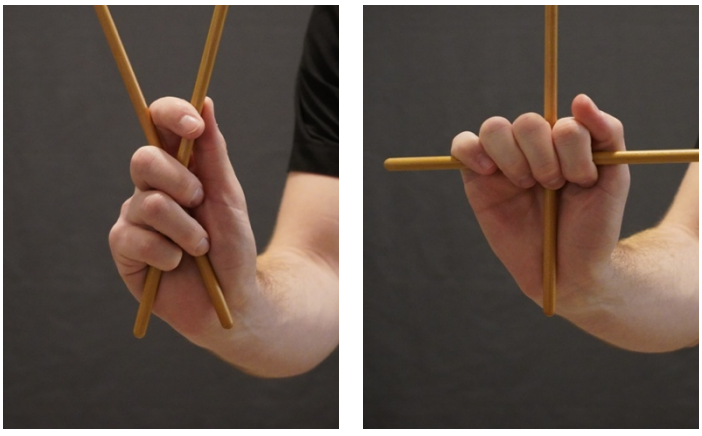

Figure 3.2: Palmar view of Burton Grip and varying finger positions

The Burton Grip requires a more pronated hand to keep the mallets flat because the inside mallet restricts the outside mallet from hanging downward. However, as the grip becomes comfortable, players will allow the inside mallet to angle downward with a more extended thumb and index finger and relaxed back fingers.[37] Nonetheless, this grip affords the most relaxed finger engagement of all three grips in all positions. However, the hand grasps a considerable portion of the mallet handles, thus reducing the mallet's overall weight and effectiveness during wrist movements. In addition, the reduced mallet length requires an increased clench of the mallets to ensure all wrist and arm motion is transferred into the mallets.

Nonetheless, the power potential of the Burton Grip is similar to Traditional Grip, as the mallets run similarly along the ulnar axis of the arm, and the hand's entire palm bears down on the mallets. This whole-hand grasp over the mallets affords a player the total weight of their forearm and torque of their wrist flexion to transfer into the mallets.

Movement Anatomy

While the hand composition of Burton Grip is relaxed, its movement characteristics are somewhat unwieldy at first and are due to the mallets' crossing point. This intersection creates a point of rotation second to the base of the wrist. Thus, when the wrist moves in any direction, it moves the mallets' intersection, constantly repositioning the point at which the mallets rotate around each other.

[37] These adjustments only supinate the wrist slightly from the grip's mostly-pronated default position.

Interval Adjustment

Interval adjustments in the Burton Grip require the least sustained muscular engagement of all three grips. However, they require more dynamic finger movement, which can be challenging for young marimbists. Except for the thumb, fingers 2 through 5 move the inner mallet to open and close the interval between the mallets. The most notable difficulty is that, as the spread increases, all fingers flex and extend at different knuckle joints. For example, as the mallets spread, F2 flexes toward the palm at both knuckles while F2, 3, and 4 extend at the first knuckle while remaining flexed at the second two knuckles (Figure 3.3). As the interval closes, F3, 4, and 5 flex at the first knuckle and extend slightly at the second two knuckles, while F2 and the thum extend almost completely.

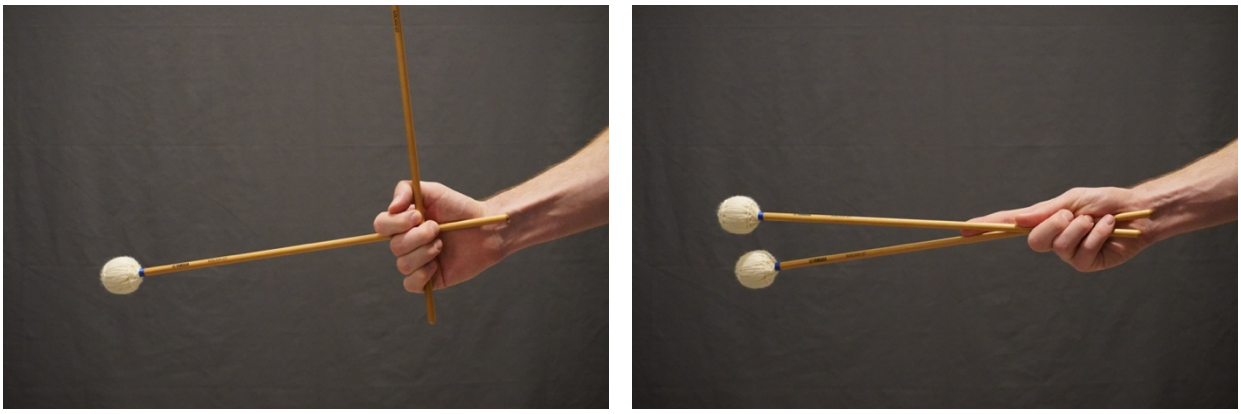

Figure 3.3: Finger engagements of large (left) and small (right) intervals in Burton Grip

Double-vertical Strokes

Burton Grip is similar to the Traditional Grip in that both muscle compartments of the forearm engage during flexion and extension during most mallet movements. However, Burton

Grip yields arguably the most strength potential for this stroke type for many reasons. Firstly, the hand is pronated at approximately 45º, giving access to the most flexion (and anterior forearm muscles) of all three grips while deviating toward the ulna (or the power side). Secondly, the grip allows more arm weight to transfer into the mallets even though it consumes more mallet handles than other grips. This arm weight transfers due to the entire palm resting atop the handles. Finally, Burton Grip fares well at most intervals because few intervals require constant finger engagement to maintain the mallet position. Thus, the wrist can stay relaxed and fluid for flexion and extension.

Single-independent Strokes

Burton Grip makes individual mallet rotation more complex by moving the rotation point further from the base of the hand and slightly inward from the ulnar bone. Figure 3.4 shows the crossing point of Traditional and Burton Grips relative to the ulna. An inner mallet stroke in Burton Grip requires more pronation and adduction than any other grip. Importantly, these strokes often reach full pronation, which is adverse because full pronation elevates carpal tunnel pressure (CTP), and persistently elevated CTP may aggravate carpal tunnel syndrome.[38, 39] In addition, the wrist adducts significantly for mallet actuation in small intervals, which is equally adverse, as CTP increases during ulnar and radially deviated postures.[40]

[38] David Rempel, "The Split Keyboard: An Ergonomics Success Story," *Human Factors* 50, no. 3 (June 1, 2008): 388, https://doi.org/10.1518/001872008X312215.

[39] Peter J. Keir, Joel M. Bach, and David M. Rempel, "Effects of Finger Posture on Carpal Tunnel Pressure during Wrist Motion," *Journal of Hand Surgery* 23, no. 6 (November 1, 1998): 1004–9, https://doi.org/10.1016/S0363-5023(98)80007-5.

[40] Ibid.

Figure 3.4: Mallet intersection offset from ulna bone at the wrist base in Burton Grip

However, slight shoulder abduction helps mitigate this over-extended pronation. Abducting at the shoulder reorients the forearm into a more pronated position without engaging the pronator muscles (Figure 3.5). Thus, inner mallet actuation requires less true forearm pronation to actuate the mallet to achieve a quality stroke.

Figure 3.5: Relaxed shoulder (left) and abducted shoulder (right) in Burton Grip

Outer mallet strokes are significantly easier to manage, as this mallet will often align with the forearm (or ulna). Forearm alignment allows a comfortable wrist flexion to achieve the outer

mallet actuation. However, when the outer mallet runs laterally from the forearm, the actuation is a mixture of flexion, supination, and adduction. The combination of movements is due to the secondary axis being away from the wrist base, forcing the wrist to rotate the outer mallet around the inner mallet (Figure 3.6).

Figure 3.6: Outer mallet actuation (single-independent stroke) in Burton Grip

Lateral Strokes

Lateral strokes in Burton Grip pose fewer strain concerns than single-independent strokes. However, reduced inner mallet range of motion and less mallet weight leverage work against rotated strokes. Fortunately, the hand can remain relaxed at nearly every interval, which ensures the forearm muscles are less constrained, allowing for fluid rotation. Interestingly, Burton Grip does not benefit from the leverage of wider intervals during rotation like other grips. Again, this is due to the offset axis in the palm, which is most pronounced at large intervals. Figure 3.7 shows the intersection at the knuckles, considerably displaced from the wrist. However, marimbists can overcome this by letting the inner mallet slide down the outer handle. Less back-finger flex plus outward pressure from thumb and F2 renders a pseudo-Traditional Grip

configuration (Figure 3.7). This adjustment moves the intersection toward the ulna, which helps reposition the mallet intersection closer to the wrist base for more balanced lateral mallet rotation.

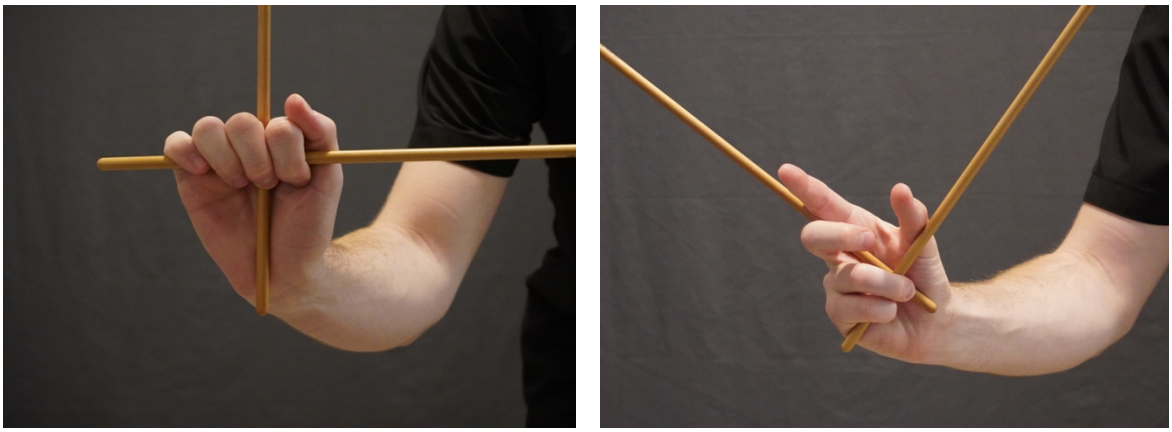

Figure 3.7: Typical wide position (left). Quasi-Traditional Grip position (right) in Burton Grip

CHAPTER FOUR: STEVENS GRIP

The Stevens Grip is the most popular and well-studied non-crossed grip used by marimbists today. Among other realms, it is widely used in method books, percussion programs across the United States, and the marching arts community. Its prevalence renders it the most technically and pedagogically developed four-mallet grip available to marimbists. Now attributed to renowned marimbist and marimba manufacturer Leigh Howard Stevens, the first iteration of this non-crossed grip was initially popularized and named after marimbist—and early pioneer of the modern marimba—Clair Omar Musser.

Musser Grip and Musser-Stevens Grip

The Musser Grip (shown in Figure 4.1) featured a mostly-pronated hand and was popularized by Musser in the 1930s. His marimba orchestra, method books, and early successors like Vida Chenoweth established a pedagogical foundation for early American marimbists after the 1950s. However, Leigh Howard Stevens published a book in 1979 titled *Method of Movement for Marimba,* where he redefined the hand composition and movement characteristics of Musser's grip. His reimagined grip became known as the "Musser-Stevens Grip" early after its inception and has since become ubiquitous among concertizing marimbists.

Steven's work significantly elevated the standard of analysis and pedagogical development of four-mallet marimba grips and movement techniques. Consequently, Musser-Stevens Grip is now often referred to as the "Stevens" Grip, and this author believes his contributions to four-mallet marimba performance warrant the grip's namesake.

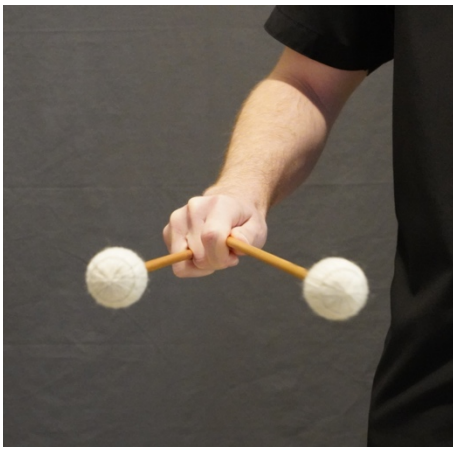

Figure 4.1: Example of Musser Grip illustrating the pronated position

While effort is made to abstain from analyzing *techniques* rather than *grips*, much of the forthcoming material explores elements likely considered Stevens's "techniques" applied to his grip. Observations hereafter will not address the entirety of Stevens's hand composition and movement principles championed in *Method of Movement*. Rather, they will address grip characteristics as exclusive of his technical concepts as possible. Any contradictions to his philosophies do not intend to challenge or discount his development of the grip.

Grip Anatomy

The hand composition of Stevens Grip is visually uncomplicated but notably demanding on small muscle control compared to its crossed counterparts. The grip requires the marimbist to grasp each mallet separately with different fingers. The outside mallet is held by fingers 4 and 5 (secondary pinch point), while the inner mallet is held by the thumb and finger 2 (primary pinch point) with stabilization at the mallet end against the palm by finger 3. Stevens Grip grasps the smallest portion of the mallet handle of the three grips. Initially, this will make the mallets feel

heavy, as the entire mallet's weight acts against the small amount of handle in the hand. Likewise, the slightest variations in pressure and positioning of the fingers (primarily T and F2) significantly alter the mallets' positions. While these factors afford the grip its extremely versatile dexterity, they likewise cause young players to grasp tightly to feel in control of the mallets.

The resting orientation of the hand ranges from 5–10º of extension (see Figure 4.2), while the forearm/wrist remains neutral with no pronation or supination. The lack of forearm pronation may seem advantageous initially; however, most stroke motions utilize *some* forearm pronation. Consequently, young players will often pronate inward to access flexion movement. Coupled with tension, the hands squeeze down (particularly the thumb, F2, and F3) and cause the inner mallet to angle upward, encouraging even more pronation—thus resembling the Musser Grip (Figure 4.1).

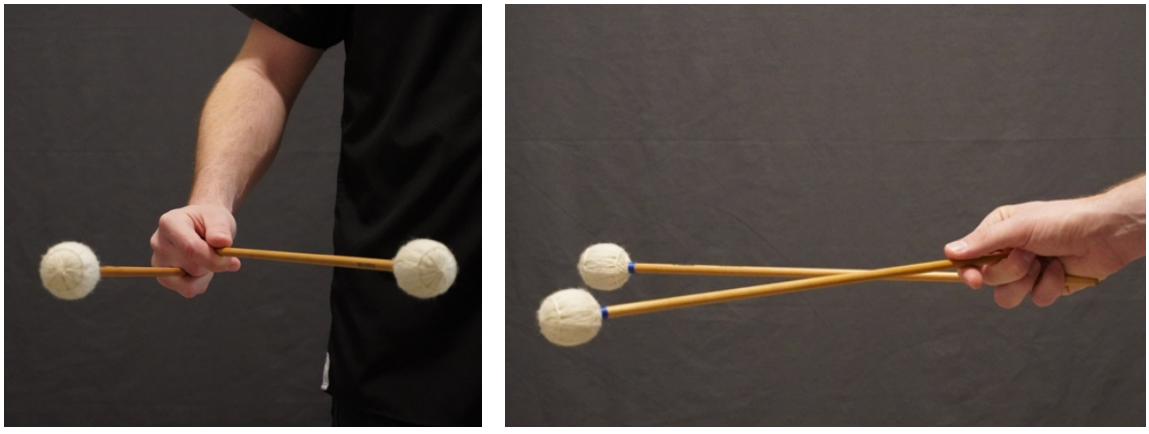

Figure 4.2: Resting position in Stevens Grip

Notwithstanding the grip's initial hand composition challenges, some muscular and nervous considerations are significant. For example, the secondary pinch point at F4 and F5 results in

more direct pressure along the ulnar nerve's palmar branches than other grips. The inner mallet handle can also put excessive pressure on the palmar arch of the ulnar artery that runs laterally across the lower palm, which "provides an arterial supply to the digits."[41] All grips pose concerns when used with extreme tension. However, Stevens Grip raises notable health considerations, as strain on arteries and primary nerve branches is worthy of extreme caution.

Movement Anatomy

The movement anatomy of Stevens Grip is straightforward but exacting because the mallets are extremely responsive to muscle engagement. Likewise, each mallet handle is mostly in line with the forearm in a neutral position (see Figure 4.3) and positioned near the base of the wrist.

Figure 4.3: Open hand showing mallets' proximity to ulna and wrist base in Stevens Grip

[41] Ronald A. Bergman et al., eds., *Bergman's Comprehensive Encyclopedia of Human Anatomic Variation* (Hoboken, New Jersey: John Wiley & Sons, Inc, 2016); "Complete Anatomy 2023."

Interval Adjustments

Interval adjustments in the Stevens Grip are among the most difficult movements to develop because they require extreme precision from the thumb and F2 (primary pinch point) while holding only about fifteen percent of the mallet handle. To spread the mallets, the thumb must abduct while F2 flexes at the first knuckle and extends at the second and third knuckles. Conversely, the opposite is necessary to bring the mallets together: the thumb will adduct while F2 will extend at the first knuckle and flex at the second and third knuckles. All of this engagement will happen while the thumb flexes down on the mallet to initiate strokes while the wrist deviates and rotates. Interval adjustments in Stevens Grip require *constant* muscular engagement in both forearm compartments to keep the thumb and F2 in position, as no locking or reverse pressure mechanisms are present like the other grips.

Double-vertical Strokes

Double-vertical strokes in Stevens Grip are much less forgiving than in either crossed grip. Volume is the first issue because the wrist can only (safely) adduct approximately 30º from neutral. In order to circumvent this limited range of motion, players may engage their bicep to add forearm motion for added height, weight, and velocity. However, added forearm movement ultimately transfers significant momentum to the mallet heads. This added momentum makes it difficult for the fingers to control the mallet interval, resulting in errors or added tension to clench and stabilize the mallets.

Double-vertical strokes are one of the most tension-inducing movements for young marimbists learning the Stevens Grip. One common issue is clamping into a fist to secure the

mallets, which causes the inside mallet to angle upward. When the inner mallet angles up, the wrist must pronate to level the mallets for an even double-vertical stroke (Figure 4.4). Proper hand composition requires a relaxed thumb and F2 to allow the inner mallet to angle down, which evens the mallet heads when the arm is in a neutral (or "handshake" position). However, the balance between relaxation and controlling the mallets to strike simultaneously is particularly demanding at first.

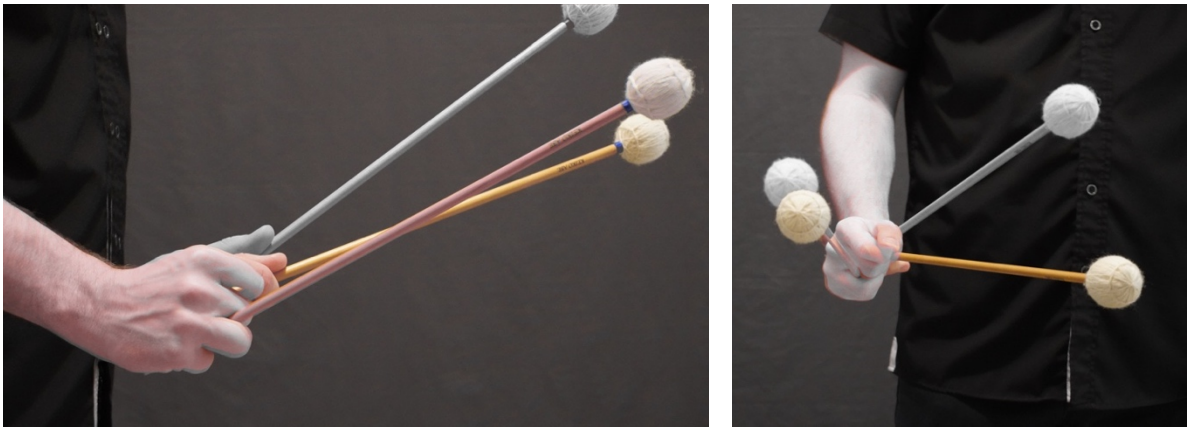

Figure 4.4: Overlapped comparison of clenched and relaxed positions in Stevens Grip

Single-independent Strokes

The movement characteristics of single-independent strokes in Stevens Grip are highly variable. In particular, different mallet intervals produce different muscle combinations to actuate individual mallets. As a result, an inner mallet stroke's movement characteristics will range from full pronation (wide intervals) to a mixture of pronation and adduction (medium intervals) to an opposition of the thumb mixed with flexion (small intervals). An outer mallet's stroke will behave similarly but inverse without the thumb, where pronation is supination.

Put simply, more pronation/supination occurs as mallet intervals widen. This is a case of mallet leverage consistent among other grips; however, it is most pronounced in Stevens Grip. The constant muscle forearm engagement to stabilize intervals forces marimbists to circumvent reduced wrist flexion and deviation mobility. With the mallets spread wide (i.e., thumb and F2 acutely engaged), the wrist's inability to deviate forces the player to rotate the forearm more to achieve an independent stroke. Conversely, as the mallet comes together (i.e., thumb and F2 less engaged), the wrist is more free to deviate and flex to actuate the mallet.

Lateral Strokes

Stevens Grip's capacity for agile lateral strokes is nearly unmatched by other grips during early development. The neutral arm position and independent mallets allow for completely unhindered rotation. The forearm's rotational axis (the ulna) extends to approximately the first knuckle of F3. For example, Tabla, Kanjira, and other frame drum techniques exploit this axis to an extremely virtuosic degree. Those techniques often separate the hand into two parts: fingers 3, 4, and 5 as one part and the thumb and F2 as the other part. Stevens Grip's hand composition is notably similar.

With the thumb and F2 controlling the inner mallet and fingers 4 and 5 controlling the outer mallet, the hand is composed perfectly to utilize this rotational axis running through the hand. By holding the mallet handles at their ends, marimbists also have tremendous momentum transfer between the mallets as they rotate interdependently. Stevens Grip allows for expeditious command of lateral strokes with few risks of developing bad habits.

CHAPTER FIVE: GRIPS IN COMPARISON

This section compares the different attributes discussed in each grip chapter. It provides a survey of the key factors of each grip and how they relate to each other. This gives a "bird's eye view" of the grips' similarities and differences and helps develop a greater perspective of each grip's unique characteristics. It is often helpful to understand what something is *not* in order to gain a better understanding of its finer details.

Grip Anatomies in Comparison

The following three subsections present comparisons among all three grips. The first two are comparisons of Traditional to Burton and Stevens Grips, while the last is a comparison of Stevens and Burton. This comparison order is significant because Burton and Stevens are descendants of Traditional Grip, and each bears similarities to this grip. The last comparison is between Burton Grip and Stevens Grip due to each grip's growing prevalence and often-disputed advantages and disadvantages. When examining differences, crossed and non-crossed are understood to avoid redundancy.

Comparison 1: Traditional and Burton

Often considered similar due to each being a crossed grip, Traditional Grip and Burton Grip are quite different from an anatomical perspective. Firstly, the Traditional Grip rest in a neutral position with the thumb facing up while the Burton Grip is pronated inward (approximately 30–45º). Secondly, the grips' contrasting mallet intersections are significant. The Traditional Grip

intersection occurs at the base of the mallet handles and the base of the wrist, yielding much more overall leverage and rotational potential than Burton Grip. Likewise, the mallet handles in Traditional Grip *always* press against one another, which provides consistent energy transfer between the mallets while playing. In contrast, Burton Grip's crossing point is near the palm's center but always moves slightly up and down the outer mallet's handle based on the interval. As a result, there is less mallet responsiveness to wrist movements, which can feel awkward due to this secondary axis.

The mallet handles of both grips extend primarily from the thumb and F2, though the inner mallet in Traditional Grip runs medially along the thumb rather along the thumb bad, as in Burton Grip. Overall, the Burton Grip offers a more relaxed hand composition than Traditional Grip, as no reverse pressure mechanism stabilizes the mallets.

Comparison 2: Traditional and Stevens

Traditional Grip and Stevens Grip share several anatomical similarities. First is the neutral wrist position; the Traditional Grip only pronates about 10º from the resting position of Stevens Grip. Both grips share a pinch point at F4 and 5, but while Traditional Grip utilizes F4 and 5 to grasp the intersection of both mallets, Stevens Grip uses those fingers to grasp *only* the outside mallet. Finally, though minor, Stevens Grip and Traditional Grip also share the same configuration; the outside mallet handle rests below the inside mallet handle.

The inner-mallet grasp is the most distinct difference between Traditional Grip and Stevens Grip. In Traditional Grip, the inner mallet runs laterally along the thumb, while Stevens Grip holds this mallet between the thumb pad and F2. This creates a significantly different movement characteristic for the front fingers during interval adjustments. Lastly, Stevens Grip holds

significantly less of the mallet handle than Traditional Grip, making them feel much heavier and less secure in the hand.

Comparison 3: Burton and Stevens

Burton Grip and Stevens Grip share few similarities in their hand compositions and are the most contrasting of the three grips. Perhaps the only similarity is the inner mallet extending from the third knuckle of F2 and the thumb pad. However, this similarity is undone upon a moderate interval spread in Burton Grip, as the inner mallet will slide off the thumb pad (Figure 3.7). The key difference is their wrist orientations; Burton Grip rests in a roughly 45º pronated position, while Stevens Grip remains neutral with no pronation. The outer mallet in Burton Grip extends from between F2 and F3, while in Stevens Grip, it extends from between F3 and F4. Additionally, the inner mallet in Burton Grip rests *below* (closer to the playing surface) the outer mallet, while the inverse is true for Stevens Grip.

Lastly, the separated handles in Stevens Grip require the inner mallet to slope downward for the mallet heads to align, ensuring a neutral wrist position. The mallets in Burton Grip are more level since they are touching inside the pronated hand. The inner mallet in Burton Grip has a slight downward slope to keep the hand relaxed and slightly less pronated; however, this is not as significant or crucial for functionality as in Stevens Grip. Table 5.1 provides a concise overview of the grip anatomies for comparison.

Table 5.1: Overview of arm positions and primary pinch points for each grip

Item	Traditional Grip	Burton Grip	Stevens Grip
Forearm position	Neutral to slight pronation	Pronated between 30º and 50º	Neutral
Wrist position	Slight extension	Very slight extension	Moderate extension
Primary pinch point	Palmar side of F4 and F5 around both mallets' intersection	Alternation of the palmar side of F4 and F5 along the outer mallet depending on interval and preference	Palmar side of the thumb and F2 along the inside mallet
Secondary pinch point	Dorsal side of the thumb and F2 against inner and outer mallets	Palmar side of the thumb and F2 along the inside mallet	Palmar side of F4 and F5 around the outside mallet

Movement Anatomies in Comparison

The following subsections compare each movement type among the three grip comparisons. These comparisons are presented as succinct overviews of the most significant similarities and differences in the grips' movement characteristics.

Interval Adjustments

Comparison 1: Traditional Grip and Burton Grip

Traditional Grip and Burton Grip use different mechanisms to adjust mallet intervals. Traditional Grip uses the thumb and F2, while Burton Grip uses all five fingers. Traditional Grip

works like a tension mechanism (like a pair of tongs), where the back and front fingers exert varying tensions in opposite directions to ensure proper mallet spread. Burton Grip functions like a locking mechanism, where all intervals can be set and locked by clamping down all fingers across the mallets. Burton Grip allows the mallets to move freely without pressure to move them into place. Depending on the player's preference, this difference can be seen as an advantage or disadvantage. However, Burton Grip requires significantly less tension to adjust and maintain a specific interval.

Comparison 2: Traditional Grip and Stevens Grip

Setting and maintaining an interval in Stevens Grip is similar to Traditional Grip because they are the responsibility of the thumb and F2; however, the movements of these fingers are drastically different. In Traditional Grip, the spread of the thumb and F2 dictates the spread of the mallets. Conversely, Stevens Grip requires the thumb and F2 to work together with extension and abduction to manipulate the interval spread. Perhaps the most significant difference is that interval adjustments in Traditional Grip strain the back fingers to maintain control of the mallet handles of *both* mallets. In contrast, in Stevens Grip, the back finger engagement remains relatively stable regardless of interval.

Comparison 3: Burton Grip and Stevens Grip

Burton Grip and Stevens Grip use markedly different mechanisms for interval adjustment. This movement functions like a hinge in Stevens Grip, with the inner mallet handle pivoting from its base stabilized at the palm. The hinge component is much more precise than Burton's

locking mechanism, where the inner mallet will rotate and slide into slightly different spots. Furthermore, where nearly the entire hand manipulates the inside mallet in Burton Grip, Stevens Grip utilizes the thumb and F2 exclusively. However, Stevens Grip requires more constant engagement than Burton Grip to maintain an interval, though minimal muscle engagement is needed to move the mallet a large distance because the inner mallet is held at the handle's end compared to Burton Grip.

Double-vertical Strokes

Comparison 1: Traditional Grip and Burton Grips

The crossed grips generally make double-vertical strokes easier to perform than the non-crossed grips. In addition, they provide consistent mallet positioning because the mallets extend from the hand even to the playing surface (as opposed to Stevens Grip, for example). The key difference between Burton Grip and Traditional Grip is the forearm position. With the Traditional Grip mostly neutral, its double-vertical motion consists of adduction and some flexion. In contrast, Burton Grip's pronation results in a flexion-based stroke. Lastly, Traditional Grip will provide a more weighted sensation in the hand because the mallets are held at the wrist base as opposed to mid-palm like with Burton Grip.

Comparison 2: Traditional Grip and Stevens Grip

While the wrist position of the Traditional Grip and Stevens Grip are only about 10º different, the Traditional Grip has access to more wrist flexion than Stevens Grip. Traditional

Grip's flexion provides significantly more range of motion to achieve double-vertical strokes. In addition, because so much hand covers the mallet handles in Traditional Grip, double-vertical strokes are much easier to stabilize and play consistently. In contrast, Stevens Grip's minimal grasp on the mallet handles (and a relaxed hand) allows more freedom for the mallets to shift during wrist rotation, which may cause small, unintended interval adjustments. The minimal grasp also results in more vibration from each mallet transferring into focused points of the hand. This shock is more evenly dispersed in Traditional (and Burton) Grip.

Comparison 3: Burton Grip and Stevens Grip

In most interval spreads and arm positions, the considerable difference in pronation ensures that each grip uses entirely different muscle groups and wrist motions to play double-vertical strokes. Burton Grip utilizes flexion, while Stevens Grip relies on adduction to actuate the mallets. Adduction has a more limited range of motion and strength compared to flexion. This strength disparity is highlighted even more, as Burton Grip can produce more volume with less effort due to more hand covering the mallets and transferring arm weight into the stroke. However, a particular advantage of Stevens Grip with double-vertical strokes is an easier ability to voice each mallet.

Mallet voicing is when a marimbist accentuates or "brings out" one mallet over another (particularly in one hand) and is a crucial technique for advanced marimbists. While a thorough analysis of this technique is beyond this document's scope, its accessibility in Stevens Grip is noteworthy.

Single-independent Strokes

Comparison 1: Traditional and Burton Grips

Traditional Grip and Burton Grip use similar motions to actuate individual mallets. The inner mallet movement is the same, but Burton Grip requires more pronation than Traditional Grip. Burton Grip's resting position is already pronated, requiring even more pronation to actuate the mallet. The secondary axis in Burton Grip also creates an awkward wrist motion often accommodated by deviating ulnarly or radially to align one of the mallets with the forearm for a simpler rotation. Traditional Grip does not require such adjustments, as the mallets are mostly aligned with the forearm and begin in a neutral position. In addition, actuating the inner mallet does not pronate the hand as far from neutral as in Burton Grip.

The outer mallet strokes are nearly identical and are considerably more comfortable for each grip. Both grips allow for strong strokes because they easily align with the ulna with minimal adjustment. Most of the hand is on top of the handles for each grip, so hand and arm weight add to the volume potential. Burton Grip does, however, provide slightly more power potential because the entire palm rests atop the handle, and more pronation can access the anterior compartment muscles. Traditional Grip must still rely on the thumb and F2's control and stability as vibrations run along the boney portions of each finger.

Comparison 2: Traditional Grip and Stevens Grip

Because Traditional Grip and Stevens Grip operate from a neutral position, their mallet movements engage the same muscle groupings. The primary difference is the finger movements

required for each grip. Traditional Grip maintains a consistent finger pressure regardless of wrist motion except for nominal added tension during strokes for stabilization.[42] However, Stevens Grip requires varying finger pressure depending on the interval and amount of rotation.

With Stevens's grip, the thumb and F2 engagement varies significantly for inside mallet strokes. For small intervals, the thumb and F2 stay mostly relaxed as the wrist pronates to rotate the mallet downward. This is because there is less mallet weight acting against the thumb.[43] The hand must stay relaxed to allow the utmost rotation to achieve a quality stroke. For wider intervals, the thumb and F2 must abduct and extend to maintain the interval while the wrist rotates the mallet. This requires more flexion from the thumb to control the leverage acting against it. With Traditional Grip, the same leverage principles apply. However, the fingers remain in more consistent positions, so there is little change in pressure for individual strokes regardless of interval.

Outer mallet actuation functions similarly for both grips; however, Stevens Grip requires an awareness of the back finger's tension while rotating that mallet. Most of the time, a firm but relaxed grasp suits most strokes regardless of interval spread. Most of the time, a firm but relaxed grasp is sufficient. However, wider intervals can cause the outer mallet to slip along F4 and into the webbing between F4 and F5. The hand may pronate slightly, allowing the mallet to slide up the more vertically positioned fingers. This may also occur with Traditional Grip's outside mallet slipping into the webbing between F2 and F3 for the same reasons.

[42] This applies to average strokes, not to loud, aggressive strokes, which induce added grip tension to any motion.

[43] Remembering that as mallets spread from the axis, there is more leverage and weight interacting with the fingers during rotations.

Comparison 3: Burton Grip and Stevens Grip

Single-independent strokes vary the most between Burton Grip and Stevens Grip. Respectively, the pronated and neutral positions use different muscle groupings for each grip's inner and outer strokes. However, the most drastic difference is the mallets' proximity to the forearm rotational axis in each grip. Stevens Grip secures the mallet handles at their ends near the center of the palm (inner mallet) and the end of the ulna (outer mallet). Burton Grip secures the mallets in different ways depending on the interval, and the crossing point around which the mallets rotate is around the center of the palm and also changes depending on the interval.

Regardless, the single-independent stroke experience for Stevens Grip is much more akin to Traditional Grip, whereas Burton Grip is an outlier due to the additional pronation and juxtaposed axes. Most notably, the power capacity of the Burton Grip's inner mallet stroke is far less than Stevens, while the inverse is true of the outer mallet. Where Stevens Grip provides ample power in the outside mallet from a mixture of supination and adduction to actuate the mallet, Burton Grip has access to the full force of the hand atop the mallet and pure flexion.

Lateral Strokes

Comparison 1: Traditional and Burton Grips

Lateral strokes share a similar muscular sensation during rotation due to the mallets extending from the front fingers. However, there is noticeably more leverage in Traditional Grip due to the inner mallet resting outside the thumb. When the hand rotates in Traditional Grip, the thumb and F2 apply force against the mallets spread further from the mallet intersection than in

Burton Grip. This provides an advantage even at the smallest intervals where leverage is minimal. At larger interval spreads, however, the Burton Grip's locking mechanism allows a player to secure the larger interval with a more relaxed grasp than Traditional Grip. The tension involved in large spreads for Traditional Grip makes a relaxed wrist rotation more challenging.

While Traditional Grip offers a player more leverage, Burton Grip does offer a player more overall relaxation. Because lateral strokes rely on the interdependence of each mallet and the hand's manipulation of each mallet's momentum, controlling the mallets in Traditional Grip can be challenging since they are resting on the boney outer portions of the thumb and F2. There is virtually no "grasp" of the mallets; thus, they risk slipping from the desired position on the fingers. While this slippage is not an issue in Burton Grip, there is a parallel issue where the hand "eats" the handles. Often during rotation, a relaxed hand may allow the mallet handles to slide into the hand, effectively causing a player to "choke up" on the handles.

Comparison 2: Traditional Grip and Stevens Grip

The most similar characteristic regarding lateral strokes between Traditional Grip and Stevens Grip is the wrist orientation. The more neutral position offers a similar experience of muscular engagement and range of motion. A second similarity is the rotational axis the two grips share. The Traditional Grip's mallet intersection at the base of the hand offers excellent balance when rotating. Stevens Grip offers balance from the independence of each mallet held at the front and back of the hand, which rotates around the axis extending from the ulna. Likewise, the point at which the fingers exert force on each mallet is spread reasonably far from the rotation point, unlike Burton Grip.

Again, Stevens Grip offers more control at larger intervals due to significantly less tension to maintain the spread, allowing for a more relaxed rotation. However, Traditional Grip offers more leverage at smaller intervals because more of the hand rests on the mallet handle to rotate it down around the outer mallet. Stevens Grip requires a slight depression of the thumb at smaller intervals to aid the mallet rotation. Likewise, because the mallet handle sits in the palm in Stevens Grip, as the hand rotates, it effectively rotates the entire handle parallel to the playing surface. Traditional Grip's intersection at the base of the hand allows the hand's rotation to truly rotate the mallet handle around the axis, which provides more leverage.

Comparison 3: Burton Grip and Stevens Grip

Burton Grip and Stevens Grip share few similarities in the physical mechanisms of lateral rotations. As a result, the varying wrist orientations yield drastically different sensations and ranges of motion. Additionally, the mallet intersection for Burton Grip yields significantly less leverage than all other grips and is even more pronounced when comparing these grips side-by-side. Moreover, Burton Grip requires significantly more forearm rotation than Stevens Grip to achieve an adequate stroke, as the mallets must rotate around each other at a point further up the mallet handle.

Additionally, no interval spread in Burton Grip is more advantageous than Stevens Grip for controlling lateral strokes. However, Burton Grip can allow for more uncommon positionings than Stevens Grip. The pronated hand and minimal strain at every interval allow for wrist deviations coupled with elbow repositioning that Stevens Grip *nor* Traditional Grip can achieve comfortably. In nearly any position, a marimbist can flex or rotate for an adequate stroke.

CONCLUSIONS

Each grip used by marimbists is far more than just “holding the mallets.” It is a visual statement to the audience, a kinesthetic relationship with the mallets, and a foundation upon which a technical language is built. When a marimbist adopts a primary grip, they accept the advantages and disadvantages of that grip, its learning curve, and even the repertoire most suitable for the grip. While the debate over the most effective grip will continue indefinitely, objective limitations exist for any decision we make as musicians.

As with other disciplines, numerous iterations of similar techniques and approaches garner a passionate following. This fervent belief in one’s “way” allows most musicians to overcome that way’s limitations and achieve success. As such, I believe no grip poses insurmountable flaws or dangers for healthily accomplishing a marimbist’s most virtuosic endeavors. However, this document illustrates the physical characteristics of these grips relative to anatomy and physiology, exclusive of one's journey to perfect their command of a grip. While this document addresses only a fraction of the variables involved in four-mallet grips and their movements, it provides a starting point for further discussion.

Therefore, pedagogues and performers should arm themselves with the fundamental knowledge of each grip’s anatomy and movement characteristics in preparation for this discussion. In addition, an awareness of the relationship between hand and mallet will answer many questions that arise throughout a marimbist’s studies. Consequently, while it is practical and advised that marimbists develop mastery of a primary grip, I believe all marimbists should understand all three on a fundamental level.

This survey may help students and pedagogues determine appropriate grips for considerations far beyond the scope of this research. For example, compositions by composer-

performers who espouse a particular grip may write idiomatically for that grip, thus making it more challenging to play in another grip. Likewise, each grip stabilizes the mallets differently, altering their capacity to vibrate freely and changing how arm weight affects their impact. Thus, subtle differences in each grip's sonic characteristics may appeal to some marimbists more than others. Conversely, such differences may deter a marimbist due to the effort necessary to circumvent or alter that inherent sound characteristic.

An awareness of health implications may also guide players and educators when determining how to utilize these grips *beyond* solo marimba. For example, using four-mallet grips and playing techniques is now common for solo multiple percussion performances and is invaluable for musical pit orchestra percussionists. In addition, understanding each grip's physical stressors may alter a performer's choice when playing various instruments in different positions. Thus, the value of this knowledge transcends solo marimba.

Nonetheless, fundamental knowledge of all three grips raises the overall standard of four-mallet marimba pedagogy. Marimbists will always perform with others using other grips, students come from different backgrounds, and injuries may force individuals to modify or change grips altogether. Understanding *each* grip means marimbists can communicate and share ideas for learning, performing, and embracing change. So while everyone must "get *a* grip," we should really get a grip on *all* of them.

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