

The Process of Progress in Medicine, in Sports Medicine, and in Baseball Medicine

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Some years ago, a mentor once said “I’m not interested in what you know as much as I’m interested in how you think.” That was a very curious statement for an orthopedic surgeon. Doesn’t a surgeon have to know the facts of the human body? Wasn’t that “what” I knew?

Now, when at the opposite end of the career spectrum, the wisdom behind those words is apparent. “How we think” determines the progress we’ll make. “What we think” is that which we memorized to get through medical school and is good only for today.

With that in mind, the story of baseball medicine is not just a story of baseball statistics—rather, it is a story of how we arrived at today and where we are going tomorrow. If we are wise, we can learn from the story: we won’t need to repeat history, but rather we can look at the commonalities in the progressive steps and invent our future. Now, let’s start at the beginning, with the Ancient Greeks.

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Ancient Greece

The time of the Ancient Greeks was around 500 BC. Herodicus is one of the first progressive medical practitioners of whom we know. Herodicus was a “gymnast”—a physician who interested himself in all phases of an athlete’s training. Literally, *gymnase* in Greek means naked. And, it was Herodicus himself who recommended that the athletes exercise and compete in the nude in order to keep as cool as possible and to perspire freely in the humidity.

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Herodicus was a firm believer in diet and exercise, and he used these tools for physical rehabilitation as well as for the treatment of patients suffering from the “fevers.” His patients did well and he began to have followers. One of them was Hippocrates.

In addition to practicing medicine, Hippocrates was a scientist. And he wrote prolifically. Actually, it is thanks to Hippocrates that Herodicus’s works survived. It was Hippocrates who documented these, in addition to many of his own subsequent works.

Hippocrates lived in a time when people believed that disease was due to divine origin.¹ Not only did they believe that there was no way to prevent or to treat disease, but they even considered it sacrilegious to attempt this. Yet, Hippocrates realized that if he carefully observed enough cases, he could predict the course of a disease course: a basic concept of modern medicine.

In his “Treatise on Surgery,” Hippocrates wrote “Whoever wants to practice surgery, needs to go to war.”¹

Medicine obviously was needed on the battlefield, and surgeons honed their practice out of necessity, given the abundance of cases. Even today, this proliferation of cases around a battlefield continues to create the opportunity to learn from them and spur medical advances.

Roman Times

The most influential sports medicine doctor of this time would be Claudius Galen, and the time was 200 AD. He was probably the first team physician—for the Gladiators. One of his frequent treatments for the Gladiators was to pour wine onto the wounds.

While most of his research in anatomy and physiology was confined to animal dissection, Galen tells the story of finding the bones of a robber that were picked clean by wild animals. And, he does urge the student to be on the lookout for an occasional human bone exposed in the graveyard.²

Like Hippocrates, Galen was a prolific writer: he has over 2.5 million words in print that span the arenas of science, medicine, law, philosophy, mathematics, and grammar.^{3,4}

Galen, again like Herodicus and Hippocrates, frequently prescribed exercise for diseased patients. He was the first to realize that muscle had one function: to contract. He realized muscles work in one direction, they frequently work in groups, and there is commonly an antagonistic motion.

The Dark Ages

Then came the fall of the Roman Empire and the rise of the Medieval Church. Progress in this part of the world was halted. Fortunately, Galen's work survived thanks to a man who is called the Father of Muslim Medicine: Hakim ibn-e-Sina, or as he was known in the West, Avicenna.² Avicenna found a copy of Galen's work and translated it into Arabic. He found the works so believable that he too began to utilize Galen's ideas on medical gymnastics.

In his "Poem on Medicine," Avicenna wrote, "Do not give up hard exercise; do not seek rest too long; preserve a happy medium. Exercise your limbs to help them repel the bad humors by walking and struggling until you succeed in panting."⁵

Then came the Crusades, and the Arabic version of Galen's work was reintroduced to the Western world, and a rebirth, or Renaissance period, began.

The Renaissance

By the time of the Renaissance, exercise was thought of as both preventive and therapeutic. Therapeutic exercise was taught in medical schools by the 15th century. Even in grammar schools, exercises were taught through physical education classes.

Ambroise Paré demonstrates many of the commonalities of the process of progress in medicine. In 1537 Paré, a 20-year-old barber-surgeon, found himself at the siege of Turin without a drop of cauterizing oil. (Cauterizing oil

was the accepted treatment for wound care.) Other physicians said there was nothing to be done and walked away. Paré was determined to find a way to treat these soldiers, so he began débriding and dressing the wound. He observed the results very carefully—and, lo and behold, his patients did better than those who had the hot oil treatment. Thanks to Paré's logical innovations and observations, this treatment still stands today.

Paré was also a supporter of exercise, and in his prolific writings, we see that he endorses exercising a fractured limb after treatment. He stated that exercise was indispensable to recovery.

Paré was a biomechanist and an anatomist. In the autumn of 1542, Paré journeyed to the siege of Perpignan, where he removed a lead ball (arquebus ball) from the shoulder of the Grand Master of the Artillery. Locating and extracting the ball had baffled the other surgeons. Paré, however, placed the patient in the exact position that he was in when he'd been hit and quickly found the damaging lead ball. This incident led to his first book.⁶

Paré demonstrated great interest in anatomy. He relates that he obtained the body of a criminal and dissected one side of the body and left the other side untouched. He claimed that he kept the body with all of its organs in good condition for over 27 years. Paré and his friend Thierry de Héry (another barber-surgeon) published a small treatise on anatomy in 1549.⁶

Commonalities Among These Pioneers

The common characteristics of these great men are what we will take forward into our look at the world of baseball medicine. Those characteristics include intense study of anatomy and mechanics, hands-on clinical care with a volume of patients, believing there are always alternatives, integrating good diet and exercise into patient care, prolific writing, and astute observation along with documentation of patients' responses to controlled treatment.

BASEBALL MEDICINE

It is appropriate to first ask, "What is baseball medicine?" For our purposes, baseball medicine is defined as an intervention focused on the prevention and rehabilitation of injury (and, in the rare case, on surgery), based upon anatomy and baseball mechanics. Philosophically, this aligns with the approach of some of the great medical practitioners mentioned earlier. Given this definition, we'd like to paraphrase Hippocrates' quote from his "Treatise on Surgery" and say "Whoever wants to practice baseball medicine need to go to the diamond."

To historically look at mechanics and interventions, while also incorporating anatomy, we now turn to baseball's rules, its statistics, and the injuries of the athletes.

It was 1884 when the overhand pitch was first allowed. At that time there were approximately 112 games per season. Within the ensuing 8 years, there were 69 pitchers who threw in excess of 389 innings. To put this in perspective, today's professional pitchers throw for 140 to

Cy Young's Story: Insight Into the Requirements for Longevity in Baseball

Cy was a farmer and a rail splitter until age 23, when he entered professional baseball (1890). He acknowledged that he had strong legs and endurance from “squirrel chasin.”⁷ In 1894, he noted that his arm was “tired,” and the following year he rested his arm by having seven fewer starts. In 1896, he increased his pitching to 414 innings, and his record fell the subsequent year. He’d learned his lesson by 1898, when he diminished his workload for the rest of his career.

Cy’s success can be attributed to at least four factors.

- First, he was fascinated by mechanics—a trait shared by successful pitchers such as Sandy Koufax and Orel Hershiser. Cy was constantly studying and improving his mechanics. He had four successful deliveries: the fastball, the overhand curve, the sweeping sidearm curve, and the spitball.

- A second potential factor in his success is that of a late start in professional pitching. This, too, is something shared

by many longevity pitchers. It appears that the young men who throw hard and fast have very short careers.

- Third, Cy strongly believed in conditioning. “My arm would get weak and tired at times, but never sore. I credit it to my legs and my off-season conditioning.”⁷

- Fourth, in Cy’s mind there was no reason to waste a pitch. Slidin’ Billy Hamilton was known for fouling off pitches. As a matter of fact, at one point he fouled off 29 consecutive pitches. Once, when Billy was batting against Cy Young and had fouled off three balls, Cy walked to the plate to have a chat with Billy. The story is that the conversation went something like this: “Look, Billy, I’m putting the next pitch right over the heart of the plate. If you foul it off, the next one goes right in your ear.”⁷ Enough said—the pitch was not wasted.

240 innings a year. Of the 69 pitchers in the late 1800s, 41% had their last win within 3 years. Only 21% avoided significant injury for 5 years—and most of those were submariners (pitchers who threw underhanded).⁷

Around this time, the man who may be the first baseball physician began writing. In 1887, Alexander H. P. Leuf wrote an article entitled “Baseball Pitcher’s Arm: Points in Its Anatomy, Physiology, Symptomatology and Treatment, Together With Suggestions as to Its Prophylaxis.” He wrote in great detail about the mechanics of the “up curve,” drop ball, screw ball, and curve ball. For each of these four curve balls, he describes which muscles and ligaments are involved. This leads him into a discussion of the anatomy, physiology, and pathology of pitcher’s arm. In this article, he states, “I feel quite certain that much of soreness is due to accumulated excrementitious products, the result of sudden transient and excessive, functional activity.”⁸

The following year, Dr. Leuf published *Hygiene for Baseball Players; Being a Brief Consideration of the Body as a Mechanism; the Art and Science of Curve Pitching; a Discussion of the Causes and Treatment of the Disabilities of Players; With a Few Practical Hints to Club Managers*. In this book, he states “that something treating of this subject is now urgently needed is amply shown by the large army of disabled players, especially pitchers.”⁹ Keep in mind that Leuf’s era had no MRIs, no x-rays, no arthroscopes, nor even anesthesia, yet these two publications clearly identify overuse.

In his last apparent publication on baseball medicine in 1888, Dr. Leuf wrote “Two Cases of Base-ball Pitcher’s Arm.”¹⁰ One case was a shoulder injury and the other was an elbow injury. The pitcher with a shoulder injury was August Weyhing. Leuf notes of Weyhing that “Pitching the out-curve pains him.” The treatment included heat, exercise, and galvanism “to the teres minor and anterior fibres of the deltoid” (p. 96). Weyhing improved and went on to beat the World Champion St. Louis Browns.

Dr. Leuf’s patient with an elbow injury was Al Atkisson, who was ...“injured at Cleveland while pitching, so that he had to stop at once. Since then he has been under medical treatment, but was getting worse all the time... Can hardly bend elbow... The out-curve is the most painful by far...” (p. 97). In addition to treatment of heat, decreasing the workouts, and electrical stimulation, Dr. Leuf “showed him how to pitch an overhead in-curve and out-curve without straining his elbow and radio-ulnar joint” (p. 97).

Dr. Leuf then seems to abandon his interest in writing about injuries to professional baseball players; this, unfortunately, seems to be a theme in his life. His pattern of intense yet brief involvement is noted in his professional involvement in numerous societies (including the Association of American Anatomists) and in his promising job titles. The brevity of his interest in topics is an exception to the commonalities of progressive medical practitioners.

For a long time, there were no physicians involved in the science and writing of baseball medicine.¹¹ It was the players and the managers themselves who tracked, documented, and created change in the injuries related to volume of play.

In the early 1890s, there was a group of “Cyclones,” or speed-ball pitchers. The most famous of them all was, of course, Cy Young. The Cyclone pitchers pitched all innings of 50 to 60 games per season.

While the Cyclones were concerned about the pitching volume, it was the manager of the 1893-1894 Baltimore Orioles, Ned Hanlon, who diminished the amount of work his pitchers had to do. He brought six pitchers to his roster, when other teams had only four. None of his pitchers threw more than 275 innings. By 1894, the Orioles took the National League pennant, and by 1897, the whole league was following Hanlon’s guidelines.⁷

Cy Young had a long and successful pitching career (Box, above). Like him, a couple of other notable pitch-

ers spoke of the need to savor their pitches. Eddie Plank (the first left-handed pitcher to win 200, then 300 games) is known to have said, “There are only so many pitches in this old arm and I don’t believe in wasting them throwing to first base.” Sad Sam Jones remarked on his technique to keep his pitch count down “...There was a time there, for five years, I never once threw to first base to chase a runner back... If you stand there like you’re ready to pitch, and just stare at him long enough, it’ll be too much for him and he’ll lean back toward the base. Then you pitch.”⁷

Yet some habits die hard—sometimes history has to repeat itself in order for humans to learn. An example of this lies in the four pitchers who threw more than 425 innings per season between 1893 and 1902. Pink Hawley, Lefty Killen, and the Hoosier Thunderbolt were each 22 years old when they threw in excess of 425 innings. Hawley’s and Killen’s last winning seasons were at age 25, and the Thunderbolt’s was at age 27. Ted Breitenstein threw more than 425 innings when he was 25 years old, and his last win was at age 31.⁷

The lesson of high workloads seems to have been learned—at least for professional pitchers—by 1904. The danger and the outcome of too much volume had become the antithesis to a successful pitching career.

Dr. George Bennett may be the man who opened the door for the modern age in baseball. In 1941, Dr. Bennett wrote an article for *The Journal of the American Medical Association* entitled “Shoulder and Elbow Lesions of the Professional Baseball Pitcher.”¹² At this point, x-rays had become available. And Dr. Bennett offers numerous x-rays to demonstrate pathology in the shoulder and elbow of pitchers.

Yet, it wasn’t until the early 1960s that there was a burst of surgical procedures for the baseball athlete. The first procedures were for the knee, followed by the shoulder and the elbow.

BASEBALL YOUTH TODAY—AND TOMORROW

So what about our young athletes today? Here it is a century later, and could it be that we are allowing overuse injuries to our young people? *The New York Times* reported that in 1989, 20% of youth injuries were overuse and now the number surpasses 70%.¹³ *Business Week* similarly reported that between the years of 1988 and 1994, one surgeon performed the “Tommy John” (ulnar collateral ligament reconstruction) on 7 high school players, and in the year 2003, he performed it on 55 high school players.¹⁴ Was it an issue of better diagnosis, more availability of surgery, or simply more overuse?

In a study of 476 young pitchers who were 9 to 14 years of age and were followed for one season, 15% of the pitching appearances resulted in shoulder or elbow pain.¹⁵ Approximately half of the youths reported shoulder or elbow pain at some point in the season. The more pitches thrown per game, the greater the risk of shoulder or elbow pain.

The reasons for these injuries are, most likely, multifactorial. The injuries could be due to improper mechanics, throwing the wrong types of pitches before the basic mechanics are ingrained, or lack of sport-specific conditioning. Most likely the injuries are related to the volume of play due to competitive pressure, year-round seasons, sport specialization, and parental

influence. While the game of baseball should be fun at any age, the competitive pressure to win and the volume of play in our youth are immense. It may be that the cartilage is not well developed at a young age; thus the ensuing trauma occurs with less volume than could have been handled at an older age.

A wise professional pitcher once simply stated the Zen of baseball as “to throw hard, you must first throw easy.” Maybe our youth—and their parents—are trying too hard.

So, history is repeating itself. But, does it have to? Are there lessons that we’ve learned from the big-league players that we could apply to our youth? If the pattern of injury/volume of play was apparent to the world of professional baseball in 1904, can we apply that lesson to youth in 2007? Will we be considered renegades if we pull our own children into just one baseball team rather than let them play on multiple teams—and be proud

“Do we...accept the status quo and think we’ve gone “as fur as we c’n go”?”

of the title of “renegade”? Can we think differently, scientifically document changes, and move forward? Will we use our knowledge in anatomy and in mechanics to prevent injury? Is there some way of thinking from the time of the ancient Greeks and Romans that could influence how we resolve the problems in our baseball youth? Or, will we feel helpless, as did Paré’s colleagues, and just walk away saying that there is nothing that we can do? Will we find alternatives, not just to the problems faced by our baseball youth, but to other medical issues? What do we want from our careers—a flash-in-the-pan idea, or a lifetime of curiosity, or simply to be content?

There are three non-philosophical characters that we’d like to share at the close of this writing: Fred Flintstone, Will Parker, and Martin Van Buren. These three characters were content with the status quo (and, in the case of Van Buren, attempted to prevent change).

There is an image from the cartoon *The Flintstones* in which Fred Flintstone and Barney are sitting around a campfire with Wilma and Pebbles looking on. The men are chewing on steaks, and Fred is saying “Wilma, it can’t get much better than this” Old Fred was content with the discovery of fire to cook his meat, and honestly didn’t think it could get much better than that! That would be one way of looking at today’s baseball medicine. Or, can it get better than this?

And, there is Will Parker, the character in *Oklahoma!* Will returns from a steer-roping contest in Kansas City and tells his friends

Ev’rythin’s up to date in Kansas City.

They’ve gone about as fur as they c’n go!

They went and built a skyscraper seven stories high,

About as high as a buildin’ orta grow.

From “Kansas City” by Richard Rodgers and Oscar Hammerstein II.

From the musical “Oklahoma!” Copyright © 1943 by Williamson Music.

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Do we, as medical practitioners accept the status quo and think that we've gone "as far as we c'n go"?

And, in real life, there is Martin Van Buren as governor of New York writing to President Andrew Jackson in 1829 lamenting (in an attempt to prevent) the development of railroads. He starts the letter off by stating: "The canal system of this country is being threatened by the spread of a new form of transportation know as 'railroads.'" He continues with a forceful argument to prevent such an "evil" development. His arguments include the fact of the tremendous speed at which these "engines" pulled the carriages (15 miles per hour!), as well as his fears that soaring unemployment would result if the railroads replaced canal boats. Finally he attempts to convince the president that without canals, the United States would be defenseless against England in the event of expected trouble.¹⁶ He was doing his best to prevent change. (In the long run, however, and to his credit, he did accept the railroad and even utilized it in his subsequent campaign for the presidency.)

Progress means change. Baseball medicine has made progress in surgery and in rehabilitation. One of the next areas to lead progress is in prevention of injury and in education. Overuse injuries of our youth is a problem that can be curbed before it starts. We can change the rate of injury through education of parents and coaches. We hope that none of us are content with the high frequency of injury—and will not resent the people who will lead this change. *Our wish for you is to invent the coming of change in baseball medicine and beyond.*

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COMMENTARY

The history that Dr. Jobe and Dr. Pink relate to us about "baseball medicine" is quite good and reflects the historical perspective in which medical treatment for injuries related to throwing has developed. The treatment is reflected in the opinion and experience of individual orthopedic leaders involved in the care of throwing athletes. This perspective has been passed on in the form of individual preceptorships or in "op-ed" pieces in journals. The information has consisted primarily of level 4 and 5 evidence for treatments recommended.

Now the challenge to orthopedic surgeons and other physicians treating throwing athletes is to take that treatment to the next level by applying scientific principles and finding an evidence basis for recommended treatments. So far, there are no level 1, 2, or 3 studies documenting the effectiveness of treatments recommended for a variety of throwing ailments. There is little or no comparison of nonoperative and operative treatments for throwing athletes. Players, their agents, and management have relied on the opinions of individual operating surgeons to determine "best practice." For baseball medicine to take the next step, the scientific approach should be applied to managing these problems, especially for younger athletes in middle school, high school, and college. Many of these athletes might escape surgical intervention if appropriate nonoperative treatment were rendered earlier and if care were taken to regulate how much throwing these athletes do.

A basic principle of epidemiology is that exposure is critical in determining risk and injury. The number of minutes that a football player is on the field relates to the frequency with which he is injured. The number of throws a pitcher makes relates to the occurrence of overuse problems.

For each surgical procedure, there are an upside and a downside. It now appears that, with ulnar collateral ligament surgery, risk for injury and even for the need for shoulder surgery goes up after ulnar collateral ligament reconstruction. Perhaps there are better ways to treat these overuse problems, but the only way we will learn about the issues or about the efficacy of our current treatments is by careful, controlled prospective study. This is what is needed in "baseball medicine," as in all areas of orthopedic surgery.



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